AN EMPERICAL APPROACH TO TIMBRE-BASED MODELS IN BROWNFIELD REDEVELOPMENT

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PROBLEM STATEMENT

Over the last several decades, extensive de-industrialization and land use changes of former military, industrial, and commercial sites across Europe have lead to a large number of derelict and underutilized lands with varying degrees of contamination also known as Brownfields [11]. Acute demands for land in and around cities, on the other hand, have made urban sprawl one of the major challenges facing Europe [10]. During the last decade, brownfield site remediation and revitalization has gained increasing attention as a sustainable land use strategy to combat urban sprawl [2] and additional infrastructure and mobility costs entailed in developing a free developable land. However, regeneration of contaminated fields is a complex and multidimensional problem that entails many risks and uncertainties, such as risk of liability claims, investment, usability, and marketability (stigma) risks [1]. The objective of this paper is to construct, calibrate and validate a risk assessment model in order to evaluate and predict the development potential of industrial brownfields that can assist investors and decision-makers.

METHODOLOGY

Several brownfield scoring schemes, prioritization tools, and identification approaches have been proposed in the literature that focus on various aspects of regeneration of brownfields, such as uncertainty assessment, environmental and health risk assessment, remediation cost assessment, etc. However, they are either developed case-by-case or lack a multidisciplinary approach [6]. One major project that merges most existing models into one is the Tailored Improvement of Brownfield Regeneration in Europe (TIMBRE), which assists the stakeholders to rank brownfields based on their redevelopment potential. The ranking is performed by using multi-criteria decision analysis methodology, which uses different components in a hierarchical structure, including dimensions, factors and indicators. On the highest level, dimensions account for specific aspects of redevelopment potential, such as local development potential, site attractiveness, marketability, and environmental risks. Each dimension is identified through factors, which lead to successful brownfield redevelopment. Indicators are used to simplify the factors to qualitative or quantitative measurable variables. After assigning weights to the indicators, they are aggregated by convex combination into factors, which are then weighted and aggregated into dimensions. Finally, dimensions are aggregated again to a final prioritization or ranking score [12].

Three model constructions are considered, which are separately calibrated and validated. Model 1, set as benchmark, follows the guidelines of TIMBRE. Four dimensions are chosen by experts, which have the most impact on the potential regeneration of a brownfield. Calibration of model 1 is performed by weighting the relevant factors produced from an expert-based questionnaire. The model is then validated by assessing its discriminatory power based on receiver operating characteristic (ROC) method. [13]

Model 2 uses statistical method of supervised learning to retrieve the most suitable variables and their weights such that the discriminatory power of the model is maximized. Linear discriminant analysis (LDA) aims to best discriminate between classes of a dependent categorical variable, depicted here by the fact that whether a brownfield is successfully regenerated or not with a linear combination of a set of continuous independent variables [8].

Model 3 focuses on the aspects of machine learning, dealing with the problem of big data. Here, a major part of all logistic regression models containing all possible combination of the variables available are calibrated and cross-validated. Based on the predictability of these models, the best one is chosen as a final model for each federal state.

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