



TRENDS AND CHALLENGES IN BROWNFIELD REVITALIZATION: A GIS BASED APPROACH

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Abstract

Brownfield sites have negative effects on the spatial, economic, environmental and social aspects of community life. During the past decades, examples of good practice around the world showed that the revitalization of brownfields contributed to material and non-material prosperity, and the realization of a sustainable economic and social development. Once large corporations, who represented the foundation of economic development of Vojvodina, Serbia, are now mainly devastated and powerless to independently find a solution for revitalization. Investors are faced with the problem of non-defined, disorganized and unregulated locations, but primarily with the lack of associated database, which would shorten the process of selecting the most suitable location. To activate brownfield sites, it is necessary to pinpoint these locations, and conduct a detailed analysis. When it comes to trends in revitalization of brownfields in the practice of other countries, the use of geographic information systems (GIS) has proven to be one of the most effective tools for visualization of attributes of the brownfields in terms of socio-economic factors, the environment, and the immediate surrounding of the location. Thus, the formation of a unified database of brownfields, which would have public access, represents the first step in solving the problem of brownfield revitalization. GIS technology allows spatial analysis which includes an assessment of potential environmental threats, data comparison, resource management and development planning. This paper presents current trends and challenges in brownfield revitalization with emphasis on geographic information systems application.

Key words: *brownfield; geographic information system (GIS); revitalization; sustainable development.*

1. INTRODUCTION

Cities are increasingly facing the lack of building sites, which represent the most important resource of all. One of the main problems is the increase of building sites at the expense of the agricultural sector, although there are plenty of abandoned and unused sites throughout the settlements.

Brownfields, as insufficiently exploited, neglected sites, which, to a greater or lesser extent, adversely affect the state of the environment, pose a problem for local communities from the spatial, economic and social aspects. On the other hand, brownfield sites have the

potential for urban renewal and sustainable development and can become initial driver of economic development. Land is an asset which has an economic value and it is capitalized by putting it into operation, thus creating a new social product.

There is no official definition, classification and records of brownfield locations in Serbia. Also, a lack of integrated and comprehensive knowledge of the status of brownfield locations is noticeable. The Spatial Plan of the Republic of Serbia defines operational goals in the use of new technological achievements in order to improve the ecological environment and establishes the institution at the national level that would deal with

urban renewal, recycling and offering brownfield sites, where priority is the creation of a brownfield cadastre with valorisation development of GIS and monitoring [1].

Regarding the trends in the revival of brownfield in the practice of other countries, the use of geographic information systems (GIS) has proven to be one of the most effective tools for visualizing the brownfield attributes in terms of socio-economic factors, the environment and the immediate surroundings of the site. In this context, it is necessary to create a unique brownfield database at the national level with a detailed geographic register on the status and use of brownfield sites that would have public access and constitute the first step in solving the problem of revitalization of brownfields.

2. BROWNFIELD AS THE CHALLENGE

In national economy of every country, one of the basic generators of growth is the development of business infrastructure, which includes the revitalization of brownfields. In order to develop the business infrastructure, it is necessary to do a lot of work and contribute effort in order to determine the basic principles and principles of placing and attracting capital (direct investments, domestic and foreign, multinational companies, etc.), with the optimal use of the available potentials of the space. It is necessary that local self-governments understand the opportunities and benefits they gain by restoring brownfields and that they show the initiative for active involvement in the process of implementation. The performance of brownfields depends on the engagement of each stakeholder, where it is necessary for the brownfield site to be economically feasible and environmentally friendly.

For the sake of sustainable urban development, the general strategy for revitalizing brownfield space implies:

- a clearly defined legal framework
- developed awareness of the potentials of these areas of local and state authorities, institutions and all stakeholders
- developed knowledge capacity in solving these problems
- the emphasis on brownfield in programs, strategies and plans in spatial and urban planning
- cooperation between the public and the private sector and all stakeholders and
- precisely defined intervening steps [2].

The initial step of successfully renewing a brownfield is the good coordination of all institutions, from the provincial level to the level of local government, in order to bring a legal framework that would define the brownfield revitalization problem. In addition, it is important to achieve standards for collecting and updating data, to reach an agreement on the sharing of information between institutions, which would shorten the time of data collection, and to develop a system which would allow data to be collected in terms of information exchange and enable public access to data to all interested parties.

The process of revitalization of brownfield is a complex and long-lasting process consisting of many phases:

1. Data evaluation
2. Pre-feasibility study
3. Feasibility study
4. Implementation

Each of these phases (Fig. 1) involves a series of activities that are crucial for the revitalization of brownfields [3].

2.1 Data collection and processing

The first step in solving brownfield projects is the collection, input and processing of data such as: the spatial location of the site and its surroundings, urban parameters, the ecological aspect of the site, ownership structure, infrastructure facilities, architectural heritage and other relevant data. Data collection was considered one of the most complex and expensive tasks pertaining to the creation of GIS [4]. However, today's collecting of data for the GIS database is still an exhausting job and a difficult way of finding information, but it can be built independently with relatively few resources and can be modified and analysed in terms of occurring changes [5], [6], [7]. The analysis and assessment based on the collected data is extremely important, because based on this, it is possible to determine the extent of the risk posed by the location, and therefore to assess whether the site has the potential for investment.

Practice has shown that investors, who select brownfield investments, are interested in, above all, the condition of the facility, the enclosure of pollution of the site and its equipment, as well as the resolved property-legal relations. Therefore, the greatest importance of data collection is attributed to the size of the location, the original purpose, the infrastructure, the ownership structure, and the traffic connection of the location with the environment.

The more accurate the data, the better results are achieved. Some sites have the value of cultural heritage, so their revitalization must be coordinated with the conservation and adaptation of existing buildings. Other locations may be subject to a complicated and long-lasting property-legal process in terms of ownership or, from the point of view of environmental contamination, not suitable for revitalization.

The public sector must be active in creating an incentive environment in which the private sector, through the realization of its own business interests, will contribute to achieving general social and development goals.

In this context, the key role of local authorities is to create a suitable business environment, one that will not only promote, but also stimulate and facilitate the establishment, growth and development of small and medium-sized enterprises, and to initiate, create and coordinate other entrepreneurial projects and endeavour.

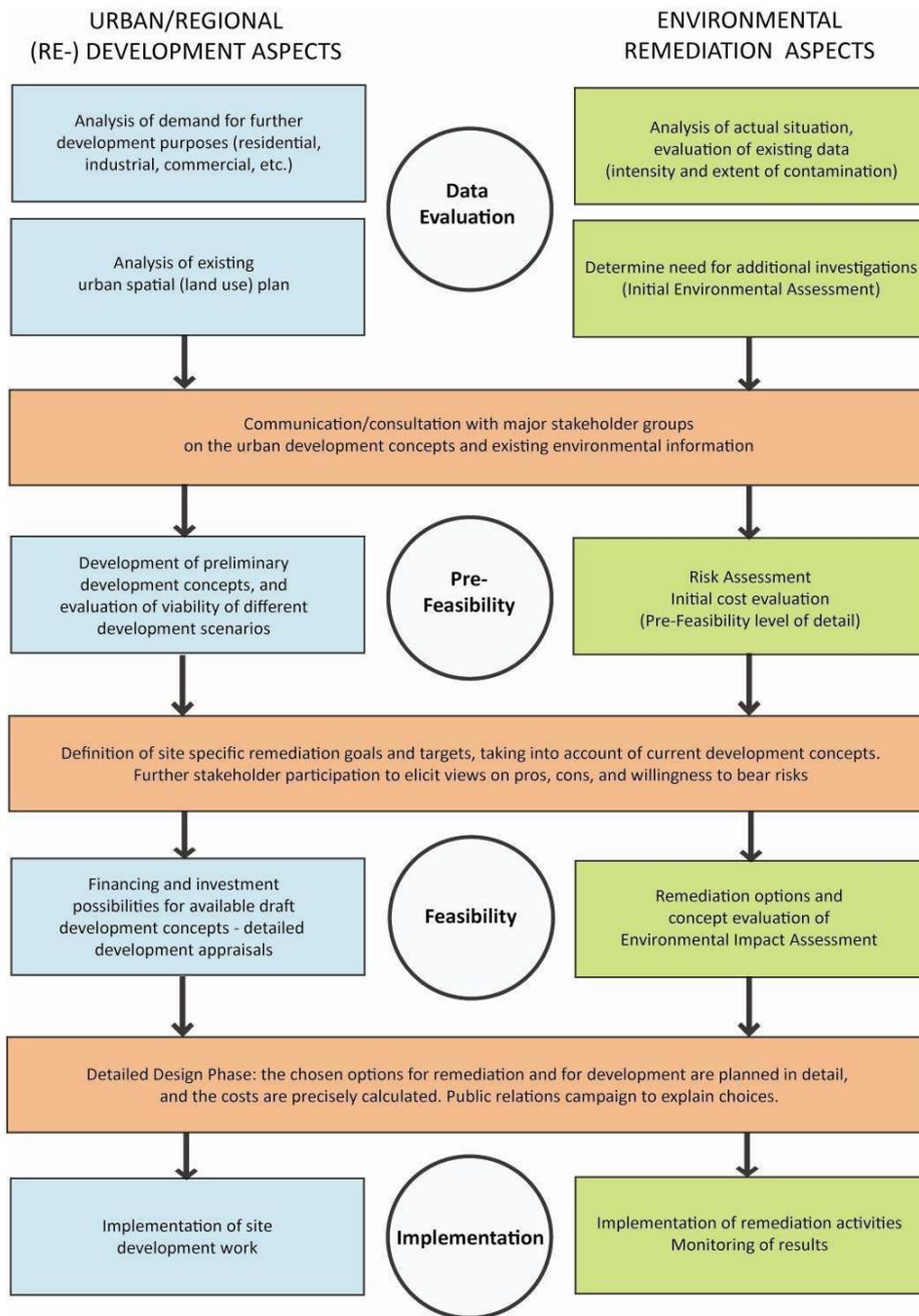


Figure 1. Recommended Planning Sequence for the Development of Brownfields

Investors, with the intention of starting production and investing, are faced with the problem of undefined, disorganized and unregulated locations, but primarily with an inadequate database that would shorten the process of selecting an adequate location.

Data collection, processing and updating of interactive database of brownfield sites is an instrument for more efficient planning and management of spatial development, that is, an instrument that allows permanent monitoring of changes in the area, thus contributing to promoting the principles of sustainable development.

2.2 Pre-feasibility study

The pre-feasibility study determines the spatial, ecological, social and economic justification of the investment [8], ie the assessment of the possibilities for investing in the brownfield project, as well as the analysis of potential risks for realization based on the collected data. [3]

Certainly important for revitalization is sustainable spatial and urban planning that looks at the social aspect. At this stage of realization, the participation of all stakeholders is important in order to identify the potential users and their needs.

2.3 Feasibility study

Based on the feasibility study, a decision is made on the justification of investment in a concrete project and, possibly, the initiation of the procedure for issuing construction permits. [8]

Thus, the elaboration of a feasibility study is of exceptional benefit before the beginning of the development of the brownfield site plan, since it helps in the dimensioning and determination of future steps.

During the feasibility study phase, the project is defined in detail and preparatory actions are underway. The project is further developed to provide a more precise cost estimate and a clearer concept. [3] It is necessary that all stakeholders from the private and public sector establish a relationship and inform each other about the planned activities. The analysis provides objective information for a given site so that stakeholders, such as local governments and investors, can make proven investment decisions and accept the potential investment risk.

2.4 Implementation

The phase of realization of brownfield sites implies primarily solving of ecological problems, that is, the required extent of revitalization depending on the degree of pollution in order to protect the environment and the proceedings on bringing the area to the intended purpose.

Without solving a prospective ecological pollution, the process of reusing brownfield is not possible, especially if land conversion is planned. Solving ecological problems for potential investors represents an additional risk, higher costs and longer timeframe for planned projects on this type of brownfield [9].

Although the benefits of revitalization of brownfield are clearly documented in terms of improving the urban core and the health and well-being of citizens in post-industrialized cities, the fact remains that several barriers inhibit the revitalization of brownfields [10]. Funding constraints and responsibilities for remediation are key obstacles to the revitalization of brownfield [11].

Revitalization projects for brownfield sites offer an opportunity to establish and test new sustainable development practices (for example, recycling materials after demolition of buildings, isolation of polluters, greening of locations that were once neglected, etc.) [3].

3. GIS APPROACH FOR BROWNFIELD REVITALIZATION

Data sets represent intersection of problems that affect the development of brownfield sites, with an emphasis on the integration of environmental data sets and socio-economic and infrastructural data.

One of the most powerful characteristics of GIS is the capacity to perform various spatial analyses in an easy and fast manner.

There are many advantages of GIS brownfield over traditional forms of data collection.

It is necessary to integrate different datasets so that comparisons of parameters relating to the state of the environment, ownership structure, brownfield type, location size, infrastructure equipment, traffic connectivity, urban parameters, market valuation and other relevant parameters between brownfield sites can be quickly performed.

When it comes to brownfield sites, GIS is used as management, decision support, institutional control, and as a tool to help revitalize brownfields in conducting economic analysis, environmental assessment, site promotion, and monitoring the realization of brownfield revitalization.

In this way, GIS can be used to track and list brownfield locations, interactive mapping, location and environmental status overview, and to promote potential locations for future users [12] Thus, efforts to restore brownfield help in three important ways: through data integration, project management, and relationships with stakeholders [13].

The main objective is to include the comprehensive registration of brownfield sites, i.e. establishing a database, for the purpose of their adequate valorisation and availability of information for the purpose of their future development.

The ultimate goal is to make brownfield sites competitive and return these areas for production purposes, stimulating local economic growth by returning these assets to tax flows, providing jobs and attracting other jobs to the environment [14].

The methodology of comprehensive valorization of brownfield sites is necessary in providing support to local community authorities and decision makers in:

- the perception of the degree of neglect and inexperience of pre-built areas on the territory of local governments,
- analyzing the losses arising from their neglect and non-use, as well as recognizing the multiple potentials of these spaces;
- planning strategic development of cities on the principles of sustainability, and based on comprehensive information on brownfield spaces,
- promoting brownfield through a web-based database, easily accessible to the public with information on free spaces available for future development and investment, within the brownfield zone [9].

Creating a database and designing a database creation process (Fig. 2):

- creating (preparing) graphics in AutoCAD in relevant layers

- graphic transformation in Gauss-Krieger's projection (Hermannskogel's date)
- controlling the graphics before entering ArcGIS - import data into ArcGIS
- transformation of graphics from Hermannskogel to WGS84 (World Geodetic System - Worldwide Reference Date-Applied by Google) using Geocentric Translation
- inserting a satellite reference folder (which is in WGS84)
- controlling the position of the brownfield location relative to the reference map
- graphics processing in ArcGIS / geo-visualization
- relational connection of spatial data with alpha-numeric data
- entering attribute (alpha-numeric) data into the database
- controlling of compliance of attribute and spatial data
- entering already prepared layers of infrastructure (traffic, electricity, thermal power, water management, etc.) on the territory of the province of Vojvodina, Serbia, in the form of information:
 - review and analysis of infrastructure data in the territory of the province of Vojvodina, Serbia, created in the process of drafting Regional spatial plan of the province of Vojvodina
 - graphic transformation from Hermannskogel to WGS84 (World Geodetic System - world reference date-applied by Google) using geocentric translation
 - control of compliance of spatial and attribute data and
 - final control.



Figure 2. Database creation process

6. CONCLUSION

One of the key problems of the industry, identified by the Spatial Plan of the Republic of Serbia, is falling behind in the implementation of innovations, new technologies, inefficient use of inputs, neglect of infrastructure and poor equipment of industrial sites.

Bearing in mind the significance and positive impact of the revitalization of brownfield sites in the development of their wider environment, it is necessary to provide a shorter and easier way of realization for potential investors.

After identifying brownfield sites and collecting data of relevance for reuse of space, GIS tools are becoming a tool for evaluating the brownfield status indicators in order to reduce the risk of failure of investing in the sites.

Considering the economic crisis and the period of transition we are currently in, great efforts, that require strong organization and significant financial resources, are needed in the years ahead, in order to achieve the level of urban renewal by revitalization. The prosperity of Vojvodina, Serbia, is reflected in breaking the negative development tendencies and establishing an economic balance that would improve the ecological structure, the economic situation, in creating the benefits for new jobs, rational use and adequate exploitation of construction land, as well as social progress.

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