

THE EXPERT SYSTEM FOR BROWNFIELD REVITALIZATION PROJECTS

Assoc. Prof. Ing. Barbara Stalmachová, CSc

Assoc. Prof. Dr. Ing. Zdeněk Neustupa

Ing. Roman Danel , Ph.D.

VŠB – Technical University of Ostrava, Czech Republic



ABSTRACT

The article presents an analysis of steps necessary to create an expert system applicable by project managers to solving problems associated with brownfield restoration and redevelopment projects. The analysis is based on information published by the team of authors in articles dealing with issues related to information technologies in brownfield revitalization, i.e. above all revitalization project database design and models creation in the area of brownfield revitalization. The mentioned technologies represent an initial precondition for the creation of an expert system that would be able, on the basis of experience in already realized projects and in combination with developed models, to provide managers with recommendations for the realization of new brownfield revitalization projects.

Keywords: brownfield, revitalization, landscape restoration, COBRAMAN, information system, expert system

INTRODUCTION

Utilization of information technologies and technologies for modelling to handle landscape affected by industrial activity, raw material gaining particularly, is a part of long term research activities of Faculty of Mining and Geology, VŠB – Technical University of Ostrava. These activities were gradually dealt with in several projects. Information systems for planning of revitalization and modelling of after mining areas were created [6]. In this article we want to present ideas about next step, the building an expert system for landscape revitalization projects. The research is based on results of European Union project “Manager Coordinating Brownfield Redevelopment Activities” (“COBRAMAN”, the European Union project 1CE014P4, Central Europe Programme co-financed by the ERDF), homepage <http://www.cobraman-ce.eu>, which was solved from 2008 and have been finished in April 2012.

COBRAMAN DATABASE AND ELECTRONIC GUIDE

The transnational COBRAMAN project deals with redevelopment and reuse so-called “brownfields”. CABERNET (The Concerted Action on Brownfield and Economic Regeneration Network) defines brownfield as “sites that have been affected by the former uses of the site or surrounding land, are derelict or underused, are mainly in developed urban areas, require intervention to bring them back to beneficial use and

may have real or perceived contamination problems” [1]. One of the aim of the COBRAMAN project has built a database of implemented brownfield redevelopment projects (successful and unsuccessful both) with a web user interface for international professional public.

The projects stored into database provide us with this information [6]:

- basic information about the project (name, idea, details, background),
- information on the area (characteristics of the area, the previous function, type of area, current use, post-industrial landscape, accessibility, infrastructure, pollution and contamination),
- detailed description of the project (objectives, budget, deadlines, the most important experience, the owner at the time of the project, the owner of the project after the implementation of it, funding sources, the stages of the project),
- best practices,
- tools,
- sources of information,
- contact information,
- photos, pictures, illustrations,
- GPS (display the position of area using GoogleMap service)

The database and Guide to Brownfield Management is designed for users from institutions (municipalities, regional authorities, business and research institutions or universities) and for individuals as professionals or students [4].

The database web interface has been complemented by “Guide to Brownfield Management”. This electronic guide is directly connected to the example solution of the revitalization projects in database.

The experience and best practices stemming from these projects provide knowledge and lessons learned that are useful when making decisions related to post-industrial area development. When it comes to effective post-industrial land regeneration management, it is important to utilise information concerning the identification of area/process conditions and knowledge about previous project completion experience. Process completion can also be supported by specialist knowledge in the fields of environmental protection and cultural heritage, marketing and management, communication, economy and finance as well as spatial and urban planning. The guide allows browsing through identified tools and concepts in European post-industrial area revitalization projects and is organized according to categories. The user may find information about the main benefits of specific tools and practical implications of the applied tool on a project’s success [2].

The database of revitalization projects and Guide to Brownfield Management created during COBRAMAN project is accessible at <http://database.cobraman-ce.eu> since December 2011.

THE EXPERT SYSTEM

The expert system is defined as a computer program that can offer intelligent advice or make intelligent decisions using rule-based programs.

The expert systems are custom-written computer programs that are "expert" in some narrow problem area, and embody (to a certain extent) a true human expert's knowledge, experience and problem-solving strategies. Expert system is a computer simulation of a human expert. Conventional computer information systems are based on factual knowledge. Human experts solve problems with a mixture of factual and heuristic knowledge. Heuristic knowledge composes from logical interferences, judgment and intuition. Expert system should combine facts and heuristics and merge human knowledge with computer power in solving problems.

There are two general groups of expert systems – for decision support (to remind a human expert of issues to consider, alternatives to explore, etc) and for decision making (to aid a person in problem solving an area that he/she is unfamiliar in, or is inexperienced in).

We deal with a second type of the expert system – decision making support. Project manager of brownfield revitalization need information support for decision and the higher level of information support is expert system. This system, according demands for solution of brownfield revitalization, should be able to give a recommendation. Recommendation is based on knowledge base of the real revitalization projects. Tool can search similar condition and solution.

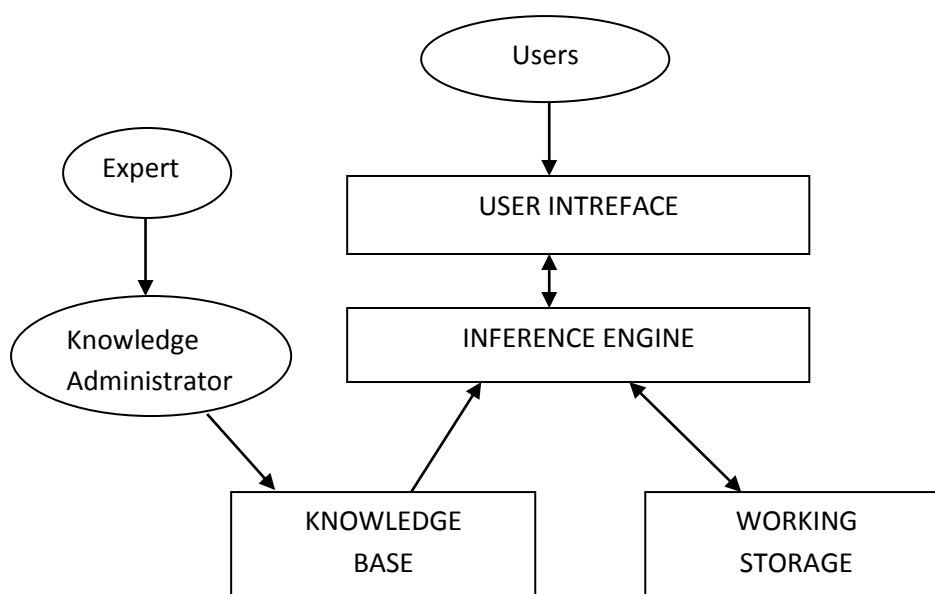


Fig. 1 The components of the expert system

Basic components of the expert system are drawn in the Figure 1. The knowledge base is a representation of expert's knowledge. The working storage contain data specific to a solved problem, it's the most dynamic component of system. Core of the system is the

inference engine which derives recommendations from the knowledge base and working storage. The knowledge is declared in rules. The expert system should have ability to explain the process that it used to give a recommendation.

Knowledge administrator encodes the expert’s knowledge in a declarative form (“if-then” rules). The user is a person who consults the system to get advice.

There are two type of algorithm: data driven and goal driven. In data driven the algorithm proceeds from given situation to a goal, in goal driven the algorithm proceeds from the goal backward, breaks problem into sub-problems. Expert system must be able to work with uncertainty also.

THE EXPERT SYSTEM FOR BROWNFIELD REDEVELOPMENT PROJECTS

Currently there is an abundance of methodological results, approaches and technical tools available from recent European Union funded and national projects. Brownfield regeneration processes are often long term, complex and involve a wide range of professional disciplines, as well as political actors and different stakeholder groups. Co-ordination and communication are essential to sustain complex projects. The management of the process as such more evidently facilitates the redevelopment than sole technical aspects. Key tasks for professional regeneration managers are to develop and deliver opportunity plans and to steer revitalization processes.

From the beginning of a project a multitude of information, planning documents, technical reports etc. will be produced by various involved actors. Keeping the overview, structuring and filing, assessing according to relevance and target groups, as well as drawing appropriate conclusions are fundamental tasks to ensure the information flow within the project and its environment [3].

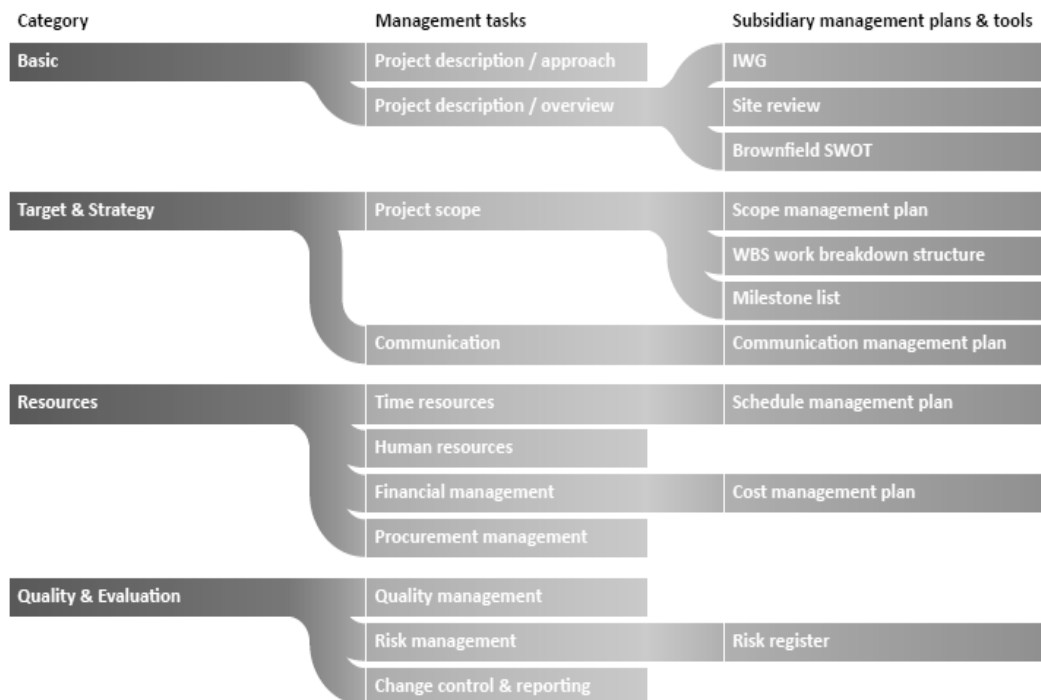


Fig. 2 Brownfield regeneration management plan [3]

Project managers work with the brownfield regeneration management plan. The structure of the plan is shown in a picture 2. The picture explains what information the project managers need.

You can find an on-line internet expert system dealing in landscape redevelopment. These systems are mainly based on GIS layers [e.g. 7]. Our research team, which was involved in COBRAMAN project (2008-2012), made some achievements in building basics of knowledge base of brownfield revitalization projects (building the database with electronic guide for management, collecting the data, building GIS layers and creating models of landscape, landscape revitalization, site contamination etc.).

There are a lot of information sources deals with brownfield issues but the tool that concentrates and transforms information into a single platform was missing. Currently is available the database of significant brownfield redevelopment projects with electronic management guide as a result of the Cobraman project.

Recently at VŠB – Technical University of Ostrava we have started to build the expert system, designed for project managers and investors, who are solving the best way for brownfield site redevelopment. They need to choose from several possibilities and find solution, which is useful and also not too expensive. They want to avoid mistakes during the past revitalization project.

Users ask the system to obtain the recommendation about brownfield re-use solution. Initial input information for the decision is:

- Type of brownfield
- Current and future use
- Information about area and topology of site
- Social and cultural aspects
- Communication access
- State of infrastructure
- State and type of contamination
- Type of revitalization project (PPP, private, public...)
- Budget and financial issues
- SWOT analysis
- Market situation and competitors
- Stakeholder engagement
- First idea of re-use
- Timeline

The expert system should connect this information with knowledge base and rules defined by experts. The results of processing are answers to these questions:

- Are there similar projects with analogous conditions?
- Which type of re-use is recommended for this project? (heritage protection, economic or technical aspects, nature conservation, remediation methods ...)
- Are there any best practices for such projects ready for use?
- Are there any known problems connected with such projects?
- Are there recommended steps for project solution?
- Are there any legislation requirements related to the brownfield?

CONCLUSION

We have presented the database of brownfield redevelopment projects (including the web interface) and electronic guide for brownfield management that has been developed as one of the results of transnational project COBRAMAN. This was the first step for creating of the expert system designed for project managers or investors who decide about solution of brownfield redevelopment. The expert system, based on this database (including GIS) and models, would be able analyze the demands of managers to find the best way for solution of redevelopment projects. With connection to the knowledge base the system could to give the recommendations for the best solution on issue connected with the brownfield revitalization projects. We intend to solve this in future work.

REFERENCES

- [1] CABERNET Brownfield definition. [online] [cit. 2012-04-23]. Available at <<http://www.cabernet.org.uk/index.asp?c=1134>>.
- [2] COBRAMAN Database Web Interface [online] [cit. 2012-04-23]. Available at <<http://database.cobraman-ce.eu/index.php?menu=about>>
- [3] COBRAMAN Research Team – Brownfield Regeneration Management: from Education to Practice – Final Brochure, 20 p., Urban Planning Institute of Ljubljana, Slovenia, 2012.
- [4] Danel R. & Neustupa Z. & Stalmachová B. COBRAMAN Knowledge Database Matrix, 2009 [online] [cit. 2012-04-18], available at <<http://www.cobraman-ce.eu>>.
- [5] Danel R. & Neustupa Z. & Stalmachová B. Design and Implementation of the Database of Brownfield Revitalization Projects. CINEST - International Symposium on Earth Science and Technology 2011, Fukuoka, Japan, pp. 415-418, 2011.
- [6] Neustupa Z. & Stalmachová B. & Danel R. Information system for regeneration of landscape affected by mining, 11th International Multidisciplinary Scientific GeoConference SGEM 2011, Albena, Bulgaria, pp. 809-816, 2011.
- [7] Thomas M. R. A GIS-based decision support system for brownfield redevelopment. [online] [cit. 2012-04-27]. Available at <http://www.mendeley.com/research/a-gisbased-decision-support-system-for-brownfield-redevelopment>, 2002