Chapter 12
Learning and Explaining the Impact of Enterprises’ Organizational Quality on their Economic Results

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ABSTRACT
The authors employed traditional and novel machine learning to improve insight into the connections between the quality of an organization of enterprises as a type of formal social units and the results of enterprises’ performance in this chapter. The analyzed data set contains 72 Slovenian enterprises’ economic results across four years and indicators of their organizational quality. The authors hypothesize that a causal relationship exists between the latter and the former. In the first part of a two-part process, they use several classification algorithms to study these relationships and to evaluate how accurately they predict the target economic results. However, the most successful models were often very complex and difficult to interpret, especially for non-technical users. Therefore, in the second part, the authors take advantage of a novel general explanation method that can be used to explain the influence of individual features on the model’s prediction. Results show that traditional machine-learning approaches are successful at modeling the dependency relationship. Furthermore, the explanation of the influence of the input features on the predicted economic results provides insights that have a meaningful economic interpretation.

DOI: 10.4018/978-1-4666-1806-0.ch012
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INTRODUCTION

The central question of this article is whether the novel intelligent data analysis methods can provide insight into the connections between the quality of an organization and its economic performance. We adopt the definition of an organization as a set of relationships between members of a formal social unit that are characteristics of the social unit and that ensure its existence, development, and rational achievement of the enterprise’s goals (Mihelčič, 1992a). According to this definition, at the core of an organization there are organizational relationships; therefore, it is logically assumed that the very same relationships determine the quality of the organization.

As the analysis of Mihelčič (1992b) argues, the most relevant goal-oriented relationships can be divided into five basic types: technical, personnel, coordinative, communicational, and motivational. These relationships and their implementation should be evaluated, either directly through different aspects of the relationships’ conditioned organizational life or indirectly through organizational contextual factors. Whichever approach is used, particular interdependent indicators as measures of organizational quality can be derived (e.g. value or worth, orientation towards people or technique, reliability, commitment, consistency, and provision of information). When such indicators of organizational quality are determined, we can explore their connections with the enterprise’s economic results.

In our study, we determined the organizational quality and economic results of 72 Slovenian enterprises. The resulting data are suitable for intelligent data analysis, using traditional statistical and machine-learning methods. We used Logistic Regression, Naïve Bayes, Random Forests, and Artificial Neural Networks to evaluate the extent to which economic results can be predicted from indicators of organizational quality. Although our results reveal that the indicators of organizational quality have predictive power, the best performing model for a particular indicator of economic performance is often complex and difficult to interpret. Exploring the data with different types of models also makes comparison across models very difficult. To deal with these issues, we take advantage of a novel general explanation method (Štrumbelj & Kononenko, 2010). This method can be applied to any type of prediction model in a uniform way to provide insight into how the input features influence the model’s prediction. This also simplifies the comparison of different types of models.

The remainder of this chapter is dedicated to explaining the economic background, with an emphasis on measuring organizational quality, and to describing our economic data. In the following sections, we first provide some background on general explanation methods and describe the explanation method we used in our study. This is followed by a description and the results of two sets of experiments that illustrate the usefulness of the explanation method and how it was successfully applied in our study. Before we conclude the chapter, we provide some ideas for further research.

BACKGROUND

Organizational Outcomes and their Measures

Observing the roles of members in an enterprise can lead to five fundamental relationships, defined as technical, personnel, coordinative, communicational and motivational issues, which can be arranged in pairs of relationships, as a cluster, a honeycomb or a wedge, or an inverted pyramid, as shown on Figure 1 (Mihelčič, 2007).

As part of the method of assessing the quality of organization of enterprise, known as MUKOZ (Mihelčič, 1992b), an extensive list of aspects of relationships was developed as distinct expressions of organizational events, acts, and conse-