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Factors affecting brownfield regeneration in post-socialist space: The case of the Czech Republic

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Abstract

Using an example of the Czech Republic, this explorative study attempts to answer the question of what factors have a significant influence on a successful regeneration of brownfields in a post-socialistic space. The study is based on a comparative analysis of two data files – the database of existing brownfields provided by the national CzechInvest agency, and the database of successfully regenerated brownfields compiled by the authors themselves. The paper consists of three interrelated parts, the first one dealing with an analysis of the structure of regenerated brownfields, the second one confronting this with the structure of the existing brownfields by means of a comparative analysis, and the third one analyzing the factors of brownfield regeneration. The main types of functional transformation of space were identified and the factors that appeared to be significant determinants of brownfields regeneration were classified as the result.

Keywords
Brownfields, Success factors, Land use management, Urban renewal, Post-socialist space, Czech Republic

1. Introduction

Spatial processes reflect the social processes within them, and at the same time social processes are imprinted onto space through policy and administration. The administration and management of space represent a concrete materialization of social values within space (Lefebvre, 1991). Just as the geographical imagination was transformed throughout history (Gregory, 1994), so also were the importance of space and its manipulation transformed (Soja, 1996, 2011). With the onset of postmodernism there has been a transformation in the meaning of space (Giddens, 1991; Warf and Arias, 2008), which might be identified in the social processes of demilitarization, de-agriculturization, or deindustrialization. Such social processes thus transform both the value of current space and its present administration. While these processes appeared in Western Europe (Great Britain, France, the former West Germany) as early as the 1970s, thus being in progress a longer period of time and with consequences of less intensity, in post-socialist countries they started to appear as late as after 1989, and their progress has much more intensive (Frantál et al., 2013). One consequence of these processes has been a huge increase in the amount of unused space, so-called brownfields.

Brownfields (underused, abandoned, derelict and often contaminated lands and premises), being products of mutual relations within the concrete locality, its history, social, legislative, and ecological processes (Bjelland, 2002), represent particular information about the state of the surrounding society. What is more interesting, though, from the analytical point of view, and what provides us with noticeably more critical material reflecting the contemporary society, are the issues driving discussion of the future of these unused spaces, the degree of attention that they attract, who is in charge of their management, what is happening in them, and what their transformations are.

Generally, brownfields have received increasing political credence in recent decades, since vacant agricultural or natural developable lands become less available, more expensive and more protected in densely populated areas. The increasing number of projects and research platforms demonstrates the increasing interest of policy makers, too (see the summary reports on activities, products and tools developed by previous brownfield projects by Tölle (2009) or Frantál et al., (2012). Many previous studies have investigated and conceptualized drivers and barriers of brownfields redevelopment – whether on the basis of stakeholder surveys or interviews with experts (Adair et al., 2002; Alberini et al., 2005; De Sousa, 2000; Letang and Taylor, 2012) or assessments of a limited number of local case studies (Coffin and Shepherd, 1998; Dixon, 2007; Dixon et al., 2011; Nijkamp et al., 2002).

Although it is possible to get an international comparison of various attitudes toward brownfield management, such studies have compared merely two countries, their definitions, or related legislative documents (De Sousa, 2004; Oliver et al., 2005; Cobârzan, 2007; Dixon, 2007; Cheng et al., 2011; Otsuka et al., 2013).

Most previous projects also created some inventories of so called “best-practice projects” (examples of successfully regenerated brownfields, see Table 1). However, these examples comprised just few projects from specific regions or countries. More systematic, extensive and detailed database of regenerated brownfields covering whole country has not been created and analyzed so far.

Table 1. Previous projects dealing with the brownfield regeneration ‘best practices’.

Acronym	Project name	End of the project	Number of cities included	General charakterization	Detailed destription of brownfields	Photos	Destription of regeneration processes	Analysis of success factors
RECORE	Regenerating Europe's Coalfield Regions	–	0	0	0	0	0	0
CLARINET	Contaminated Land Rehabilitation Network for Environmental Technologies	2001	0	0	0	0	0	0
INCORE	Integrated concept for groundwater remediation	2003	4	0	0	0	0	0
CABERNET	Concerted Action of Brownfield and Economic Regeneration Network	2005	8	0	0	0	1	1
RESCUE	Regeneration of European Sites in Cities and Urban Environments	2005	8	1	1	1	0	0
LUDA	Improving the quality of life in Large Urban Distressed Areas	2006	12	1	1	0	1	0
REKULA	Restructuring Cultural Landscapes	2006	0	0	0	0	0	0
REVIT	Revitalising industrial sites	2007	6	1	1	1	1	1
SEBCO	City-hinterland cooperation as motor for regional development in the South Eastern Baltic	2007	0	0	0	0	0	0
MAGIC	Management of Groundwater in Industrially Contaminated Areas	2008	4	1	1	1	0	0
COBRAMAN	Cobraman	2011	31	1	1	1	1	1
ReSource	ReSource – Turning Problems into Potentials	2012	100	1	1	1	1	1
TIMBRE	Tailored Improvement of Brownfield Regeneration in Europe	2014	63	1	1	1	1	1
EPA	U. S. Environmental Protection Agency	–	100	1	1	1	0	0
SMARTe	Sustainable Management Approaches and Revitalization Tools-electronic	–	100	1	1	1	0	0

Source: own compilation.

This contribution joins the discussion with some experience of handling brownfields in the Czech Republic, or, more precisely, with the state of recycling space in one of the post-socialist countries (Sýkora and Bouzarovski, 2012). The study has an explorative character and attempts to identify (i) what are the most frequent new functions that brownfields obtain after they have been regenerated, and (ii) what are the factors that determine and drive the regeneration of brownfields in post-socialistic contexts.

2. The post-industrial era in post-socialist space

The most significant difference between capitalist and post-socialist countries regarding attitudes toward brownfield regeneration is a certain time delay. While in capitalist countries the major increase in the number of brownfields occurred during the 1970s, and became a relevant social topic in the 1990s, in post-socialist countries they started to appear only after the collapse of the Eastern Bloc, and became a publicly discussed topic only after 2010, a two-decade delay (Frantál et al., 2013). The formation and regeneration of brownfields in post-socialist space depends on utterly distinct conditions. The collapse of key economic entities was concentrated within a very short span of time at the beginning of the 1990s (Myant, 1995). In post-socialist space, unlike in capitalist countries, public facilities, retail business, and services above all are largely insufficient (Szczyrba, 2010). Brownfields within the inner parts of cities immediately became the subjects of competitive bidding, primarily between international supermarket companies. After the withdrawal of the Soviet Army, post-socialist space, unlike the capitalist, included a large number of newly abandoned military sites (Matlovič et al., 2001). Those situated centrally were regenerated into housing sites, those on the periphery into sport and recreational facilities (Klusáček et al., 2013). A great number of large areas, mainly in rural space, still remain unused (Hercik et al., 2011, 2012). A remarkable phenomenon of brownfield management in the post-socialist environment is the culture of democracy and negotiation. The process of regeneration is thus very often accompanied by a non-existence of functional communities and a lack of interest in public issues (Berki, 2012), an inability to lead a dialogue and reach a

compromise (Myant and Smith, 2006), or varying notions of disadvantages and regeneration opportunities supported by experts and non-professionals (Loures, 2015). However, the active participation of local communities is considered one of the key pillars of a successful regeneration policy, especially in the case of less economically viable brownfields; the more economically viable a site, the less dependent its redevelopment will be on this factor (McCarthy, 2002).

Besides the temporal (historical) factors affecting the formation and evolution of brownfields in different European countries, it has been argued that internal geographical factors, too, affect the actual situation and patterns of redevelopment. The definition of brownfields as a whole refers to the significance that the chosen country attaches to its space (Alker et al., 2000). Oliver et al. (2005) made a comparative study that identified significant regional trends among European definitions, or rather concepts, of brownfields, reflecting national policy strategies regarding land regeneration and development. The authors documented how two (not indisputable) indicators (population density and economic competitiveness) at a country level determine the perception of what brownfields and derived regeneration priorities are. Thus shifts in perception of the brownfield issue from being purely a contamination problem to being areas of development potential are obvious (for more detailed analysis see Oliver et al., 2005).

The factors used by Oliver et al. (2005) to compare European countries show how the policy of centrally directed economies materialized into their social and spatial dimensions. All post-socialist European countries belong to the third group of countries with a medium population density and a low level of competitiveness, where competitiveness is measured as a percentage of the most competitive nation (the USA in 2004). Such a distinct socio-spatial context of post-socialist countries (Sýkora and Bouzarovski, 2012) demonstrates the importance of studying brownfield management in these countries separately. The experience with regeneration of unused sites in the Czech Republic thus represents a more detailed insight into the more general issues of how post-socialist spatial management works.

3. Geographical context of the study: the example of the Czech Republic

Developed countries such as the US, Great Britain, France or Germany have long-term experience with the problems of brownfields, which had emerged already during the 1970's as a result of massively declining mining, heavy industries and textiles. In comparison, in post-socialistic countries such as the Czech Republic, Poland or Romania, brownfields appeared in large quantities only after the collapse of socialism and the return to a market economy, with the restructuring of traditional industries, and following globalization trends during the last decade of the 20th century. The evolution of brownfields in post-socialist countries, their spatial distribution and functional structure are characterized by some specific factors, such as the large occurrence of agricultural brownfields resulting from the decline of socialist agricultural cooperatives (Skála et al., 2013), and military brownfields as relics of the military sector restructuring (Hercik et al., 2014). Industrial brownfields, however, are considered the most pressing problem to be resolved within the urban context (Kunc et al., 2014).

The Czech Republic is regarded one of the most developed, industrialized and prosperous (according to the gross domestic product at purchasing power parity per capita) economies of the countries in Central and Eastern Europe (World Bank, 2014). The Czech Republic is also one of the most successful transition economies in terms of attracting foreign direct investment, which is one of significant drivers of the brownfields redevelopment.

A definition of brownfield that is widely accepted in the Czech Republic is provided by the Business and Investment Development Agency CzechInvest (hereinafter CzechInvest), the agency of the Ministry of Industry and Trade, which has been quoted and reflected in several legislative documents. Brownfield is defined here as *"Property (land, building, area), that is underused, derelict and may be contaminated. It occurs as reminder of industrial, agricultural, residential, military or other activity.*

It is not possible to use such site suitably and effectively without regeneration process" (CzechInvest, 2008). For the purpose of this contribution, we have adopted this definition of brownfield, which originates from the internationally most widely used Cabernet definition, since most of the relevant institutions dealing with the brownfields management (such as regional authorities, regional development agencies, city councils, etc.) accept and use it. Few other existing alternatives of brownfield conceptualizations have been used for specific intra-sectoral purposes (e.g., the register of contaminated sites provided by the Central Institute for Supervising and Testing in Agriculture).

The National Strategy for Regeneration of Brownfields of the Czech Republic has been developed by the CzechInvest on the basis of resolution of government of the Czech Republic No. 1100 from August 31, 2005. The main emphasis was to ensure these types of sites for potential investments and location of strategic industrial zones and funding of their development from state budget.

Besides that, many studies, guidances or manuals for most diverse tasks in the frame of brownfield regeneration have been provided by different governmental and non-governmental institutions (e.g., Research Center for Industrial Heritage, Institute for Sustainable Development of Settlements (IURS), Institute for Ecopolicy, etc.).

Some institutions even proposed own definition of brownfields reflecting specific context of the sector. In the Czech Republic, for example, there is an extensive database of brownfields administered by the Ministry of Environment (National Inventory of contaminated Sites – SEKM), whose primary purpose is the protection of the environment. Ministry of Environment uses its own definition for the brownfield considered only contaminated sites. Since database of contaminated sites primarily focuses on polluted areas with environmental problems, plenty of non- contaminated sites stay out of this database (like former hotels, abandoned housing etc.). Although it is a very valuable resource for risk assessment of contaminated sites (environmental hazards management) etc., the reasons for its creation was motivated by other objectives which are not suitable for the analysis of the general factors brownfield regeneration in the Czech Republic. The database of the CzechInvest agency is more general, contains information relevant to the issue of regional development and hence was chosen as a reference file for the purposes of this paper.

All together 2355 brownfield sites were identified on the basis of the national 'Research Study for the Location of Brownfields in the Czech Republic' provided by the CzechInvest agency within the period 2005–2007. These brownfields covered area of approximately 10.3 thousands of hectares with circa 14% of built-up areas (1412 ha). The database comprised brownfield sites with an area greater than 1 ha from all regions of the Czech Republic excluding the capital Prague. However, the actual total number of brownfields in the Czech Republic is much higher; last estimations are working with numbers between 8.5 and 11.7 thousands of brownfield sites, which cover area of 27–38 thousands of hectares (CzechInvest, 2007).

4. Methodological approach and its limitations

There is no institution within the Czech Republic that has officially started to monitor projects of brownfields regeneration. To analyze the factors behind successful regeneration a completely new database is needed. We traced cases of successful brownfield regeneration using web searches; the Web browser Mozilla Firefox and the Internet search engine Google were used. This method of data collection was chosen because there is not any other database successfully regenerated brownfields in the Czech Republic. The key words "revitalization", "regeneration", "conversion", "reconversion", "brownfield", and their mutual combinations, entered in the Czech language, were used. These keywords were chosen in relation to research questions; the definition of a brownfield site and linguistic conventions of media space in the Czech Republic. Terms such as "environmental burden"; "old environmental burden"; "environmental risk" or "environmental hazard" were not used; mainly because they are not commonly used in Czech media space and were not suitable for the chosen method of data collection.

Only cases having met the above-mentioned definition of a brownfield were considered as regenerated brownfields, i.e., being (economically) utilized in the past, subsequently passing through a period without being fully used, and currently being (economically) utilized once again. The minimum length of the period without usage was arbitrarily set to one year so that we could differentiate regeneration from mere reconstruction. Information about such chosen cases was collected in a format that corresponded to the CzechInvest brownfield database so that the subsequent comparison would be feasible.

The purpose of the Google searching for regenerated brownfields was not to create a complete file of all regenerated brownfields in the Czech Republic. It was rather to form a selective database of those cases of brownfield regeneration that attracted the biggest media interest, thanks to which it was possible to find all necessary facts about them. In any respect it can not be considered a representative sample of all successfully regenerated brownfields. However, it still allows a comparison that provides valuable information for understanding the process of brownfield regeneration in post-socialist space, if the structural characteristics of entire databases are compared only.

Due to the non-existence of older monitoring of successfully regenerated brownfields, it was not possible to follow another structure of the selective pattern than the territorial. The database thus includes 101 cases in all regions (NUTS III) and at the same time 65 districts (NUTS IV) of the Czech Republic, which is equivalent to 4.3% of all of 2355 documented existing brownfields.

The first research question concerns changes in the functional use of regenerated brownfields. To answer such a question successfully, a comparison of both the mentioned databases is necessary. First the structure of the CzechInvest national database with 2355 existing brownfields will be presented, followed by the structure of our newly created selective database with 101 regenerated brownfields. Finally, a comparison of the structural differences in these two data files will allow us to identify some major trends in the changes to their functional uses.

The second research question focuses on identifying the factors that determine brownfield regeneration. To answer this question successfully, it was necessary in compiling the second database to observe 15 predefined characteristics of regenerated brownfields (see Table 5) that are regarded in the professional literature as the main factors underlying successful brownfield regenerations (Bacot and O'Dell, 2006; Nijkamp et al., 2002). We evaluated whether each factor applied to a given regenerated brownfield. If this was the case, one point was assigned, otherwise no point was assigned. There were 15 characteristics observed in total, thus each brownfield studied could gain as many as 15 points. Relating to this data, we were able to check the relevance of individual factors in regenerating concrete brownfields in the context of the Czech Republic.

5. Results

5.1. Structure of existing brownfields

In 2005, the CzechInvest agency, in collaboration with individual regions, initiated the Research Study for Locating Brownfields. The whole project lasted more than two years, during which a database of 2355 brownfields with a total area of 10 326 ha (0.13% of the land area of the Czech Republic) was compiled. Agricultural (34.9%) and industrial (33.3%) brownfields made up the largest part of the database; by area the largest part was taken up by industrial brownfields (42.8%), followed by military areas (23.2%) and agricultural brownfields (17.8%). Localities originally used for military purposes showed the biggest average area, with 15.9 ha per one brownfield (Table 2).

Table 2. Basic characteristics of existing brownfields in the Czech Republic.

	Number		Area		
Original use	Abs.	Rel. [%]	Abs. [ha]	Rel. [%]	Average [ha]
Agriculture	821	34.9	1840.4	17.8	2.2
Industry	785	33.3	4423.2	42.8	5.6
Civic amenities	304	12.9	413,3	4.0	1.4
Military	151	6,.4	2394.1	23.2	15.9
Housing	95	4.0	88.3	0.9	0.9
Accommodation facility (hotel, guest house)	22	0.9	22.4	0.2	1.0
Other	177	7.5	1144.6	11.1	6.5
In total	2355	100.0	10326.3	100.0	4.4

Source: Research Study for Locating Brownfields 2007, CzechInvest.

5.2. Structure of regenerated brownfields

In the course of the year 2013 the first database of regenerated brownfields in the Czech Republic was created. This database includes 101 unique entries, of which 71% were located within urban areas and 29% within rural areas. Their most common original use was in the manufacturing industry (45%), followed by military purposes (21%) and agricultural (16%). These three types of use together account for more than 80% of all monitored cases. As far as use after regeneration, the rather broad category of public facilities is the most frequent one, albeit representing only 18% of all regenerated localities. Next most common were mixed used developments with space for retail, services, housing, and administration (16%); industrial zones (11%); sport and recreational areas (11%); and areas for the manufacturing industry (11%). Simply by comparing the original and present uses of regenerated localities, an apparent shift from production to consumer activities is observed, which is supported by the broader processes of demilitarization, de-agriculturization, and industrial restructuralization. Industry plays a significant role in both the original and present uses of sites, yet its character and spatial pattern have changed completely. As original uses, industrial localities were located inside the settlement area (69%, i.e., 31 localities out of 45), while in their present uses they are located on the outskirts of the settlement (82%, i.e., 18 cases out of 22). New activities have emerged associated with recreation, tourism, leisure time, retail, service, sharing and spreading know-how, or alternative means of energy production. The structure of the selective sample of regenerated brownfields in the Czech Republic is stated in Table 3.

Table 3. Basic characteristics of sampled regenerated brownfields in the Czech Republic.

Characteristic	Category	Abs.	Rel. [%]
Localization	Urban area	72	71.3
	Rural area	29	28.7
Original use	Manufacturing industry	45	44.6
	Military	21	20.8
	Agriculture	16	15.8
	Mining industry	5	5.0
	Civic amenities	5	5.0
	Religious objects	3	3.0
	Cultural objects	2	2.0
	Dump	2	2.0
	Store	1	1.0
	Transport	1	1.0
Present use	Civic amenities	18	17.8
	Mixed use (retail, services, housing, administration)	16	15.8
	Industrial zone	11	10.9
	Sport and recreation area	11	10.9
	Manufacturing industry	11	10.9
	Retail and services	8	7.9
	Technological and business incubators, innovative centres	7	6.9
	Accommodation facility (hotel, guesthouse)	7	6.9
	Housing	5	5.0
	Transport	2	2.0
	Photovoltaic power plant	2	2.0
	Health care institution	2	2.0
	Waste collection yard	1	1.0
Area (ha)	>50.1	9	8.9
	10.1–50	11	10.9
	5.1–10	11	10.9
	3.1–5	7	6.9
	1.1–3	30	29.7
	<1	33	32.7
Type of locality	Built-up area inside the city	44	43.6
	Built-up area on the outskirts of the city	21	20.8
	Built-up area on the outskirts of the municipality	14	13.9
	Built-up area inside the municipality	13	12.9
	Sparcely built-up area on the outskirts of the city	5	5.0
	Unbuilt area on the outskirts of the municipality	2	2.0
	Unbuilt area on the outskirts of the city	1	1.0
	Linear element outside built-up area	1	1.0
Environmental burden	After complete decontamination	51	50.5
	Originally without contamination	33	32.7
	Expected contamination	17	16.8
Majority ownership	Legal person	47	46.5
	Municipality	42	41.6
	Natural person	6	5.9
	Region	2	2.0
	Civic association	2	2.0
	Country	2	2.0
Investment costs (mil. of Czech crowns)	>500.1	14	13.9
	200.1–500	12	11.9
	100.1–200	23	22.8
	50.1–100	16	15.8
	20.1–50	16	15.8
	<20	20	19.8
In total		101	100.0

Source: own compilation.

The total regeneration costs of all localities in the file approaches 30 billion Czech crowns (1.5 billion USD)[1], with an average cost of 288 million CZK (14.4 million USD) per project. 80% of the projects came in below this average value, while the median cost was 100 million CZK (5 million USD). 14 projects exceeded half a billion crowns. The localization of investment costs confirmed unequivocally an imbalance between the countryside and the city. The level of the average cost of one project (i.e., 288 million CZK; 14.4 million USD) was reached by only one project situated in the countryside, while 20 projects implemented in cities reached this amount. The median value (i.e., 100 million CZK; 5 million USD) was reached by 7 rural and 42 urban regenerations. From the total costs of 29.1 billion CZK (1.5 billion USD), projects undertaken in urban areas amounted to 26.9 billion CZK/13.45 billion USD (92%), while only 2.2 billion CZK/0.1 billion USD (8%) were spent on projects in the countryside. In cities the average price of a brownfield regeneration project was 373 million CZK (18.65 million USD), while in the countryside it was merely 76 million CZK (3.8 million USD). For simplicity's sake it can be said that a majority of the current uses are directly connected with places of increased concentration of activities (i.e., built-up areas inside cities and municipalities). The typical sorts of activities involving concentration and agglomeration effects are retail and services, health care institutions, public facilities, and mixed use areas. The implication is that there is a restricted number of activities suitable for unbuilt areas on the outskirts of settlements or in the open countryside. Sports and recreation areas, technological and business incubators, and innovative centers seem to be the places that are the least connected with a concentration of activities. There is a certain potential for photovoltaic power plants or other types of alternative energy production as well.

5.3. Which brownfields are regenerated?

In the third step of our project, the structure of the file of existing brownfields administered by the national CzechInvest agency will be compared with our file of regenerated brownfields (Table 4). In the database of regenerated brownfields, sites with an original industrial or military purpose are represented excessively compared to the CzechInvest database; while in the existing brownfields database the share of localities with an original industrial use is merely one-third (33.3%), in the regenerated brownfields database it has increased to almost one-half (49.5%). Such a disparity is emphasized when we compare areas. Existing brownfields with an original industrial use account for 43% of the area catalogued in that database, while regenerated ones make up 65% of the area of their file. The case with originally military localities is similar. Whereas within the file of existing brownfields these localities make up only 6% of all cases and 23% of the total area, within the file of regenerated brownfields they account for 21% of all cases and 31% of the area. It can therefore be observed that localities originally used for industrial and military purposes are regenerated with a higher frequency than localities with other types of original use. On the other hand, originally agricultural or residential localities were regenerated less frequently relative to their importance in the structure of existing brownfields; within the file of existing brownfields agricultural localities represent the category with the highest frequency (34.9%) but within the file of regenerated brownfields they account for only one-sixth (15.8%) of cases. In the category of living and accommodation facilities there was not even one single case recorded in our database of regenerated brownfields. It can be stated at the same time that brownfields with an original agricultural or residential use were regenerated with less frequency than localities with different functions.

Table 4. Comparison of the structure of existing brownfields and regenerated brownfields.

[1] The price in American dollars was calculated by the exchange rate of 1:20 (1 USD = 20 CZK).

	Existing brownfields			Regenerate brownfields		
	CzechInvest database			Authors' database		
Original use	Number [%]	Area [%]	Average [ha]	Number [%]	Area [%]	Average [ha]
Agriculture	34.9	17.8	2.2	15.8	3.0	4.4
Industry	33.3	42.8	5.6	49.5	65.0	30.8
Civic amenities	12.9	4.0	1.4	9.9	0.5	1.2
Military	6.4	23.2	15.9	20.8	31.0	35.0
Housing	4.0	0.9	0.9	0.0	0.0	–
Accommodation facilities	0.9	0.2	1.0	0.0	0.0	–
Others	7.5	11.1	6.5	4.0	0.4	2.6
In total	100.0	100.0	4.4	100.0	100.0	23.5

Source: CzechInvest, own compilation.

More significant differences between the monitored files may be traced if we take into account the area of individual localities. Regenerated brownfields showed, in the majority of categories, a higher average project area than the existing brownfields. This difference was most significant in the case of brownfields with an original industrial use, where the average area of each locality in the file of existing brownfields was no more than 5.6 ha, whereas in the file of regenerated localities it exceeds 30 ha. Similar is the case with localities originally used for military purposes, where the average area of one regenerated project is twice as large (35 ha) as in non-regenerated localities (15.9 ha). Based on this data we may conclude that in the case of localities with the above mentioned purposes, brownfields occupying larger areas are regenerated more frequently. This may be interpreted through their significant barrier effect, their symbolic value, and public pressure on resolving their status.

We may also compare the data files from the standpoint of ownership. Among existing brownfields, majority shareholder ownership prevails (72.5%), while in the file of regenerated brownfields this percentage is considerably lower (52.5%). On the other hand, public entities are the plurality owners of regenerated brownfields (47.5%), while with the existing brownfields the percentage is much lower (20.3%). A significant difference can be traced between the monitored files when comparing the contamination of brownfields. While within the file of existing brownfields more than a half of the localities are without any environmental burden (52.4%) and only 7.5% are with the burden, the situation within regenerated brownfields is entirely the opposite. More than a half of regenerated localities studied have been decontaminated (50.5%), and just one third are localities without contamination (32.7%). Once again we may postulate that bigger pressure is put on the regeneration of brownfields with environmental burdens; in other words, the factor that natural resources and public health might be threatened is employed.

5.4. What are the main factors of regeneration?

In the fourth and last step, the principal factors of browfield regeneration will be analyzed. When creating the database of successfully regenerated brownfields in the Czech Republic the individual factors of such success were monitored as well. The success rate was evaluated by 15 predefined factors (see Table 5). Each brownfield may obtain a maximum of 15 points, which corresponds to a maximum theoretical value of 1515 points for the selective file, considering that it contains 101 cases. The total number of points that were assigned was merely 789, which amounts to 52% of all points that could have been obtained. Among the most frequent factors were *the proximity of railway*

(11.5%), *support of local self-government* (10.8%) and *decontamination* (10.6%). On the other hand, the least frequent factors were *same or similar type of use after regeneration* (2.5%) and *historical value of area or sites* (3.0%).

Table 5. Factors in the generation of brownfields.

Factors of regeneration	Abs.	Rel. [%]
Proximity of railway	91	11.5
Support of local (regional) self-government	85	10.8
Level of contamination	84	10.6
Commercial use potential	75	9.5
Subsidy grounds support	62	7.9
Proximity of motorway or A-road	59	7.5
Proximity of city or municipality centre	55	7.0
Locality with high unemployment rate	52	6.6
Central authorities' support	51	6.5
Proximity of national border	40	5.1
Tourist attraction	33	4.2
Long-term effort to regenerate the area	32	4.1
Potential for developing human resources (sociocultural area)	26	3.3
Historical value	24	3.0
Same or similar type of use after regeneration (tradition continuity)	20	2.5
In total	789	100.0

Source: own compilation.

When we contrast the factors of brownfields located within cities and the countryside, it provides us with a rather remarkable perspective. While the successfully regenerated localities within cities obtained 599 points (75.9%), in the countryside it was only 190 (24.1%). Proportionally the employment of a majority of the factors was comparable in both categories, with only two factors showing distinct differences: *locality with high unemployment rate* and *long-term effort to regenerate the area*. The first of these factors is observed more in the countryside (8.9%) than in the cities (5.8%), the latter one contrarily more in cities (4.8%) than in the countryside (1.6%).

The largest differentiation of individual factors most likely occurs when we consider investment costs for regeneration. In 52 cases out of the mentioned 101, the brownfield was located within an *area with high unemployment rate*, which represents more than a half of the regenerated brownfields studied, and ads up to 6.6% of all points assigned. The occurrence of this factor within projects with investment costs ranging up to a maximum of 20 million CZK accounted for 13.8% of cases, in the category between 20 and 50 million it was 7.5% of cases, in the category between 50 and 100 million it was 8.4% of cases, in the category between 100 and 200 million it was 5.7% of cases, in the category between 200 and 500 million it was 3.9% of the cases, and in the category of projects costing over a half billion CZK it was merely 3.3% of all cases. In other words it can be observed that the factor of *high unemployment rate* made a bigger impact on the regeneration of less expensive brownfields. With the factors of *proximity of motorway or A-road* and *long-term effort to regenerate*

the area, it was just the opposite. These factors were important predominantly in cases of more expensive projects, while in terms of less financially demanding projects they decreased in importance or even became insignificant.

6. Discussion and conclusions

This paper attempted to answer two research questions: (i) What are the new functions that brownfields obtain after they have been regenerated? (ii) What are the factors that determine the reuse of brownfields? The main purpose of generally formulated research questions is to avoid studying the particular dimension of brownfield regeneration and understand the complex nature of of this issue. The absence of uniform data base at European Union level and even at the level of individual Member States (in the case of post-socialist space) complicates systematic research of brownfield regeneration in this space. For this reason it was decided to collect our own data, which offer interesting conclusions despite its limited scope. On the basis of the analyzed data we can draw partial conclusions concerning the administration and management of the current space in the Czech Republic.

The first research inquiry about the new functions of brownfield is rather easy to address. These are predominantly public facilities, service and retail (Szczyrba, 2010), in combination with industrial activities, which nonetheless are not re-established in their original localities within inner parts of the cities, but are organized within industrial areas and parks on the outskirts of cities. Such a spatial reorganization of industry affected countries with market economies as early as the 1970s (Harvey, 1989), and while it proceeded rather spontaneously in those countries and conformed to land prices and transport connections, in the Czech case it is strictly regulated here as far as the space is concerned, and it is located in chosen areas of industrial zones, business incubators, or within existing brownfields. Yet when we compare original and current uses of regenerated localities, an obvious shift from production to consumer activities is observed, corresponding to the impacts of such processes as demilitarization, de-agriculturization, and industrial restructuralization. The allocation of investment costs showed a significant asymmetry between the countryside and cities, unequivocally in favour of cities. The major part of current use is directly connected with built-up areas within inner cities and countryside. Typical representatives of activities assuming concentration and agglomeration effects include retail, services, health care institutions, public facilities, and mixed use areas.

It seems to be more complicated to respond to the second inquiry concerning the main factors of regeneration. Related literature describes prosperity of municipality or region, proximity to the core areas of settlement system, proximity to major transport infrastructure, previous functional use of brownfields and threat of environmental burdens as the most important factors of brownfield regeneration. Longo and Campbell (2007) analyzed spatial distribution of existing and revitalized brownfields in England and found that sites located in more prosperous regions (London, the South West, and the South East) are more likely to be regenerated compared to sites located in other regions. Their analysis, however, did not reveal a significant influence of population density on brownfields regeneration, nor a significant difference in the redevelopment of sites in rural versus urban areas. Lange and McNeil (2004) reported that brownfield sites in the United States, which have been located near airports, close to the central city, or close to rail access, get developed faster. Novosák et al. (2013) confirmed on data from the city of Ostrava (Czech Republic) that environmental burden (site contamination) and previous functional use of brownfields are significant factors affecting potential redevelopment. Frantál et al. (2013) empirically verified that regenerated brownfields are more likely located in municipalities with a higher development potential, which is determined by spatial peripherality (measured as the distance of the municipality from the regional centre and the distance from main road networks), the rate of local business activities (measured as the number of entrepreneurial subjects per capita), and the quality of local infrastructure.

Spatial context and nature of the underlying data draw attention to importance of some other factors brownfield regeneration. The *proximity of railway*, followed by *support of local self-government*,

decontamination, *commercial use potential*, and *subsidy grounds support* (see Table 3) were among the most employed factors. *Original use of brownfields* also plays an important part, though. It can be observed that localities with original industrial and military uses are regenerated far more frequently than localities with different original uses, and at the same time brownfields with originally agricultural or residential uses were regenerated less frequently than localities with different functions. The *size* of the brownfield is crucial as well. Among localities originally used for industrial and military purposes, the ones with larger areas are more frequently regenerated. The factor of *higher unemployment rate* was seen to a greater extent in the regeneration of less financially demanding brownfields. Factors such as *proximity of motorway or A-road* and *long-term effort to regenerate the area* were on the contrary applied when regenerating more financially demanding brownfields.

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