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The RISCONA system: constructability appraisal through the identification and assessment of technical project risks sources

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Abstract

In construction management, constructability and risk analysis have never been methodologically and computationally integrated, leading to non-optimal construction knowledge implementation, stakeholders' cooperation, choice of construction method, and risk-driven perception of key managerial concepts. In this paper, a methodology unifying constructability and risk analysis is delineated, where: (1) risk sources are derived with unsupervised machine learning, (2) actual projects' data are collected and suitably correlated with the derived risk sources, and (3) the appraisal of constructability through the data-correlated risk sources is modelled with supervised machine learning. As the culmination of this modelling, the prototype software application RISCONA (RIsk Source-based CONstructability Appraisal) is presented, as a tool that can help construction managers in their decision-making regarding constructability and risk analysis.

Keywords: constructability; risk analysis; project management; holistic integration; unsupervised and supervised machine learning; k-means++; nonnegative matrix factorization; support vector machines; classification prediction; prototype software application.

1. Introduction

Constructability is 'the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives' [1]. It is an integral Construction Management (CM) framework implemented through the initiation, execution, and delivery lifecycle phases to optimize the project's performance objectives of time, cost, quality, and client satisfaction [2]. This is realized through constructability programs, i.e., 'the application of a disciplined, systematic optimization of construction-related aspects of a project during the planning, design, procurement, construction, test, and start-up phases by knowledgeable, experienced construction staff who are part of a project team' [3].

Risk Analysis (RA), also deployed within CM, is the collective mathematical methodology and systematic decision-making process to accept known or assumed risks, and implement actions to reduce their harmful consequences and probability of occurrence, or transform them into potential opportunities and revenue sources; for this, RA includes the steps of risk identification, assessment, response, monitoring, and control [4-5]. RA can be conducted through the whole project lifecycle, but especially during its initiation, execution, and delivery [6-7]. However, risk identification suffers – in research and practice – from a definitional discrepancy, where risks are meddled with relative but not contextually same notions, like hazards, impacts, and defects [8]. To ameliorate this discrepancy, the preliminary steps of risk source identification and assessment are

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