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A Multi-Criteria Decision-Making Approach for Prioritizing Strategies to Leverage the Potential of the African Continental Free Trade Area (AfCFTA) Initiative

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ABSTRACT

The African Continental Free Trade Area (AfCFTA) is a free trade zone implemented among most African countries in 2018, with the objective of eradicating tariffs on most services and goods over a certain period based on the nature of the goods and the degree of development of each country. Although there are many benefits from its implementation, various challenges have impeded its full adoption across several African countries. To overcome these challenges, twenty-four strategies under six main categories were identified through a literature review. To determine the most appropriate strategies for leveraging the potential of the AfCFTA initiative, our study adopted a fuzzy simple weight calculation (F-SIWEC) method to calculate their weights. Four experts participated in data collection. The findings indicate that infrastructural development emerged as the most important strategy, followed by financial support and resources, and AfCFTA leadership and governance.

1. Introduction

The African Continental Free Trade Area (AfCFTA) is a major ambition intended to establish a consolidated African market and eliminate trade barriers. For many years, logistical challenges and greater costs have restricted the intra-African trade. By allowing free tariff trade in the continent, the AfCFTA will develop value chains in the region, stimulate investment, and assist the development of industries [1]. With over 1.5 billion population recently and prediction of doubling by 2050 in Africa, the continent can benefit from the AfCFTA in employment generation, increasing of economic stability and prosperity [2-4]. Yet, there is a lower intra-trade in the continent, which represents approximately 14% of total trade, in comparison to 67% and 61% in Europe and Asia, respectively [5]. This issue can be changed by the AfCFTA through an effective participation of African countries in value chains at international level and the encouragement of closer economic integration. Various studies have recently indicated how the AfCFTA initiative has potential macroeconomic ability. For

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instance, Maliszewska *et al.,* [6] determined the durable economic impacts of the AfCFTA initiative. Their findings indicated that AfCFTA can remove over 25 million of people in Africa from severe poverty, while increasing the income and doubling trade between regions. Fofack *et al.,* [7] evaluated the impacts of AfCFTA initiative on the flows at intra-African level and found that the trade could rise by over 20% in short-term and little higher in long-term. However, a variation on the possible trade and welfare benefits is expected between countries. Wonyra and Bayale [8] offered an insight on the possible insights of AfCFTA initiative in Togo and found that there is a likely promotion of consumer welfare while the impacts of trade will be surging. Shinyekwa *et al.,* [9] appraised the possible impacts of the AfCFTA initiative in the east part of Africa and found a mixed impact between countries. Their study showed a positive welfare impacts in Burundi and Uganda, while the opposite effect is noticed in Rwanda, Tanzania, and Kenya. However, these studies overlook the main logistical challenges affecting the development of value chains at regional level under the AfCFTA initiative. In the sub-Saharan Africa (SSA) region, these challenges are of great severity and differ from one member state to another [10-12]. Despite their identification along with possible alternative strategies to overcome them by Nitsche *et al.,* [13], there is a research gap regarding the prioritization of strategies to leverage the potential of the African AfCFTA from a multi-criteria approach. The application of multi-criteria decision-making (MCDM) approach has proven to be successful in various studies [14-16]. In this study, a fuzzy simple weight calculation (SIWEC) method is adopted to calculate the weights of 24 strategies under six main categories to leverage the potential of the AfCFTA initiative.

The remaining of the study is comprised of six sections.

2. Literature Review

2.1 Studies related to the AfCFTA initiative

Since the AfCFTA initiative has been established in 2018, various studies have been conducted related to it. For instance, Wapmuk and Ali [17] explored the challenges and prospects related to the AfCFTA initiative after covid-19 pandemic. Their study indicated that various challenges are impacting the intra-African trade. Nwankwo and Ajibo [18] pinpointed the potential of the initiative among some realities at local level and explored which implications it has on multilateral trading framework. Chukwu *et al.,* [19] determined what can be the potential challenges and prospects related to the initiative on the South-South trade. Rikhotso [20] explored how the challenges related to the initiative might be a huge issue for various types of enterprises in continental trade than the possible advantages they could obtain. Khan [21] looks for how external effects, state preferences, and structural imbalance can model the adoption of the initiative and results. Ajibo and Kaime [22] explore sustainability development under the initiative with respect to various restrictions, prospects, and dimensions. Uzomah and Abdullahi [23] determined how the issues related to borders can affect trade, which is considered as an interface for the initiative's domestication. Gumede [24] indicated how the future of regional economic communities can be resolved through the initiative.

2.2 Applications and extensions of SIWEC approach

Puška *et al.,* [25] has developed an approach called simple weight calculation. Since then, various studies have used in different extensions. Badi *et al.,* [26] adopted it in a fuzzy environment to assess potential alternatives for strategic railway infrastructure planning in Libya. Their results indicated the strategy related to the development of coastal corridor as the most appropriate one. Katrancı *et al.,* [27] applied it for the choice of durable disposal technology and revealed how composting is considered the most appropriate technology. Şimşek *et al.,* [28] proposed an approach to pinpoint the most influential parameters to the procurement performance in the investment of solar energy projects. Their findings indicated how important strategy definition is during this process. Štilić *et al.,*

[29] evaluated the ability to valorize tourist in botanical gardens and found that how these gardens playing an important role in varying tourist offerings. Yalçın *et al.,* [30] adopted a new integrated framework for choosing a transport policy in Northern Russia. Cao *et al.,* [31] assisted countries in the selection of transport policies in Northern Sea route. Çizmecioğlu *et al.,* [32] adopted an integrated framework to evaluate the most appropriate investment strategies for enhancing the technologies related to digital twins. Puška *et al.,* [33] adopted a fuzzy rough technique for the choice of electric vehicles for small farming. Eti *et al.,* [34] assessed the main strategies for the adoption of renewable energy in localized supply chain networks. The application and extensions of SIWEC approach is indicated in Table 1.

Table 1
Application and extensions of SIWEC method

Authors	Objective	Methodology	Location
Puška *et al.,* [25]	Choice in the sale channels of agricultural things	SIWEC, F-SIWEC	Bosnia and Herzegovina
Badi *et al.,* [26]	Strategic railway planning development	F-SIWEC, RAWEC	Libya
Katrancı *et al.,* [27]	Choice of sustainable waste disposal	F-SIWEC, F-RAWEC	Turkish
Şimşek *et al.,* [28]	Assessment of purchasing procedure in solar energy project investment	SIWEC	-
Štilić *et al.,* [29]	Valorizing tourism in botanical gardens	F-SIWEC, TOPSIS	Croatia
Yalçın *et al.,* [30]	Choice of transportation policy	IF-SIWEC-ARLON	Northern Russia
Cao *et al.,* [31]	Implementing new techniques to green digital twins	SF-SIWEC-SAW	-
Çizmecioğlu *et al.,* [32]	Strategic choice of competitive intelligence platforms	p, q-QOFN, SIWEC-MABAC	-
Puška *et al.,* [33]	Choice of electric cars	FR-SIWEC-RAWEC	-
Eti *et al.,* [34]	Strategy building for the adoption of renewable energy in localized supply chain networks	FF-SIWEC-EDAS	-

Note: ARLON- Alternative Ranking using two-step LOgarithmic Normalization; EDAS- Evaluation Based on Distance from Average Solution ; FF-Fermatean Fuzzy; FR-Fuzzy Rough; MABAC- Multi-Attributive Border Approximation area Comparison ; p, q-QOFN- p , q-quasirung Orthopair fuzzy number; RAWEC- Ranking of Alternatives with Weights of Criterion; SAW - Simple Additive Weighting; TOPSIS- Technique for Order of Preference by Similarity to Ideal Solution.

3. Problem definition

In this section, the problem related to how to leverage the potential of the AfCFTA initiative is defined. Table 2 indicates the strategies under different categories.

Table 2
Strategies to leverage the potential of the AfCFTA initiative

Main strategies	Sub-strategies	References
Market intelligence (S1)	Gather and share market intelligence (S11)	[13, 35, 36]
Skills and capability development (S2)	Upskill logistic personnel (S21)	
	Raise knowledge and familiarity with latest technologies (S22)	
	Promote more structured and skilled business practices (S23)	
	Strengthening the teaching of major languages in schools (S24)	

Table 2
Continued

Main strategies	Sub-strategies	References
Market linkages (S3)	Encourage collaboration and joints ventures (S31)	[13, 35, 36]
	Online platforms for trade and suppliers (S32)	
	Expand the number of African trade fairs (S33)	
Infrastructural development (S4)	Regional infrastructure financing (S41)	
	Collaborative rail and road projects (S42)	
	Optimize rail usage (S43)	
	Port and logistics privatization (S44)	
	Liberalize air transport and cabotage (S45)	
AfCFTA leadership and governance (S5)	Centralized African leadership under the AU for regulation and policy (S51)	
	Policies for infrastructure development (S52)	
	Enhance dispute resolution systems (S53)	
	Implement transport safety standards (S54)	
	Promote industrial development policies (S55)	
	Align trade quality standards (S56)	
	Enforce anti-corruption policies (S57)	
	Development of regional economic alliances (S58)	
Financial support and resources (S6)	Implement a monetary union (S61)	
	Adopt a single physical or digital currency (S62)	

4. Methodology

To assess the most appropriate strategies to leverage the potential of the AfCFTA initiative in Africa, we adopted the fuzzy simple weight calculation (F-SIWEC), a technique that has the capacity to overcome ambiguities and subjective opinions of the expert. The technique gathers assessments from the experts using linguistic variables, transferring them into fuzzy numbers, and then computing the normalized weights that mirror the associated significance of each parameter. The steps related to our employed technique are shown bellows [25].

Step 1. The relative significance of each criterion is assessed by experts by attributing linguistic variables from very low to very high to represent the opinion of experts. These qualitative evaluations apprehend the observed importance of each parameter in affecting the potential of the AfCFTA initiative.

Step 2. Experts offered linguistic evaluations which are transferred to triangular fuzzy numbers, which are defined as lower, middle, and upper bounds, thereby apprehending the subjectivity in experts' opinions.

$$\tilde{x}_{ij} = \left(x_{ij}^{l}, x_{ij}^{m}, x_{ij}^{u}\right) \tag{1}$$

Step 3. The original fuzzy decision matrix is established according to fuzzy numbers obtained from the assessment of the experts. Each parameter represents the observed significance of a defined criterion, including the ambiguity apprehended through the evaluation of linguistics. This matrix represents the foundation for criteria weights computation using the F-SIWEC technique.

$$\begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \ldots. & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \ldots. & \tilde{x}_{2n} \\ . & . & \ldots. & . \\ . & . & \ldots. & . \\ . & . & \ldots. & . \\ \tilde{x}_{m1} & \tilde{x}_{m2} & \ldots. & \tilde{x}_{mn} \end{bmatrix} \tag{2}$$

Step 4. In this stage, there is a normalization of fuzzy values from the decision matrix by dividing them by the greater upper bound ($\max x_{ij}^{u}$) seen through all criteria and experts.

$$\tilde{n}_{ij} = \frac{x_{ij}^{l}}{\max x_{ij}^{u}}, \frac{x_{ij}^{m}}{\max x_{ij}^{u}}, \frac{x_{ij}^{u}}{\max x_{ij}^{u}} \tag{3}$$

Step 5. There is a calculation of standard deviation (std.dev_j) according to fuzzy numbers obtained from experts. This calculation represents consistency or variation in the criteria assessment, permitting the approach to highlight criteria where the judgments of experts indicate higher differentiation, an important characteristic of the F-SIWEC technique for apprehending the associated importance under ambiguity.

Step 6. A multiplication of normalized fuzzy rating by related values of standard deviation is made to reflect the normalized fuzzy rating.

$$\tilde{v}_{ij} = \tilde{n}_{ij} \times st.dev_j \tag{4}$$

Step 7. An aggregation of fuzzy weighted values for each parameter is made through the summation of weighted fuzzy assessment offered by all experts. This produced a general representation of each parameter's significance, allowing both independent expert opinions and the ambiguity captured in antecedent steps. The results are an integrated fuzzy weight for each parameter, which becomes a foundation for finding the final significance rankings.

$$\tilde{S}_{ij} = \sum_{j=1}^{n} \tilde{v}_j \tag{5}$$

Step 8. There is a division of each independent fuzzy value by total sum of all fuzzy values to acquire the normalized fuzzy weight for each parameter. During this procedure, it is important to guarantee that the lower bound is less or equal to the middle value. This is possible only if the logical order of the fuzzy numbers is maintained.

$$\widetilde{w}_{ij} = \frac{S_{ij}^{l}}{\sum_{j=1}^{n} S_{ij}^{u}}, \frac{S_{ij}^{m}}{\sum_{j=1}^{n} S_{ij}^{m}}, \frac{S_{ij}^{u}}{\sum_{j=1}^{n} S_{ij}^{l}} \tag{6}$$

Step 9. There is a retention in the final fuzzy weights of each criterion through their fuzzy form or de-fuzzified into crisp values, based on the analytical necessities. In this study, there is a de-fuzzified of fuzzy weights employing a suitable defuzzification approach to transfer each fuzzy number into a unique representative value.

$$w_{jdef} = \frac{w_{ij}^{l} + 4 \times w_{ij}^{m} + w_{ij}^{l}}{6} \tag{7}$$

5. Application

In this study, a fuzzy SIWEC approach is adopted to assess the strategies to leverage the potential of the AfCFTA initiative. To collect data, four experts have participated. Their background is shown in Table 3.

Table 3
Background information of experts

Experts	Occupation	Experience	Education level	Gender
Expert 1	Industry	10	Master's degree	Male
Expert 2	Academia	5	Bachelor's degree	Male
Expert 3	Academia	8	Master's degree	Female
Expert 4	Industry	7	Master's degree	Female

To establish a comprehensive framework for analysis, this study identifies and categorizes a total of twenty-four distinct strategies for addressing the logistics challenges of the AfCFTA. These strategies are systematically grouped into six main categories: market intelligence (S1), skills and capability development (S2), market linkages (S3), infrastructural development (S4), AfCFTA leadership and governance (S5), and financial support and resources (S6). Each expert assessed the criteria using a predefined linguistic scale, which was subsequently converted into triangular fuzzy numbers to facilitate the fuzzy weight calculation. The derived criterion weights were then applied to evaluate and rank the strategic categories and their corresponding sub-strategies, establishing a clear priority for implementation under the AfCFTA. The linguistic scale used for this assessment is presented in Table 4. Table 5 shows the linguistic decision-making matrix for the main strategies.

Table 4
Fuzzy linguistic evaluation scale

Linguistic terms	Membership function
Absolutely bad (AB)	(1,1,1)
Very bad (VB)	(1,2,3)
Bad (B)	(2,3,4)
Medium-bad (MB)	(3,4,5)
Equal (E)	(4,56)
Medium-good (MG)	(5,6,7)
Good (G)	(6,7,8)
Extremely good (EG)	(7,8,9)
Absolutely good (AG)	(8,9,10)
Perfect (P)	(9,10,10)

Table 5
Linguistic decision-making matrix

	S1	S2	S3	S4	S5
E1	VB	MG	MB	EG	MG
E2	B	MB	B	G	MG
E3	VB	MG	MB	AG	MG
E4	VB	MG	B	AG	MG

Normalization of the initial fuzzy decision matrix was essential to establish a uniform comparative scale. This matrix was constructed from expert evaluations. Following the F-SIWEC methodology, we achieved this by simply dividing each fuzzy number by the maximum upper bound value across all criteria and responses. This procedure effectively rescales the data to the standardized [0, 1] range. Crucially, this action must retain the original relational significance of the expert judgments. The resulting normalized matrix mitigates potential scale discrepancies, ensuring a reliable foundation for subsequent criterion weight derivation. The finalized matrix (Table 6) now forms the direct input for our computational phase.

Table 6
Normalized fuzzy decision-making matrix

	S1	S2	S3	S4	S5
E1	(0.1,0.2,0.3)	(0.5,0.6,0.7)	(0.3,0.4,0.5)	(0.7,0.8,0.9)	(0.5,0.6,0.7)
E2	(0.2,0.3,0.4)	(0.3,0.4,0.5)	(0.2,0.3,0.4)	(0.6,0.7,0.8)	(0.5,0.6,0.7)
E3	(0.1,0.2,0.3)	(0.5,0.6,0.7)	(0.3,0.4,0.5)	(0.8,0.9,1.0)	(0.5,0.6,0.7)
E4	(0.1,0.2,0.3)	(0.5,0.6,0.7)	(0.2,0.3,0.4)	(0.8,0.9,1.0)	(0.5,0.6,0.7)

Following our normalization process, the F-SIWEC procedure multiplies the normalized fuzzy values by the standard deviation derived for each criterion. This operation directly incorporates the dispersion of expert opinions into the calculation. Essentially, this amplifies the influence of criteria exhibiting greater divergence in expert assessments. We then aggregate these products in a subsequent step: we sum up the values across all experts for each individual criterion as shown in Table 7. This summation produces preliminary fuzzy weights. These weights collectively represent the criterion's integrated importance within a framework of uncertainty. Throughout this computational stage, we preserve the integrity of the triangular fuzzy number structure, ensuring the fundamental condition (L≤M≤U) is consistently maintained.

Table 7
Obtaining final values of the criteria by using fuzzy SIWEC method

	S1	S2	S3	S4	S5	S6
$\tilde{s}_{ij}$	(0.11,0.20,0.28)	(0.41,0.50,0.59)	(0.22,0.31,0.40)	(0.65,0.74,0.83)	(0.44,0.53,0.62)	(0.47,0.55,0.64)
$\widetilde{w}_{ij}$	(0.03,0.07,0.12)	(0.12,0.18,0.25)	(0.07,0.11,0.17)	(0.19,0.26,0.36)	(0.13,0.19,0.27)	(0.14,0.19,0.28)

The results of the defuzzied criterion weights reveal a clear hierarchy of strategic priorities for implementing the AfCFTA, as shown in **Table 8**.

Table 8
Defuzzied value of the weights of criteria

	S1	S2	S3	S4	S5	S6
w_j	0.0720	0.1794	0.1135	0.2667	0.1924	0.2003

The expert evaluations of the identified sub-strategies are presented in **Table 9**.

Table 9
Expert evaluations of the identified sub-strategies

E#	S21	S22	S23	S24	S31	S32	S33	S41	S42	S43	S44	S45
E1	AG	MG	G	MB	E	G	G	AG	G	MG	E	E
E2	MG	MG	AG	MG	MG	MG	AG	G	G	G	MB	E
E3	MG	G	MG	MB	E	G	G	MG	AG	MG	E	E
E4	G	MG	G	MB	MB	MG	G	MG	AG	E	MB	MG
E#	S51	S52	S53	S54	S55	S56	S57	S58	S61	S62	S63	
E1	AG	MG	MG	MB	E	G	AG	E	E	G	AG	
E2	AG	MG	E	B	E	MG	G	MB	E	G	G	
E3	G	MG	MG	B	E	G	G	E	MB	E	AG	
E4	AG	MG	E	B	MB	MG	G	MB	E	MG	AG	

Note: E-Expert.

Table 10 presents the final weights for both local and global calculated for the sub-strategies using the F-SEWIC method.

Table 10
Sub-strategies weights

Main Strategies	Sub-strategies	Local weight	Global weight
S1: w= 0.0720	S11	0.0720	0.0720
S2: W=0.1794	S21	0.2898	0.0520
	S22	0.2516	0.0451
	S23	0.2939	0.0527
	S24	0.1821	0.0327
S3: W=0.1135	S31	0.2688	0.0305
	S32	0.3439	0.0390
	S33	0.4042	0.0459
S4: W=0.2667	S41	0.2308	0.0616
	S42	0.2659	0.0709
	S43	0.1969	0.0525
	S44	0.1495	0.0399
	S45	0.1749	0.0466

Table 10
Continued

Main Strategies	Sub-strategies	Local weight	Global weight
S5: W=0.1924	S51	0.1877	0.0361
	S52	0.1316	0.0253
	S53	0.1201	0.0231
	S54	0.0721	0.0139
	S55	0.1040	0.0200
	S56	0.1418	0.0273
	(S57	0.1646	0.0317
	S58	0.0984	0.0189
S6: W=0.2003	S61	0.2455	0.0492
	S62	0.3192	0.0639
	S63	0.4515	0.0904

6. Comparative analysis

To ensure the robustness and stability of our prioritization hierarchy, we employed the Fuzzy Technique for Order Preference by Similarity to Ideal Solution (F-TOPSIS) as a comparative method, as shown in Table 11. Crucially, F-TOPSIS was conducted using the same initial fuzzy decision matrix derived from the expert evaluations, and the analysis was limited to the six main strategic categories (S1–S6). As Table 11 demonstrates, the highest relative importance is assigned to S4 (0.2598), followed by S6 (0.1968), and S5 (0.1890) and, together, they represent the highest priorities established by the F-SEWIC calculation.

Table 11
F-TOPSIS evaluation of the strategies

Strategy	Fuzzy Weight $\widetilde{w}_j$	De-fuzzified Weight w_j'	Normalized Weight w_j	Crisp
S1	(1.25, 2.25, 3.25)	2.2500	0.0709	
S2	(4.50, 5.50, 6.50)	5.5000	0.1732	
S3	(2.50, 3.50, 4.50)	3.5000	0.1102	
S4	(7.25, 8.25, 9.25)	8.2500	0.2598	
S5	(5.00, 6.00, 7.00)	6.0000	0.1890	
S6	(5.25, 6.25, 7.25)	6.2500	0.1968	

Figure 1 compares the final rankings of the main strategic categories (S1–S6) derived from both the F-SEWIC and F-TOPSIS methods. It clearly demonstrates that both techniques yield the same result. The perfect correlation in the ranking order across these two approaches provides compelling evidence for the robustness and reliability of the established implementation hierarchy for the AfCFTA logistics strategies.

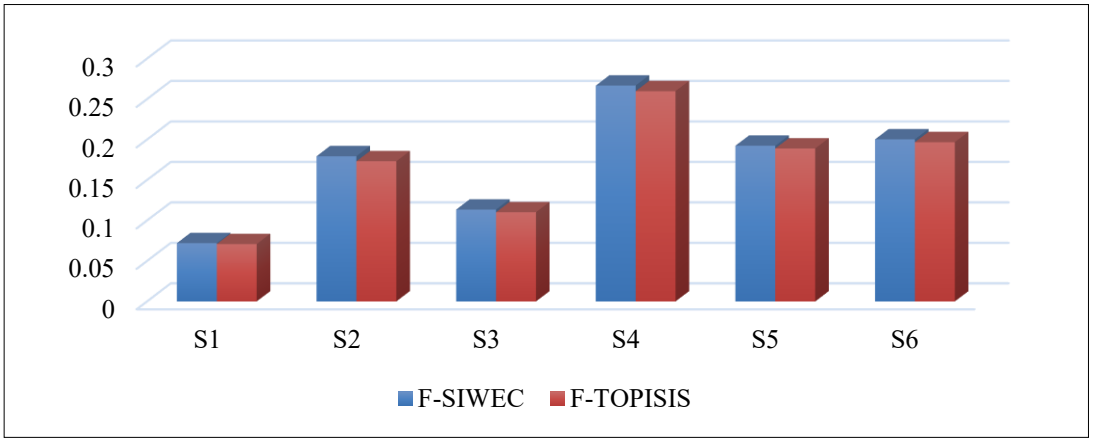

Fig. 1. Comparative analysis of both methods

7. Discussion

Infrastructural development (S4) emerged as the most important strategy, receiving the highest weight of 0.2667. This underscores the expert consensus that physical connectivity through roads, rails, and ports is the fundamental prerequisite for unlocking intra-African trade. It is closely followed by the combined importance of financial support and resources (S6) and AfCFTA leadership and governance (S5), with weights of 0.2003 and 0.1924 respectively, highlighting that robust monetary frameworks and strong political-regulatory systems are indispensable companions to physical infrastructure. The significantly lower weight (0.0720) for market intelligence (S1) suggests that while market intelligence is valuable, it is perceived as a secondary enabler that yields greater returns only after the primary structural barriers are addressed.

Delving into the sub-strategies reveals critical actionable insights within each category. The top-ranked sub-strategy overall is harmonized monetary policies (S63) within financial support and resources, indicating that policy alignment is a more immediate and critical goal than implementing a monetary union (S61). In Infrastructural related development (S4), collaborative rail and road projects (S42) are prioritized over regional infrastructure financing (S41), emphasizing the need for tangible projects. Under the AfCFTA leadership and governance category (S5), centralized African leadership under the AU for regulation and policy (S51) and enforcing anti-corruption policies (S57) are very crucial, focusing on political will and integrity. Notably, in market linkages (S3), expanding the number of African trade fairs (S33) has a greater priority followed by online platforms for trade and suppliers (S32), then encouraging collaboration and joints ventures (S31). These granular rankings provide a definitive sequence for policymakers to allocate resources and sequence interventions effectively.

8. Conclusions and future recommendations

In this study, a fuzzy SIWEC technique is adopted to leverage the potential of the AfCFTA initiative through the evaluation of 24 strategies under six main categories in Africa. The results revealed that the top three strategies to leverage this potential are infrastructural development, financial support and resources, and AfCFTA leadership and governance. These strategies not only indicated how

important is the physical connectivity through roads, rails, and ports for unlocking intra-African trade, but also how indispensable are powerful political-regulatory systems to physical infrastructure. While the study has made greater contribution through the provision of appropriate strategies to leverage this initiative potential, there is a limitation. There are a few experts that are involved in data collection. Future study should consider increasing this number to 10 or more.

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Conflicts of Interest
The authors declare no conflicts of interest.

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