INTEGRATING CNN AND AHP FOR SUPPLIER SELECTION OF AGRICULTURAL PRODUCT

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ABSTRACT

Decisions in the company can be strategic, tactical, or operational. An example of a strategic decision is supplier selection. For selecting suppliers of agricultural products where variation exists, the company needs to investigate whether product samples from prospective suppliers comply with the company's existing standards, such as those related to the color or texture of the product.

Investigating the conformity between a product sample and the company's standards takes time, especially if done manually. Apart from that, because the variation of agricultural products is high, there is the potential for decision maker fatigue to emerge. To anticipate this, convolutional neural network (CNN) techniques will be applied in this case to provide recommendations on whether product samples coming from prospective suppliers meet standards (acceptable) or do not meet standards (not acceptable). The proposed CNN model is created using approximately 3000 images of the same product, which have been labeled: 1) meets standards (acceptable) and does not meet standards (not acceptable). If this model is applied to investigate the sample product from a prospective supplier, the model can provide decision recommendations.

However, CNN alone is not enough because, in reality, the supplier selection criteria are not only related to product quality but are also related to price, vendor reputation, and supplier capacity. Because it involves several criteria, and there is no interdependency between the criteria, the Analytic Hierarchy Process (AHP) method can be used together with CNN. The work presented in this paper is to try to integrate CNN and AHP for the supplier selection problem of agricultural products where, in this proposed framework, the results of the CNN can be used to eliminate the prospective supplier where the product does meet quality standards. In addition, the result from CNN can be used as the basis for a pairwise comparison value between two suppliers. With the contribution of pairwise

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values related to quality, the supplier selection problem can be modeled completely with AHP.

Keywords: supplier selection, agricultural products, quality criteria, CNN, AHP

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Decision-making in a company spans strategic, tactical, and operational levels. Supplier selection, a critical strategic decision, requires evaluating whether product samples from prospective suppliers meet the company's established standards, such as color and texture. This evaluation process is time-consuming and labor-intensive when conducted manually, especially given the inherent variability of agricultural products. Moreover, the high variability can lead to decision fatigue among evaluators.

To address these challenges, this study proposes using Convolutional Neural Network (CNN) techniques to automate the evaluation process. A CNN model, trained on approximately 3,000 labeled images of a specific agricultural product, classifies samples as either meeting standards (acceptable) or not meeting standards (not acceptable). By applying this model, the company can efficiently assess whether a product sample from a prospective supplier aligns with its quality standards and generate automated decision recommendations.

However, product quality is only one of several criteria involved in supplier selection. Other critical factors, such as price, vendor reputation, and supplier capacity, must also be considered. The Analytic Hierarchy Process (AHP) is employed alongside the CNN model to incorporate these multiple criteria. In the proposed framework, CNN results filter out suppliers whose products do not meet quality standards and provide pairwise comparison values for the "quality" criterion in AHP. Combined with other criteria, these pairwise comparisons enable a comprehensive AHP-based decision model for supplier selection.

This integrated CNN-AHP framework streamlines the supplier selection process by automating quality assessments and systematically addressing multiple decision criteria. It offers a robust solution for strategic decision-making in agricultural supply chains.