Centre for Research on Settlements and Urbanism
Journal of Settlements and Spatial Planning
Journal homepage: https://jssp.reviste.ubbcluj.ro

Typological Classification and Spatial Analysis of Brownfields. A Case Study from Czechia

Jaroslav SKRABAL*[1], Martina PAVLACKOVA[2], Jiri FISER[2]
**Corresponding author*
[1] Moravian Business College Olomouc, Institute of Economics and Regional Development, Olomouc, CZECH REPUBLIC
[2] Moravian Business College Olomouc, Institute of Applied Mathematics and Information Technology, Olomouc, CZECH REPUBLIC
jaroslav.skrabal@mvso.cz 0000-0002-4685-9836
martina.pavlackova@mvso.cz 0000-0002-7376-5755
jiri.fiser@mvso.cz 0000-0002-9958-2543
DOI: https://doi.org/10.24193/JSSP.2025.2.05
Received: 03 July 2025
Received in revised form: 28 August 2025
Accepted for publication: 12 November 2025
Available online: 29 December 2025

Keywords: brownfields, spatial analysis, land regeneration, site typology, spatial planning

ABSTRACT

This study examines the regeneration potential of brownfield sites in Czechia from a spatial and typological perspective. It aims to identify the key physical and locational characteristics that influence the redevelopment of such sites, based on data from the National Brownfield Database managed by CzechInvest. The analysis includes 653 brownfield sites recorded as of December 2024. Using descriptive statistics and spatial analysis in the R environment (packages sf and ggplot2), the study evaluates variables such as site area, ownership type, former land use, level of environmental contamination, and proximity to selected transport nodes (cadastral centres, public transport stops, railway stations, and first-class roads). The results reveal substantial regional differences in the distribution and typology of brownfields. Large, contaminated, and privately owned sites are more likely to be located in peripheral areas with low investment attractiveness. In contrast, smaller, publicly owned sites with better transport accessibility tend to have higher regeneration potential. The study proposes a new analytical framework for spatial planning and regional development, enabling more targeted identification of priority sites for redevelopment while also addressing structural barriers that may hinder the regeneration process.

1. INTRODUCTION

The regeneration of brownfields represents a key instrument of sustainable spatial development, particularly in the context of climate change, limited developable land, and the need to protect agricultural areas. Brownfields are abandoned, underused, or degraded sites that often exhibit signs of deterioration and are commonly associated with environmental burdens, unclear ownership, and low investment attractiveness. At the same time, they offer development potential that can be activated under appropriate planning, institutional, and decision-making frameworks. Similar transitions have also been observed in European regions where regeneration aligns with innovation-oriented strategies, such as the transformation of science and technology parks into innovation districts (Valdaliso and Andres, 2025). These sites also provide opportunities for transformation and innovative reuse, as shown by recent approaches to co-governance and participatory planning in Western Europe (Rădulescu et al., 2025).

Recent work also highlights the role of adaptive reuse, showing how undesignated industrial heritage can support local identity while contributing to sustainable redevelopment (Yildirim Okta, 2025).

Academic research has long examined the factors influencing successful brownfield regeneration. Alker et al. (2000) and Thomas (2003) defined basic typologies and functional classifications, while Dixon (2007) highlighted environmental and institutional constraints. In addition, analytical tools have been developed to support decision-making, including frameworks such as SYRIADE (Agostini et al., 2012) and the TIMBRE Brownfield Prioritization Tool (Pizzol et al., 2016). In the Czech context, attention has been focused on the spatial distribution of brownfields, their classification by type and degree of environmental burden, and the identification of barriers to regeneration. Significant studies have examined their uneven occurrence in relation to settlement size, regional economic performance, and institutional context (Frantal and Martinat, 2013; Martinat et al., 2016). This variation can also be interpreted within broader processes of peripheralisation, which shape regional disparities in access to investment and planning capacity (Willett et al., 2025). Tureckova et al. (2018) identified the main obstacles and factors influencing municipalities' willingness to regenerate, while Navratil et al. (2022) emphasised the importance of public-sector involvement and transparent access to information. More recently, Persson et al. (2025) underlined the role of city-regional governance and inter-municipal cooperation in building effective planning capacity and aligning regeneration with broader development goals.

In addition to structural factors, it is essential to consider local perceptions and public attitudes. Alker et al. (2000) stress the importance of public opinion, while Chen and Chi (2022) highlight that regeneration is also a cultural and emotional process. This perspective is reinforced by Navratil et al. (2022, 2023), whose research on the residents' preferences in different types of municipalities in Czechia and Central Europe demonstrates that expectations regarding brownfields vary significantly with local experience and the socioeconomic profile of the population.

The issue of brownfields has become an integral part of the global discourse on sustainable spatial development and strategic planning, with particular emphasis on their regeneration as a driver of economic, ecological, and social renewal. In neoliberal contexts, strategic planning is often employed as a governance tool to reconcile market dynamics with long-term land-use objectives, especially in relation to housing and brownfield redevelopment (Hanssen et al., 2024). A parallel tendency can be seen in Nordic countries, where regional planning strategies have been formalised to support the regeneration of complex sites such as brownfields (Hagen and Higdem, 2024). Abandoned and frequently contaminated sites that have lost their original function are therefore framed not only as urban challenges but also as opportunities for the systematic transformation of neglected structures in line with the principles of the circular economy and environmental integrity. Within academic debates, their regeneration is portrayed as a means to limit the conversion of agricultural and natural land, foster social inclusion, and enhance resilience to climate change.

A key finding of international research is that brownfield areas are highly heterogeneous, with characteristics that vary considerably across regions and even within individual sites. Bardos et al. (2016) and D'Angelo et al. (2025) describe them as dynamic systems whose successful transformation requires a coordinated, interdisciplinary response. Whereas earlier work was dominated by a technocratic focus on remediation, more recent approaches focus on environmental sustainability, social justice, and the cultural values of place. Case studies from the United Kingdom (Bardos et al., 2015), Germany (Altrock, 2024), the United States (Cui, 2017), France (Darchen and Simon, 2022), and China (Ni et al., 2025) illustrate the diversity of classification and evaluation practices. Increasingly, research combines environmental, economic, and social indicators, integrating quantitative data (e.g. GIS, contamination databases) with qualitative insights (e.g. expert assessments, participatory workshops).

Among the most robust evaluation tools developed in the past decade is the Multi-Criteria Decision Analysis (MCDA) model, which integrates diverse types of data into decision-making processes. MCDA has been widely applied in Anglo-American contexts (Li et al., 2019; Wan et al., 2024; Skrabal and Vybiral, 2025a) and in European settings (Tobias et al., 2018), with growing use also reported in China (Ni et al., 2025). Complementary visualisation tools and expert systems have further advanced this approach, as demonstrated by Hammond et al. (2021, 2024), who propose next-generation decision support systems that integrate accessibility, risk, and social impacts of regeneration. Central to these models is the transparent weighting of indicators and the clear documentation of input data.

Skrabal and Vybiral (2025a) analyse key factors influencing brownfield regeneration in Czechia within a wider regional development framework, identifying the main economic, environmental, and social determinants of successful revitalisation. Using factor analysis and comparative methods, they propose an evaluation framework for assessing the investment potential of individual sites. Skrabal et al. (2021) examine the implementation of regeneration support tools, focusing on the effectiveness of municipal grant schemes and highlighting the limitations of Local Action Groups and European funding mechanisms. Building on this, Skrabal (2020) provides a spatial analysis of national brownfield databases, showing that peripheral locations often display higher regeneration potential. Finally, Skrabal and Vybiral (2025b) investigate the economic dimension of revitalisation and the role of brownfields in business development, stressing the need for an integrated approach that addresses legislative and environmental barriers. Together, these studies enrich understanding of the brownfield issue and outline practical recommendations for sustainable spatial development policy.

Tvrdon and Chmielova (2021) examined the interconnection of strategic, financial, and regional frameworks for brownfield regeneration in Czechia using data from 2000–2020. Their results reveal marked regional disparities in both the number of regenerated sites and the absorption of European Union funds. While they note gradual improvements in strategic planning, the authors also emphasise a persistent time lag in addressing this issue compared with Western European countries. Complementing this perspective, Tureckova et al. (2019) assessed the regeneration potential of more than 460 sites through multiple correspondence analysis. Their findings identified several brownfield typologies and key variables such as former land use, locational features, and ownership relations that strongly influence revitalisation outcomes. Appropriate combinations of these factors were shown to significantly increase the chances of successful regeneration and to enhance the effectiveness of public funding allocation.

The present paper builds on a previous data analysis from 2020 (Skrabal, 2020) and introduces a revised weighting scheme that captures regeneration dynamics not only in absolute numbers but also in shifts in the relative importance of key criteria. A further contribution lies in integrating datasets with map-based visualisation, which improves the identification of regional trends and specificities. In parallel, the study also considers the concept of temporary use as an effective strategy for activating land prior to permanent transformation. Altrock (2024) illustrates how interim uses such as community gardens, cultural centres, or sports facilities can reintegrate brownfields into the urban fabric, while Bardos et al. (2015) and Rihana-Abdallah and Pang (2018) outline their ecological and social benefits. In the Czech context, such "soft reuse" remains rare, but it shows potential for sites with unclear ownership or low market attractiveness, serving not only aesthetic or community purposes but also as a testing ground for the feasibility of future permanent projects.

In the governance and management of abandoned buildings and sites, increasing attention is being paid to the role of public and stakeholder involvement. Mukherjee et al. (2025), Wan et al. (2024), and Chen and Hashimoto (2025) show that participation is not a procedural formality but a decisive factor for successful regeneration. Where it is lacking, projects often face community resistance, delays in implementation, or inefficient use of investment. Strengthening participatory planning also contributes to the standardisation of evaluation methods and improves the comparability of projects across regions. Building on this perspective, He et al. (2024), in a systematic review of 80 studies, identify five core dimensions of regeneration sustainability - ecological, economic, social, cultural, and institutional. They stress the absence of an integrated evaluation framework and call for interdisciplinary collaboration to embed these dimensions within a single decision-making system.

International research increasingly highlights the importance of data standards and spatial typologies in guiding regeneration strategies. Maldonado Lopez et al. (2021), for instance, propose a practical prioritisation matrix for 16 categories of unused urban land, while Ni et al. (2025) introduce a multi-source classification of Chinese brownfields that integrates administrative data, satellite imagery, and expert assessments. Other studies broaden the perspective. Popa et al. (2025) explore cultural regeneration, showing how abandoned industrial sites can be repurposed for creative industries, thereby supporting economic diversification and revitalising urban peripheries. In a related policy context, Sun et al. (2022) trace the evolution of China's regeneration framework and recommend five key improvements: systematic site classification, integrated management, stronger environmental standards, community participation, and the establishment of a national database of contaminated sites.

Recent findings indicate a clear shift in brownfield research from purely technical solutions towards integrated planning models that combine modern data, sustainability criteria, and active public engagement. The Czech case study presented here illustrates how such international insights can be translated into a national context. This transformation also underscores the growing importance of agglomeration economies and spatial factors in shaping regional investment patterns and redevelopment potential (Kimino, 2025). Within this framework, the use of descriptive statistics provides not only an analytical baseline but also a practical tool for regional and environmental decision-making.

The primary aim of this paper is to assess the spatial and physical characteristics of brownfields in Czechia that may affect their potential for regeneration. Two secondary aims are also pursued: (i) to compare regional differences in the distribution and typology of brownfields at the NUTS III level, and (ii) to analyse how factors such as site size, ownership structure, former land use, contamination, and transport accessibility influence their regeneration potential. The paper is structured into four parts: Part 2 presents the data sources and methodological framework applied in the study; Part 3 reports the empirical results, including sub-parts on the spatial differentiation of brownfield typologies (3.1) and their proximity to infrastructural nodes (3.2); and Part 4 concludes by summarising the main findings and highlighting their implications for spatial planning and regional development.

2. DATA AND METHODOLOGY

The second part of the study renders the data sources and methodological framework. A regional comparison was carried out at the NUTS III level using the National Brownfield Database administered by the CzechInvest agency (2024). For consistency, the dataset was fixed as of December 20, 2024, since the content of the database changes considerably over time. The analysis builds on earlier work by Skrabal (2020), which examined the number and area of brownfields in 2018 and 2020, and extends it to the current territorial distribution of sites. The present study identifies the total number of brownfields within the CZ-NUTS III structure (Fig. 1), their overall area, the proportion of regional territory they occupy, and the relative share of brownfield land.

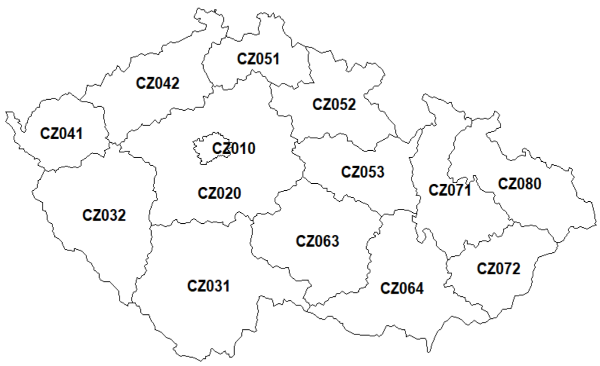

Fig. 1. Regional division of Czechia at the NUTS III level.

In addition to site numbers and areas, the study also considers ownership structure, former land use, and the level of contamination (Fig. 2–5). Map outputs were generated from the GPS coordinates recorded in the database, while further spatial analysis measured the distance of brownfields from selected reference points (Fig. 6–9): the cadastral centre, the nearest public transport stop, the nearest railway station, and the nearest first-class road. Distances were calculated in kilometres, enabling an assessment of transport accessibility and the degree to which brownfields are integrated into regional and urban structures.

Within the chosen methodological framework, several general research methods were employed, including analysis, synthesis, deduction, comparison, and description. Analysis served to disaggregate individual indicators and spatial factors influencing the distribution of brownfields, while synthesis reconnected these elements to show their interrelations. Deductive reasoning enabled broader conclusions to be drawn from partial findings, and comparative techniques were applied to reveal regional differences across Czechia. The descriptive method summarised the spatial distribution of brownfields in relation to selected indicators and available data. Taken together, these approaches position the study as applied research (Hendl, 2023) aimed at tackling practical questions of brownfield distribution and regeneration potential and at providing insights directly useful for spatial planning, regional development, and sustainable land reuse.

To provide spatial context, Figure 1 displays the regional division of Czechia at the NUTS III level. The National Brownfield Database recorded 653 abandoned sites, although the actual number is likely higher since only properties with resolved ownership and consent for publication are included (Skrabal and Vybiral, 2025b). Table 1 highlights marked regional differences: the Central Bohemian Region contains the largest absolute area of brownfields (over 836 ha), while the Karlovy Vary Region shows the highest relative share (0.12%), reflecting long-standing structural problems and deindustrialisation. High values are also evident in the Usti nad Labem and Moravian-Silesian regions, historically shaped by intensive industrial activity.

In contrast, the lowest shares of brownfields-below 0.01% of regional area-were recorded in the South Bohemian, Zlin, and Pardubice regions.

Table 1. Brownfield sites by NUTS 3 regions in Czechia (2024), with areas expressed in hectares and square metres.

Name of Regions	CZ-NUTS	Area of the region in (ha)	The area of brownfield sites in (ha)	Share of BF area in NUTS 3 region area (2024) in %	The number of brownfield sites (n)
Karlovy Vary Region	CZ041	331,040.0	408.4	0.123373	44
Plzen Region	CZ032	764,900.0	244.6	0.031981	53
Usti nad Labem Region	CZ042	533,870.0	393.7	0.073738	91
South Bohemian Region	CZ031	1,005,810.0	37.6	0.003741	33
Vysocina Region	CZ063	679,580.0	37.0	0.005443	40
Central Bohemian Region	CZ020	1,092,850.0	836.4	0.076533	64
Pardubice Region	CZ053	451,930.0	38.9	0.008600	33

Hradec Kralove Region	CZ052	475,920.0	174.5	0.036656	41
Liberec Region	CZ051	316,340.0	100.8	0.031854	63
Moravian-Silesian Region	CZ080	543,070.0	355.9	0.065536	83
Olomouc Region	CZ071	527,160.0	125.0	0.023705	37
Zlin Region	CZ072	396,290.0	37.7	0.009526	18
South Moravian Region	CZ064	718,770.0	71.0	0.009882	49
Prague (Capital City)	CZ010	49,600.0	11.3	0.022863	4
Total	CZ0	7,887,130.0	2,872.8	0.036424	653

Source: own elaboration based on CzechInvest data (2024).

These values reflect not only local territorial conditions but also differences in reporting activity and data transparency. In Prague, the database lists only 11.3 hectares and four sites, a likely consequence of high land-use pressure and elevated property values, although the real extent is considerably greater. By comparison, the highest numbers of brownfields occur in structurally affected regions such as Moravian-Silesian, Liberec, and Usti nad Labem (Skrabal et al., 2021; MMR, 2024), historically shaped by mining and heavy industry and now undergoing economic restructuring.

The maps were produced in R (version 4.4.2; R Core Team, 2024) using specialised spatial packages, including *sf* and *ggplot2* (Pebesma, 2018; Wickham, 2016). Administrative boundaries were obtained from the *RCzechia* package (Lacko, 2023). The brownfield dataset, containing GPS coordinates and site attributes, was pre-processed for mapping.

Brownfield locations were visualised as points over regional boundaries, with thematic colouring applied to four key variables: previous land use, ownership structure, environmental burden, and site size. For the latter, values were converted into hectares and grouped into three categories: small (≤ 0.25 ha), medium (0.25–1.5 ha), and large (> 1.5 ha). To ensure consistency and readability, colour schemes optimised for accessibility were used, and all maps (Fig. 2–5) share a uniform coordinate frame covering the territory of Czechia.

3. RESULTS AND DISCUSSION

The third part of the study presents a detailed analysis of the spatial and physical characteristics of brownfields in Czechia. The assessment draws on key variables, including site size, ownership structure, former land use, level of contamination (Fig. 2–5), and proximity to cadastral centres and major transport nodes (Fig. 6–9). The analysis, conducted at the NUTS III regional level, combines descriptive statistics with cartographic representation to visualise territorial differences. This approach makes it possible to track not only the spatial concentration of brownfields but also the structural attributes that shape their future redevelopment potential.

3.1. Spatial differentiation of brownfield typology

Figure 2 illustrates the distribution of brownfield site sizes in Czechia and shows clear regional disparities. Large sites are concentrated mainly in the Usti nad Labem, Karlovy Vary, and Moravian-Silesian regions, historically burdened by heavy industry and structural decline (Frantal and Martinat, 2013; Skrabal and Vybiral, 2025a). Such locations often face environmental risks, complex ownership relations, and low investment appeal, which reduce their regeneration prospects (Ferber et al., 2006; Frantal et al., 2015). By contrast, smaller sites, more common in central and suburban zones, tend to be more adaptable to new business uses (Ahmad et al., 2021; Wang et al., 2011). This spatial pattern corresponds with earlier findings by Skrabal (2020), while Tureckova et al. (2018) also highlight site size as a critical factor shaping municipal interest in revitalisation. From a strategic planning perspective, site size should therefore be incorporated into evaluation frameworks, for example as a parameter within MCDA models, to ensure a transparent comparison of regeneration potential across regions (Pizzol et al., 2016; Bottero et al., 2019).

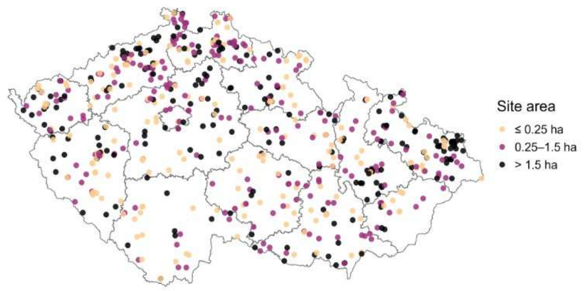

Fig. 2. Spatial distribution of brownfield sites in Czechia by area size *(source: own elaboration based on data from the CzechInvest National Brownfield Database, 2024).*

Figure 3 shows the distribution of brownfields by ownership type - public, private, and mixed - and reveals a clear dominance of privately owned sites across most Czech regions. International research confirms this pattern: D'Angelo et al. (2025) and Bottero et al. (2019) stress the difficulties of redeveloping privately or jointly owned sites, particularly when stakeholder cooperation is lacking.

Publicly owned brownfields occur more often in peripheral areas, where market pressures are weaker, but public authorities play a stronger role in initiating regeneration (Savini, 2015). Mixed ownership proves the most problematic; as Altrock (2024) notes, it frequently results in delays and unclear responsibilities among stakeholders. Similar challenges are highlighted in the Czech context by Frantal and Martinat (2013), as well as Skrabal (2020), who underline the close link between ownership structure and the willingness of municipalities or investors to pursue regeneration.

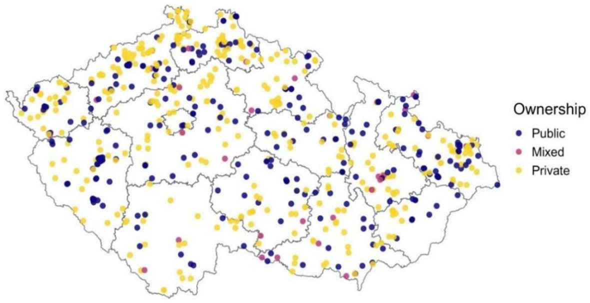

Fig. 3. Ownership structure of brownfield sites in Czechia *(source: own elaboration based on data from the CzechInvest National Brownfield Database, 2024).*

Figure 4 shows that industrial and mining brownfields are heavily concentrated in the northern and north-western regions of Czechia, reflecting structural disparities and the legacy of heavy industry in Usti nad Labem and Moravian-Silesian (Frantal and Martinat, 2013). The predominance of industrial and transport-related sites in these areas is also associated with higher levels of contamination and more complex regeneration processes (Ferber et al., 2006; Skrabal and Vybiral, 2025a).

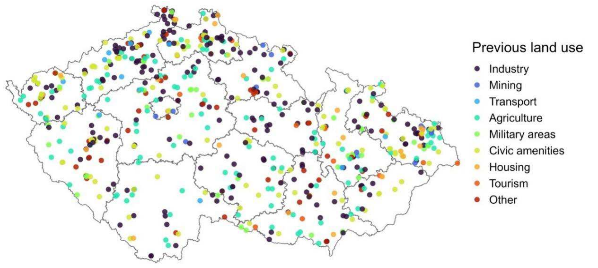

Fig. 4. Spatial distribution of brownfields by previous land use in Czechia *(source: own elaboration based on data from the CzechInvest National Brownfield Database, 2024).*

By contrast, southern and central Bohemia display a more diverse history of land use-including agriculture, civic amenities, and tourism-which increases the scope for mixed-use revitalisation (Alker et al., 2000; Pizzol et al., 2016). Clusters of sites in rural areas further illustrate the point made by Tureckova et al. (2018), namely that municipal motivation for regeneration depends on institutional capacity and the availability of information. Likewise, Skrabal (2020) demonstrates that peripheral locations, distant from urban cores, generally face lower investment attractiveness.

Figure 5 shows that environmental burdens affect many abandoned sites in Czechia, though their distribution is uneven. Contaminated or potentially contaminated brownfields are concentrated in northern Bohemia, the Ostrava region, and around Brno, reflecting the legacy of past industrial activity (Frantal and Martinat, 2013; Ferber et al., 2006). Similar patterns have been observed elsewhere in Europe, where former industrial zones often face higher contamination risks due to cumulative impacts (Li et al., 2019). A large share of sites classified as "presumed" or "unknown" reveals a diagnostic gap in risk assessment, which Navratil et al. (2022) identify as a major barrier to effective regeneration planning. Uncertainty over contamination, as noted by Hurnikova (2009) and Skrabal (2020), further reduces investor interest and delays land-use decisions. Addressing this requires systematic monitoring and transparent evaluation of environmental risks, as emphasised by Laprise et al. (2018), who regard such practices as essential for sustainable urban planning.

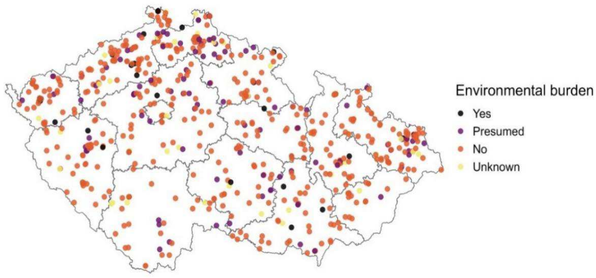

Fig. 5. Environmental burden status of brownfield sites in Czechia *(source: own elaboration based on data from the CzechInvest National Brownfield Database, 2024).*

3.2. Analysis of the spatial proximity of brownfields to infrastructural nodes

Figure 6 presents the average distance of brownfields from the centroid of cadastral territories. The highest value was recorded in Prague (CZ010; 1.825 km), reflecting the metropolitan structure where most sites lie outside the historic core, often in peripheral industrial zones (Osman et al., 2015). Above-average distances were also found in the Olomouc (CZ071; 1.378 km), Zlin (CZ072; 1.273 km), and Moravian-Silesian regions (CZ080; 1.517 km), linked to the legacy of marginally located industrial complexes. By contrast, Pardubice (CZ053; 0.850 km), Vysocina (CZ063; 0.858 km), and South Bohemia (CZ031; 0.884 km) show much shorter averages, indicating a more compact distribution of sites near settlement centres. Shorter distances, as Navratil et al. (2022) argue, improve information accessibility and support municipal engagement. Proximity to cadastral cores also raises the likelihood of environmentally friendly and energy-efficient regeneration (Ahmad et al., 2021), while spatial indicators such as distance from the municipal centre are recognised by Laprise et al. (2018) as key criteria for prioritising sustainable territorial development.

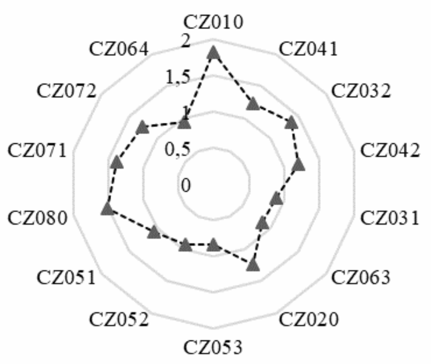

Fig. 6. Average distance of brownfields from the centre of cadastral units [km] *(source: own elaboration based on data from the CzechInvest National Brownfield Database, 2024).*

Figure 7 illustrates regional differences in the average distance of brownfields from public bus stops. The Karlovy Vary Region (CZ041; 0.740 km) shows the longest average distance, reflecting a sparse transport network and low urbanisation (Hurnikova, 2009). Relatively high values also occur in Zlin (CZ072; 0.543 km) and Liberec (CZ051; 0.466 km), where stops are decentralised and often located outside urban cores. By contrast, Hradec Kralove (CZ052; 0.291 km), Vysocina (CZ063; 0.310 km), and South Bohemia (CZ031; 0.322 km) report the shortest averages, indicating better public transport accessibility. Such disparities influence investor interest, since improved accessibility lowers entry barriers and supports environmentally responsible regeneration (Li et al., 2019; Ahmad et al., 2021). As Navratil et al. (2022) note, proximity to public transport also facilitates the integration of redeveloped brownfields into broader urban functions.

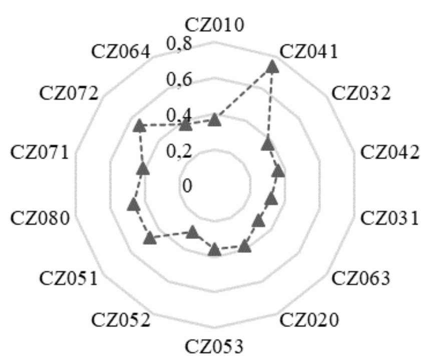

Fig. 7. Average distance of brownfield sites from public transport stops (bus) [km] *(source: own elaboration based on data from the CzechInvest National Brownfield Database, 2024).*

Figure 8 shows that Prague (CZ010) records the longest average distance from brownfields to the nearest railway station-over 5 km. This outlier partly reflects the small number of sites reported in the city's database, which skews the result, but it also indicates weaker spatial integration that may hinder sustainable land use. In contrast, the Moravian-Silesian and Liberec regions report averages of around 2 km, suggesting much better accessibility. Previous studies underline the significance of rail proximity: Rihana-Abdallah and Pang (2018) note that poor connectivity reduces economic attractiveness, Altrock (2024) observes its influence on investor decisions and functional reuse, and D'Angelo et al. (2025) link inadequate serviceability to the risk of site devaluation. Overall, the results confirm that transport accessibility can act either as a limiting factor or as a catalyst for brownfield regeneration, making spatial connectivity a crucial condition for their successful integration into the urban system.

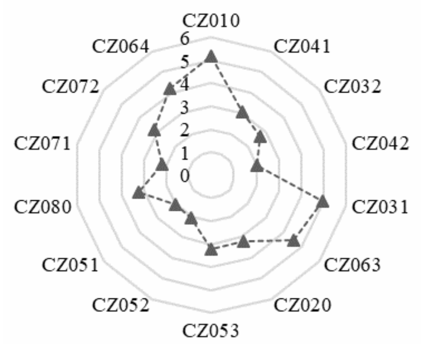

Fig. 8. Average distance of brownfields from the nearest railway stop (station) [km] *(source: own elaboration based on data from the CzechInvest National Brownfield Database, 2024).*

Figure 9 highlights regional differences in the average distance of brownfields from first-class roads. The South Moravian Region (CZ064) shows the highest value at more than 6.8 km, while the Vysocina (CZ063) and Zlin (CZ072) regions also exceed 6.4 km, indicating weaker logistical connectivity.

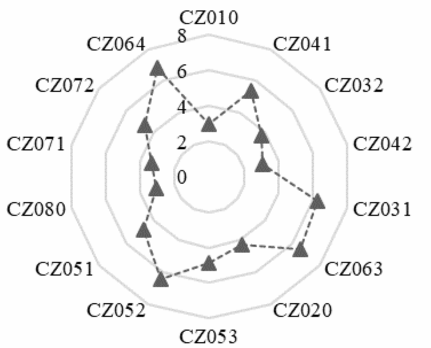

Fig. 9. Average distance of brownfields from first-class roads [km] *(source: own elaboration based on data from the CzechInvest National Brownfield Database, 2024).*

By contrast, the Usti nad Labem Region (CZ042) reports a much shorter average of about 3.1 km, suggesting better accessibility. Previous studies confirm the importance of this factor: Frantal et al. (2023) link good road access to greater potential for entrepreneurial reuse, Leger et al. (2016) demonstrate its influence on investors' location strategies, and Altrock (2024) emphasises that proximity to transport networks is often decisive in converting industrial areas into logistics and commercial hubs. The pronounced regional variability observed here underscores the need to treat transport infrastructure as a critical determinant of brownfield regeneration potential.

4. CONCLUSIONS

The findings of this paper demonstrate that brownfields in Czechia are unevenly distributed, with a strong concentration in structurally affected regions such as Usti nad Labem, Karlovy Vary, and Moravian-Silesian (Frantal and Martinat, 2013; Skrabal and Vybiral, 2025a). Large, contaminated, and privately or jointly owned sites in peripheral locations face the most severe regeneration barriers (Ferber et al., 2006; D'Angelo et al., 2025; Altrock, 2024), while smaller, centrally located sites, often under public ownership, are more adaptable and attract stronger municipal and investor interest (Ahmad et al., 2021; Wang et al., 2011; Navratil et al., 2022). Systematic patterns of former land use were also observed: northern regions remain dominated by industrial and mining sites, while civic and agricultural brownfields are more common in the south (Frantal and Martinat, 2013; Alker et al., 2000; Pizzol et al., 2016). Environmental burdens continue to represent a critical barrier, particularly in northern Bohemia and the Ostrava region, where diagnostic uncertainty undermines investor willingness (Li et al., 2019; Navratil et al., 2022; Hurnikova, 2009).

Accessibility analysis confirmed that proximity to cadastral centres and transport nodes substantially influences regeneration potential. Shorter distances are linked to stronger governance capacities and more sustainable outcomes (Osman et al., 2015; Ahmad et al., 2021; Laprise et al., 2018). Conversely, long distances from bus stops, railway stations, or first-class roads, as in Prague or Vysocina, reduce attractiveness and delay redevelopment (Rihana-Abdallah and Pang, 2018; Leger et al., 2016; Altrock, 2024). These findings address the paper's primary aim of assessing spatial and physical brownfield characteristics, as well as the secondary aims of identifying regional disparities at the NUTS III level and analysing how site size, ownership, land use, contamination, and accessibility shape redevelopment opportunities.

From an international perspective, the results resonate with broader debates on spatial planning and regeneration. The evolution of innovation districts illustrates how brownfields can be repositioned as hubs of regional innovation (Valdaliso and Andres, 2025). Nordic planning strategies demonstrate how statutory tools strengthen institutional capacity (Hagen and Higdem, 2024), while studies in neo-liberal contexts confirm the balancing role of strategic planning (Hanssen et al., 2024). Research on city-regional governance highlights the role of inter-municipal cooperation (Persson et al., 2025), and the concept of peripheralisation explains why disadvantaged regions struggle to attract investment, a challenge also evident in Czech industrial peripheries (Willett et al., 2025). The adaptive reuse of undesignated heritage further demonstrates how regeneration can sustain local identity while advancing sustainability goals (Yildirim Okta, 2025). Finally, evidence on FDI (Foreign Direct Investment) and agglomeration economies confirms that connectivity and clustering embed redevelopment within global value chains (Kimino, 2025).

Methodologically, the study contributes an analytical framework that combines cartographic representation, descriptive statistics, and accessibility indicators to identify both opportunities and barriers to regeneration. A key limitation lies in the incompleteness of the national brownfield database, which under-reports many sites, particularly in metropolitan areas such as Prague. Nonetheless, by integrating Czech evidence with international insights, the study offers a comparative perspective linking post-socialist transformation with global debates on regeneration, peripheralisation, and strategic planning.
Future research should expand to socio-economic and institutional dimensions of regeneration, refine evaluation frameworks, and incorporate systematic feedback from completed projects to support evidence-based decision-making. In particular, further work could develop integrated models that combine spatial accessibility indicators with socio-economic vulnerability measures to better identify sites with the highest long-term redevelopment potential. Strengthening the methodological link between environmental diagnostics, governance capacity, and market dynamics would also help to clarify the role of public institutions and private stakeholders in shaping regeneration outcomes. Finally, future studies could benefit from more granular temporal analyses, incorporating repeated assessments of brownfield change to capture development trajectories over time and to evaluate the effectiveness of planning interventions in different regional contexts.

5. ACKNOWLEDGEMENTS

This article was created with the financial support of an Internal Grant agency of The Moravian Business College Olomouc "Utilization of Brownfields for Entrepreneurial Purposes and Their Impact on Regional Economic Growth" [2_2024/2025].

REFERENCES

Agostini P., Pizzol L., Critto A., D´Alessandro M., Zabeo A., Marcomini A. (2012), Regional risk assessment for contaminated sites Part 3: Spatial decision support system. Environment International, 48, 121-132. DOI: https://doi.org/10.1016/j.envint.2012.07.005

Ahmad N., Zhu Y., Ullah Z., Iqbal M., Hussain K., Ahmed R. I. (2021), Sustainable solutions to facilitate brownfield redevelopment projects in emerging countries – Pakistani scenario. Land Use Policy, 109, 105727. DOI: https://doi.org/10.1016/j.landusepol.2021.105727

Alker S., Joy V., Roberts P., Smith N. (2000), The definition of brownfield. Journal of Environmental Planning and Management, 43(1), 49–69. DOI: https://doi.org/10.1080/09640560010766

Altrock U. (2024), Laissez-faire or sensitive policymaking: The legacy of creative clusters on brownfield sites in Berlin. Urban Planning, 9(4), 78-89. DOI: https://doi.org/10.17645/up.8236

Bardos P., Stephenson I., Menger P., Beumer V. (2015), Maximising the value-proposition for soft reuse of brownfields. Paper presented at AquaConSoil 2015, Session 2.3-Redevelopment of Brownfields 1. URL: http://www.zerobrownfields.eu/HombreMainGallery/Docs/Bardos%20Session%202.3%20ACS%202015%20v2%20Hombre%20web%20site.pdf. Accessed on: 04.05.2025

Bardos R. P., Jones S., Stephenson I., Menger P., Beumer V., Neonato F., Maring L., Ferber U., Track T., Wendler K. (2016), Optimising value from the soft re-use of brownfield sites. Science of The Total Environment, 563-564, 769-782. DOI: https://doi.org/10.1016/j.scitotenv.2015.12.002

Bottero M., Oppio A., Bonardo M., Quaglia G. (2019), Hybrid evaluation approaches for urban regeneration processes of landfills and industrial sites: The case of the Kwun Tong area in Hong Kong. Land Use Policy, 82, 585–594. DOI: https://doi.org/10.1016/j.landusepol.2018.12.017

Chen B., Hashimoto S. (2025), Integrate brownfield greening into urban planning: A review from the perspective of ecosystem services. Urban Forestry & Urban Greening, 104, 128642. DOI: https://doi.org/10.1016/j.ufug.2024.128642

Chen W., Chi G. (2022), Urbanization and ecosystem services: The multi-scale spatial spillover effects and spatial variations. Land Use Policy, 114, 105964. DOI: https://doi.org/10.1016/j.landusepol.2021.105964

Cui Q. W. (2017), Discussion on land reclamation and ecological restoration of mining wasteland based on a public recreation perspective. In Hu Z. (ed), Land reclamation in ecological fragile areas, First Edition, CRC Press, 6. DOI: https://doi.org/10.1201/9781315166582

CzechInvest (2024), Brownfield database. CzechInvest Brownfields Portal. URL: https://brownfieldy-dotace.czechinvest.org/Aplikace/bf-public-x.nsf/bfs.xsp. Accessed on: 20.12.2024.

D'Angelo G., Esposito G., Fumo M. (2025), Recovery and sustainable regeneration: Architectural and environmental perspectives for urban and building reuse. In Corrao R., Campisi T., Colajanni S., Saeli M., Vinci C. (eds), Proceedings of the 11th International Conference of Ar.Tec. (Scientific Society of Architectural Engineering). Colloqui.AT.e 2024, Lecture Notes in Civil Engineering, Springer, 610. DOI: https://doi.org/10.1007/978-3-031-71855-7_13

Darchen S., Simon G. (2022), 'Transitory urbanism' for the creative industries in a top-down regeneration process (Nantes, France). European Planning Studies, 30(10), 2084-2101. DOI: https://doi.org/10.1080/09654313.2021.2024149

Dixon T. (2007), Heroes or villains? The role of the UK property development industry in sustainable urban brownfield regeneration. In Dixon T., Raco M., Catney P., Lerner D.N. (eds.), Sustainable brownfield regeneration: Liveable places from problem spaces, Blackwell Publishing Ltd., 89–118. DOI: https://doi.org/10.1002/9780470692110.ch5

Ferber U., Grimski D., Millar K., Nathanail P. (2006), Sustainable brownfield regeneration: CABERNET network report. First Edition. University of Nottingham. ISBN 0-9547474-5-3

Frantal B., Martinat S. (2013), Brownfields: A geographical perspective. Moravian Geographical Reports, 21(2), 2-4. DOI: https://doi.org/10.2478/mgr-2013-0006

Frantal B., Kunc J., Novakova E., Klusacek P., Martinat S., Osman R. (2013), Location matters! Exploring brownfields regeneration in a spatial context (A case study of the South Moravian Region, Czech Republic). Moravian Geographical Reports, 21(2), 5–19. DOI: https://doi.org/10.2478/mgr-2013-0007

Frantal B., Kunc J., Klusacek P., Martinat S. (2015), Assessing success factors of brownfields regeneration: International and inter-stakeholder perspective. Transylvanian Review of Administrative Sciences, (44E), 91–107. DOI: https://rtsa.ro/tras/index.php/tras/article/view/427

Frantal B., Frajer J., Martinat S., Brisudova L. (2023), The curse of coal or peripherality? Energy transitions and the socioeconomic transformation of Czech coal mining and post-mining regions. Moravian Geographical Reports, 30(4), 237–256. DOI: https://doi.org/10.2478/mgr-2022-0016

Hagen A., Higdem U. (2024), Regional planning strategies: understanding the implementation of a new strategic tool in Norwegian planning law. European Planning Studies, 32(12), 2555–2573. DOI: https://doi.org/10.1080/09654313.2024.2385773

Hammond E. B., Coulon F., Hallett S. H., Thomas R., Dick A., Hardy D., Dickens M., Washbourn E., Berrio D. (2024), The development of a novel decision support system for regional land use planning for brownfield land. Journal of Environmental Management, 349, 119466. DOI: https://doi.org/10.1016/j.jenvman.2023.119466

Hammond E. B., Coulon F., Hallett S. H., Thomas R., Hardy D., Kingdon A., Berrio D. J.

(2021), A critical review of decision support systems for brownfield redevelopment. Science of The Total Environment, 785, 147132. DOI: https://doi.org/10.1016/j.scitotenv.2021.147132

Hanssen G. S., Nyseth T., Ringholm T. M., Benjegård M. (2024), The role of strategic planning in ensuring sustainable housing markets in a neo-liberal planning context. European Planning Studies, 32(12), 2641–2660. DOI: https://doi.org/10.1080/09654313.2024.2396490

He D., Zainol R., Azali N. S. (2024), Navigating challenges in the sustainable development of urban brownfields: A PLS path modeling perspective. Ain Shams Engineering Journal, 15, 103002. DOI: https://doi.org/10.1016/j.asej.2024.103002

Hendl J. (2023), Kvalitativní výzkum: Základní teorie, metody a aplikace (5., přeprac. vyd.) [Qualitative Research: Basic Theory, Methods and Applications (5th revised edition)]. Portál [in Czech]. ISBN 978-80-262-1968-2

Hurnikova J. (2009), Brownfieldy a územní rozvoj. Urbanismus a územní rozvoj [Brownfields and spatial development. Urban Planning and Spatial Development], 12(6), 3–5 [online], URL: https://www.uur.cz/media/phbljrgx/01_brownfieldy-rozvoj.pdf. Accessed on 02.07.2025

Kimino S. (2025), What drives global value chains of FDI at sub-national regions? Roles of agglomeration economies. European Planning Studies, 33(2), 204–225. DOI:https://doi.org/10.1080/09654313.2024.2422902

Lacko J. (2023), R. Czechia: Spatial objects of the Czech Republic. Journal of Open Source Software, 8(83). https://doi.org/10.21105/joss.05082

Laprise M., Lufkin S., Rey, E. (2018), An operational monitoring tool facilitating the transformation of urban brownfields into sustainable neighborhoods. Building and Environment, 142, 221–233. DOI: https://doi.org/10.1016/j.buildenv.2018.06.005

Leger C., Balch C., Essex S. (2016), Understanding the planning challenges of brownfield development in coastal urban areas of England. Planning Practice & Research, 31(2), 119–131. DOI: https://doi.org/10.1080/02697459.2016.1146428

Li X., Bardos P., Cundy A. B., Harder M. K., Doick K. J., Norrman J., Williams S., Chen W. (2019), Using a conceptual site model for assessing the sustainability of brownfield regeneration for a soft reuse: A case study of Port Sunlight River Park (U.K.). Science of The Total Environment, 652, 810-821. DOI: https://doi.org/10.1016/j.scitotenv.2018.10.278

Maldonado Lopez J. I., Kim G., Lei Y., Newman G., Suppakitpaisarn P. (2021), An assessment method and typology for the regeneration of vacant land in Quito, Ecuador. Urban Forestry & Urban Greening, 62, 127130. DOI: https://doi.org/10.1016/j.ufug.2021.127130

Martinat S., Dvorak P., Frantal B., Klusacek P., Kunc J., Navratil J., Osman R., Tureckova K., Reed M. (2016), Sustainable urban development in a city affected by heavy industry and mining? Case study of brownfields in Karvina, Czech Republic. Journal of Cleaner Production, 118, 78–87. DOI: https://doi.org/10.1016/j.jclepro.2016.01.029

Ministry of Regional Development of the Czech Republic (2024), Regional Development Strategy of the Czech Republic: Action Plan 2025–2027. SRR21+. URL: https://mmr.gov.cz/getmedia/94ce3163-6bad-413b-b23f-ec04112ff73b/Akcni-plan-20252027.pdf.aspx?ext=.pdf. Accessed on: 07.05.2025

Mukherjee A., Banerji H. (2025), Jute mills as restorative landscapes: Perceptions of environmental aesthetics in living industrial heritage. Regional Studies, Regional Science, 12(1), 45–56. DOI: https://doi.org/10.1080/21681376.2025.2454264

Navratil J., Martinat S., Frazier R. J., Klusacek P., van der Horst D., Skrabal J., Krejci T., Osman R., Pícha, K, Dvorak, P. (2022), Preference and paradox: Local residents' perspectives on the reuse of post-agricultural brownfield sites. Sociologia Ruralis, 63(3), 514–543. DOI: https://doi.org/10.1111/soru.12418

Navratil J., Martinat S., Hewitt R. J., Frazier R. J., Klusacek P., Skrabal J., Krejci T., Osman R., Picha K. (2023), Community landscape preferences for reuse of Soviet-era post-agricultural brownfields-What's the difference? Rural Sociology, 88(2), 362-391. DOI: https://doi.org/10.1111/ruso.12479

Ni X., Jiang C., Jiang F., Luo H., Diao Y., Jiang F., Zhang Q., Wang J. (2025), Characteristics of environmental efficiency for different types of contaminated sites in China. Materials Today Sustainability, 30, 101092. DOI: https://doi.org/10.1016/j.mtsust.2025.101092

Nogues S., Arroyo N. L. (2015), Alternative approach to prioritization of brownfield reclamation attending to urban development potentialities: Case study in a depressed industrial district in Northern Spain. Journal of Urban Planning and Development, 142(1). DOI: https://doi.org/10.1061/(ASCE)UP.1943-5444.0000272

Osman R., Frantal B., Klusacek P., Kunc J., Martinat S. (2015), Factors affecting brownfield regeneration in post-socialist space: The case of the Czech Republic. Land Use Policy, 48, 309–316. DOI: https://doi.org/10.1016/j.landusepol.2015.06.003

Pebesma E. (2018), Simple features for R: Standardized support for spatial vector data. The R Journal, 10(1), 439–446. DOI: https://doi.org/10.32614/RJ-2018-009

Persson B., Hermelin B., Backström E. (2025), Developing city-regional governance capacity: the case of skill formation in the Gothenburg city-region. European Planning Studies, 33(5), 721–738. DOI: https://doi.org/10.1080/09654313.2025.2451816

Pizzol L., Zabeo A., Klusacek P., Giubilato E., Critto A., Frantal B., Martinat S., Kunc J., Osman R., Bartke S. (2016), Timbre brownfield prioritization tool to support effective brownfield regeneration. Journal of Environmental Management, 166, 178-192. DOI: https://doi.org/10.1016/j.jenvman.2015.09.030

Popa N., Pop A.-M., Marian-Potra A.-C. (2025), Culture-led urban regeneration in post-socialist cities: from decadent spaces towards creative initiatives. Cities, 158, 105707. DOI: https://doi.org/10.1016/j.cities.2025.105707

R Core Team (2024), R: A language and environment for statistical computing (Version 4.4.2) [Computer software]. R Foundation for Statistical Computing. URL: https://www.R-project.org/. Accessed on: 10.05.2025.

Rădulescu M. A., Leendertse W., Arts J. (2025), Co-creation in spatial planning: analysing the different forms and natures of interactions between multiple actors. European Planning Studies, 33(5), 699–720. DOI: https://doi.org/10.1080/09654313.2025.2490121

Rihana-Abdallah A., Pang Y. (2018), Mapping of brownfield properties in the Detroit community using GIS. In Kirkland E.K., Ekey-Radford M.L. (eds), Environmental chemistry: Undergraduate and graduate classroom, laboratory, and local community learning experiences, Washington, DC: American Chemical Society, 1276, 125–133. DOI: https://doi.org/10.1021/bk-2018-1276.ch009

Savini F., Aalbers M. B. (2015), The de-contextualisation of land use planning through financialisation: Urban redevelopment in Milan. European Urban and Regional Studies, 23(4), 356–371. DOI: https://doi.org/10.1177/0969776415585887

Skrabal J. (2020), What can we learn from brownfield databases? Exploring specifics of the location of brownfields in the Czech Republic. Geographia Technica, 15(2), 191-201. DOI: https://doi.org/10.21163/GT_2020.152.18

Skrabal J., Vybiral M. (2025a), Analysis of factors influencing brownfield redevelopment in the context of regional development. In Building a green future through essential decision-making competencies, IGI Global Scientific Publishing, 437-470. DOI: https://doi.org/10.4018/979-8-3373-0189-1.ch016

Skrabal J., Vybiral M. (2025b), Regeneration of brownfields for business purposes in the context of regional development. In Šivkruha M. Krňja A., Greisigerová L. (eds), Publicy 2024 I. Obce, mestá a vyššie územné celky v regionálnom rozvoji: Zborník príspevkov z medzinárodnej vedeckej konferencie, Univerzita sv. Cyrila a Metoda v Trnave, 318–333. URL: https://fsvucm.sk/wp-content/uploads/2025/05/Zbornik_Final.pdf. Accessed on 20.06.2025

Skrabal J., Chmielova P., Tureckova K., Nevima J. (2021), Applicability of tools for brownfield regeneration in the Czech Republic: A regional perspective. Geographia Technica, 16(2), 132–148. DOI: https://doi.org/10.21163/GT_2021.162.11

Sun Y., Li H., Lei S., Semple K. T., Coulon F., Hu Q., Gao J., Guo G., Gu Q., Jones K. C. (2022), Redevelopment of urban brownfield sites in China: Motivation, history, policies and improved management. Eco-Environment & Health, 1(2), 63–72. DOI: https://doi.org/10.1016/j.eehl.2022.04.005

Thomas M. R. (2003), Brownfield redevelopment: Information issues and the affected public. Environmental Practice, 5(1), 62-68. DOI: https://doi.org/10.1017/S1466046603030175

Tobias S., Conen F., Duss A., Wenzel L. M., Buser C., Alewell C. (2018), Soil sealing and unsealing: State of the art and examples. Land Degradation & Development, 29(6), 2015-2024. DOI: https://doi.org/10.1002/ldr.2919

Tureckova K., Nevima J., Skrabal J., Martinat S. (2018), Uncovering patterns of location of brownfields to facilitate their regeneration: Some remarks from the Czech Republic. Sustainability, 10(6), 1984. DOI: https://doi.org/10.3390/su10061984

Tureckova K., Nevima J., Skrabal J., Tuleja P. (2019), Categorization of impact of the selected variables for potential brownfield regeneration in the Czech Republic by means of correspondence analysis. Geographia Technica, 14(2), 120–130. DOI: https://doi.org/10.21163/GT_2019.142.11

Tvrdon M., Chmielova P. (2021), Interlinkages between strategic, financial and regional frameworks of brownfield regenerations: The case of the Czech Republic. Geographia Technica, 16(1), 113-127. DOI: https://doi.org/10.21163/GT_2021.161.10

Valdaliso J. M., Andrés C. (2025), Science and technology parks as evolving policy instruments: challenges when embracing the innovation district model. European Planning Studies, 33(4), 646–664. DOI: https://doi.org/10.1080/09654313.2025.2490119

Wan Y., Chen S., Liu J., Jin L. (2024), Brownfield-related studies in the context of climate change: A comprehensive review and future prospects. Heliyon, 10(4), e25784. DOI: https://doi.org/10.1016/j.heliyon.2024.e25784

Wang L., Fang L., Hipel K. W. (2011), Negotiation over costs and benefits in brownfield redevelopment. Group Decision and Negotiation, 20, 509–524. DOI: https://doi.org/10.1007/s10726-009-9179-5

Wickham H. (2016), ggplot2: Elegant graphics for data analysis. Springer-Verlag New York. DOI: https://doi.org/10.1007/978-3-319-24277-4. ISBN 978-3-319-24275-0

Willett J., Williams M., Akerman L., Rawlinson H., Ghezal A., Pitts F. H. (2025), Peripheralization and economic development: a multi-causal approach. European Planning Studies, 33(4), 471–490. DOI: https://doi.org/10.1080/09654313.2025.2492180

Yildirim Okta, B. (2025), Undesignated heritage unveiled: a review of Forth Goods Yard Station's regeneration plan. European Planning Studies, 33(10), 1754-1778. DOI: https://doi.org/10.1080/09654313.2025.2522927