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# Selection of the Best Option of Brownfield Revitalization Using the Habu Method

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**Abstract.** The article focuses on the research into the evaluation of the socio-economic efficiency of selected brownfield revitalization projects. Revitalization of brownfields has become the focus of urban planning in recent decades not only in the Czech Republic. The city of Brno has also been involved in the development of these areas for a long time, and the proposal for a new zoning plan, which is currently under discussion, should significantly facilitate the development of such areas. Spatial planning documentation aims at determining the urban concept, the concept of landscape layout and the concept of public infrastructure, it defines the built-up areas, other areas, and corridors and sets the conditions for their use. Regarding the fact that a significant part of these development areas is located in strategically important parts of the city, their use is crucial for their further development. It is therefore appropriate to consider what land-use alternatives are allowed by the zoning plan and how these alternatives can contribute to the effective use of the area in the context of its surroundings and in connection with strategic urban development plans. The main goal of the research is to define a procedure for evaluating individual alternatives of the use of a given area in order to find an optimal solution for both the investor and the city (public). To reach this goal, the HABU method was chosen, which evaluates the development of the area from the point of view of being legally accessible, physically possible, financially feasible and maximally productive, further supplemented by specific elements of cost-benefit analysis (CBA) so as to evaluate the impact of revitalization projects on the broader public space. The output of the research described in this article is a methodical procedure for the evaluation of alternative solutions for the development of brownfields.

## 1. Introduction

Brownfields are characterized by abandoned areas, empty halls, traffic structures, airports, industrial areas and dilapidating residential buildings. They represent a historical footprint, cultural and architectural heritage, economic resource as well as business activity, however, there are also brownfields that will never find their new use. Due to the fact that building plots in the city centres are a really valuable commodity, brownfields located there and their use become subject of intensive public discussion, which has been gaining emphasis in recent years also in connection with ever-rising real estate prices. The issue of brownfields is also dealt with in the current draft of the zoning plan of the Statutory City of Brno, which in a broader context builds the so-called "city of short distances". The aim is to minimize commuting of residents to work, for culture and services from their place of residence. This shall be achieved by building smaller local centres so that each area or the city district with a higher



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concentration of inhabitants also creates jobs, cultural activities and civic amenities in addition to housing opportunities. One of the global goals is to reduce the traffic load in the city. The "cities of short distances" strategy represent a reaction to the current situation where it has not been possible to create a good environment for real estate development within the wider city centre. The long-lasting insufficient supply of new housing areas has caused a significant increase in construction activity in the outskirts of the city and within smaller cities surrounding Brno. This leads to a heavy load on communications and also to a loss of time efficiency for workers who spend tens of hours a month commuting to work.

The possibility of implementing larger development projects in these areas is associated with the investment costs of the city/municipality for the preparation of the area for its intended use, according to the zoning plan. These include mainly cleaning or decontamination of brownfields, construction of flood protection structures and construction of roads and backbone networks if they were not implemented in the area earlier.

The aim of the research described in the article is to define the evaluation of individual alternatives for the area used in order to determine an optimal solution for both the investor and the city (public).

## **2. Analysis of the current situation**

The planned area use must be consistent with sustainable development. Urban sustainability is a multi-dimensional concept that includes environmental, economic, social and political dimensions [1][2]. According to The World Commission for Environment and Development: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." [3]. It seems that the method of evaluating the highest and best use could suit this comprehensive view as one of the possible methods (Highest and Best Use, HABU) [4][5]. Highest and Best Use method are defined by the Appraisal Institute of Canada as "The reasonably probable and legal use of property, that is physically possible, appropriately supported, and financially feasible, and that results in the highest value." [6]. The method is also mentioned in the Fifth Edition of The Dictionary of Real Estate Appraisal by the Appraisal Institute which defines highest and best use as "The reasonably probable and legal use of vacant land or an improved property that is physically possible, appropriately supported, financially feasible which results in the highest value." [7]. In these definitions these four steps are implicit and are applied in the following order to develop adequate support for the appraiser's highest and best use opinion:

1. Legally permissible,
2. Physically possible,
3. Financially feasible,
4. Maximally productive.

The authors of this article focus mainly on the third step of the methodology, which they aim to put into the context of public sector decision-making process. The research is aimed at finding suitable criteria that can be used to assess the socio-economic potential of locations that are defined as areas, sets of areas or parts of areas, defined on the basis of their predominant character. Different criteria have different impacts on territorial development [8]. At the moment, it is necessary to look for a solution to the issue of defining these criteria for the territorial unit itself [9]. The municipality in whose cadastral territory the area is placed has to incur certain expenditures on its preparation for its intended use. These expenditures can be marked as agglomeration effects; effects that are behind the origin of cities or their

development [10]. The question is whether, at this level, data can be found to illustrate future income and/or socio-economic benefits that a new area can bring to a municipality/society.

### 3. Methodology

The zoning plan defines the urban concept, the concept of landscape organization and the concept of public infrastructure, it defines the built-up area, other areas and corridors and sets the conditions for the use of these areas and other activities affecting development of the territory. Efforts of making full use of the potential of the territory make possible its subsequent development [11]. It therefore allows for land use alternatives; it is important to find out how these alternatives can contribute to the effective use of the area also in the context of its surroundings and in connection with strategic urban development plans.

A modified HABU methodology was chosen to select the best variant for the use of brownfield revitalization. As mentioned above, development projects can be evaluated according to 4 conditions, namely according to be legally permissible, physically possible, financially feasible and maximally productive.

Legally permissible aspect inquiries into whether a given project alternative complies with applicable legislation. In the Czech legal environment, this means in particular evaluating whether:

- The project meets the requirements of the zoning plan and other spatial planning documentation – what type of construction can be implemented in the area
- It complies with environmental regulations,
- The constructions are subject to any protection restrictions (protection zones, cultural heritage zones, flood area, nature protection, etc.),

Physically possible aspect examines whether the project is compatible with the given space (land) due to its spatial arrangement. In the case of vacant, undeveloped area, it is sufficient to verify whether the built-up area is not larger than the land area or whether it is not in conflict with the maximum area of construction set out in the zoning plan. It is also advisable to pay attention to accessibility to the area and its possibility of connection to engineering networks and communications.

Financially feasible aspect tests the project in terms of investment and operational phase, it determines the expected cash flows and evaluates the project on the basis of economic efficiency indicators, which are mainly NPV (Net Present Value), IRR (Internal Rate of Return) or RI (Rentability Index). From the point of view of a private investor as the owner of a future project, it means an assessment of direct cash flows, i.e. income and expenditures within the evaluated period, consisting mostly in the economic service life of the project.

From the point of view of the public sector, however, it means a society-wide view, where project alternatives are assessed in terms of economic cash flows, which include not only income and expenditures but also socio-economic benefits and harm (e.g. jobs creation, capacity of permanent residents, parking spaces, shortening transport distances, increasing or decreasing the quality of public space).

Maximally productive aspect means that project alternatives with the highest added value should be selected. However, the view of the private investor and the public interest may differ with regard to the financially feasible condition testing. From the point of view of public interest, the maximum societal benefit given by the highest value of ENPV is examined.

#### 4. Results and discussion

The database of brownfields of the statutory city of Brno, which should help potential investors to make the right choice of their business plan, considers localities with an area of over 0.5 ha and an area use of the locality up to 30%. The database currently contains 117 areas, among the most important in terms of area size are mainly former industrial areas of the textile and arms industries and former military facilities. Their list and basic parameters (area, original and new use) are given in the following Table 1.

**Table 1.** The most important brownfields of the city of Brno according to their area

	Brownfield designation	Original use	Area [ha]	New use acc. to zoning plan	Ratio of area use [%]
	Territory of the South				
1	Centre between the Uhelná, Opuštěná, Trnitá Streets	Others – unspecified	8.65	PS + MR + TI + PA	38/26/19/17
2	Czech Railways landfill, Bidláky St.	Others – unspecified	9.42	TI + MR	65/35
3	The original area of the textile factory Vlněna	Industrial production	3.32	MR	100
4	Zetor Husovice	Industrial production	5.19	MR + TI	80/20
5	Former ABB EJF area, Cimburkova St.	Industrial production	5.27	MR + CA	71/29
6	Arms factory ZBROJOVKA	Industrial production	22.69	MR + TI + PA	84/10/6
7	Former Kohn brickkiln	Mining od raw materials, waste disposal	9.45	H + PS + PA + MR + S	46/27/17/6/4
8	Air repair base	Military area	13.99	LP	100
9	Former Florimex next to Sokolova St.	Agricultural production	8.83	LP + TI	53/47

Source: Authors' own processing acc. to [gis.brno.cz](http://gis.brno.cz) [12]

(PS – Public spaces / MR – Mixed residential / TI – Transport infrastructure / PA – Public amenities / Green areas / LP – Light production / H – Housing / S – Sport / CA – Commercial amenities)

To apply the "Financially feasible" condition for public sector decision-making process, the following relation was determined based on the CBA methodology. The economic net present value (ENPV) can be marked as a suitable variable for the decision-making process.

$$ENPV = \sum_{i=0}^n \frac{1}{(1+r)^i} \left[ \sum_{k=1}^u (SB_{ik} - SC_{ik}) + \sum_{m=1}^v (PEX_{im} - NEX_{im}) - \sum_{j=1}^t C_{ij} \right] \quad (1)$$

Where:

ENPV Economic Net Present Value in €

SB<sub>ik</sub> k<sup>th</sup> Social Benefit in the i<sup>th</sup> time period in €

SC<sub>ik</sub> k<sup>th</sup> Social Cost in i<sup>th</sup> time period in €

$PE_{im}$	$m^{\text{th}}$ Positive Externality in $i^{\text{th}}$ time period,
$NE_{im}$	$m^{\text{th}}$ Negative Externality in $i^{\text{th}}$ time period in €
$C_{ij}$	$j^{\text{th}}$ Cost in the $i^{\text{th}}$ time period in €
$r$	discount rate in %/100,
$n$	length of the evaluated period in years,
$u$	number of Societal Benefits or Costs,
$v$	number of Negative Externalities or Positive Externalities,
$t$	number of life cycle costs of the investment project.

In the current phase of the research, the first two benefits were investigated and a procedure for their evaluation was determined. These are the expected numbers of jobs and the expected capacity of permanent residents in individual revitalized areas. To determine the societal benefit of the capacity of permanent residents, the tax revenue of the municipality was used based on the budget determination of taxes and on the number of residents. The used value of the city income per capita is based on statistical data of the municipality researched. In the case of Table 2 below, the values of the final account of the statutory city of Brno in the current value of €1,020/inhabitant were considered. [13]. The average value of the socio-economic benefits generated for the society in the creation of one job reflects the costs of the state to qualify the workforce. The value of €12,401/job [14] was used for the calculation, which is currently considered as an average value for the Czech Republic.

The following table describes the selected benefits for the above-mentioned brownfields both in units of measure and in monetary units.

**Table 2.** Socio-economic impacts of the brownfield development

n	Brownfield designation	Permanent residents' capacity		Estimated number of jobs	
		Number	Benefit value	Number	Benefit value
1	Territory of the South Centre between the Uhelná, Opuštěná, Trnitá Streets	6,481	6,610,620 €	7,038	87,278,238 €
2	Czech Railways landfill, Bidláky St.	4,179	4,262,580 €	9,605	119,111,605 €
3	The original area of the textile factory Vlněna	0	-	6,197	76,848,997 €
4	Zetor Husovice	3,247	3,311,940 €	2,698	33,457,898 €
5	Former ABB EJF area, Cimburkova St.	3,571	3,642,420 €	3,625	44,953,625 €
6	Former ZBROJOVKA factory	5,703	5,817,060 €	5,559	68,937,159 €
7	Former Kohn brickkiln	1,845	1,881,900 €	877	10,875,677 €
8	Air repair base	466	475,320 €	5,314	65,898,914 €
9	Former Florimex next to Sokolova St.	0	-	251	3,112,651 €

Source: Authors' own processing acc. to [gis.brno.cz](http://gis.brno.cz) [12]

It can be clearly seen from Table 2 that, in addition to direct income for private investors who carry out their business activities on revitalized brownfield sites, developing areas bring significant benefits also to municipalities as shown on the example of the statutory city of Brno. The amount of basic benefits in € can be seen from the column "Permanent residents 'capacity" and "Estimated number of jobs".

## 5. Conclusion

The article deals with the methodology for the evaluation of brownfields from the perspective of municipalities. Revitalization of brownfields is a costly process, so monitoring its effects by municipalities is very important. Both from the scientific literature research and the authors' own research, the Highest and Best Use (HABU) method were a suitable option. This method of evaluating individual variants of development projects for land use allows them to be assessed not only in terms of their feasibility but also in terms of financial and economic benefits. The aim of the research was to extend the HABU method, which evaluates the view of a private investor also by a more comprehensive view of municipalities – a public investor. The core of the research was the elaboration of the financially feasible aspect for the calculation of the impacts of brownfields revitalization from the perspective of the municipality. In the article, the authors identified two basic societal benefits – the permanent resident capacity and the expected number of jobs in a given area to outline possible procedures for their evaluation.

The research sample consisted of the area size of the most important brownfields in the city of Brno. Subsequently, on the basis of the valuation of benefits, the financial benefit of these socio-economic benefits was defined.

Subsequent research will focus on defining and evaluating other socio-economic benefits/harms, such as benefits from the creation of parking spaces in urban areas, benefits from shortening commuting distances or harm caused by increased traffic on roads and the resulting negative externalities related to the environment. Along with the identification, mapping and evaluation of benefits and externalities, the investment costs of municipalities which consist of the costs of decontamination of brownfields, providing construction of necessary roads, backbone engineering networks or flood control measures will be also examined.

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