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Investment Decision-Making for High-Potential Startups in the Digital Economy Using AHP and VIKOR

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Abstract–The rapid growth of the digital economy has driven the emergence of numerous startup companies that play a vital role as catalysts for innovation and business transformation in the modern era. However, the increasing number of startups poses a major challenge for investors in selecting the most potential and profitable investment opportunities. The main problem lies in the multi-criteria evaluation process, which involves various aspects such as market potential, product innovation, business model, team performance, and financial stability. To address this complexity, this study applies a combination of the Analytical Hierarchy Process (AHP) and VlseKriterijumska Optimizacija I Komprimisno Resenje (VIKOR) methods as an objective and measurable multi-criteria decision-making approach. The AHP method is utilized to determine the priority weights of each criterion through a pairwise comparison process. The results show that market potential (C1) is the most dominant criterion with a weight of 0.458, followed by product innovation (C2) with a weight of 0.247, and business model (C3) with a weight of 0.144. Meanwhile, team performance (C4) and financial stability (C5) have relatively lower weights of 0.105 and 0.046, respectively. These findings indicate that market and innovation aspects are the primary factors influencing startup investment feasibility. Furthermore, the VIKOR method is employed to rank the alternatives based on compromise solutions toward the ideal outcome. The results reveal that startup A17 has the lowest compromise value (Q = 0.0000), making it the most optimal investment alternative, followed by A4 (Q = 0.0303) and A19 (Q = 0.0586). This study demonstrates that the combination of AHP and VIKOR methods provides a comprehensive, objective, and consistent analysis in the decision-making process for digital startup investments. The proposed approach assists investors in evaluating startups more systematically and accurately based on the priority of relevant criteria in the context of the dynamic digital economy. Therefore, a decision support system based on the AHP-VIKOR method can serve as an effective solution for decision-makers to identify and select the most promising startups for future development.

Keywords: Digital Startup; Analytical Hierarchy Process (AHP); VIKOR; Investment; Multi-Criteria Decision-Making

1. INTRODUCTION

In the current era of rapid digital economic growth, startups play a crucial role as the primary drivers of technological innovation and digital business transformation. Their presence not only fosters economic growth but also offers new solutions that have the potential to transform people's lives. However, the rapid increase in the number of startups poses a significant challenge for investors in identifying which ones have the best prospects for investment. The selection process becomes complex as it involves multiple interrelated criteria with varying degrees of importance [1].

The main challenge in evaluating high-potential startups lies in developing a systematic and objective multi-criteria assessment approach to determine the most optimal investment candidates [2]. Various criteria must be considered, including team quality, product innovation level, market potential, business model, as well as financial and technical factors[3]. Traditional decision-making methods are often unable to handle this complexity in a transparent and consistent manner[4].

To address these issues, the Analytical Hierarchy Process (AHP) and VIKOR methods have been widely applied in multi-criteria decision-making processes [5]. The AHP method is employed to establish the priority weights among criteria through a systematic pairwise comparison, ensuring consistency in judgment[6]. Meanwhile, the VIKOR method is used to identify the best alternative by finding a compromise solution based on the distance from the ideal solution, making it effective in handling conflicting criteria[7]. The combination of AHP and VIKOR provides a comprehensive and efficient approach for selecting potential startups for investment in the digital economy era, thereby enabling investors to make decisions more objectively and quantitatively[8].

A previous study conducted by Ogie Ariansah Pane and Muhammad Dedi Irawan (2024) applied the AHP method to determine the level of importance of various criteria in the digital startup selection process. The results indicated that product innovation had the highest priority weight of 0.35, followed by business model (0.30) and market potential (0.25). After weighting, the VIKOR method was used to rank the startup alternatives. The analysis revealed that Startup A achieved the lowest compromise value (Qi = 0.15), designating it as the most optimal investment option [9]. Another study by Ari Putra Wibowo and Era Yunianto (2020) examined digital startup investments by integrating fuzzy AHP and VIKOR methods. The study identified the priority weights for each criterion as data security (0.40), technological scalability (0.35), and market readiness (0.25). The VIKOR analysis indicated that Startup X had the lowest compromise value (Qi = 0.12), implying that it was the most promising investment option based on balanced evaluation across the assessed criteria[10]. Furthermore, research conducted by Kharis Hudaiby Hanif et al. (2022) applied the AHP and VIKOR methods in the selection process of outstanding teachers. The AHP method was used to establish the priority weights for each assessment criterion, while the VIKOR method was employed to rank teachers based on compromise scores. The results showed that the teacher with the lowest VIKOR value of 0.10 achieved the highest rank, reinforcing that the combination of AHP and VIKOR is effective for objective and measurable multi-

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criteria selection [11]. Another study by Irfan Rafi Maulana et al. (2024) revealed that Indonesia ranks fifth globally in terms of the number of startup businesses, with a total of 2,203 startup companies. This finding underscores that Indonesia's startup ecosystem holds tremendous potential and can serve as a key driving force for digital economic development and national investment growth [12].

2. RESEARCH METHODOLOGY

2.1 Research Stages

The research stages are structured to help the researcher complete the study in a more systematic and organized manner. Through these stages, the research process can be conducted effectively to achieve the expected results.

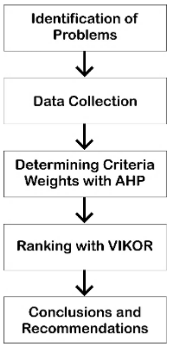

Figure 1. Research Stages

Based on Figure 1, the following explanation is provided to help readers clearly understand each stage of the research process:

a. Problem Identification. This stage aims to understand the main problem, namely how to determine the most potential startup for investment amid the abundance of options in the digital economy era.
b. Data Collection. This stage is carried out through observation techniques such as interviews or questionnaires to obtain relevant data from experts, practitioners, or respondents involved in startup investment.
c. Determining Criteria Weights Using AHP. At this stage, the Analytical Hierarchy Process (AHP) method is employed to determine the weight or importance level of each criterion. The process involves pairwise comparisons based on input from experts or respondents with experience in startup investment. The output of this stage is the priority weight of each criterion, which is used in the subsequent ranking stage.
d. Ranking Using VIKOR. After determining the criteria weights, the VIKOR method is applied to evaluate and rank the startup alternatives based on compromise values among the criteria. This method aims to produce a ranking of startups that are closest to the ideal solution by balancing different assessment aspects.
e. Conclusion and Recommendation. The final stage involves drawing conclusions from the analysis results and providing recommendations for investors or decision-makers in selecting the most promising startup for investment. The findings are expected to contribute to the development of a multi-criteria-based investment decision support framework.

2.2 Decision Support System

A Decision Support System (DSS) is a structured approach to problem-solving that processes collected data into useful information while incorporating various critical factors as the basis for decision-making [9][13]. DSS is an information system that utilizes decision models, databases, and supporting knowledge to assist ad-hoc and interactive decision-making processes, allowing decision-makers to select the most appropriate option for a specific situation[14]. The use of a decision support system provides faster and more reliable solutions, increases decision-makers' confidence in their choices, and offers a competitive advantage to organizations by improving time, effort, and cost efficiency [15].

2.3 Analytical Hierarchy Process (AHP) Method

The Analytical Hierarchy Process (AHP) was introduced by Dr. Thomas L. Saaty from the Wharton School of Business in the 1970s as a decision-making approach that helps decompose complex problems into a hierarchical structure consisting of several levels goals, criteria, and alternatives[16]. This hierarchy represents the problem in a multilevel structure, where the first level contains the goal, followed by factors, criteria, sub-criteria, and alternatives at the final level[17]. By structuring the problem hierarchically, complex issues can be divided into simpler and more systematic components, facilitating analysis and decision-making[18]. In general, the steps in the Analytical Hierarchy Process (AHP) are described as follows [19][20]:

a. Summing each column in the pairwise comparison matrix.
b. Normalizing the matrix by dividing each element in a column by the total value of that column so that each column sums to one:

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$$\sum_{j=1}^{n} \alpha_{ij} = 1 \quad (1)$$

where, a_{ij} is the element in the i-th row and j-th column of the pairwise comparison matrix.

c. Calculating the average value of each row by summing the normalized values in each row and dividing by the number of criteria (n) to obtain the priority weight (w_i).

$$w_i = \frac{1}{n} \sum_{j=1}^{n} \alpha_{ij} \quad (2)$$

where, n is the number of criteria and, w_i is the average weight of the i-th row.

2.4 Vise Kriterijumska Optimizacija Kompromisno Resenje (VIKOR) Method

The VIKOR method (VlseKriterijumska Optimizacija I Kompromisno Resenje), which originates from Serbian and means Multi-Criteria Optimization and Compromise Solution, is a ranking technique used to evaluate alternatives based on their proximity index to the ideal solution in multi-criteria decision-making problems[21]. VIKOR is part of decision-making methods in decision support systems designed to determine the best alternative among several options[22]. In its application, this method simulates the evaluated cases to produce a ranking order based on each alternative's calculated value[23]. The steps in the VIKOR Method are as follows[24][25]:

a. Determining the weight of each criterion, Each criterion is assigned a weight w_j, with the total sum equal to one:

$$\sum_{j=1}^{n} w_j = 1 \quad (3)$$

where w_j is the weight of the j-th criterion and $j = 1,2,3,\ldots,n$.

b. Constructing the decision matrix, The criteria and alternatives are arranged into a decision matrix X, where X_{ij} represents the performance of the i-th alternative concerning the j-th criterion.

$$Xij = \begin{bmatrix} X_{11}X_{12} \ldots X_{1n} \\ X_{21}X_{22} \ldots X_{2n} \\ \vdots \quad \vdots \quad \ddots \quad \vdots \\ X_{m1}X_{m2} \ldots X_{mn} \end{bmatrix} \quad (4)$$

Di mana $A_i$adalah alternatif ke-i, dan $C_j$adalah kriteria ke-j.

c. Determining the positive and negative ideal solutions for each criterion.
For Benefit criteria:

$$\mathrm{f}_j^+ = \max(\mathrm{f}_{1j,}\mathrm{f}_{2j,}\, \mathrm{f}_{3j,} \ldots, \mathrm{f}_{mj}) \quad (5)$$

$$\mathrm{f}_j^- = \min(\mathrm{f}_{1j,}\mathrm{f}_{2j,}\, \mathrm{f}_{3j,} \ldots, \mathrm{f}_{mj}) \quad (6)$$

For Cost criteria:

$$\mathrm{f}_j^+ = \min(\mathrm{f}_{1j,}\mathrm{f}_{2j,}\, \mathrm{f}_{3j,} \ldots, \mathrm{f}_{mj}) \quad (7)$$

$$\mathrm{f}_j^- = \max(\mathrm{f}_{1j,}\mathrm{f}_{2j,}\, \mathrm{f}_{3j,} \ldots, \mathrm{f}_{mj}) \quad (8)$$

d. Normalizing the decision matrix:

$$N_{ij} = \frac{f_j^+ - f_{ij}}{f_j^+ - f_j^-} \quad (9)$$

e. Calculating the weighted normalized value:

$$f_{ij}^* = w_j . N_{ij} \quad (10)$$

f. Calculating the Utility Measure (S) and Regret Measure (R):

$$S_i = \sum_{j=1}^{n} w_j \frac{(f_j^+ - f_{ij})}{(f_j^+ - f_j^-)} \quad (11)$$

$$R_i = max_j \left[w_j \frac{(f_j^+ - f_{ij})}{(f_j^+ - f_j^-)} \right] \quad (12)$$

g. Calculating the VIKOR Index (Q):

$$Q_i = v \left[\frac{S_i - S^-}{S^+ - S^-} \right] + (1 - v) \left[\frac{R_i - R^-}{R^+ - R^-} \right] \quad (13)$$

h. Ranking the alternatives, The alternatives are ranked based on the value of Qi in ascending order. The alternative with the smallest Qvalue represents the best option that is closest to the ideal compromise solution. ideal.

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3. RESULTS AND DISCUSSION

In this study, the startup evaluation process was conducted using a combination of the Analytical Hierarchy Process (AHP) and VIKOR methods to obtain more objective and structured assessment results. Before calculating the weights using AHP and ranking the alternatives with VIKOR, initial data were required in the form of each startup's score on the predetermined criteria. Table 1 presents the evaluation data for 20 startups based on five main criteria used in this research: market potential, product innovation, business model, team performance, and financial stability.

Table 1. Startup Evaluation Data

Alternative	Alternative	Alternative	Alternative	Alternative	Alternative
A1	7	8	7	6	7
A2	8	7	6	7	6
A3	6	9	8	8	7
A4	9	8	9	8	8
A5	7	7	8	7	6
...	...	...	...	...	...
...	...	...	...	...	...
A20	8	8	9	9	8

All criteria in Table 1 use a numerical scale from 1 to 10; therefore, no linguistic conversion process is needed as in qualitative data. Each score in the five criteria—market potential, product innovation, business model, team performance, and financial stability—is already quantitative and can be directly applied in the weighting and ranking analysis without the need for category-based normalization. This dataset represents the initial evaluation of each startup's performance and feasibility within the research context.

3.1 Application of the AHP Method

The study employed five evaluation criteria: market potential (C1), product innovation (C2), business model (C3), team performance (C4), and financial stability (C5). These criteria served as the basis for assessing the feasibility level of each startup in determining the best alternative for investment. Table 2 presents the list and classification of the criteria.

Table 2. Types of Criteria

Criteria	Description	Type of Criteria
C1	Market Potential	Benefit
C2	Product Innovation	Benefit
C3	Business Model	Benefit
C4	Team Performance	Benefit
C5	Financial Stability	Benefit

The following process is carried out to determine the priority weights of each criterion used, in order to identify which criteria are considered the most important or prioritized.

a. Pairwise Comparison Matrix

Before calculating the priority weights using the AHP method, a pairwise comparison matrix among the criteria was constructed to determine their relative importance using the Saaty scale. The resulting comparisons formed the basis for normalization and weight calculation. Larger numerical values in the matrix indicate greater importance of one criterion over another, whereas fractional values indicate the opposite relationship.

Table 3. Pairwise Comparison Matrix

Criteria	C1	C2	C3	C4	C5
C1	1	3	5	3	7
C2	1/3	1	3	3	5
C3	1/5	1/3	1	3	3
C4	1/3	1/3	1/3	1	3
C5	1/7	1/5	1/3	1/3	1

Table 3 presents the pairwise comparison of criteria using the Saaty scale. A larger numerical value indicates that the corresponding criterion is considered more important than another, whereas a fractional value represents the inverse relationship. This matrix serves as the foundation for the normalization process and the calculation of priority weights in the Analytical Hierarchy Process (AHP) method.

Table 4. Criteria Comparison Matrix

Criteria	C1	C2	C3	C4	C5
C1	1,000	3,000	5,000	3,000	7,000

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Criteria	C1	C2	C3	C4	C5
C2	0,333	1,000	3,000	3,000	5,000
C3	0,200	0,333	1,000	3,000	3,000
C4	0,333	0,333	0,333	1,000	3,000
C5	0,143	0,200	0,333	0,333	1,000
Total	2,009	4,866	9,666	10,333	19,000

Table 4 shows the criteria comparison matrix expressed in full numerical form without fractions. Each element represents the degree of dominance of one criterion over another according to the Saaty scale. The values in each row and column are processed to obtain the total of each column, which will later be used in the normalization stage to calculate the priority weight of each criterion in the AHP method.

b. Criteria Priority Weights

Normalization among criteria (C1):

$$C_{11} = \frac{1}{2,009} = 0,498$$

$$C_{21} = \frac{0,333}{2,009} = 0,166$$

$$C_{31} = \frac{0,200}{2,009} = 0,100$$

$$C_{41} = \frac{0,333}{2,009} = 0,166$$

$$C_{51} = \frac{0,143}{2,009} = 0,071$$

Normalization among criteria (C2):

$$C_{12} = \frac{3}{4,866} = 0,617$$

$$C_{22} = \frac{1}{4,866} = 0,206$$

$$C_{32} = \frac{0,333}{4,866} = 0,068$$

$$C_{42} = \frac{0,333}{4,866} = 0,068$$

$$C_{52} = \frac{0,200}{4,866} = 0,041$$

This normalization stage is carried out repeatedly and consistently until all elements in the final column, namely the fifth criterion, are normalized using the same procedure. Consequently, each column in the criteria comparison matrix (Table 5) has a total value equal to 1. This normalized matrix then serves as the basis for calculating the eigenvector or the priority weight of each criterion.

Table 5. Normalization Matrix

Criteria	C1	C2	C3	C4	C5
C1	0,498	0,617	0,517	0,290	0,368
C2	0,166	0,206	0,310	0,290	0,263
C3	0,100	0,068	0,103	0,290	0,158
C4	0,166	0,068	0,034	0,097	0,158
C5	0,071	0,041	0,034	0,032	0,053

After all elements in the pairwise comparison matrix have been normalized, as shown in Table 5, the next step is to determine the priority weight of each criterion. The priority weights are obtained by calculating the average value of each row in the normalized matrix. This average value represents the relative importance level of each criterion with respect to all the criteria considered in the analysis.

c. Priority Weights

$$C_1 = \frac{0,498+0,617+0,517+0,290+0,368}{5} = 0,458$$

$$C_2 = \frac{0,166+0,206+0,310+0,290+0,263}{5} = 0,247$$

$$C_3 = \frac{0,100+0,068+0,103+0,290+0,158}{5} = 0,144$$

$$C_4 = \frac{0,166+0,068+0,034+0,097+0,158}{5} = 0,105$$

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$C_5 = \frac{0{,}071+0{,}041+0{,}034+0{,}032+0{,}053}{5} = 0{,}046$

The priority weight values obtained from the average calculation of each row in the normalization matrix are subsequently summarized in Table 6: Criteria Priority Weights. This table represents the final outcome of the normalization and weighting process described earlier. It also illustrates the relative level of importance of each criterion, expressed in both numerical and percentage forms.

Table 6. Criteria Priority Weights

Criteria	Criteria	Criteria
C1	0,458	45,8%
C2	0,247	24,7%
C3	0,144	14,4%
C4	0,105	10,5%
C5	0,046	4,6%
Total	1	100%

After completing the normalization process, the priority weights were derived by calculating the average value of each row in the normalized matrix. The final priority weights are summarized in Table 6, showing that market potential (C1) obtained the highest weight of 0.458 (45.8%), followed by product innovation (C2) with 0.247 (24.7%), business model (C3) with 0.144 (14.4%), team performance (C4) with 0.105 (10.5%), and financial stability (C5) with 0.046 (4.6%). These values indicate that market potential and innovation are the most dominant factors influencing investment decisions in startups.

3.2 Application of the VIKOR Method

After the weighting process is completed, the ranking of alternatives is carried out using the VIKOR method, as shown below.

a. Normalization for criterion C_1 (Benefit) :

$R^+ = 9$

$R^- = 6$

$R_{ij} = \frac{R^+ - R_{ij}}{R^+ - R^-}$

$R_{11} = \frac{9-7}{9-6} = \frac{2}{3} = 0{,}6667$

$R_{12} = \frac{9-8}{9-6} = \frac{1}{3} = 0{,}3333$

$R_{13} = \frac{9-6}{9-6} = \frac{3}{3} = 1{,}0000$

For R_{14} to R_{120} the calculations were carried out using the same formula and procedure.
Normalization for criterion C_2 (Benefit) is as follows:

$R^+ = 9$

$R^- = 7$

$R_{ij} = \frac{R^+ - R_{ij}}{R^+ - R^-}$

$R_{21} = \frac{9-8}{9-7} = \frac{1}{2} = 0{,}5000$

$R_{22} = \frac{9-7}{9-7} = \frac{2}{2} = 1{,}0000$

$R_{23} = \frac{9-9}{9-7} = \frac{0}{2} = 0{,}0000$

For R_{24} to R_{220} the calculations were carried out using the same formula and procedure
Normalization for criterion C_3 (Benefit) is as follows:

$R^+ = 9$

$R^- = 6$

$R_{ij} = \frac{R^+ - R_{ij}}{R^+ - R^-}$

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$R_{31} = \frac{9-7}{9-6} = \frac{2}{3} = 0,6667$

$R_{32} = \frac{9-6}{9-6} = \frac{3}{3} = 1,0000$

$R_{33} = \frac{9-8}{9-6} = \frac{1}{3} = 0,3333$

For R_{34} to R_{320} the calculations were carried out using the same formula and procedure
Normalization for criterion C_4 (Benefit) is as follows:

$R^+ = 9$

$R^- = 6$

$$R_{ij} = \frac{R^+ - R_{ij}}{R^+ - R^-}$$

$R_{41} = \frac{9-6}{9-6} = \frac{3}{3} = 1,0000$

$R_{42} = \frac{9-7}{9-6} = \frac{2}{3} = 0,6667$

$R_{43} = \frac{9-8}{9-6} = \frac{2}{3} = 0,3333$

For R_{44} to R_{420} the calculations were carried out using the same formula and procedure
Normalization for criterion C_5 (Benefit) is as follows:

$R^+ = 9$

$R^- = 6$

$R_{ij} = \frac{R^+ - R_{ij}}{R^+ - R^-}$

$R_{51} = \frac{9-7}{9-6} = \frac{2}{3} = 0,6667$

$R_{52} = \frac{9-6}{9-6} = \frac{3}{3} = 1,0000$

$R_{53} = \frac{9-7}{9-6} = \frac{2}{3} = 0,6667$

For R_{54} to R_{520} the calculations were carried out using the same formula and procedure. Based on the normalization calculations for criteria C_1 to C_5, the following normalization matrix is obtained:

$$Rij = \begin{bmatrix} 0,6667 & 0,5000 & 0,6667 & 1,0000 & 0,6667 \\ 0,3333 & 1,0000 & 1,0000 & 0,6667 & 1,0000 \\ 1,0000 & 0,0000 & 0,3333 & 0,3333 & 0,6667 \\ 0,0000 & 0,5000 & 0,0000 & 0,3333 & 0,3333 \\ 0,6667 & 1,0000 & 0,3333 & 0,6667 & 1,0000 \\ 0,3333 & 0,0000 & 0,3333 & 0,3333 & 0,3333 \\ 0,6667 & 0,0000 & 0,3333 & 0,3333 & 0,6667 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 0,3333 & 0,5000 & 0,0000 & 0,0000 & 0,3333 \end{bmatrix}$$

b. Weighted Normalization Matrix
The weighted normalization is obtained using Equation (10), resulting in the following matrix:

$$Rij \times W = \begin{bmatrix} 0,3053 & 0,1527 & 0,3053 & 0,4580 & 0,3053 \\ 0,1527 & 0,3053 & 0,4580 & 0,3053 & 0,4580 \\ 0,4580 & 0,0000 & 0,1527 & 0,1527 & 0,3053 \\ 0,0000 & 0,1527 & 0,0000 & 0,1527 & 0,1527 \\ 0,3053 & 0,3053 & 0,1527 & 0,3053 & 0,4580 \\ 0,1527 & 0,0000 & 0,1527 & 0,1527 & 0,1527 \\ 0,3053 & 0,0000 & 0,1527 & 0,1527 & 0,3053 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 0,1527 & 0,1527 & 0,0000 & 0,0000 & 0,1527 \end{bmatrix}$$

c. Calculation of Utility Measure (S) and Regret Measure (R)
The values of S and R are calculated using Equations (11) and (12). The results are shown in Table 7.

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Table 7. Utility (S) and Regret (R) Values

Alternative	Alternative	Alternative
A1	0,6605	0,3053
A2	0,6597	0,2470
A3	0,5717	0,4580
A4	0,1738	0,1235
A5	0,7163	0,3053
A6	0,2510	0,1527
⋮	⋮	⋮
A20	0,2915	0,1527
MAX	0,7163	0,4580
MIN	0,1388	0,1235

In Table 7, the S value represents the total deviation of each alternative from the ideal solution, while the R value indicates the maximum deviation in the most unfavorable criterion for that alternative. The smaller the values of S and R, the better the performance of the alternative. The MAX row indicates the highest value in each column, whereas MIN represents the lowest. These MAX and MIN values serve as references for calculating the compromise index (Q) in the next stage.

d. VIKOR Index Calculation

The smaller the VIKOR index (Q), the better the alternative, as it is closer to the ideal compromise solution. To compute the Q value for each alternative, the parameters S^+, S^-, R^+, and R^-. are first determined. The Q index is then calculated using Equation (13), producing the following results:

$$Q_1 = \left[\frac{0{,}6605 - 0{,}1388}{0{,}7163 - 0{,}1388}\right] 0{,}5 + \left[\frac{0{,}3053 - 0{,}1235}{0{,}4580 - 0{,}1235}\right] (1 - 0{,}5) = 0{,}7235$$

$$\vdots$$

$$Q_{20} = \left[\frac{0{,}2915 - 0{,}1388}{0{,}7163 - 0{,}1388}\right] 0{,}5 + \left[\frac{0{,}1527 - 0{,}1235}{0{,}4580 - 0{,}1235}\right] (1 - 0{,}5) = 0{,}1758$$

The VIKOR indices of all evaluated alternatives are presented in Table 7.

Table 8. VIKOR Index Values

Alternative	Alternative
A1	0,7235
A2	0,6355
A3	0,8747
A4	0,0303
A5	0,7718
⋮	⋮
A20	0,1758

The VIKOR index (Q) is obtained by combining the weight of the majority of criteria (v) with the calculated utility (S) and regret (R) measures.

e. Determination of Alternative Ranking

After obtaining the S, R, and Q values, the final step is to determine the overall ranking of each alternative. The ranking process is performed by arranging the Q index values in ascending order, where a smaller Q value indicates that the alternative is closer to the ideal compromise solution and therefore demonstrates better overall performance.

Table 9. Ranking of Alternatives

Alternative	Alternative	Alternative
A17	1	0,0000
A4	2	0,0303
A19	3	0,0586
A15	4	0,1104
A10	5	0,1237
⋮	⋮	⋮
A3	20	0,8747

Table 9 presents the final ranking results of the alternatives based on the VIKOR method using Q index values. Alternatives with smaller Q values occupy higher ranks, as they are closer to the ideal compromise solution. The results show that A17 ranks first with Q = 0.0000, followed by A4, A19, and A15. As the Q values increase, the performance of the alternatives decreases, indicating that A3, with the highest Q value (0.8747), performs the worst among all evaluated alternatives.

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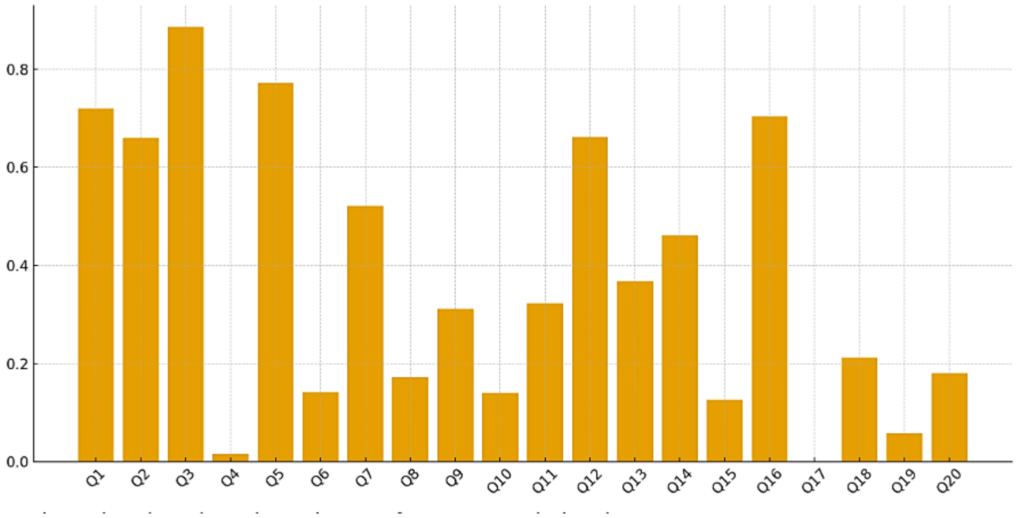

Figure 2. Visualization of Q Values

As illustrated in Figure 2, alternative A17 has the lowest Q value (0.0000), making it the best alternative since it is closest to the ideal compromise solution. It is followed by A4 (0.0303) and A19 (0.0586). Conversely, alternatives with higher Q values, such as A3 (0.8747), demonstrate poorer performance. Thus, the visualization confirms that A17 is the most promising alternative for startup investment based on all evaluated criteria.

3.3 Discussion

The combined application of AHP and VIKOR provides a comprehensive understanding of the most influential factors in determining potential startups for investment and identifies the optimal alternative across all evaluation criteria. The AHP results revealed that market potential (C1) is the most dominant criterion, followed by product innovation (C2) and business model (C3), whereas team performance (C4) and financial stability (C5) contributed less significantly. These findings indicate that market-related and innovation-oriented factors play a key role in investment decision-making for startups. Investors tend to prioritize market opportunities and product uniqueness over internal organizational or financial conditions.

This outcome aligns with previous research [9] which found that product innovation and market potential are the primary determinants of startup attractiveness for investment. Similarly, [10] emphasized that market factors and technological scalability strongly influence investor interest. The VIKOR ranking process confirmed these tendencies, with startup A17 achieving the best compromise between all criteria, reflecting balanced performance across market, innovation, and business model dimensions.

These results demonstrate the effectiveness of combining AHP–VIKOR in multi-criteria decision-making contexts. AHP effectively establishes the relative importance of evaluation criteria, while VIKOR identifies the best compromise alternative among those with diverse strengths and weaknesses. The integration of these methods ensures objectivity, consistency, and robustness in decision-making consistent with the findings of [11], who applied AHP–VIKOR in evaluating teacher performance, and with [12], which reported Indonesia’s position as the fifth-largest startup ecosystem globally. Therefore, employing systematic decision-support methods such as AHP–VIKOR is crucial for investors seeking to select startups effectively amid increasingly competitive market conditions.

4. CONCLUSION

This study aimed to determine the best investment alternative among digital startups by applying a combination of the Analytical Hierarchy Process (AHP) and VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) methods. The results indicate that AHP effectively identifies the relative importance of each criterion, while VIKOR efficiently ranks the alternatives based on a compromise solution toward the ideal condition. According to the AHP weighting results, market potential (C1) obtained the highest weight of 0.458, followed by product innovation (C2) with 0.247, and business model (C3) with 0.144. The remaining criteria, team performance (C4) and financial stability (C5), received lower weights of 0.105 and 0.046, respectively. The VIKOR results revealed that startup A17 achieved the lowest compromise value (Q = 0.0000), identifying it as the most optimal investment alternative, followed by A4 (Q = 0.0303) and A19 (Q = 0.0586). These findings emphasize that startups with high market potential and strong innovation capabilities are more likely to attract investment opportunities. Overall, this study demonstrates that the combined application of AHP and VIKOR provides an effective and objective approach for decision-makers in evaluating and selecting the most promising digital startups. The use of this decision-support framework allows investment assessments to be conducted more systematically, transparently, and in alignment with the dynamic development of the digital economy.

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