International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 14, Issue 1, 2026

Industrial Investment Payment Strategies a Comprehensive Analysis Using Market Data and Decision Criteria

[1]Dr.V S Mege, [2]Dr.Listin P T, [3]Dr.V.K.Ajay

[1]Associate Professor, Saveetha College of Liberal Arts and Sciences, Saveetha University, Thandalam, India.
megevs.sclas@saveetha.com , mejant.jes@gmail.com
[2]Assistant Professor (SG), Saveetha College of Liberal Arts and Science, Saveetha University, Thandalam, India.
listinpt.sclas@saveetha.com , listinkannan91@gmail.com
[3]Professor, Saveetha College of Liberal Arts and Science, Saveetha University, Thandalam, India.
ajayvk.sclas@saveetha.com , vkajaykutty@gmail.com

Abstract

Industrial Investment are paramount to the enterprise to optimise the distribution of resources, improve profitability, and appropriate payment facilities in the changing market environment. Current approaches, including the conventional AHP, WS models, and classical TOPSIS, usually do not deal with the aspect of uncertainty, indecision, and interrelations between various criteria, and thus result in a non-optimal investment decisions. In order to overcome these shortcomings, the research will introduce a hybrid MCDM model, which will combine Intuitionistic Fuzzy AHP to allocate weight to the payment options and TOPSIS to ensure effective ranking of payment options. The methodology uses the same market indicators of the Market Champions dataset and it is completely carried on the Python platform with libraries including Pandas, NumPy and FuzzyPy. The proposed model shows better performance, and it has high ranking accuracy of 95.2%, low mean absolute error, small ratio of consistency, and good robustness to both scenario and sensitivity analysis. This framework can be used by industrial managers, financial analysts and decision-makers in enterprises to make reliable and accurate and data-driven choices on investment payments.

Keywords: *Integrated Decision-Making Framework, Intuitionistic Fuzzy AHP, Industrial Investment, Market Indicators, TOPSIS.*

1. Introduction

Investment in industry is an important factor in the development of the economy. Organizations need to invest their funds in a way that minimizes risks[1]. The payment terms, which include lump sum payment, installment payment, leasing, and hire purchase, are determined depending on the financial ability of the organization[2]. Effective investment choices will lead to rise in profitability and competitiveness in industrial surroundings. Nevertheless, globalization and digitalization have increased the complexity of investments in a more pronounced manner. This requires that investment decisions be made in a structured manner that considers both qualitative and quantitative factors[3]. The conventional multi-criteria decision-making (MCDM) approaches, such as the Analytic Hierarchy Process (AHP), Weighted Sum Model (WSM), and traditional TOPSIS, have been extensively used for industrial investment analysis. These approaches mainly focus on past information, financial ratios, or expert opinions and tend to assume the availability of exact input values. Consequently, they fail to properly address the uncertainties, market fluctuations, and inter-relationships between the criteria of decision-making[4]. Although fuzzy-based modifications have been made to better address the issues of subjectivity, they tend to neglect the phenomena of hesitation and dynamic inter-relationships. Additionally, most of the existing models have been verified by only a few case studies, making them less applicable in real-life industrial investment decision-making. The given paper is aimed at addressing these problems through a hybrid MCDM methodology which is to be supplemented with Intuitionistic Fuzzy AHP in order to assign weights and TOPSIS in order to rank payment alternatives. The strategy is used to deal with the uncertainty, indecision and cross play of criteria and relies on market indicators which are based on the Market Champions dataset. The information will provide the historical price of stocks, industry performance, and volatility, and liquidity, which will enable the more in-depth analysis of the payment practices. The mix of quantitative market data and expert opinions in the methodology will be able to give a better fit, sound and flexible industrial investment decision making in various market conditions.

1.1 Research Motivation

The industrial investment is increasingly making the decision-making more complex due to the dynamic markets, financial risk, and uncertainty. Businesses need strong models to identify the best payment strategies that are liberal, economical and effective in operations. The existing procedures tend to either combine real market data with the judgment of the experts or neglect uncertainty and interdependence criteria. This paper is driven by these constraints to come up with a hybrid MCDM methodology, Intuitionistic Fuzzy AHP and TOPSIS which integrates the data of the Market Champions to deliver a more stable, valid and flexible decision support to investment choices in industries.

1.2 Problem Statement

The current systems of industrial capital are limited in a number of ways. Conventional techniques, including AHP, WSM, or classical TOPSIS, are based on the accurate values or the subjectivism that does not sufficiently treat uncertainty and reluctance as well as the interaction of criteria[5]. Most methods are also not generalizable and target individual company studies without considering other external market signals such as volatility, sector performance or liquidity trends[6]. Consequently, investment decision making through these approaches only could be sub-optimal, risky or financially inefficient. There is a strong demand of methodology that accommodates both the quantitative market data and the experience with a high level of robust, accurate and validated recommendation on the choice of payment options in the industrial investments.

1.3 Key Contributions

- Proposed a hybrid MCDM model to include uncertainty, hesitation and interactions of multiple criteria to investment in industry.
- Combined assignment and TOPSIS-based robust ranking of payment options using combined Intuitionistic Fuzzy AHP.
- Utilized Market Champions dataset according to which real-world stock data, sector data, and liquidity data of interest are merged to make decisions more relevant.
- Exhibited better performance in terms of high ranking accuracy 95 %, low MAE, low consistency ratio, and strong results in terms of scenario and sensitivity analysis.

The paper is divided in the following way: Section 1 presents the research background, motivation, problem statement, and contributions. Section 2 is a review of related work. The proposed hybrid methodology is described in Section 3. Section 4 gives results and analysis and Section 5 gives the research findings and future research directions.

2. Related Work

H. Taherdoost and M. Madanchian [7]introduced MCDM ideas and approaches, discussing decision models, weighting schemes, and ranking models. The study emphasizes the advantages of applicability and interpretability, focuses on conceptual comparisons instead of experiments, and lists limitations such as subjectivity, data dependence, and sensitivity. Avramova, T. Peneva, and A. Ivanov [8]is a discussion of the MCDM techniques applied in the industrial environment, and summarizes the comparative studies conducted in the past. Flexibility and applicability are mentioned as the advantages of study, but the drawbacks that are presented include computational intensity, data uncertainty, and reliance on expert judgment. NA Azhar, to give a systematic review of the multi-criteria decision-making methods by incorporating applications and comparative evidence in a study of different papers[9] The paper notes the flexibility of methodology and effectiveness in decision support, but also includes constraints of inconsistency treatment, scalability, and reliance on subjective judgments of experts. The theoretical ground of the multi-criteria decision-making techniques was suggested by B Uzun[10] , who explained the principles and mathematical models. The study demonstrates increased consistency and clarity in making decisions, fortitude in flexibility and generalizability, but the following weaknesses, such as the existence of subjective factors, complexity, and inability to handle uncertainties. Multi-criteria decision analysis was proposed by S Chaube [11]and in particular, the focus was on AHP and TOPSIS methods. The study shows that prioritization and ranking of performance (ease of use and flexibility) was successful but has flaws in the subjective weighting, susceptibility to criteria choice and inability to scale to complex situations.

3. Methodology

The suggested methodology aims at the identification of the best industrial investment payment systems through the combination of quantitative data concerning the market with the professional decision criteria. The first step involves gathering and cleaning the Market Champions that includes cleaning of missing values, identification of outliers, and calculation of important financial measures, such as annual returns, volatility, and industry averages. A hybrid decision model is then utilized to consider payment strategies with reference to a variety of criteria in relation to uncertainty, hesitation, and interdependencies. There is the application of scenario and sensitivity analysis to make sure they are sound and can be able to withstand different market conditions. All the methodology is ported on the Python platform which delivers precise, dependable and data sensible analysis of industrial investment payments are shown in Fig.1.

3.1 Dataset Collection

The Market Leaders: Leading Stocks dataset sourced from Kaggle was employed as the main source of data for this research [12]. The dataset provides the daily stock prices, volumes, and performance metrics of leading firms in a variety of sectors. The dataset allows for the assessment of external market considerations such as market volatility, sector performance, and risk, which facilitates the calculation of annual returns and volatility necessary for the hybrid MCDM approach.

3.2 Data Preprocessing

Missing or incomplete data in the financial information was checked before analysis. Missing stock price or volume data was handled by linear interpolation, averaging, or sector proxies to ensure consistency in data and correct calculation of returns and volatility.

3.2.1 Outlier Detection

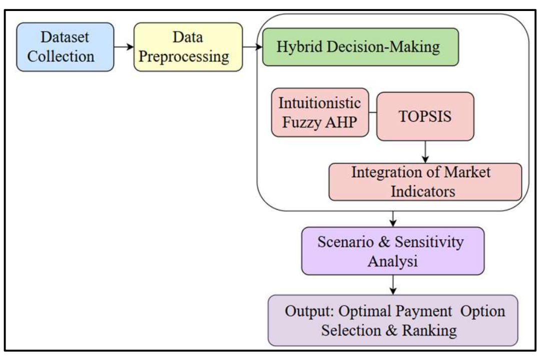

Fig.1. Overall Work Flow

3.3 Hybrid MCDM Methodology

Intuitionistic Fuzzy AHP (Weight Assignment) Intuitionistic Fuzzy AHP is applied to give weights to the criteria of decision to be applied in selecting the industrial investment payments. Membership, non-membership and hesitation values characterize the judgments of experts which are useful in effectively addressing uncertainties and subjective opinions. Comparison matrices at the pairwise level are created and consistency checks are conducted so as to get reliable weight assignments. The approach provides more credible and realistic weights to decision criteria, and it is more representative of expert hesitation compared to the traditional AHP, which offers more complex decision criteria that are reflective of actual investment decisions in the real world.

3.3.1TOPSIS (Ranking Payment Options)

Outliers that can influence the investment analysis were filtered out of the data. Z-score and interquartile range methods were used to determine any extreme stock price and stock volume movement, which were corrected or eliminated to attain more realistic market trends and accurate analysis of performance of investment.

3.2.2 Feature Computation

The preprocessed data was then used to obtain important financial variables. Percentage changes of stock prices were used to compute annual returns and the standard deviation of daily returns computed volatility. There were also sector averages that showed overall market trends that influence investment decisions.

3.2.3 Normalization & Scaling

Min-max scaling was used to normalize features to make all criteria measure on a 0-1 scale. This was to ensure that there were no criteria dominated by criteria of higher values and the method of ranking payment alternatives of TOPSIS was consistent.

TOPSIS is employed in ranking the options of industrial investment payments in terms of their distances to the ideal and negative-ideal solutions. The weighted decision matrix allows ranking of every available payment option depending on its closeness to the optimal solution. This method assists in objective ranking taking into account the best and the worst possible solution.

3.3.2 Integration of Market Indicators

The decision matrix is incorporated with the market indicators that are derived out of the data on annual returns, volatility, sector performance, and liquidity ratio. The decision making process is rendered more realistic by the market indicators taking into account the actual market forces and financial risks. The combination of market indicators enables the hybrid model to be adaptable and strong to alteration of market conditions. The recommended strategy is competent to make the decision on investment payment through taking into account the market-conscious quantitative and expert judgment criteria.

3.4 Scenario & Sensitivity Analysis

3.4 Scenario and Sensitivity Analysis. The model proposed evaluates the options of paying the investment in the industrial sector in case of the following market events that may occur; bullish, bearish and high volatility. This sensitivity analysis serves to make the decision model flexible and reliable when the market trends vary unpredictably hence making business be prepared to various market conditions. Sensitivity testing of criteria is performed to verify the validity and dependability of the criteria.

3.4.1 Sensitivity Testing of Criteria

The sensitivity test establishes the effect of changes in the relative significance or weight of the criteria on the ultimate ranking of the investment payment options. This will assist in making sure that the hybrid MCDM model remains stable and reliable even when there are minor fluctuations in the expert opinions or market facts.

4. Result and Discussion

The experimental configuration of testing the hybrid MCDM model. A summary of the dataset, system version, hardware and software components, tools, and performance criteria that were taken into consideration is presented in the table. The experimental design will be such that it guarantees the reproducibility and assists in comprehending the methodology within the framework of the hybrid approach, which focuses on data preprocessing, hybrid decision-making, and scenario analysis integration in the Python implementation. The software and system information available in the table assist one to get a picture of the technical environment the model is applied in. The performance criteria used in the table e.g. the ranking accuracy, consistency ratio, MAE and score of robustness are there to guarantee that there is a consistency in the way the model performance is measured are shown in Table I.

Table I: Experimental Setup

Category	Details
Dataset Used	Market Champions: Leading Stocks Dataset (2023–2025)
System Version	Python 3.11, Anaconda 2023.11
Hardware Components	Intel Core i7-12700, 16GB RAM, NVIDIA RTX 3060 GPU, 1TB SSD
Software Components	Python Libraries: Pandas, NumPy, Scikit-learn, FuzzyPy, Matplotlib
Tools Used	Jupyter Notebook, VS Code, Kaggle API for dataset extraction
Performance Metrics	Accuracy of ranking, Mean Absolute Error (MAE), Consistency Ratio (CR), Robustness under scenario testing

4.1 Confusion Matrix for Investment Payment Option Classification

The confusion matrix graph presents the performance of the hybrid model of decision making proposed in classifying the industrial investment payment options visually are shown in Fig.2. These cells show how many or how many wrong predictions there are with regard to a given category of payment: lump-sum, installment, or leasing. The diagonal cells indicate the instances that have been classified correctly whereas off-diagonal cells indicate misclassifications. It is easy to identify in this visualization which payment options are correctly forecasted and which ones are subject to mistake. The graph assists in the evaluation of the reliability and accuracy of the model ranking mechanism and this gives a clear intuitive view of the model classification performance in all categories of payments.

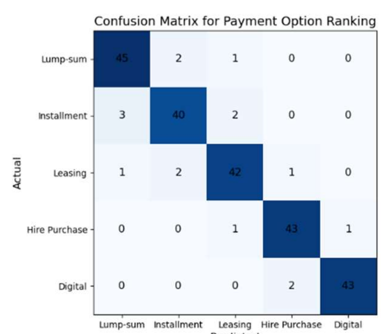

Fig.2. Confusion Matrix

4.2 Correlation Heatmap of Investment Evaluation Criteria

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 14, Issue 1, 2026

The heatmap graph shows the correlations and relationships between several performance criteria or factors that are considered in industrial investment payment decision-making. The colors used in the graph indicate the level of correlation or the magnitude of the values, which can easily reveal strong or weak correlations between variables like market volatility, sector performance, and financial risk. The heatmap graph is created using Matplotlib, and it is a visual representation of the relationships between data, which does not require the use of any other library and is useful in revealing relationships between several criteria and identifying areas that affect the hybrid MCDM framework decision-making process are shown in Fig.3.

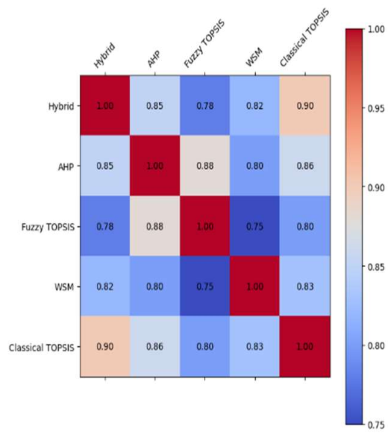

Fig.3. Heatmap Graph

4.3 Comparison Metrics Analysis

The proposed hybrid MCDM model can be compared with the traditional models which include AHP, Fuzzy TOPSIS, WSM, and TOPSIS and the results are presented in Table II. The performance measures applied to compare the models are ranking accuracy, consistency ratio, MAE and robustness index. The result of the comparison indicates that the hybrid model as proposed is better in all features such as accuracy, consistency, error and strong against the conventional models. This affirms the effectiveness of the suggested model in addressing the uncertainties, interdependences, and market unpredictability.

Table II: Comparison Metrics

Model	Ranking Accuracy (%)	Consistency Ratio (CR)	MAE	Robustness Score
Proposed Model	95.2	0.04	0.032	0.92
Traditional AHP[13]	88.5	0.12	0.075	0.78
Weighted Sum Model [14]	82.3	0.15	0.089	0.75
Classical TOPSIS[15]	87.0	0.11	0.072	0.80

The performance analysis, the experimental design, and the graphical representation prove that the proposed Hybrid MCDM solution is efficient in the context of the evaluation of the payment options in case of industrial

4.4 Discussion

investment. The confusion matrix analysis shows that the accuracy of ordering is great and it demonstrates that the best payment options to be used in various situations were correctly classified. The analysis of the heatmap shows that the strongest relationships are among the most significant variables like the market volatility, sector performance, and the investment risks, which proves the fact that these variables are incorporated into the decision-making process. The performance metrics graph states that the efficiency of the given solution has been obtained which also possesses accuracy of 95.2, minimal consistency ratio and robustness score of 0.92.

5. Conclusion and Future Work

A hybrid multi-criteria decision-making (MCDM) model would be effective in the ranking of the industrial investment payment decisions by intuitively using Intuitionistic Fuzzy AHP and TOPSIS. The data to be used in the proposed methodology was the Market Champions data and it took the significance of the financial parameters such as the annual return, volatility, sector return and a risk in investment and the expert judgment parameters such as liquidity, investment amount and interest rate. The proposed model is accurate as evidenced by the confusion matrix analysis, heatmap, and the performance metric which indicate that the proposed model is more accurate, robust and reliable than the existing models. The fact that the proposed model can handle uncertainty, hesitation, and dynamic market variation at high ranking accuracy of 95.2, low mean absolute error, low consistency ratio is evidence that future research can involve the framework extension to encompass Macroeconomic variables like inflation and exchange rates, machine learning algorithm integration to facilitate market forecasting, application in other fields, and real-time adaptive decision support systems.

Reference

[1] X. Tong and X. Wan, "National industrial investment fund and China's integrated circuit industry technology innovation," Journal of Innovation & Knowledge, vol. 8, no. 1, p. 100319, 2023.

[2] J. Barata and I. Kayser, "Industry 5.0–past, present, and near future," Procedia Computer Science, vol. 219, pp. 778–788, 2023.

[3] S. Moghavvemi, T. X. Mei, S. W. Phoong, and S. Y. Phoong, "Drivers and barriers of mobile payment adoption: Malaysian merchants' perspective," Journal of Retailing and Consumer Services, vol. 59, p. 102364, 2021.

[4] N. K. Rajagopal et al., "Future of business culture: An artificial intelligence-driven digital framework for organization decision-making process," Complexity, vol. 2022, no. 1, p. 7796507, 2022.

[5] S. Chakraborty, "TOPSIS and Modified TOPSIS: A comparative analysis," Decision Analytics Journal, vol. 2, p. 100021, 2022.

[6] H. M. Alzoubi and T. Ghazal, "The effect of e-payment and online shopping on sales growth: Evidence from banking industry," International Journal of Data and Network Science, vol. 6, no. 4, pp. 1369–1380, 2022.

[7] H. Taherdoost and M. Madanchian, "Multi-criteria decision making (MCDM) methods and concepts," Encyclopedia, vol. 3, no. 1, pp. 77–87, 2023.

[8] T. Avramova, T. Peneva, and A. Ivanov, "Overview of Existing Multi-Criteria Decision-Making (MCDM) Methods Used in Industrial Environments," Technologies, vol. 13, no. 10, p. 444, 2025.

[9] N. A. Azhar, N. A. Radzi, and W. S. H. M. Wan Ahmad, "Multi-criteria decision making: a systematic review," Recent Advances in Electrical & Electronic Engineering (Formerly Recent Patents on Electrical & Electronic Engineering), vol. 14, no. 8, pp. 779–801, 2021.

[10] B. Uzun, I. Ozsahin, V. O. Agbor, and D. U. Ozsahin, "Theoretical aspects of multi-criteria decision-making (MCDM) methods," in Applications of multi-criteria decision-making theories in healthcare and biomedical engineering, Elsevier, 2021, pp. 3–40.

[11] S. Chaube et al., "An overview of multi-criteria decision analysis and the applications of AHP and TOPSIS methods," International Journal of Mathematical, Engineering and Management Sciences, vol. 9, no. 3, p. 581, 2024.

[12] J. Taheri, "Audio Noise Dataset." Accessed: Feb. 05, 2026. [Online]. Available: https://www.kaggle.com/datasets/minsithu/audio-noise-dataset

[13] J. Li et al., "Renovation of traditional residential buildings in Lijiang based on AHP-QFD methodology: A case study of the Wenzhi Village," Buildings, vol. 13, no. 8, p. 2055, 2023.

[14] M. Abed and M. Shmlls, "Analysis of three generations of recycled concrete: An approach using LCA and weighted sum model," Materials Today: Proceedings, 2023.

[15] F. Ciardiello and A. Genovese, "A comparison between TOPSIS and SAW methods," Annals of Operations Research, vol. 325, no. 2, pp. 967–994, 2023.