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Effectiveness of Weighting in Assessing Ranking Criteria on the SWOT-MAGIQ Matrix

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Abstract

The Analytical Hierarchy Process (AHP) has been a prominent tool in decision-making, but the Multi-Attribute Global Interference of Quality (MAGIQ) offers an alternative with its unique weighting mechanism. This research delves into the effectiveness of weighting in assessing ranking criteria within the SWOT-MAGIQ matrix. The study contrasts the traditional Rank Order Centroid (ROC) approach with the Improved Rank Order Centroid (IROC), focusing on their application in the SWOT analysis. While ROC provides simplicity, IROC aims for enhanced accuracy by considering variability in rankings. The results indicate nuanced differences, with ROC assigning higher weights to criteria such as "Friendly Staff" (0.3183 vs. IROC's 0.3125), while IROC prioritizes aspects like "Strong Customer Relationships" more significantly (0.1103 vs. ROC's 0.1053). The choice between ROC and IROC hinges on the specific needs of the decision-making context, with IROC potentially offering a more detailed perspective in complex scenarios. This research underscores the importance of selecting the appropriate weighting mechanism to ensure informed and strategic decisions within the SWOT-MAGIQ framework.

Keywords: SWOT-MAGIQ Matrix; ROC; IROC; Weighting Mechanism; Decision-Making

1. INTRODUCTION

Decision-making is a critical component when formulating strategic policies and requires a methodological approach that is both structured and systematic. Over the years, the Analytical Hierarchy Process (AHP) has emerged as a widely recognized tool in addressing complex decision problems involving multiple criteria. Supported by numerous empirical studies, such as those presented in [1], [2], [3], AHP has proven its adaptability across domains ranging from engineering and business to environmental and social sciences[4].

The AHP methodology is gaining traction in decision-making owing to its comprehensive benefits. It facilitates the elucidation of latent knowledge, comprehends the intricate relationships among decision variables, and offers a more nuanced value assessment than verbal expressions. Moreover, it integrates intuitive and analytical judgments and synthesizes varied perspectives, irrespective of geographical constraints. As a result, this method is both insightful and practical for decision-makers[5], [6].

Subsequently, McCaffrey[7] proposed the Multi-Attribute Global Interference of Quality (MAGIQ) as an alternative to the AHP. The development of MAGIQ responded to the limitations of AHP, particularly in terms of complexity and the burden of pairwise comparisons[8]. MAGIQ adopts a rank-based approach, offering a simplified yet structured framework for evaluating multiple criteria.

The fundamental difference between AHP and MAGIQ lies in their weighting mechanisms. While AHP employs eigenvalues for its comparison matrix[9], [10] MAGIQ uses the Ranking Order Centroids (ROC) approach. ROC ranks solutions based on performance across various criteria, emphasizing critical ones[11]. The technique calculates a centroid rank, with solutions having the highest centroid ranks considered optimal.

The application of the ROC method has been explored in a range of MCDM frameworks. Rachmat et al.[12] employed ROC in the Priority Sequence Level Assessment context, deriving insights from the SMART paradigm. Subsequently, Sholeha and Aldisa[13] integrated ROC into the Topsis method to improve its precision in ranking alternatives. Meanwhile, Prayoga et al.[14] juxtaposed ROC with the Full Consistency Method (FUCOM) in the MOORA framework, highlighting its potential in comparative weighting analysis. These diverse implementations demonstrate ROC's flexibility and suitability in structured decision-making environments.

Considering the widespread application of the ROC method in various MCDM contexts, this study adopts the MAGIQ framework and integrates it with SWOT analysis, following the approach introduced by Forte et al.[15]. Building upon MAGIQ's rank-based weighting mechanism, the framework integrates objective prioritization into traditional SWOT analysis. Unlike conventional SWOT, which relies solely on subjective assessments, the enhanced SWOT-MAGIQ model incorporates structured weighting techniques, such as ROC and IROC, to determine the relative importance of strategic factors. This integration transforms SWOT from a qualitative diagnostic tool into a semi-quantitative decision-support framework, thereby enabling more transparent and data-driven prioritization.

SWOT analysis is a widely used strategic planning tool designed to identify an organization's internal strengths, weaknesses, external opportunities, and threats. Decision-makers typically use this framework to rank each factor based on its relative importance. The integration of MAGIQ enables the assignment of structured weights to these factors, thereby enhancing the precision of strategic prioritization.

According to Ambarsari et al.[16], Integrating the ROC method into the SWOT analysis, grounded in the MaGIQ concept, offers game developers a structured framework to assess and enhance their game's position in a fast-paced and

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competitive market. By pinpointing and tackling internal and external factors impacting a game's success, developers can more effectively strategize to maintain and grow their user base over time.

In a related study by Subagio et al.[17] the Rank Order Centroid (ROC) technique within the SWOT-MAGIQ framework proves pivotal when assessing SWOT factors for Micro, Small, and Medium Enterprise (MSME) Laundry Services. This method introduces an objective weighting approach. The ROC's strength lies in its ability to reduce subjectivity by allocating weights based on rankings, guaranteeing a balanced weight distribution, and aiding in pinpointing suitable business strategies.

However, according to Hatefi[18], the Rank Order Centroid (ROC) method is marred by significant shortcomings due to its underlying assumption of extreme corner weight vectors within decision-makers' preference structures. These assumptions may misrepresent the actual importance of the criteria. As a result, they can reduce the reliability of strategic decisions. To address the methodological shortcomings of the ROC approach, the Improved Rank Order Centroid (IROC) method was introduced as a more refined and adaptive solution. By incorporating differentiated coefficients derived from simulation-based models, IROC aims to produce more representative weights that better reflect the nuanced preferences of decision-makers and reduce estimation bias. This enhancement positions IROC as a viable alternative for use in complex decision-making environments that require nuanced weight allocation[19].

Although IROC offers theoretical improvements over ROC, its application within the SWOT-MAGIQ framework has not been thoroughly investigated in previous literature. Most prior studies have continued to rely on the traditional ROC method without critically evaluating whether IROC provides more representative or accurate weighting in practical decision-making scenarios[20]. This gap highlights the need for an empirical comparison between the two weighting approaches in a structured SWOT-MAGIQ context. This condition reflects a clear research gap in the current literature regarding the empirical validation of IROC within the SWOT-MAGIQ framework. Therefore, this study seeks to fill that void by implementing both methods in a real-world case and analyzing their impact on weight distribution and strategic prioritization. The novelty of this research lies in its comparative insight into two weighting mechanisms, offering a more robust basis for decision-support frameworks.

This study examines the comparative performance of IROC and the traditional ROC method in accurately prioritizing strategic factors within the SWOT-MAGIQ framework. By implementing methods in a real-world SWOT-MAGIQ scenario, this research not only tests the practical implications of improved weighting mechanisms but also contributes a novel perspective to the discourse on decision support systems.

The insights derived from this investigation are expected to assist practitioners and researchers in selecting appropriate weighting techniques, especially in environments where decision quality significantly influences strategic outcomes.

2. RESEARCH METHODOLOGY

2.1 The Improved Rank Order Centroid

The IROC method refines assigning weights to ranked criteria, building on the Rank Order Centroid (ROC) approach. The ROC averages the coordinates of specific points, called vertices, in a weight space. A crucial part of IROC is the Vertex Methods (VMs). These VMs pinpoint specific vertices in the weight space, emphasizing the most extreme weight distributions used in decision-making. IROC stands out by giving different importance levels, or coefficients, to these vertices. It means that a decision-maker might value one VM differently from another. The formula for IROC is as follows [18]:

$$w_j = \sum_{r=j}^{n} (\varphi_{rn}/r) \quad (1)$$

Furthermore, Figure 1 shows how the IROC method works in the SWOT-MAGIQ framework—from identifying relevant SWOT factors, calculating their weights, to incorporating them into the matrix for strategic prioritization.

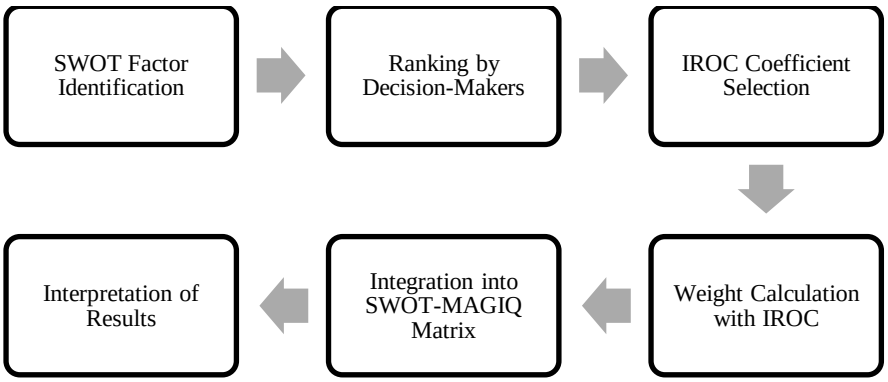

Figure 1. Flowchart of IROC Implementation in the SWOT-MAGIQ Framework

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Based on Figure 1, strategic factors are first categorized into four dimensions of SWOT—namely Strengths, Weaknesses, Opportunities, and Threats—through expert input or literature review. Stakeholders then rank each factor according to its perceived strategic importance within its respective category.

As shown in Table 1, IROC coefficients are derived from pre-simulated values that match the number of ranked items. These coefficients are then used in the IROC formula to generate final weights by multiplying each with its corresponding rank.

Following this step, the computed weights are integrated into the SWOT-MAGIQ matrix to construct a structured prioritization of strategic elements. Factors receiving the highest weights are identified as key priorities, serving as a foundation for data-driven strategic planning.

2.2 ROC Coefficients Determination

The IROC method offers two primary strategies for deriving the coefficients (φ_{jn}):

a. Subjective Approach: This method derives coefficients from the Decision Maker's (DM's) insights and perspectives.
b. Objective Approach: This method establishes standard coefficients, which is particularly beneficial when the DM does not possess a distinct preference or cannot allocate time for input.

Therefore, this study predominantly focuses on the objective approach—systematic simulation experiments developed by Hatefi [18] were utilized to estimate the coefficients, as delineated in Table 1, which involved 15,000 Monte Carlo runs for each combination of alternative and criterion levels. The simulations applied the Multi-Attribute Value (MAV) function and evaluated efficacy through Hit Ratio (HR) and Rank Correlation (RC). Default coefficients were computed as geometric means over normalized HR values across scenarios, ensuring robustness across typical MCDM cases. The range of criteria (n = 2 to 25) was selected to reflect realistic decision-making contexts, and statistical tests confirmed the superiority of IROC over ROC in most cases.

Table 1. The Coefficients Objective Approach

n	the coefficients φ_{jn} (1, 2, 3,…, n)
2	0.51150,0.48850
3	0.32415,0.35529,0.32056
4	0.23236,0.26888,0.26293,0.23583
5	0.17918,0.21316,0.21710,0.20416,0.18639
…	...
25	0.02702,0.03286,0.03681,0.03932,0.04108,…,0.03556

2.3 Data Reference

In applying the IROC methodology, this research references Subagio et al.[17] The source has previously integrated the traditional ROC within the SWOT-MAGIQ framework, specifically focusing on "Strategies for the Enhancement of Laundry Service Quality." The core elements of the SWOT framework are detailed subsequently:

Table 2. SWOT Framework

SWOT	Factors
Strengths	Friendly Staff
	Competitive Pricing
	Prime Roadside Location
Weaknesses	Limited Capacity for Laundry Services
	Staffing Shortages
	Limited Marketing Efforts
Opportunities	Growing Local Population
	Changing Lifestyle Trends in the Community
	Strong Customer Relationships
Threats	Rise of New Competitors
	Growth of Online Laundry Services
	Rising Operational Expenses

3. RESULT AND DISCUSSION

This section presents the results of applying the IROC method to assess strategic factors within the SWOT-MAGIQ framework, using data from MSME laundry services. Each factor was ranked, weighted, and analyzed to generate a prioritized strategic matrix. Based on Table 2, we outline the SWOT analysis components as follows:

a. Strengths: Encompasses three factors.
b. Weaknesses: Identifies three factors.
c. Opportunities: Lists three factors.

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d. Threats: Includes three factors.

Overall, the SWOT analysis comprises four primary dimensions. The following illustrates the derivation of IROC weights applied to each category.

In the IROC methodology, we calculate the weight for each criterion using the predetermined coefficient (φ_{jn}). Since we have three criteria in each category (Strength, Weakness, Opportunity, Threats), we use the coefficient for n=3 from Table 1 as follows:

$$\varphi_{13} = 0.32415,\ \varphi_{23} = 0.35529,\ \varphi_{33} = 0.32056$$

Using equation (1), we can calculate the weight for each criterion:

a. Weight for the First Factor w_1:
j=1 (since this is the first factor)

$$\begin{aligned} w_1 &= \frac{\varphi_{13}}{1} + \frac{\varphi_{23}}{2} + \frac{\varphi_{33}}{3} \\ &= 0.32415 + \frac{0.35529}{2} + \frac{0.32056}{3} \\ &= 0.608648333 \end{aligned}$$

b. Weight for the Second Factor w_2:
j=2

$$\begin{aligned} w_2 &= \frac{\varphi_{23}}{2} + \frac{\varphi_{33}}{3} \\ &= \frac{0.35529}{2} + \frac{0.32056}{3} \\ &= 0.284498333 \end{aligned}$$

c. Weight for the Third Factor w_2:
j=3

$$\begin{aligned} w_3 &= \frac{\varphi_{33}}{3} \\ &= \frac{0.32056}{3} \\ &= 0.106853333 \end{aligned}$$

The SWOT has four elements, with the coefficient as follows:

$$\varphi_{14} = 0.23236,\ \varphi_{24} = 0.26888,\ \varphi_{34} = 0.26293,\ \varphi_{44} = 0.23583$$

a. Weight for Strength:

$$\begin{aligned} Strength &= \frac{\varphi_{14}}{1} + \frac{\varphi_{24}}{2} + \frac{\varphi_{34}}{3} + \frac{\varphi_{44}}{4} \\ &= 0.23236 + \frac{0.26888}{2} + \frac{0.26293}{3} + \frac{0.23583}{4} \\ &= 0.513400833 \end{aligned}$$

b. Weight for Weakness:

$$\begin{aligned} Weakness &= \frac{\varphi_{44}}{4} \\ &= \frac{0.23583}{4} \\ &= 0.0589575 \end{aligned}$$

c. Weight for Opportunity:

$$\begin{aligned} Opportunity &= \frac{\varphi_{24}}{2} + \frac{\varphi_{34}}{3} + \frac{\varphi_{44}}{4} \\ &= \frac{0.26888}{2} + \frac{0.26293}{3} + \frac{0.23583}{4} \\ &= 0.281040833 \end{aligned}$$

d. Weight for Threats:

$$\begin{aligned} Threats &= \frac{\varphi_{34}}{3} + \frac{\varphi_{44}}{4} \\ &= \frac{0.26293}{3} + \frac{0.23583}{4} \\ &= 0.146600833 \end{aligned}$$

The IROC weighting results are then incorporated into the SWOT-MAGIQ matrix, as presented in Table 3:

Table 3. SWOT-MAGIQ Matrix

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Factors/Variables	*Ranking* by participants Q1	Q2	Q3	Average	Final Weight	*Rank*
Strengths		0.513400833				
Friendly Staff	0.6086483	0.608648	0.608648	0.608648	0.312480561	1
Competitive Pricing	0.2844983	0.284498	0.284498	0.284498	0.146061681	2
Prime Roadside Location	0.1068533	0.106853	0.106853	0.106853	0.05485859	3
Weakness		0.0589575				
Limited Capacity for Laundry Services	0.1068533	0.608648	0.106853	0.274118	0.016161332	3
Staffing Shortages	0.6086483	0.284498	0.284498	0.392548	0.023143668	1
Limited Marketing Efforts	0.2844983	0.106853	0.608648	0.333333	0.0196525	2
Opportunity		0.281040833				
Growing Local Population	0.1068533	0.608648	0.106853	0.274118	0.077038445	3
Changing Lifestyle Trends in the Community	0.6086483	0.106853	0.284498	0.333333	0.093680278	2
Strong Customer Relationships	0.2844983	0.284498	0.608648	0.392548	0.11032211	1
Threats		0.146600833				
Rise of New Competitors	0.6086483	0.608648	0.284498	0.500598	0.073388133	1
Growth of Online Laundry Services	0.2844983	0.106853	0.608648	0.333333	0.048866944	2
Rising Operational Expenses	0.1068533	0.284498	0.106853	0.166068	0.024345756	3

Upon analyzing the provided SWOT-MAGIQ in Table 3, we can derive the following insights:

a. Strengths:
   1. Friendly Staff: A final weight of 0.3125 identifies this as the primary strength. This weight suggests that stakeholders highly value an amiable staff, recognizing it as a significant asset for the organization.
   2. Competitive Pricing: With a final weight of 0.1461, competitive pricing positions the organization favorably within the market landscape.
   3. Prime Roadside Location: A final weight of 0.0549 indicates that the organization benefits from its strategic roadside location, though not as prominently as the other two strengths.
b. Weaknesses:
   1. Staffing Shortages: A final weight of 0.0231 highlights staffing deficits as the most pressing concern that the organization must address.
   2. Limited Marketing Efforts: A final weight of 0.0197 reveals that the organization faces challenges due to its constrained marketing endeavors.
   3. Limited Capacity for Laundry Services: The organization's final weight of 0.0162 indicates a vulnerability due to its restricted capacity for laundry services.
c. Opportunities:
   1. Strong Customer Relationships: With a final weight of 0.1103, it is evident that the organization has the potential to leverage its robust customer relationships to achieve substantial growth.
   2. Changing Lifestyle Trends in the Community: With a final weight of 0.0937, the organization can capitalize on shifting lifestyle trends.
   3. Growing Local Population: A final weight of 0.0770 suggests that the organization can consider the escalating local populace as a potential avenue for business expansion.
d. Threats:
   1. Rise of New Competitors: A final weight of 0.0734 indicates that new competitors significantly threaten the organization's market position.
   2. Growth of Online Laundry Services: With a final weight of 0.0489, the organization must remain wary of the growing influence of online laundry services.
   3. Rising Operational Expenses: The organization should note that a final weight of 0.0243 indicates the potential hazard of escalating operational costs.

The organization possesses strengths in its affable staff, competitive pricing strategy, and strategic location. However, it must address weaknesses such as staffing deficits, limited marketing initiatives, and constrained laundry service capacity. While opportunities exist in strengthening customer relationships and tapping into changing lifestyle trends and local population growth, the organization must also strategize against threats from emerging competitors, the surge in online laundry services, and rising operational costs.

3.1 Discussion

The results we have obtained indicate that the ranking from the SWOT MAGIQ has not undergone significant changes. However, we can compare the ROC weighting from Subagio et al.[17] with that of IROC in Figure 2 as follows:

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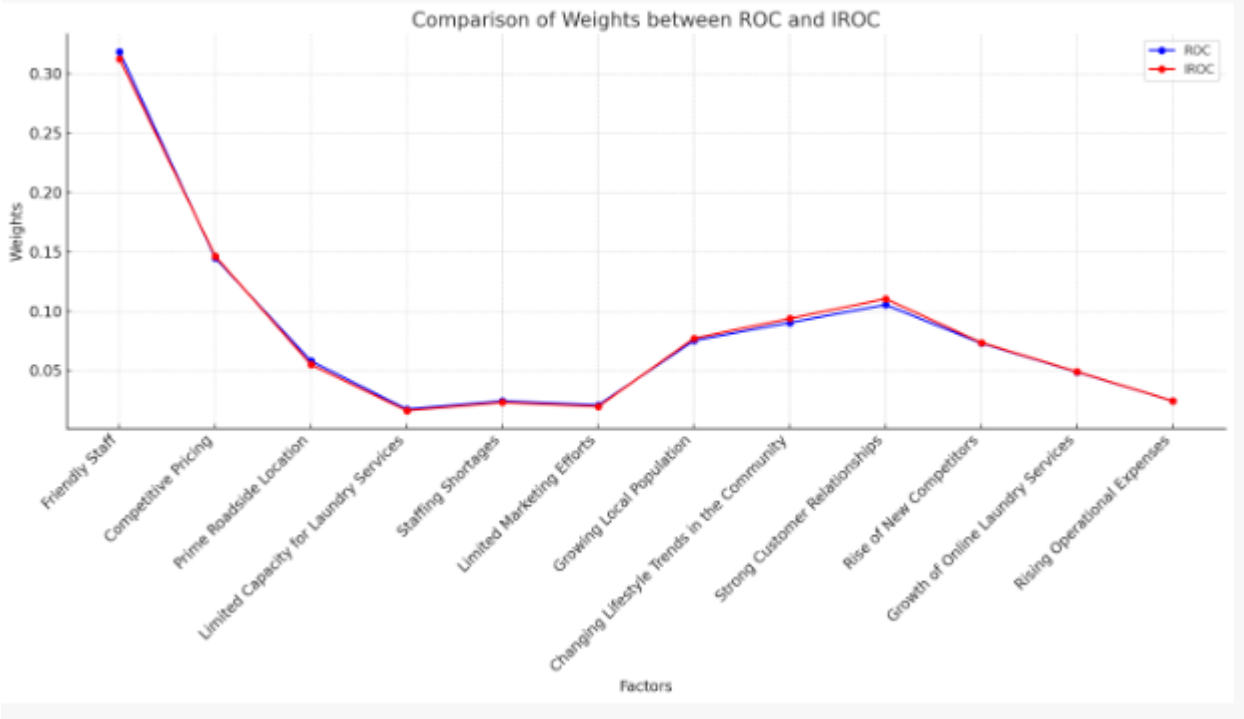

Figure 2. Comparison of Weights Between ROC and IROC in MAGIQ-SWOT

Based on Figure 2, the ROC and IROC methodologies exhibit comparable patterns when analyzing different factors. We believe that both methods generally agree on the significance of each factor, though there are some slight differences in their assessments. For example, the ROC method places a slightly higher emphasis on the "Friendly Staff" factor than IROC. Conversely, aspects like "Strong Customer Relationships" and " Changing Lifestyle Trends in the Community" are more prioritized in IROC. The most notable disparities between the two approaches are evident in factors like "Prime Roadside Location," "Limited Capacity for Laundry Services," and "Limited Marketing Efforts." These differences indicate that the two methodologies might have more pronounced disagreements on certain factors. However, it is essential to highlight that the general concordance between ROC and IROC is notably high, suggesting that conclusions drawn using either method would likely converge.

To further illustrate the differences between ROC and IROC, Table 4 presents a comparison of the final weights assigned to selected SWOT factors by each method.

Table 4. Comparison of Final Weights Between ROC and IROC for SWOT Factors

Factor	ROC	IROC	GAP (IROC - ROC)
Friendly Staff	0.318287037	0.312480561	-0.005806476
Competitive Pricing	0.144675926	0.146061681	0.001385755
Prime Roadside Location	0.05787037	0.05485859	-0.00301178
Limited Capacity for Laundry Services	0.017361111	0.016161332	-0.001199779
Staffing Shortages	0.024305556	0.023143668	-0.001161888
Limited Marketing Efforts	0.020833333	0.0196525	-0.001180833
Growing Local Population	0.075231481	0.077038445	0.001806964
Changing Lifestyle Trends in the Community	0.090277778	0.093680278	0.0034025
Strong Customer Relationships	0.105324074	0.11032211	0.004998036
Rise of New Competitors	0.072916667	0.073388133	0.000471466
Growth of Online Laundry Services	0.048611111	0.048866944	0.000255833
Rising Operational Expenses	0.024305556	0.024345756	4.02E-05

Although the ROC and IROC results appear generally consistent, this study does not include formal statistical validation such as paired t-tests or confidence interval analysis. Nevertheless, observable differences—such as ROC's stronger emphasis on "Friendly Staff" and IROC's prioritization of "Strong Customer Relationships"—indicate that IROC may capture subtleties in stakeholder preference with greater sensitivity. These preliminary insights should be interpreted cautiously, and future studies are encouraged to incorporate inferential statistical testing to confirm the robustness of these findings.

When conducting a SWOT analysis, decision-makers must recognize that they can sometimes reach a mutual agreement. If they achieve this consensus, they will base their choice between ROC and IROC on the group's preference, the specific context, and the nature of the decision. The ROC method is praised for its simplicity and wide applicability, making it accessible across various domains. However, it assumes equal importance among all criteria, which may oversimplify complex decisions. On the other hand, IROC offers improved accuracy by considering variability through the use of quadratic means, though this comes at the cost of slightly higher computational complexity. Thus, ROC is better suited for situations prioritizing ease of use, whereas IROC is more appropriate when a nuanced understanding of ranking variability is required.

ROC and IROC provide valuable perspectives. The optimal selection hinges on the distinct needs of the decision-making context. If decision-makers value simplicity and straightforward application, they might favor ROC. Conversely, if they seek a more detailed and nuanced method that accounts for variability in rankings, they should consider IROC. These findings demonstrate how the IROC-enhanced SWOT-MAGIQ framework can support more nuanced prioritization decisions for strategic planning, especially in small business contexts.

4. CONCLUSION

This study evaluated the effectiveness of the IROC method in enhancing strategic prioritization within the SWOT-MAGIQ framework, compared to the traditional ROC approach. Using a case study of MSME laundry services, the results demonstrate that IROC yields more varied and refined weight distributions. For example, the “Strong Customer Relationships” factor received a higher final weight in IROC (0.1103) than in ROC (0.1053), while ROC tended to overweight “Friendly Staff” (0.3183 vs. 0.3125 in IROC). These patterns support the conclusion that IROC provided more nuanced prioritization and proved superior within the context of this study. The improvement in prioritization effectiveness is evident through the redistribution of weights that better reflect the complexity of stakeholder preferences across SWOT factors. This contributes to a clearer strategic focus for decision-makers. Integrating IROC into SWOT-MAGIQ offers MSMEs a more structured and objective basis for evaluating internal and external factors in strategic planning. However, this study is limited to a single case in the laundry service sector and does not incorporate formal statistical significance testing. Future research is needed to validate IROC’s advantages across different industries and decision-making scenarios.

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