CREDIT-WORTHINESS PREDICTION IN ENERGY-SAVING FINANCE USING MACHINE LEARNING MODEL

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ABSTRACT

Companies can form their own "ESCO model" with their capitals. New opportunities that Energy Saving Company (ESCO) can do was to offer PSS business model in the form of Energy Saving Agreement (ESA) or Energy Saving Performance Contract (ESPC), which was known as "saving back arrangement financing." ESCO contracts could free business owners from new upfront investment. Unfortunately, customer's creditworthiness was becoming more crucial for ESCO. Machine learning was used to predict the creditworthiness of clients in ESCO financing processes. This research aimed to develop a scoring model to leverage a machine learning and life cycle cost analysis (LCCA) to evaluate alternative financing for Energy Saving in Indonesia. Research from the case studies leads to a clearer understanding of the factors that affect all parties' decisions to implement and continue with their ESCO project. Both considerations, technology, and administration emerge from this case study which greatly influenced the participants to adopt the decision and continue with the ESCO project. In contrast, both parties agreed to solve the credit risk constraints on the project. This study indicates that administration influences were more significant than the technological factor in shaping their decisions.

Keywords: *LCCA, Machine Learning, ESCO, Creditworthiness*

RESEARCH HIGHLIGHTS

This study explored the impact of an energy-efficiency lighting program on one of the ways of reducing energy usage was by switching to energy-saving lightings. The use of energy-saving equipment reduces energy costs (Almeida, Santos, Paolo, & Quicheron, 2014; Bennich, 2015; Polzin, von Flotow, & Nolden, 2016). Despite the numerous opportunities, retrofitting remains an exception; the energy efficiency potential in Indonesia was immense. Life cycle cost (LCC) was one way of calculating the overall cost of ownership. LCC may be used as an investment strategy that measures a company's entire cost of owning, managing, sustaining, and disposing of an asset (Fuller & Petersen, 1996). In addition to the cost of credit default risks, the retrofitting aspects' cost was a critical factor. The authors investigate which factors, as an ESCO, approved the final retrofitting project chosen. The authors used Machine Learning (ML) to predict the probability of future actions.

GRAPHICAL ABSTRACT

Fig. 1. Retrofitting Steps (modified from X. Liang, Peng, & Shen, 2016)

Research Objectives

Our research aims to build a credit risk modeling framework that will reduce the risk of credit given to retrofitting projects while growing ESCO benefits. As a result, this research aimed to find the best modeling with the best performance and accuracy. This paper endeavors to show how ESCO can help customers tackle energy efficiency projects with a real case study. The ESCO provider was 'MWS,' and the customer was SHJ. The authors referred to use a pseudonymous name for this study. This study focuses on MWS that adopted the retrofitting practices with their own "ESCO model" on energy management or conservative energy projects or activities. MWS was intended to introduce the latest PSS model in their own "ESCO model" with their capitals in Indonesia. To finance the retrofitting project, MWS performed a simple financial analysis to determine the value, risk, and liquidity effect of suitable projects. To perform successfully, energy efficiency projects need to be regarded on the same par as others. The MWS uses finance analysis to assess whether an investment results in a good return while not damaging the consumer base.

Methodology

This paper endeavors to show how ESCO can help customers tackle energy efficiency projects with a real case study. The ESCO provider was 'MWS,' and the customer was SHJ.

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Results

This model's p-value was $1,852 \times 10^{-187}$ which less than 0.01 or 1% as was thought 'very good.' The p-value of each variable as a list under $P > |z|$ was less than 0.01 or 1%. Pseudo R-Squared was 0.4810 or 48.19%. From the pseudo R-Square value, it was obtained that the influence of all independent variables on dependent variables (retrofitting project) was 48.19%. Obtained multinomial logistics regression model for log category ratio retrofitting project=1(Take) and retrofitting project =0 (Hold and Reject) was $-6.5619 + -4.0780$ (Project Agreement) $+ 0.5237$ (Upfront Investment) $+ 2.0639$ (Revenue Factors) $+ 0.4995$ (Additional Revenue Factors) $+ 0.5579$ (Investment Return) $+ 1.3236$ (Customer) $- 0.7805$ (Type of Customer).

Findings

The misclassification rate of this model can be computed as: Accuracy Rate = $\frac{FP+FN}{(TP+TN +FP+FN)} = \frac{473 + 43}{(28+40)} = 88.3562\%$. The results of calculations using multinomial logistic regression showed that the accuracy value of prediction data with test data was 88.3562 %. A common practice was to use the Receiver Operating Characteristics (ROC) curve, which plots the false positive rate (FPR) on the Y-axis against the true positive rate (TPR) on the X-axis, for a range of threshold values (usually percentile values). Prediction rate result that refers to the percentage of correct predictions among all test data, were as follows: Prediction Rate = $473 / (473+43) = 91.67\%$, False Positive Rate (FPR) = $28 / (28+43) = 39.44\%$ and True Positive Rate, it called as Recall or 'Sensitivity Rate' as it was defined as number of positive cases that were correctly identified (TPR) was $473 / (473+40) = 92.20\%$.

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