Examination the Usefulness of Selected Classification Methods in the Pre-Qualification of Construction Contractors

Paweł Błaszczyk, Institute of Mathematics, University of Silesia, Katowice, Poland

Tomasz Błaszczyk, Department of Operational Research, University of Economics in Katowice, Katowice, Poland

ABSTRACT

For most of projects, including major infrastructure enterprises a key success factor is an appropriately selected general contractor. In addition to technical and organizational criteria the assessment of its financial capacity is strongly important to provide liquidity to the cash flows of the project. Unfortunately, the practical experience of the construction market during the economic downturn shows that many projects have been delayed or suspended as a result of the bankruptcy of general contractors. The purpose of this paper is to present the results of studies on the use of Partial Least Square, Fisher Linear Discriminant, Support Vector Machine methods, and the authors' proprietary approach to the Extraction by Applying Weighted Criterion of Difference Scatter Matrices (EWCDSM) for the pre-qualification of potential contractors. The study included an ex post evaluation of selected large construction companies, operated in Poland by reference the fact of their bankruptcy or maintain the market to historical financial data for the prior year period. Then, for the same set of data the authors performed the identification of companies at risk of bankruptcy. The results obtained are confronted with the actual condition of the surveyed companies. Proposed operating models have been validated on publicly available financial data of construction companies listed on the Polish Stock Exchange.

KEYWORDS

Classification, Contractors Pre-Qualification, Extraction by Applying Weighted Criterion of Difference Scatter Matrices, Feature Extraction, Fisher Linear Discriminant, Partial Least Square, Project Procurement, Support Vector Machine

INTRODUCTION

During the economic downturn a growing number of bankrupted companies is observed. It's reason due to the non-revenue generating contracts with the need to incur the fixed costs of maintaining capacity, delays in payment for loss of liquidity and insolvency of customers, resulting in a lack of payment for the order or the products delivered. Failure to pay for the contractor is in the best case, the need for temporary financing funds from other sources, at the expense of the use of debt financing or destination of their income from other contracts to cover costs already incurred manufacture of a product or completion of the service that is not covered by the customer. On the other hand, the project owner or the general contractor is exposed to the risk of bankruptcy of its subcontractors. In this case, the money involved in the project in the form of an advance or partial payments made yet are usually very difficult to recover. Depending on the legal structure of the contract, owner of the project may also be forced to settle certain liabilities incurred by the bankrupt contractor for the project. Another

problem is the suspension of the work on the project, resulting in the need to secure already realized the extent the selection of a new contractor, sometimes changing technology and project parameters what, amongst others could be the critical factor of project delays (see. Motaleb & Kishk, 2013).

An advanced multi-criteria approach is appropriate in project management for not only human resources selection (Hajeeh, 2013).

The problem of contractor pre-selection has been recognized and supported by optimization methods based on different classes of models. El-Sawalhi made a review (El-Sawalhi, Eaton & Rustom R., 2007). and pointed out the following:

- Dimensional Weighting Aggregation (DWA)
- Knowledge Based System (KBS),
- Multi-attriubute Analysis (MAA),
- Fuzzy set Pre-qualification,
- PERT model for contractor pre-qualifiaction,
- Analytical Hierarchy Process (AHP),
- Multi-attribute utility,
- Case-based reasoning,
- Artificial Neural Networks (ANN).

In this review (El-Sawalhi, Eaton & Rustom R.,2007) authors indicate math model's advantages, disadvantages and compare them in terms of applicability to group decision making, non-linear behavior, deal with subjective judgment, deal with both qualitative and quantitative criteria, simultaneous Multi-criteria decision making, concern of uncertainty and risk, adaptiveness, needs of system training and high knowledge of the user, understanding the mathematical behavior, and results interpretation ability. Based on this comparison, it can be stated that user expectations in the highest degree meet models based on the methods of Artificial Neural Networks and fuzzy sets. The ANN approach disadvantages came from the need of system training (here it is necessary to remember than in repeated evaluations of the same market players with unchanged selection criteria system needs be learned only once at the beginning), understanding of mathematical behavior and results interpretation. The negative impact of this last two features may be minimized by using the simple classification rule assigning bidders into clear and easy to understand classes (e.g. reliable and non-reliable companies). The unified criterion of "reliability" must be aggregated on the basis of several criteria, where values are clear and accessible for all bidders. Different sets of criteria are defined by several authors. El-Sawalhi (El-Sawalhi, Eaton & Rustom R.,2007) proposed 31 attributes grouped in seven classes (financial stability, management and technical ability, experience, historical non-performance, resources, quality, health and safety). Shen (Shen, Lu, Shen Q & Li, 2003) focuses on social influence and technical ability group of criteria to calculate the total competitiveness value. Lam and Yu (Lam & Yu 2011) indicate scoring standard for three quantitative criteria (human resource, financial strength, current workload) and eight qualitative (equipment resources, environmental considerations, claims history, management capacity, quality management potentials, safety and health aspects, past experience and past performance) criteria for their Decision Support System. Palaneeswaran and Kumaratswamy (Palaneeswaran & Kumaratswamy, 2001) proposed ten criteria in three groups (responsiveness, responsibility, competency) for construction projects. The PMI (Project Management Institute) standard PMBoK Guide (PMI, 2008) introduces the "Evaluation Criteria" as a result (output) of contract planning process on the basis of "Procurement Management Plan", "Contract Statement of Work", "Make-or-Buy Decisions" and "Project Management Plan", processed by "Standard Forms" and "Expert Judgment" techniques. PMI introduces also a process "Request Seller Responses" with an output "Qualified Sellers List", but it is created on the basis of "Organizational Process Assets", "Procurement Management Plan" and "Procurement Documents only", not concerning the "Evaluation Criteria".

Related Content

Modelling the Impact of Administrative Access Controls on Technical Access Control Measures
Winfred Yaokumah (2017). *Information Resources Management Journal (pp. 53-70).*
www.irma-international.org/article/modelling-the-impact-of-administrative-access-controls-on-technical-access-control-measures/186888

Knowledge of IT Project Success and Failure Factors: Towards an Integration into the SDLC
Walid Al-Ahmad (2012). *International Journal of Information Technology Project Management (pp. 56-71).*
www.irma-international.org/article/knowledge-project-success-failure-factors/72344

Knowledge Management and New Organization Forms: A Framework for Business Model Innovation
Yogesh Malhotra (2000). *Information Resources Management Journal (pp. 5-14).*
www.irma-international.org/article/knowledge-management-new-organization-forms/1204

Research on Semi-Structured and Unstructured Data Storage and Management Model for Multi-Tenant
Xin Huand Yabin Xu (2019). *Journal of Information Technology Research (pp. 49-62).*
www.irma-international.org/article/research-on-semi-structured-and-unstructured-data-storage-and-management-model-for-multi-tenant/216398

Client/Server and the Knowledge Directory
Stuart D. Galup, Ronald Datteroand Richard C. Hicks (2005). *Encyclopedia of Information Science and Technology, First Edition (pp. 430-434).*
www.irma-international.org/chapter/client-server-knowledge-directory/14275