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Regional Potential for Brownfield Regeneration in the Czech Republic Using Multi-Criteria Decision Analysis

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Abstract: This paper evaluated the potential for brownfield regeneration in the Czech Republic using a multi-criteria decision analysis (MCDA) framework. A set of ten quantitative and qualitative criteria was established, including ownership structure, previous land use, site area, and accessibility to key infrastructure. Each criterion was first normalized. Then, weights were assigned based on its relevance to regeneration. MCDA scores were calculated for all NUTS 3 regions. This enabled a comparison of their redevelopment readiness. The Ústí nad Labem Region achieved the highest score, followed by the Moravian-Silesian and Liberec Regions, primarily due to a combination of public ownership, high brownfield density, and transport accessibility. Pearson correlation coefficients confirmed the dominant role of site count, former land use, and public ownership in influencing regeneration potential. Conversely, overall infrastructure distance had a weaker correlation with readiness. The results provide a data-driven and transferable framework to support regional planning and brownfield policy development.

Keywords: brownfields, infrastructure, MCDA, planning, regeneration, regional development, spatial analysis, weighted scoring.

JEL classification: R11, Q24, C65

Introduction

The regeneration of brownfields is a key tool for sustainable territorial development, especially due to climate change, limited buildable land, and the need to protect agricultural areas. Brownfields are abandoned, underused or undervalued sites showing signs of degradation, often associated with environmental burdens, legal ownership issues and low investment appeal. At the same time, they offer development potential that can be activated under appropriate planning, institutional and decision-making frameworks. Academic literature has long focused on classifying the factors influencing successful brownfield regeneration. Alker et al. (2000) and Thomas (2003) defined basic typologies and functional classifications of brownfields, while Dixon (2007) highlighted environmental and institutional limitations to redevelopment. In addition, analytical tools have been developed to assess brownfield sites, including decision-making frameworks such as SYRIADE (Agostini et al. 2012) and TBPT (Pizzol et al. 2016).

In the Czech context, research has primarily focused on the spatial distribution of brownfields, their classification by type and degree of environmental burden, and the identification of barriers to redevelopment. Significant studies have addressed the uneven occurrence of brownfields in relation to settlement size, regional economic performance, and institutional context (Frantal et al. 2013, Martinat et al. 2016). Tureckova et al. (2018) distinguish the main types of obstacles and identify factors influencing municipal interest in regeneration. Navratil et al. (2022) highlight the importance of involving public institutions and ensuring transparent access to site-specific information. Although there is extensive evidence on brownfield locations and a number of partial analyses, Czech research has so far lacked a systematic application of multi-criteria decision analysis (MCDA) methods. These methods enable a comprehensive comparison of regeneration potential across regions and can support public intervention planning. MCDA is suitable not only for site classification but especially for determining the weights of individual factors and assessing spatial disparities. International literature has successfully applied it in the fields of environmental policy, development strategies and investment prioritisation (e.g. Bottero et al. 2019).

The motivation for this paper stems from the need to bridge the gap between the existing registry of brownfield sites and the decision-making processes concerning their redevelopment, and to offer a tool that enables the practical application of analytical outcomes in regional planning. This paper follows up on the previous study by Skrabal & Vybiral (2025a), which focused on identifying factors influencing regeneration using a quantitative analysis of data from brownfield registers. That study established a site classification based on criteria such as contamination, previous use, ownership structure, and site size, and described regional disparities in the structure of these factors. Building on this foundation, we apply the method of multi-criteria decision analysis (MCDA) along with a spatial assessment of regeneration potential across the regions of the Czech Republic (NUTS 3 level). The input data are sourced from the same validated databases as in the previous research, but are now newly weighted according to their decision-making relevance. The result is a spatial visualisation of the suitability of sites for regeneration and a determination of the weighted importance of each criterion.

The objective of this paper is to identify and quantify the weights of key brownfield attributes using the MCDA method, to determine their relative importance in the assessment of regeneration potential, and to compare regional specificities within the Czech Republic. The results may serve as a foundation for strategic planning, spatial decision-making, and the formulation of public policies aimed at the revitalisation of neglected sites. The paper is structured as follows: after the introductory section, a literature review is provided, focusing on existing findings related to the studied issue. The second section outlines the applied methodology and research design. This is followed by the presentation of empirical findings based on the analysis of a selected dataset. The final section offers conclusions, summarising the main results and implications for further research.

1 Literature Review

The issue of brownfields has gradually become an established research domain situated at the intersection of environmental planning, regional development, and urban geography. While the term “brownfield” is used with slight semantic variations, European research has generally adopted a definition referring to abandoned, neglected, or underutilised sites with actual or potential environmental burdens and disrupted functions within the urban or landscape context. Loures & Panagopoulos (2007) emphasise that such sites represent not only technical or ecological challenges but also symptoms of broader structural transformations in the territory. Alker et al. (2000) and Dixon et al. (2007) have outlined a conceptual framework for brownfield regeneration based on principles of sustainable development and integrated planning, stressing the importance of coordinating environmental, economic, and social aspects. De Sousa (2003) considers brownfields to be both a threat and an opportunity: while their revitalisation supports compact urban development, their neglect contributes to spatial fragmentation and urban degradation.

Brownfield regeneration represents a complex challenge that has long attracted the attention of academics, policymakers, and planners alike. As early as Alker et al. (2000) and Thomas (2003), scholars have argued that the issue is not merely technical or physical, but rather a multidimensional concern encompassing economic, social, and environmental aspects. Potts & Cloete (2012) suggest understanding regeneration as a process heavily influenced by external factors, including not only the economic climate and capital availability but also institutional capacity, the quality of public administration, and planning frameworks. Whereas Adams, De Sousa & Tiesdell (2010) point to barriers arising from complex ownership structures that often hinder smooth spatial development. Frantal et al. (2013) and Ferber et al. (2006) add that regeneration in post-industrial regions is further complicated by historical environmental burdens, limited access to financial resources, and slow responses from public institutions. In contrast, Davis & Sherman (2010) stress the positive impact of clear ownership, strong institutional support, and targeted economic incentives, all of which can significantly accelerate the regeneration process.

In addition to structural factors, it is essential to consider local perceptions and public attitudes. Alker et al. (2000) underline the importance of public opinion, while Tahal (2022) emphasises that regeneration is also a cultural and emotional process. This is supported by Navratil et al. (2022, 2023), whose research into the preferences of residents across various types of communities in the Czech Republic and Central Europe demonstrates that expectations regarding brownfields vary significantly depending on local experience and the socioeconomic profile of the population. In the Czech context, studies by Frantal et al. (2015), Martinát et al. (2016), and Tureckova et al. (2018) document that border and structurally affected regions, such as the Ústí nad Labem and Moravian-Silesian regions, show a higher concentration of brownfields and face greater challenges in their regeneration. The study by Skrabal et al. (2021) focuses on the analysis of brownfield regeneration tools in the Czech Republic, based on a sample of 205 municipalities with extended competencies. The authors identify the most commonly used tools, including land-use plan amendments, tailored investor support, and promotional activities. They also highlight regional and size-related differences in municipal approaches, noting that strategic and financial instruments are more frequently employed by larger municipalities. Similarly, the study by Tvrdon & Chmielova (2021) explores the interlinkages between strategic, financial, and regional frameworks of brownfield regeneration in the Czech Republic. Based on national and regional data from the 2000–2020 period, the authors demonstrate that the effectiveness of regeneration instruments varies significantly between regions, especially in terms of project numbers and financial support.

From a macro-regional perspective, the study by Skrabal & Vybiral (2025a) contributes significantly by identifying three dimensions essential for assessing brownfield regeneration potential based on a sample of 642 sites: economic potential, complexity of ownership relations, and sector-specific barriers such as contamination. The authors applied the principal component analysis (PCA) method, which allowed them to synthesise a wide range of indicators into three dominant factors explaining most of the variance in brownfield regenerability. The greatest barriers were observed in sites with low market attractiveness, whereas higher levels of regeneration were typical in regions with well-developed infrastructure. The study resulted in a proposed assessment tool for brownfield regenerability and offered policy recommendations to support regeneration efforts. The identification of key dimensions using PCA provides a suitable framework for subsequent multi-criteria decision analysis (MCDA), which enables comprehensive evaluation of individual sites based on environmental, economic, technical, and social criteria. The transformation of extensive data structures into a few key components facilitates the application of MCDA by simplifying the weighting process and enabling more efficient integration of expert inputs. In this respect, PCA serves as an appropriate analytical tool for developing supporting materials that can be further utilised for site prioritisation, the design of support strategies, or the evaluation of specific intervention outcomes.

The growing complexity of brownfield regeneration and the diversity of factors influencing decision-making have led to the broader application of multi-criteria decision analysis (MCDA), which enables the structured consideration of environmental, economic, social, and technical aspects. This approach is suitable not only for public administration but also for investors and urban planners, as it provides a transparent and reproducible decision-making framework. Frantal et al. (2013) and Alexandrescu et al. (2017) recommend combining quantitative and expert-based methods with the use of geographic information systems (GIS), while Limasset et al. (2018) emphasise the need for greater user-friendliness. Constantina and Abdel-Raheem (2023) applied MCDA through the Analytical Hierarchy Process (AHP) to develop a systematic evaluation tool for assessing regeneration suitability, integrating factors such as the contamination life cycle, costs, community benefits, and sustainability.

Notable examples of the application of MCDA approaches include the TIMBRE tool (Pizzol et al. 2016), which employs Ordered Weighted Averaging and Convex Combination methods, as well as SYRIADE (Agostini et al. 2012, Pizzol et al. 2011, Zabeo et al. 2011), based on the Source–Pathway–Receptor model and a set of socio-economic indicators. Other relevant studies include Burinskienė et al. (2017), who integrated MCDA with stakeholder evaluation; Mosadeghi et al. (2015) and Kordi & Brandt (2012), who advocate for fuzzy-AHP approaches to increase model robustness; and Liu et al. (2019), who used crowdsourcing and machine learning to select sites in Shenzhen, China. European approaches, such as those by Beames et al. (2018) and Abdullahi & Pradhan (2016), emphasise the community benefits of brownfield regeneration, particularly regarding service and infrastructure accessibility. To enhance stakeholder participation and the transparency of Decision Support Systems (DSS), Tendero & Plottu (2019) and Odii et al. (2019) recommend involving stakeholders already in the methodological design phase, ideally in combination with frameworks such as SuRF-UK. Bottero et al. (2019) illustrate a comprehensive hybrid framework incorporating stakeholder analysis, scenario development, and the NAIADE and MAVT methods, which has been successfully applied in Hong Kong. A common feature of all these approaches is the effort to integrate quantitative and qualitative information, strengthen the legitimacy of decision-making, and adapt regeneration strategies to the local context.

The literature review confirmed that brownfield regeneration is a multidimensional process influenced by various factors, including economic potential, environmental burden, institutional capacity, and social context. Special attention should be given to the study by Skrabal & Vybiral (2025a), which offers an original perspective through the application of Principal Component Analysis (PCA). This method enabled the identification of three key dimensions of regenerability, providing a robust foundation for subsequent multi-criteria evaluation using the MCDA method. This methodological linkage represents a valuable contribution to decision-making processes in the field of spatial development.

2 Methodology

MCDA was selected to reflect both recent research trends and the practical challenges faced by public administration, including limited data and conflicting stakeholder interests. In the field of brownfield regeneration, MCDA has been successfully applied in several international projects. One prominent example is the SYRIADE tool, developed as part of broader European initiatives and used to assess brownfield sites in Italy based on environmental, technical, and socio-economic criteria (Pizzol et al. 2016, Agostini et al. 2012). Its outputs enabled not only the classification of sites by risk level but also the proposal of intervention strategies. Similarly, Liu et al. (2019) employed MCDA in combination with scenario analysis to determine suitable future uses for contaminated land, while Bottero et al. (2019) developed a participatory framework involving stakeholders from the public, business, and municipal sectors in the decision-making process. These approaches demonstrate that MCDA is a flexible method capable of adapting to specific institutional and spatial contexts. Other authors have focused on the broader application of MCDA in spatial planning and strategic management. Ferretti (2013) highlight the advantages of this method when working with fuzzy data and expert estimates, which often complement or substitute for quantitative inputs. These approaches show that MCDA is not just a calculation tool, but also a way to combine different data sources into a clear and structured output.

In the Czech context, the application of MCDA in the field of brownfield regeneration remains relatively rare, despite its considerable potential. There is currently no standardized framework for evaluating land readiness for revitalization. Decisions are often made ad hoc, based on subjective judgment and affected by institutional uncertainty. This study addresses this gap by proposing a transparent, data-based method for comparing Czech regions (NUTS 3) in terms of brownfield regeneration readiness. The results provide both a regional ranking and an overview of key factors that support or hinder regeneration, offering guidance for national and regional planning.

The paper aims to identify and quantify the weights of key brownfield attributes using MCDA, assess their regeneration potential, and compare regional differences across the Czech Republic. The findings support strategic planning and public policy. Tables 1–2 show regional characteristics, including area and ownership, which can hinder regeneration (Adams et al. 2010, Skrabal et al. 2021). Table 3 addresses transport accessibility, a key success factor (Rizzo et al. 2018). Data reflect the situation at the end of 2024.

Table 1: Brownfields by Site Count, Area, and Ownership Type by Region

Region	Number of Sites	Brownfield Area (km²)	Public Ownership	Private Ownership	Mixed Ownership
CZ010	4	0.11	2	2	0
CZ041	43	4.88	16	25	2
CZ032	51	2.45	30	20	1
CZ042	91	3.95	30	59	2
CZ031	33	0.38	9	21	3
CZ063	40	0.38	18	21	1
CZ020	60	8.35	21	36	3
CZ053	33	0.39	15	18	0
CZ052	41	1.89	14	25	2
CZ051	62	1.01	21	36	5
CZ080	84	3.84	32	40	12
CZ071	37	1.27	10	21	6
CZ072	18	0.38	10	8	0
CZ064	49	0.71	14	29	6

Source: CzechInvest (2024), authors' own processing

The Table 2 shows the absolute number of brownfield sites in each region, categorised by their previous use. The classification includes industry, public amenities, agriculture, military, transport, mining, and other uses.

Table 2: Brownfield Sites by Previous Use and Region (Absolute Numbers)

Region	Industry	Public Amenities	Agriculture	Military	Other	Transport	Mining
CZ010	1	2	0	0	0	0	1
CZ041	12	16	6	3	4	2	0
CZ032	18	14	6	7	5	1	0
CZ042	43	21	10	7	5	5	0
CZ031	12	8	10	0	2	1	0
CZ063	14	11	11	2	2	0	0
CZ020	15	11	16	7	8	1	2
CZ053	18	4	8	1	2	0	0
CZ052	19	10	4	2	3	0	3
CZ051	26	21	10	1	2	1	1
CZ080	24	29	13	8	2	1	7
CZ071	7	13	5	5	3	3	1
CZ072	6	8	2	1	1	0	0
CZ064	17	13	8	4	7	0	0

Source: CzechInvest (2024), authors' own processing

The Table 3 presents the average distances of brownfield sites from key transport and administrative infrastructure across regions. The data include distances to the nearest railway, cadastre center, public transport stop, and primary road, measured in kilometres.

Table 3: Regional Averages of Brownfield Distances to Infrastructure (in km)

Region	Distance to Railway (km)	Distance to Cadastre Center (km)	Distance to Public Transport (km)	Distance to Primary Road (km)
CZ010	5.18	1.83	0.37	3.0
CZ041	3.05	1.23	0.74	5.4
CZ032	2.7	1.37	0.38	3.77
CZ042	2.0	1.21	0.36	3.06
CZ031	4.97	0.88	0.32	6.29
CZ063	4.56	0.86	0.31	6.57
CZ020	3.21	1.25	0.38	4.27
CZ053	3.24	0.85	0.36	4.85
CZ052	2.04	0.93	0.29	6.41
CZ051	2.01	1.07	0.47	4.79
CZ080	3.26	1.52	0.47	3.11
CZ071	2.19	1.38	0.42	3.33
CZ072	3.19	1.27	0.54	4.66
CZ064	4.17	0.96	0.38	6.82

Source: CzechInvest (2024), authors' own processing

2.1 The MCDA evaluation framework includes criteria, weights, and the calculation of scores

For the purpose of assessing the regeneration potential of brownfields across the individual regions of the Czech Republic, a Multi-Criteria Decision Analysis (MCDA) was applied. The evaluation criteria were selected based on the current literature, regional specifics, and data availability. The selection also followed the structure defined by the earlier PCA analysis (Skrabal & Vybiral 2025a). This phase supported the identification of the main dimensions of variability among the sites and served as an initial framework for structuring the criteria in the evaluation phase. The Capital City of Prague (CZ010) was excluded from the final MCDA results because it had too few recorded brownfield sites to allow a fair comparison with other regions.

The Weighted Sum Model (WSM) was selected for the MCDA evaluation due to its transparency, simplicity, and suitability for use in regional planning. Alternative methods such

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as AHP, PROMETHEE, or fuzzy AHP were not applied, as they require more structured input data, consistent expert assessments, or detailed pairwise comparisons, which are not feasible in the context of heterogeneous and partly incomplete regional datasets.

The criteria for evaluating brownfields were selected based on a detailed review of academic literature and past research on regeneration in the Czech Republic. The previous land use is considered a key indicator, as it significantly affects the level of environmental burden, the structure of required revitalisation, and the potential for future use. This approach is evident, for example, in the studies by Alker et al. (2000), which recommend classifying brownfields according to the dominant historical activity that took place in the respective location. Equally important is the ownership structure. Public ownership is often linked to more successful regeneration, as it allows municipalities or state institutions to take an active role in planning and implementation. These correlations are confirmed, for instance, by the study of Skrabal (2021), which demonstrates varying levels of municipal engagement depending on ownership structure. A complementary perspective is provided by the work of Dolezalova et al. (2014), which highlights institutional frameworks as a significant determinant of territorial development approaches.

Criteria reflecting the spatial and infrastructural location of the sites were also included. The monitored indicators comprised the distance to the nearest railway stop, availability of public transport, distance to a first-class road, and distance to the centre of the cadastral territory. These factors were selected based on the findings of Frantal et al. (2013), who highlight the importance of accessibility in decisions concerning the future use of land, and further inspired by approaches to geographic accessibility assessment as proposed by Rizza et al. (2015). These locational characteristics play a crucial role in brownfield regeneration, particularly in terms of investment attractiveness and the degree of integration into the existing urban structure.

The selection of evaluation criteria was determined not only by the theoretical framework but also by the availability of quantitative data at the level of individual sites. The criteria were chosen to cover four key dimensions: institutional (ownership), functional (previous land use), physical-spatial (area), and locational (distances to infrastructure). These criteria form the basic matrix for the multi-criteria assessment, with individual values transformed into comparable scales through standardization.

Weights were based on the authors’ informed judgment, supported by a thorough review of expert literature and the results of previous empirical analyses, including PCA and correlation matrices. Unlike formal methods of expert elicitation such as the Delphi technique, the weighting procedure reflects a synthesis of scholarly consensus and methodological pragmatism suitable for the available dataset. Input data were transformed using a normalization procedure to a 0-to-1 scale, enabling further processing and synthesis within the MCDA framework. This ensured the objectivity of interregional comparisons and provided a basis for calculating the aggregated score, which makes it possible to rank sites according to their suitability for regeneration. The highest weight was assigned to the criterion “public ownership” due to its proven significance in facilitating regeneration processes, as confirmed by previous studies (e.g., Davis and Sherman 2010, CABERNET 2014). Public actors often have greater capacity to overcome legal and financial barriers, enabling faster and more coordinated interventions. The identical weights (0.11) assigned to six other criteria reflect their balanced yet lower relative importance, as determined by PCA results and expert literature. While this uniformity may present challenges in distinguishing priorities in borderline cases, the MCDA framework allows for contextual interpretation. For specific applications, decisionmakers can adjust weights or apply scenario-based weighting to better reflect local conditions or strategic objectives. The MCDA framework applied in this study followed a sequential procedure: (1) identification of relevant criteria; (2) normalization of data to a common 0–1 scale; (3) assignment of weights based on expert judgment and supported by PCA and literature review; (4) calculation of weighted scores for each region; and (5) aggregation into a final ranking. This structured approach enhanced the clarity of the methodological process and ensured reproducibility of the results.

Because the criteria differ in scale and nature, a normalization procedure was applied to transform all input data to a common 0–1 scale. This step ensured full comparability across variables and regions. The min–max normalization procedure was applied using the following formula:

$$x' = \frac{x - x_{min}}{x_{max} - x_{min}} \qquad (1)$$

where:

- *x is the original value of the given criterion for a specific region;*
- *x_{min} and x_{max} are the minimum and maximum values in the given column across all regions;*
- *x' is the resulting normalized value in the interval [0, 1].*

For minimization criteria (e.g., distances), a scale inversion was applied to ensure that higher normalized values consistently indicated higher preference, i.e., a better outcome. The resulting values then served as inputs for the calculation of the weighted score for each region.

Weights were assigned using several inputs. These included literature review, expert consultations, and the frequency of factors in previous studies. Particular emphasis was placed on transport infrastructure accessibility and ownership structure, which were identified in both the literature and empirical research (e.g. Dolezalova et al. 2014) as decisive factors influencing investor interest and the actual feasibility of regeneration. The sum of weights equals 1.0, and their distribution reflects a balance between socio-economic, spatial, and infrastructural determinants of land redevelopment. The application of weights makes it possible to assign greater importance to those criteria that are essential for decision-making in spatial planning and environmental management. Table 4 presents an overview of the ten decision-making criteria used in the MCDA analysis of brownfield regeneration. The criteria encompass institutional, spatial, and infrastructural aspects, as outlined above. The table includes indicator types, measurement units, and the corresponding weights. This overview forms the basis for calculating the aggregated score of each region.

Table 4: MCDA Criteria and Weights for Brownfield Regeneration

Criterion	**Type**	**Unit**	**Weight**
Public ownership	Qualitative	% of total number	0.17
Previous land use (industry, agriculture, etc.)	Qualitative	Relative frequency	0.11
Site area	Quantitative	ha	0.11
Number of sites in region	Quantitative	pcs	0.06
Distance to cadastre center	Quantitative	km	0.11
Distance to public transport	Quantitative	km	0.11
Distance to primary road	Quantitative	km	0.11
Distance to railway stop	Quantitative	km	0.11
Brownfield density in region	Quantitative	pcs/km²	0.06
Infrastructure availability (overall)	Qualitative	Index	0.05

Source: authors' own processing

After the normalization of input data and the assignment of weights to individual criteria, the aggregate score for each region was calculated. The resulting score was obtained as a weighted sum of the normalized values of each criterion, where each value was multiplied by its corresponding weight. This approach allows comparison of regions by overall suitability for brownfield regeneration. Institutional, functional, spatial, and infrastructure aspects were assessed. Based on the final scores, regions were ranked to support interpretation and further development recommendations. During the construction of the model, attention was also paid to potential methodological limitations. The selection of criteria was constrained by the availability of quantitative data and their spatial resolution, which may have affected the completeness of the evaluation. The weighting was carried out using expert judgment based on literature and previous research, without the involvement of a broader expert panel or participatory approach. Therefore, the results of the MCDA analysis should not be considered definitive but rather as a supporting analytical tool for regional policy decision-making. The validity of the model was verified by triangulation with the results of the previous PCA analysis (Skrabal & Vybiral 2025a), which confirmed the consistency of key factors influencing brownfield regeneration. To further assess the relationships between individual criteria and the aggregate score, Pearson correlation coefficients were calculated and used as a supplementary tool for interpreting results and validating the decision model. The final score was computed using the basic MCDA framework of the Weighted Sum Model (WSM), which allows for the comparison of alternatives based on quantified and normalized criteria. This form of MCDA was selected due to its transparency, interpretability, and the ability to verify weight settings through correlation analysis.

3 Results of the MCDA Analysis and Interpretation of the Influence of Decision Criteria

This section presents the results of a multi-criteria decision analysis (MCDA) conducted to assess the regeneration potential of brownfield sites across the regions of the Czech Republic. The analysis is based on ten selected criteria, covering both quantitative attributes of the sites (e.g., number or size of sites) and qualitative or spatial factors (e.g., infrastructure accessibility or ownership structure). The findings are interpreted not only in terms of aggregated regional scores but also through the correlations between individual criteria and the overall assessment. This section builds on the theoretical and methodological framework and aims to link empirical outcomes with the existing literature on brownfield regeneration and spatial development.

3.1 MCDA Assessment Results and Regional Specifics of Brownfield Regeneration

The resulting regional ranking reveals significant differences in the level of readiness for brownfield revitalisation. The Ústí nad Labem Region (CZ042) achieved the highest score, followed by the Moravian-Silesian Region (CZ080) and the Liberec Region (CZ051). This confirms that structurally disadvantaged regions may demonstrate strong regeneration potential despite a high concentration of brownfields, provided that adequate infrastructure and public ownership are in place. The Ústí Region reached the top score (0.75), primarily due to a combination of a high number of sites (91), a significant share of public ownership (30%), and very good transport accessibility. Ownership structure has been identified in several studies (e.g. Adams et al. 2010, Skrabal et al. 2021) as a key determinant of successful regeneration, as it enables faster institutional intervention and more effective planning. The Ústí Region is also traditionally characterised by a high level of industrial burden, as confirmed by the number of sites with an industrial past (43). This finding supports the conclusions of Frantal et al. (2015), who argue that structurally affected areas may show high regeneration potential if provided with adequate strategic attention.

In second place was the Moravian-Silesian Region (0.58), which is also characterized by a high concentration of brownfields (84 sites), relatively good accessibility, and a higher proportion of public ownership (32%). The study by Skrabal & Vybiral (2025a) indicates that this region is among those where several successful regeneration projects have already taken place, supported by its history of industrialization, the presence of institutional support, and existing strategic frameworks. The high number of sites with former industrial use (24) further confirms the typical profile of a region with a historically significant industrial activity and complex environmental challenges. The third position was taken by the Liberec Region (0.54), where a balanced mix of indicators is evident, including a solid level of public ownership, density of sites, and relatively short distances to transport infrastructure. Although it is not the region with the highest concentration of brownfields, its score results from effective spatial accessibility and adequate institutional support. This situation demonstrates that not only the quantity, but also the quality of sites, their connectivity to infrastructure, and institutional capacities significantly influence the overall score. Similar conclusions are supported by international studies (e.g. Pizzol et al. 2016, Bottero et al. 2019), which emphasize the importance of locational characteristics and their integration into the decision-making framework.

At the opposite end of the ranking are the South Bohemian Region (CZ031), the Zlín Region (CZ072), and the South Moravian Region (CZ064), which recorded the lowest MCDA scores. The following table (Table 5) presents the results of the multi-criteria decision analysis (MCDA) in the form of aggregated scores and the final ranking of the individual regions of the Czech Republic. The score reflects each region’s level of readiness for brownfield regeneration, with higher values indicating greater potential for revitalization based on the selected criteria. The ranking is based on a comprehensive evaluation of ten indicators, including ownership, previous land use, accessibility, and site density. The interpretation reveals regional differences and provides a foundation for targeted policies. The table is a key tool for comparing disparities and guiding national strategies.

Table 5: Regional MCDA Scores and Rankings

Region code	MCDA score	Rank
CZ042	0.75	1
CZ080	0.58	2
CZ051	0.54	3
CZ032	0.53	4
CZ020	0.52	5
CZ052	0.44	6
CZ053	0.42	7
CZ071	0.37	8
CZ041	0.33	9
CZ063	0.32	10
CZ064	0.29	11
CZ072	0.23	12
CZ031	0.23	13

Source: authors’ own processing

3.2 Interpretation of the Results of the MCDA Analysis of Brownfield Regeneration

The attribute with the highest correlation to the final regeneration score was the number of brownfield sites in a given region (r=0.88), confirming the importance of the quantitative aspect of brownfields in revitalization planning. As Frantal et al. (2013) point out, a higher concentration of such sites can contribute to synergistic effects and better coordination of interventions, especially in structurally disadvantaged industrial regions. The second-highest correlation score was recorded by the attribute of previous land use (r=0.86). This result reflects the fact that historical industrial burden remains a key indicator of regeneration needs.

According to Ferber et al. (2006), industrial brownfields often suffer from the highest levels of contamination and complex technical conditions, requiring stronger institutional and technological intervention. This perspective is further developed by Alberini et al. (2005), who stress the economic costs of decontamination and the need to apply advanced technologies such as phytoremediation, as referenced by Rizzo et al. (2018) and Laprise et al. (2022). The third most significant factor in terms of importance is public ownership (r=0.85). As Davis & Sherman (2010) state, the presence of a public actor in the ownership structure significantly increases the chances of revitalization due to transparent governance, availability of subsidies, and strategic planning. This argument is further supported by the CABERNET model (2014), which classifies brownfields based on the degree of need for public intervention and the availability of institutional tools. Public ownership thus enables more flexible responses to market failures and eliminates delays typically associated with private entities (Adams et al. 2010).

Among the least significant attributes was the aggregate distance from all types of infrastructure, which showed a weak correlation with the final score (r=0.11). This result suggests that specific forms of connectivity (e.g., road accessibility) are more critical than an aggregated index. Green (2018) and Pizzol et al. (2016) point out in their work that the decision-making process is more influenced by particular types of transport connections rather than their overall average. Similarly, the distance from the railway (r=0.13) shows only a weak effect, despite historically being considered a strategic element for industrial use. As noted by Alker et al. (2000) and Thomas (2003), railway connectivity used to play an important role, but current trends show a shift towards more flexible and faster road infrastructure. Today, the importance of railways remains mostly supplementary, although for some types of sites (e.g., logistics parks), it can still be relevant. The third least correlated attribute is the technical infrastructure index (r=0.17), which includes access to networks such as water, electricity, or sewage. Although this is a basic prerequisite for regeneration, its low correlation score can be explained by the relatively even distribution of this infrastructure across regions, as most brownfields are located in existing urbanised areas. This interpretation aligns with the findings of Potts and Cloete (2012), who point out that the presence of infrastructure alone is not sufficient if other institutional and market motivators are lacking.

From the perspective of practical implications, the findings suggest that decisions regarding brownfield regeneration should be based primarily on spatial and institutional factors, while technical aspects should be understood as a necessary but not sufficient condition. The presence of a public actor, the historical readiness of the area, and a high concentration of sites that can be addressed systemically are key. The results also confirm the need for spatial planning based on a combination of factors; as Thomas (2003) states, an isolated view of an individual site without a broader context often leads to strategic failure. Table 6 presents the values of Pearson correlation coefficients, which express the strength and direction of the linear relationship between individual evaluation criteria and the final MCDA score for each region. The correlation coefficients were calculated based on normalized values. The presented results show that while institutional and spatial factors (e.g., ownership, previous use, site concentration) play a key role in decision-making, technical and transport indicators are rather supportive in nature and their impact may be contextually limited. The interpretation of correlations also helps refine the weighting of criteria and confirms the validity of the decision-making attributes used.

Table 6: Pearson Correlation Coefficients Between MCDA Score and Selected Criteria

Criterion	Pearson correlation coefficient
Number of brownfield sites	0.88
Previous use	0.86
Public ownership	0.85
Brownfield density	0.69
Total area of brownfield sites	0.50
Distance from cadastral center	0.40
Distance from public transport	-0.15
Distance from railway station	-0.64
Distance from main road (1st class)	-0.68
Infrastructure availability (summary index)	-0.75

Source: authors' own processing

Conclusion

The presented study focused on assessing the regeneration potential of brownfield sites in the Czech Republic using the Multi-Criteria Decision Analysis (MCDA) method. A set of ten relevant criteria was developed, encompassing locational, technical-infrastructural, ownership, and dimensional factors. Through weighted scoring, the relative suitability of individual regions for the regeneration of abandoned sites was evaluated. Each region was assigned an aggregate score, based on which a ranking of all regional units within the Czech Republic was established. The aim of the paper was to identify and quantify the weights of key brownfield attributes using the MCDA method, determine their relative importance in the regeneration assessment, and compare regional specificities across the Czech Republic. The results can serve as a basis for strategic planning, spatial decision-making, and the formulation of public policies aimed at the renewal of neglected areas. The stated objective of the paper was fully achieved. Using the MCDA method, the weights of key attributes influencing brownfield regeneration were identified and quantified, and their relative importance in the decision-making process was clarified. At the same time, regional specificities within the Czech Republic were revealed, thus generating relevant insights applicable to strategic planning and public policy development.

The results of the analysis reveal significant differences in the regeneration potential among individual regions. The highest MCDA scores were achieved by the Ústí nad Labem Region (CZ042), followed by the Moravian-Silesian Region (CZ080) and the Liberec Region (CZ051). These regions are characterised by a higher number of sites, larger average size of brownfields, good access to technical infrastructure, and partially more favourable legal conditions. At the opposite end of the ranking were the South Bohemian Region (CZ031) and the Zlín Region (CZ072), indicating less favourable initial conditions for regeneration, including a smaller number of sites, lower brownfield density, or poorer accessibility to transport infrastructure.

The highest correlation with the final regeneration score was found for the attribute "number of sites in the region" (r=0.88), confirming the importance of the quantitative dimension of brownfields for revitalisation planning. As Frantal et al. (2013) state, a higher concentration of such sites supports synergistic effects and more efficient coordination of interventions, particularly in regions with a declining industrial base. A strong correlation is also observed for the attribute "previous land use" (r=0.86); according to Ferber et al. (2006) and Alberini et al. (2005), industrial brownfields are often affected by contamination and technical degradation, requiring advanced interventions. The third strongest correlation is found with the factor of public ownership (r=0.85) the presence of a public actor significantly increases the chances of revitalisation, as noted by Davis & Sherman (2010) and CABERNET (2014), enabling more flexible responses to market failures. On the other hand, less significant factors include aggregate distance from infrastructure (r=0.11), distance from railway lines (r = 0.13), and the technical infrastructure index (r=0.17). These findings suggest that technical aspects represent more of a basic prerequisite rather than a decisive element of regeneration. Therefore, it is crucial that the decision-making process takes into account spatial and institutional dimensions, which have a fundamental impact on the successful transformation of brownfields. The correlation analysis contributed to confirming the validity of the selected decision-making framework and supported the relevance of the proposed weighting of individual criteria. These findings are consistent with empirical research on brownfield regeneration for business purposes in the Czech Republic (Skrabal & Vybiral 2025b). Based on data from 2018 to 2024, the study identified the Moravian-Silesian, Ústí nad Labem, and South Moravian regions as the most active in regeneration projects. It also confirmed that the most influential factors include the type of ownership, previous land use, and particularly the amount of EU co-financing, which accounted for up to 42.7% of total eligible project costs. These findings highlight the importance of combining spatial, institutional, and financial aspects to increase regional competitiveness and employment.

The presented study directly builds on the principal component analysis (PCA) conducted by Skrabal & Vybiral (2025a), which focused on identifying the factor structure of variables and their internal relationships. The results of PCA and MCDA are mutually consistent, with the PCA analysis confirming the existence of dominant factors (e.g., infrastructure, ownership, use) and their strong correlations. In contrast, the MCDA method enabled this structure to be translated into a practical decision-making framework and to quantify regional differences in the form of an aggregated score. This methodological linkage reinforces the credibility of the results and confirms that the selected set of criteria reflects essential differences in regeneration potential. The methodological part of this study is based on a robust weighting system, data consistency, and a validated normalisation procedure. However, some limitations need to be highlighted. Firstly, the analysis was conducted at the NUTS 3 level, meaning that internal regional heterogeneity remains hidden. Secondly, the data used for the analysis are static and do not capture the dynamic development of sites over time. Thirdly, while the criteria weights were determined based on expert judgment and previous studies, a certain degree of subjectivity in this approach remains. Based on the results, further research will focus on detailed profiling of individual regions by specific criteria. The study will conduct a comparative analysis of the composition of attributes within each region, identify key factors influencing positive or negative evaluations, and on this basis, create a new internal ranking of regions. This approach will help identify regions that may have a low overall score but excel in specific criteria, and vice versa. The findings will serve as a basis for recommendations on how to target regional and national interventions, particularly in subsidy schemes, regeneration planning, and setting priority zones.

From a practical application perspective, the MCDA analysis provides a clear, data-based framework for decision-making processes at both national and regional levels. The resulting spatial map of regeneration potential can be used as analytical support for strategic documents in spatial planning, economic policy, and the circular economy. The emphasis on linking analytical evaluation with practical decision-making aligns with current trends in public administration and regional development. The combination of PCA and MCDA approaches proves to be particularly suitable in the context of brownfield assessment, as it integrates statistical robustness with practical application. This study thus provides a clear methodology that can be further developed and simultaneously establishes fundamental parameters for decision-making on land revitalisation in the Czech Republic. The conclusions of the presented study are consistent with previous research (e.g. Frantal 2015, Adams et al. 2010, Skrabal & Vybiral 2025a) and open the way for extending the research towards multidimensional models that would combine environmental, economic, and social aspects of brownfield regeneration in the regional context.

The results of this study can also support practical decision-making. The regional ranking and key indicators identified through the MCDA framework can be used by public authorities to better allocate financial support, prioritize areas in spatial planning, and adjust regional development strategies. Furthermore, the findings may contribute to the revision and improvement of brownfield databases by adding criteria-based classifications that reflect not only physical conditions but also institutional readiness. This practical application strengthens the relevance of the study in policy design and implementation. For future development and practical application, it may be beneficial to cluster regions based on similarities in their MCDA scores and dominant attributes. Such typology could group territories with comparable regeneration potentials and challenges, offering a clearer interpretation of their position within the national context. This classification would allow for more targeted recommendations and differentiated policy support, better aligning interventions with regional profiles. Furthermore, identifying clusters of regions with similar barriers or enabling conditions could facilitate knowledge sharing and the development of joint strategic responses. Such clustering may also inform the design of region-specific policy instruments and enhance the efficiency of EU-funded regeneration programs.

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