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Evaluation Challenges of Leadership Management in the Energy Sector using Multi-Criteria Decision Making Approach

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Abstract

Leadership management has various benefits and advantages in the energy sector, such as improving energy sector development and obtaining sustainability benefits. However, the leadership management faces multiple challenges in the energy sector that must be evaluated and ranked. So, this study used the fusion multi-criteria decision-making (MCDM) methodology to assess and rank the challenges of leadership management in the energy sector. The WASPAS method is a fusion MCDM method used to rank the alternatives. Five experts are invited to evaluate the criteria and alternatives. Fourteen criteria and 13 alternatives were collected in this study. The results show that alternative 4 is the best and alternative 8 is the worst. A sensitivity analysis was conducted to show the stability of the alternatives' ranks. The sensitivity analysis was conducted in two parts. In the first part, the lambda value of WASPAS changed between 0 and 1. In the second part, 14 cases are introduced in criteria weights. The results show that the rank of alternatives is stable in different cases.

Keywords: Multi-Criteria Decision Making, Leadership Management, Energy, Uncertainty, Fusion.

1 | Introduction

In putting plans, associated policies, and procedures into practice, worldwide organizations have long struggled to strike an effective balance between local uniqueness and global standardization. In general, there seem to be arguments and data in favor of the theory that successful globalization necessitates the application of a variety of "loose/tight" couplings that permit extensive decentralization to foster local innovation while also permitting centralization around critical values, principles, products, and routes to market [1, 2].

There seems to be a widespread belief in a global setting that local innovation is essential to the creation of competitive advantage. To fully benefit from this advantage, though, one must be able to manage conflicts both at home and abroad and wrestle with issues of striking a balance between bureaucratic control and creativity. International research found that the nature of the global/local balance is often determined by an organization's basic principles. Organizations that prioritize innovation, for instance, usually give more weight to the accomplishment of local autonomy within a global framework [3, 4].

Leaders in the energy sector are aware of the complicated, unpredictable, volatile, and ambiguous contexts in which they work. But maybe less obvious are the abilities they'll need to be successful. Owing to the intricacy

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of the market and industry, including legal obstacles, geopolitical demands, and environmental concerns, it may be challenging to determine whether organizations are producing the future leaders of the energy sector with the leadership talent they already possess. The energy sector is undergoing rapid and major change amid debates over issues including regulation, sustainability, importation vs indigenous production, and government incentive policies. Success under stable circumstances is largely dependent on effective management [5, 6].

Nevertheless, during hard times, energy businesses cannot afford to invest heavily in generalized development with the hope of having workers who are qualified to run the company. Successful development programs for executives in the energy sector must be well-focused. Organizations require strong leadership to develop talent, generate a commitment to new vision and action, define new paths, and align people with mission-critical imperatives. Energy executives and organizations must devise career and development plans that facilitate extensive, cross-organizational experiences and learning. These results hold for the utilities and fossil fuel subsectors [7, 8].

A number of organizations and management specialists use competence models to plan growth, manage the talent pipeline, and assess individual leadership abilities. Determining the most critical skills for a sector of the economy or an organization is not, and shouldn't be a random process. We consulted those operating in the energy industry directly to learn about the essential abilities of these organizations [9, 10].

The well-known abbreviations for multiple-criteria decision analysis and multiple-criteria decision-making are fusion MCDM and MCDA. Fusion MCDM focuses on the structure and resolution of multiple-criteria decision and planning issues. It intends to assist those in charge of making these decisions. There are usually only some of the best options for these kinds of challenges. Therefore, decision-makers have to weigh their preferences while comparing alternative options [11, 12].

The contributions of this study are summarized as follows:

- The fusion WASPAS method is introduced to rank the challenges of leadership management in the energy sector.
- This study proposed a multi-criteria decision-making methodology to evaluate the challenges of leadership management in the energy sector.
- The sensitivity analysis is conducted to show the stability of the results.

2 |Leadership Management Challenges

The three pillars of sustainability are represented by the triple bottom line method. Every one of the three can be connected to a particular community of interests that are reflected in a variety of organizations, such as NGOs and governmental bodies[13, 14]. How does a company strike a balance between the demands of these many communities? Is balance the right course of action? The literature indicates a propensity to overlook these aspects' interrelation and to see them as antagonistic rather than complementary. This pillar strategy may also promote a trade-off-driven way of thinking, which might have some consequences but shouldn't be the standard method of engaging stakeholders. Colbert and Kuruez [15] studied businesses that had a good reputation for sustainable operations, either through national or local honors or worldwide recognition in indices like the Dow Jones Sustainability Index. According to their research, organizational leaders have varying ideas about what sustainability means for their business. The ramifications of these various schools of thinking all affect stakeholder involvement. The notion of strategic management has long included the integrated approach to stakeholder management. Stakeholders will always have divergent expectations and interests, but it is still worthwhile to investigate how a company may benefit everyone. In the literature on strategic management, this process is known as "stakeholder symbiosis" and it acknowledges that stakeholders rely on one another for their prosperity and well-being [16, 17].

People are tired of organizational change since it has gotten more frequent. Like any new effort, sustainability could be seen by staff members (as well as other stakeholders, especially suppliers) as just another fad or the flavor of the month. Organizational change is like rafting: you have to put in a lot of effort and stress when in the white water, then you may relax and recuperate in the calmer waters before moving on to the next set of rapids. An organization shouldn't always be in trouble. Between big endeavors, people need time to adjust. The incessant introduction of novel business methodologies is sometimes exacerbated by the infrequency with which recent modifications intersect or combine with earlier endeavors. Businesses that adopt sustainability without considering these problems run the danger of negatively impacting worker morale and output. The reaction might be a reluctance to change and the feeling that "here we go again."[18, 19].

The traditional foundation of corporate strategy and leadership theories has been the leader's ability to reduce complexity and ambiguity. A successful leader should be able to collect information, analyze the situation, plan the best course of action, and then motivate and inspire team members with a forward-looking vision. These strategies are predictive procedures in which managers are supposed to come up with well-reasoned, well-informed choices that will benefit the company. According to this theory, the great strategist is the effective leader. A comprehensive approach to a complex environment implies that typical management techniques are insufficient to effectuate the required organizational transformation [18, 20].

3 | Multi-Criteria Decision Making

Making decisions is essential for success in any area, but it's critical to the construction industry, where managing vast volumes of data and expertise is necessary. Most construction processes and procedures are collections of several jobs, procedures, and requirements involving various variables and considerations. Making judgments in these kinds of situations may frequently be a laborious and challenging task. These factors make a method that can help characterize such complicated events necessary. An area of operations research called multi-criteria decision analysis (MCDA) was created to help solve these problems. Since then, many fusion multi-criteria decision-making techniques (MCDM) have been developed to address them in various contexts and application domains [21, 22].

In addition to multi-criteria approaches in and of itself, the study includes some supplements that are particularly well-suited for decision-making issues, such as fuzzy sets or numerical simulations [23, 24]. These tools, which do not have the fundamentals or conventional framework required to conduct a multi-criteria analysis, are highly beneficial in handling characteristics like risk or uncertainty, which are prevalent in decision-making settings but inaccessible to conventional fusion MCDM techniques. The goal was to report the most pertinent papers using multi-criteria analysis in construction activities, paying attention to factors like several citations and variety in the field of application, regardless of their conceptual basis [25, 26].

The Weighted Sum Model (WSM) and the Weighted Product Model (WPM) are combined in the WASPAS approach. As a result, it is easy to ascertain the relative weight of each feature before ranking and evaluating the options. This strategy is used in many different decision-making processes. The following are the characteristics of the WASPAS method: It is thought of as a compensating technique; The characteristics stand alone; The process transforms the qualitative characteristics into quantitative ones [27, 28]. Figure 1 shows the steps of the fusion WASPAS method.

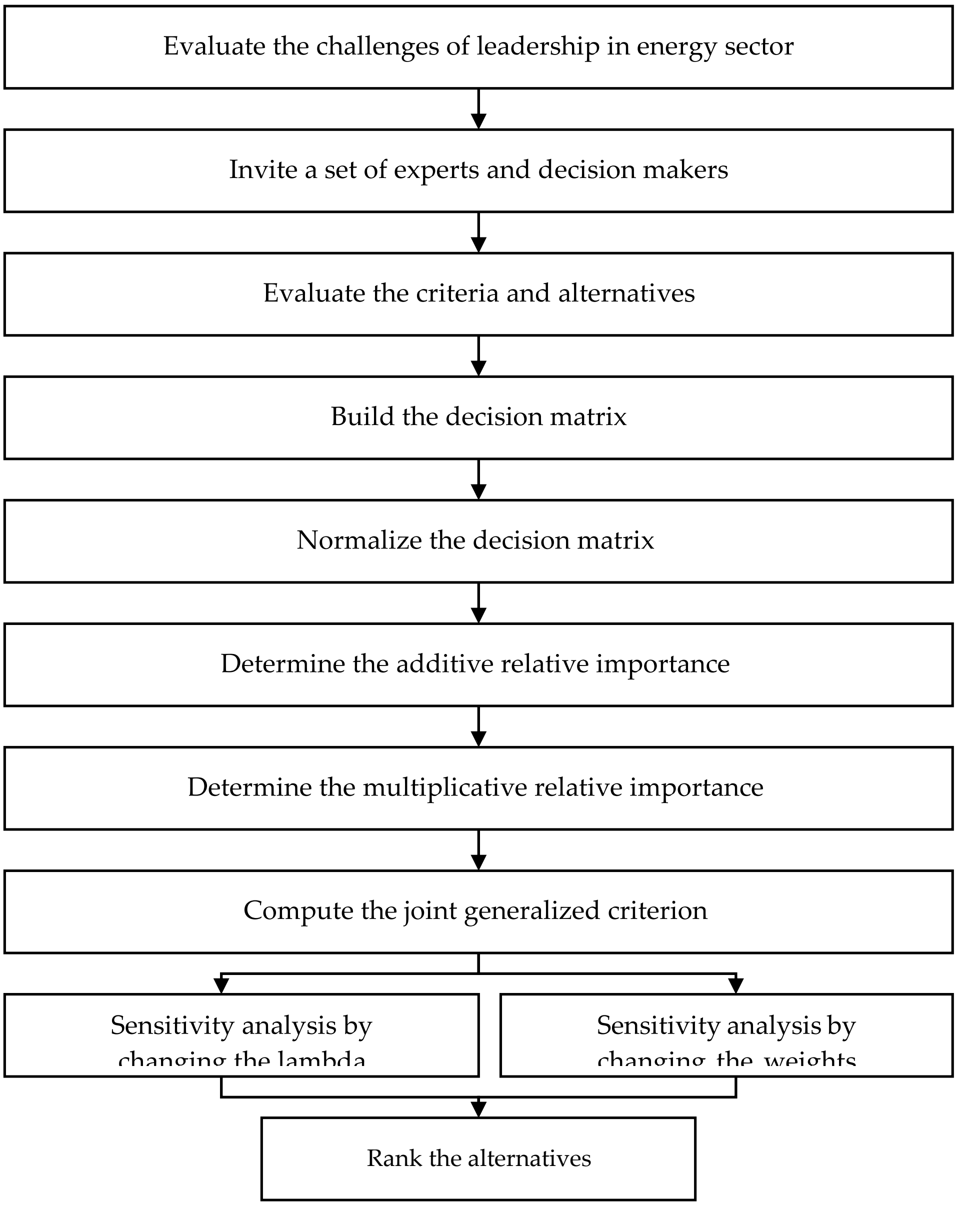

Figure 1. The steps of fusion WASPAS method.

The decision matrix is built as an input information received by decision makers and experts[29, 30] as:

$$X = \begin{bmatrix} x_{11} & \cdots & x_{n1} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

$j = 1,2,3,4, \dots, m; j = 1,2,3,4, \dots, n$

Normalize the decision matrix for positive and negative criteria as:

$$r_{ij} = \frac{x_{ij}}{\max_i x_{ij}} \quad (2)$$

$$r_{ij} = \frac{\min_i x_{ij}}{x_{ij}} \quad (3)$$

Determine the additive relative importance by weighted normalized decision matrix as:

$$U_i^{(1)} = \sum_{j=1}^{n} r_{ij} w_j \quad (4)$$

Determine the multiplicative relative importance as:

$$U_i^{(2)} = \prod_{j=1}^{n}(r_{ij})^{w_j} \quad (5)$$

Compute the joint generalized criterion

$$U_i = \exists U_i^{(1)} + (1-\exists)U_i^{(2)};\ \exists \in [0,1] \quad (6)$$

$$U_i = \exists \sum_{j=1}^{n} r_{ij}w_j + (1-\exists)\prod_{j=1}^{n}(r_{ij})^{w_j};\ \exists \in [0,1] \quad (7)$$

$$U_i = \frac{1}{2}\sum_{j=1}^{n} r_{ij}w_j + \left(1-\frac{1}{2}\right)\prod_{j=1}^{n}(r_{ij})^{w_j}; \quad (8)$$

4 | Results

This section introduces the results of applying the fusion WASPAS method to evaluate the challenges of leadership in the energy sector. This study invited five experts to assess the criteria and alternatives. Five experts have experience in leadership and energy for more than 20 years. Thirteen criteria and 12 alternatives are gathered in this study, as shown in Figure 2.

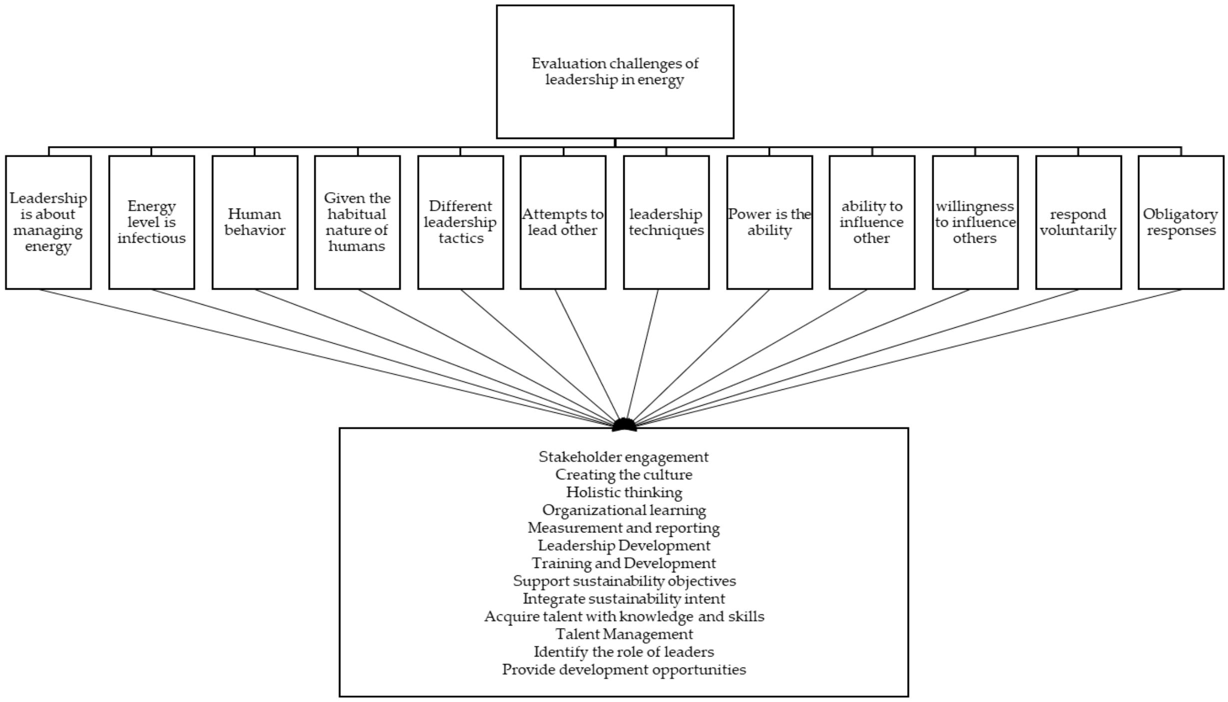

Figure 2. Leadership challenges and criteria in the energy sector.

The decision matrix is built as input information received by decision makers and experts by using Eq. (1) as shown in Tables A1-A5. Experts used a scale from 1 to 9. Then compute the criteria weights as shown in Figure 3.

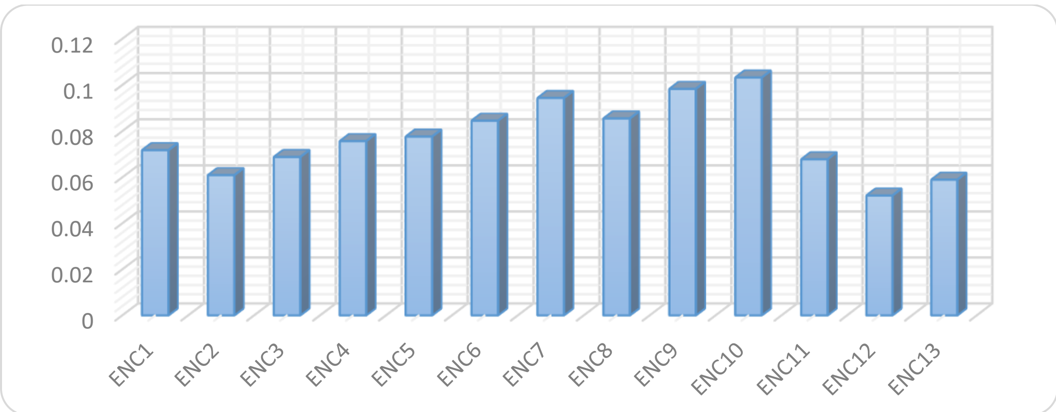

Figure 3. The criteria weights.

Normalize the decision matrix for positive and negative criteria by using Eq. (2) as shown in Table 1.

Table 1. The normalized decision matrix.

	ENC_1	ENC_2	ENC_3	ENC_4	ENC_5	ENC_6	ENC_7	ENC_8	ENC_9	ENC_{10}	ENC_{11}	ENC_{12}	ENC_{13}
ENA_1	0.368421	0.583333	0.702703	0.425	0.666667	0.783784	0.888889	0.65625	0.488889	1	0.470588	0.378378	0.447368
ENA_2	0.605263	0.416667	0.378378	0.625	0.133333	0.540541	0.972222	1	1	0.909091	0.411765	0.378378	0.210526
ENA_3	0.342105	0.361111	0.432432	0.55	0.644444	0.513514	0.305556	0.5	0.444444	0.636364	0.529412	0.324324	0.421053
ENA_4	0.605263	0.361111	0.378378	0.325	0.311111	0.486486	0.5	0.5625	0.288889	0.636364	0.617647	0.351351	0.5
ENA_5	0.763158	0.444444	0.486486	0.525	0.844444	0.432432	0.583333	0.6875	0.333333	0.606061	0.735294	0.513514	0.526316
ENA_6	0.815789	0.694444	0.621622	0.575	0.577778	0.648649	0.555556	0.84375	0.333333	0.545455	0.852941	0.702703	0.736842
ENA_7	1	0.805556	0.864865	0.825	0.511111	0.783784	0.75	0.625	0.533333	0.848485	1	0.837838	0.868421
ENA_8	0.815789	1	0.810811	1	0.555556	1	0.944444	0.875	0.555556	0.848485	0.882353	0.918919	1
ENA_9	0.868421	0.777778	0.837838	0.825	0.511111	0.702703	1	0.875	0.844444	0.939394	0.588235	1	0.552632
ENA_{10}	0.631579	0.666667	0.783784	0.875	0.866667	0.594595	0.472222	0.46875	0.688889	0.909091	0.764706	0.945946	0.421053
ENA_{11}	0.657895	0.694444	1	0.725	0.644444	0.756757	0.472222	0.53125	0.488889	0.787879	0.882353	0.297297	0.657895
ENA_{12}	0.263158	0.694444	0.675676	1	1	0.810811	0.722222	0.3125	0.555556	0.787879	0.588235	0.324324	0.657895

Determine the additive relative importance by weighted normalized decision matrix by using Eq.(3)as shown in Table 2.

Table 2. The additive relative importance.

	ENC_1	ENC_2	ENC_3	ENC_4	ENC_5	ENC_6	ENC_7	ENC_8	ENC_9	ENC_{10}	ENC_{11}	ENC_{12}	ENC_{13}
ENA_1	0.026445	0.035562	0.048367	0.032178	0.051786	0.066279	0.083907	0.056139	0.048072	0.103245	0.031928	0.019719	0.026393
ENA_2	0.043446	0.025402	0.026044	0.047321	0.010357	0.045709	0.091773	0.085546	0.098328	0.093859	0.027937	0.019719	0.01242
ENA_3	0.024556	0.022015	0.029764	0.041642	0.05006	0.043424	0.028843	0.042773	0.043702	0.065701	0.035919	0.016902	0.024841
ENA_4	0.043446	0.022015	0.026044	0.024607	0.024167	0.041138	0.047198	0.048119	0.028406	0.065701	0.041905	0.01831	0.029499
ENA_5	0.054779	0.027095	0.033485	0.039749	0.065596	0.036568	0.055064	0.058813	0.032776	0.062573	0.049887	0.026761	0.031051
ENA_6	0.058557	0.042336	0.042786	0.043535	0.044881	0.054851	0.052442	0.072179	0.032776	0.056315	0.057869	0.036621	0.043472
ENA_7	0.07178	0.04911	0.059529	0.062463	0.039703	0.066279	0.070796	0.053466	0.052442	0.087602	0.067847	0.043663	0.051234
ENA_8	0.058557	0.060964	0.055808	0.075713	0.043155	0.084562	0.089151	0.074853	0.054627	0.087602	0.059865	0.047889	0.058997
ENA_9	0.062335	0.047416	0.057668	0.062463	0.039703	0.059422	0.094395	0.074853	0.083033	0.096988	0.03991	0.052114	0.032604
ENA_{10}	0.045335	0.040642	0.053948	0.066249	0.067322	0.05028	0.044576	0.0401	0.067737	0.093859	0.051883	0.049297	0.024841
ENA_{11}	0.047224	0.042336	0.06883	0.054892	0.05006	0.063993	0.044576	0.045446	0.048072	0.081344	0.059865	0.015493	0.038814
ENA_{12}	0.018889	0.042336	0.046507	0.075713	0.077679	0.068564	0.068174	0.026733	0.054627	0.081344	0.03991	0.016902	0.038814

Determine the multiplicative relative importance by using Eq. (4) as shown in Table 3.

Table 3. The multiplicative relative importance.

	ENC_1	ENC_2	ENC_3	ENC_4	ENC_5	ENC_6	ENC_7	ENC_8	ENC_9	ENC_{10}	ENC_{11}	ENC_{12}	ENC_{13}
ENA_1	0.930834	0.967675	0.976008	0.937269	0.968995	0.979609	0.988943	0.964608	0.932053	1	0.950145	0.950614	0.953653
ENA_2	0.964602	0.948028	0.935295	0.96504	0.855117	0.949308	0.997344	1	1	0.990208	0.941576	0.950614	0.912173
ENA_3	0.925896	0.939793	0.943931	0.955745	0.966446	0.9452	0.894118	0.942428	0.923359	0.954407	0.957768	0.943008	0.950248
ENA_4	0.964602	0.939793	0.935295	0.918424	0.913293	0.940888	0.936665	0.951972	0.885064	0.954407	0.967837	0.946949	0.959931
ENA_5	0.980786	0.951765	0.951615	0.952385	0.986952	0.931563	0.950394	0.968455	0.897605	0.949611	0.979354	0.965863	0.962841
ENA_6	0.985492	0.978015	0.967806	0.958967	0.958283	0.964058	0.946027	0.985571	0.897605	0.939338	0.989266	0.981781	0.982145
ENA_7	1	0.986905	0.990057	0.985541	0.9492	0.979609	0.97321	0.960591	0.940061	0.98318	1	0.990822	0.991711
ENA_8	0.985492	1	0.985669	1	0.955368	1	0.994619	0.988642	0.943842	0.98318	0.991544	0.995603	1
ENA_9	0.989925	0.984796	0.987896	0.985541	0.9492	0.970605	1	0.988642	0.983512	0.993566	0.964639	1	0.965616
ENA_{10}	0.967553	0.975584	0.983371	0.989941	0.988946	0.95699	0.931625	0.937239	0.964019	0.990208	0.981964	0.997108	0.950248
ENA_{11}	0.970392	0.978015	1	0.975946	0.966446	0.976707	0.931625	0.947328	0.932053	0.975686	0.991544	0.938741	0.9756
ENA_{12}	0.908622	0.978015	0.973377	1	1	0.982422	0.969749	0.905288	0.943842	0.975686	0.964639	0.943008	0.9756

Compute the joint generalized criterion by using Eq. (8) with $\exists = 0.5$, as shown in Figure 4.

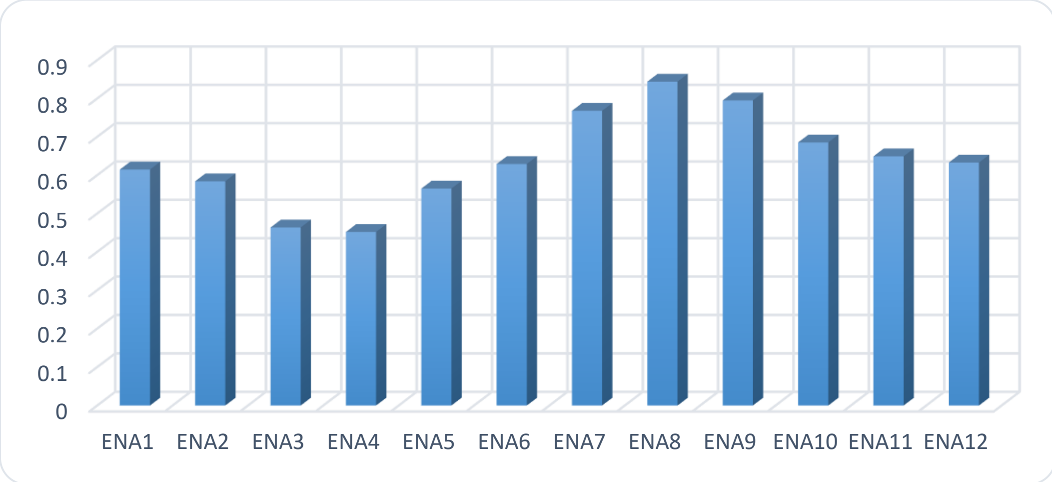

Figure 4. The joint generalized criterion values.

5 | Sensitivity Analysis

This section is divided into two parts; in the first part, we change lambda values between 0 and 1. In the second part, we change the criteria weights under 14 cases. In the first part, we change the values of lambda between 0 and 1; then, we rank the alternatives to show the stability of the rank. The joint generalized criterion values are shown in Table 4. Then, we rank the other options, as shown in Figure 5. We show that alternative 4 is the best and alternative 8 is the worst. So, the rank of other possibilities is stable in different cases.

Table 4. The joint generalized criterion values.

	$Case_1$	**$Case_2$**	**$Case_3$**	**$Case_4$**	**$Case_5$**	**$Case_6$**	**$Case_7$**	**$Case_8$**	**$Case_9$**	**$Case_{10}$**	**$Case_{11}$**
ENA_1	0.599019	0.602119	0.605219	0.608319	0.61142	0.61452	0.61762	0.62072	0.62382	0.62692	0.63002
ENA_2	0.540262	0.549021	0.557781	0.566541	0.575301	0.584061	0.592821	0.601581	0.610341	0.619101	0.62786
ENA_3	0.457022	0.458334	0.459646	0.460958	0.46227	0.463582	0.464894	0.466206	0.467518	0.46883	0.470141
ENA_4	0.44341	0.445125	0.446839	0.448554	0.450268	0.451982	0.453697	0.455411	0.457126	0.45884	0.460555
ENA_5	0.555789	0.55763	0.559471	0.561311	0.563152	0.564993	0.566834	0.568674	0.570515	0.572356	0.574197
ENA_6	0.619711	0.621602	0.623493	0.625384	0.627275	0.629166	0.631057	0.632948	0.634839	0.63673	0.638621
ENA_7	0.760213	0.761783	0.763353	0.764923	0.766493	0.768063	0.769633	0.771203	0.772773	0.774343	0.775913
ENA_8	0.835951	0.83753	0.839109	0.840688	0.842268	0.843847	0.845426	0.847005	0.848584	0.850163	0.851742
ENA_9	0.786899	0.788499	0.7901	0.7917	0.793301	0.794901	0.796502	0.798102	0.799703	0.801303	0.802903
ENA_{10}	0.674411	0.676576	0.678742	0.680908	0.683074	0.685239	0.687405	0.689571	0.691737	0.693902	0.696068
ENA_{11}	0.637209	0.639583	0.641956	0.64433	0.646703	0.649077	0.65145	0.653824	0.656197	0.658571	0.660944
ENA_{12}	0.609698	0.614347	0.618997	0.623646	0.628296	0.632945	0.637595	0.642244	0.646894	0.651543	0.656193

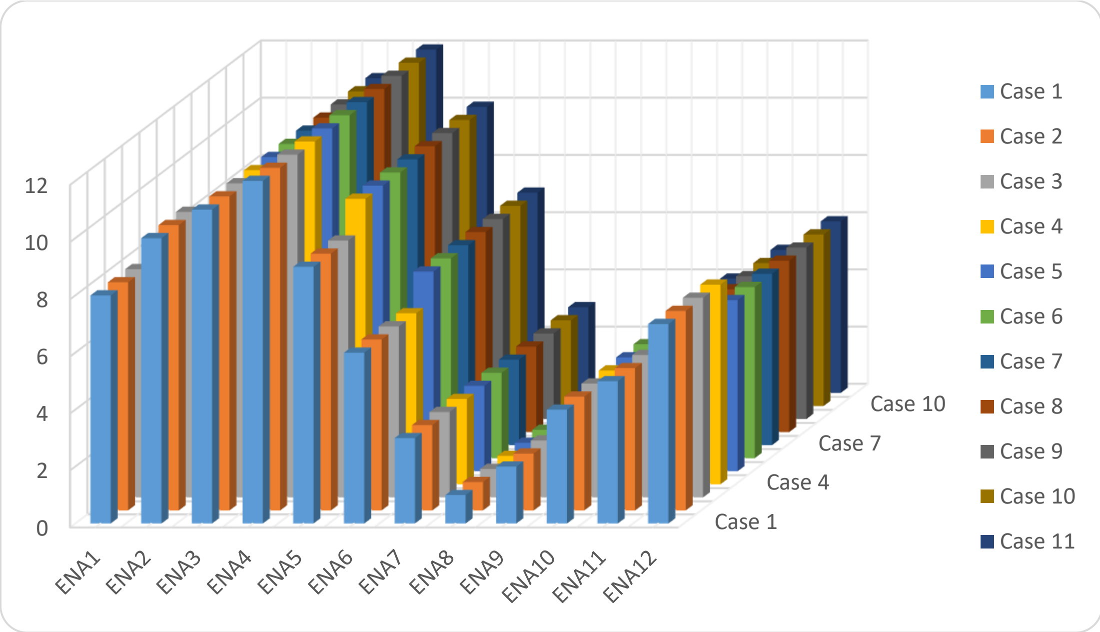

Figure 5. The rank of alternatives.

In the second part, we change the criteria weights by 14 cases, as shown in Table 5. In the first case, all criteria have the same weight. In the second case, the first criterion has a weight equal to 0.09, and the others have the same weight. In the third case, the second criterion has a weight equal to 0.09, and others have the same weight. In the fourth case, the third criterion has a weight equal to 0.09, and others have the same weight. In the fifth case, the fourth criterion has a weight equal to 0.09, and others have the same weight. In the sixth case, the fifth criterion has a weight equal to 0.09, and others have the same weight. In the seventh case, the sixth criterion has a weight equal to 0.09, and others have the same weight. In the eighth case, the seventh criterion has a weight equal to 0.09, and others have the same weight. The joint generalized criterion values are shown in Table 6. We show that alternative 4 is the best and alternative 8 is the worst. So, the rank of other possibilities is stable in different cases. Then, we rank the options as shown in Figure 6.

Table 5. The weights of criteria under sensitivity analysis.

	Case$_1$	Case$_2$	Case$_3$	Case$_4$	Case$_5$	Case$_6$	Case$_7$	Case$_8$	Case$_9$	Case$_{10}$	Case$_{11}$	Case$_{12}$	Case$_{13}$	Case$_{14}$
ENC$_1$	0.076923	0.09	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923
ENC$_2$	0.076923	0.076923	0.09	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923
ENC$_3$	0.076923	0.076923	0.076923	0.09	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923
ENC$_4$	0.076923	0.076923	0.076923	0.076923	0.09	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923
ENC$_5$	0.076923	0.076923	0.076923	0.076923	0.076923	0.09	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923
ENC$_6$	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.09	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923
ENC$_7$	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.09	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923
ENC$_8$	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.09	0.076923	0.076923	0.076923	0.076923	0.076923
ENC$_9$	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.09	0.076923	0.076923	0.076923	0.076923
ENC$_{10}$	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.09	0.076923	0.076923	0.076923
ENC$_{11}$	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.09	0.076923	0.076923
ENC$_{12}$	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.09	0.076923
ENC$_{13}$	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.076923	0.09

Table 6. The joint generalized criterion values.

	$Case_1$	$Case_2$	$Case_3$	$Case_4$	$Case_5$	$Case_6$	$Case_7$	$Case_8$	$Case_9$	$Case_{10}$	$Case_{11}$	$Case_{12}$	$Case_{13}$	$Case_{14}$
ENA_1	0.590134	0.588809	0.591927	0.593404	0.58971	0.592971	0.594343	0.595503	0.592844	0.59065	0.596673	0.590388	0.588974	0.590048
ENA_2	0.54198	0.544299	0.541854	0.541292	0.544532	0.53634	0.543508	0.548245	0.548518	0.548518	0.547612	0.541784	0.541292	0.538306
ENA_3	0.455584	0.454692	0.454973	0.455962	0.457431	0.458511	0.456992	0.454126	0.456826	0.45612	0.458421	0.457185	0.454421	0.45581
ENA_4	0.447596	0.450115	0.44705	0.447295	0.446515	0.4463	0.448716	0.448882	0.449627	0.445946	0.450462	0.450254	0.446908	0.448882
ENA_5	0.56678	0.570785	0.566743	0.567344	0.567871	0.571685	0.566565	0.568634	0.569911	0.564979	0.568921	0.570468	0.567716	0.567889
ENA_6	0.645685	0.650172	0.64871	0.647775	0.647147	0.647185	0.648128	0.646878	0.650495	0.64332	0.646736	0.6506	0.648813	0.649233
ENA_7	0.781159	0.787698	0.785334	0.78608	0.785582	0.781121	0.785054	0.784611	0.782876	0.78148	0.785877	0.787698	0.785743	0.786124
ENA_8	0.854701	0.858909	0.86124	0.858843	0.86124	0.85509	0.86124	0.86056	0.859683	0.85509	0.85934	0.859778	0.860241	0.86124
ENA_9	0.785688	0.79065	0.789499	0.790268	0.790106	0.785634	0.788494	0.792227	0.790731	0.790351	0.791513	0.786847	0.792227	0.786299
ENA_{10}	0.688105	0.690206	0.690674	0.692153	0.693236	0.693139	0.689699	0.687887	0.687832	0.690963	0.693627	0.69192	0.694044	0.68705
ENA_{11}	0.647809	0.650378	0.65084	0.654347	0.651218	0.650205	0.651603	0.647799	0.648669	0.648051	0.651973	0.653059	0.644761	0.650378
ENA_{12}	0.621626	0.618175	0.624745	0.624516	0.628165	0.628165	0.626109	0.625079	0.619159	0.622971	0.625848	0.623406	0.619379	0.624296

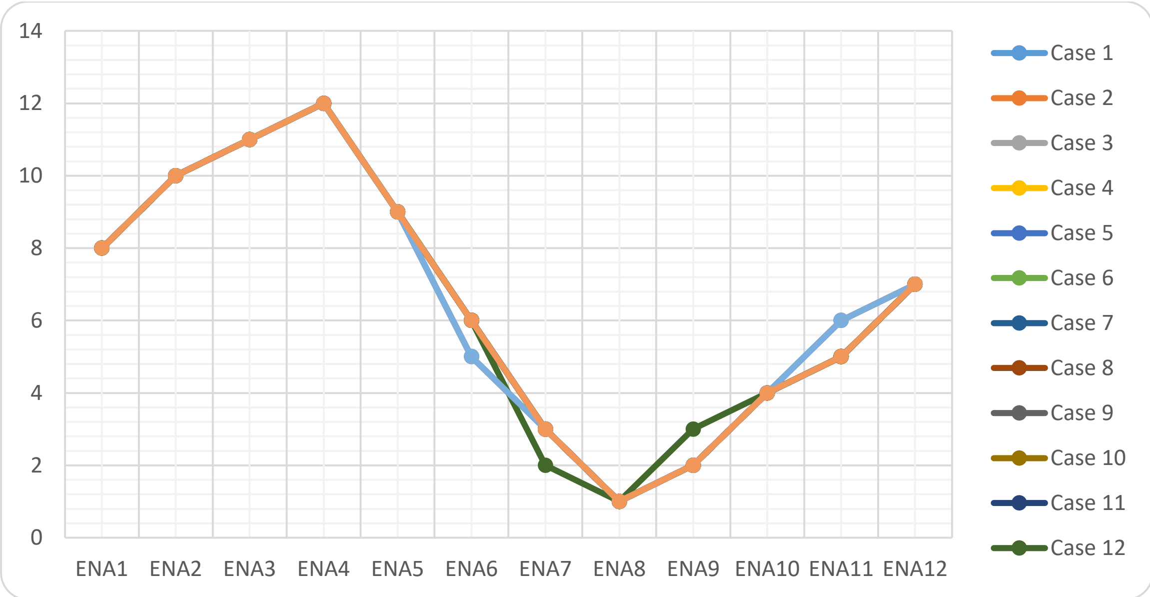

Figure 6. The rank of alternatives under sensitivity analysis.

6 | Conclusions

This study suggested a fusion MCDM method to evaluate the challenges of leadership management in the energy sector. This study used the fusion WASPAS method to rank the challenges. Five experts are invited to assess the criteria and alternatives. Five experts have experience in leadership management and the energy sector. Five decision matrices are built between criteria and alternatives. This study collected 13 criteria and 12 alternatives. The criteria weights are computed using the average method to show the importance of each criterion. The decision matrices are aggregated to obtain a single matrix. The normalized decision matrix is computed for positive and negative criteria. The weighted normalized decision matrix is calculated. Then, the joint generalized criterion values for lambda equal 0.5. The results show that alternative 4 is the best and alternative 8 is the worst. The sensitivity analysis was conducted in two parts. In the first part, the lambda value is changed between 0 and 1 to show the rank of alternatives under different lambda values. Then, in the second part, we change the criteria weights with 14 cases. The results show that alternative 4 is the best and alternative 8 is the worst. So, the rank of other options is stable in different cases.

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Author Contribution

All authors contributed equally to this work.

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Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the privacy-preserving nature of the data but are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there is no conflict of interest in the research.

Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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Appendix

Table A1. The decision matrix by the first expert.

	ENC_1	ENC_2	ENC_3	ENC_4	ENC_5	ENC_6	ENC_7	ENC_8	ENC_9	ENC_{10}	ENC_{11}	ENC_{12}	ENC_{13}
ENA_1	1	3	5	4	7	8	9	4	5	6	2	3	4
ENA_2	6	3	2	6	1	4	7	8	9	6	3	2	1
ENA_3	2	1	4	5	6	3	2	1	4	5	6	1	4
ENA_4	5	2	2	3	2	5	6	4	1	5	6	4	5
ENA_5	7	3	2	5	9	3	6	5	4	5	9	5	6
ENA_6	8	6	3	6	8	5	4	5	2	6	8	9	9
ENA_7	9	9	6	9	7	9	6	2	6	9	5	8	8
ENA_8	7	8	5	8	8	9	5	6	3	3	2	7	7
ENA_9	6	7	4	7	7	5	8	9	6	5	3	8	1
ENA_{10}	4	4	7	8	9	3	2	1	4	5	6	9	2
ENA_{11}	5	5	9	7	5	6	3	2	4	5	6	2	6
ENA_{12}	2	5	5	8	9	6	5	2	6	5	4	1	5

Table A2. The decision matrix by the second expert.

	ENC_1	ENC_2	ENC_3	ENC_4	ENC_5	ENC_6	ENC_7	ENC_8	ENC_9	ENC_{10}	ENC_{11}	ENC_{12}	ENC_{13}
ENA_1	1	3	5	4	7	8	9	4	5	6	2	3	4
ENA_2	3	3	2	1	1	4	7	8	9	6	1	2	1
ENA_3	1	1	1	3	6	3	1	1	4	1	3	1	1
ENA_4	2	3	3	1	2	5	3	4	1	3	1	1	3
ENA_5	3	1	1	2	9	1	1	1	3	1	2	3	1
ENA_6	6	3	2	3	1	3	2	3	1	2	3	1	2
ENA_7	9	1	3	6	3	1	3	1	2	3	6	2	3
ENA_8	8	2	6	9	1	2	6	2	3	6	9	3	6
ENA_9	6	3	9	7	2	3	9	3	6	9	3	6	9
ENA_{10}	4	6	7	8	3	6	2	6	9	5	6	9	2
ENA_{11}	5	9	9	7	6	9	3	9	4	5	6	2	6
ENA_{12}	2	5	5	8	9	6	5	2	6	5	4	1	5

Table A3. The decision matrix by a third expert.

	ENC_1	ENC_2	ENC_3	ENC_4	ENC_5	ENC_6	ENC_7	ENC_8	ENC_9	ENC_{10}	ENC_{11}	ENC_{12}	ENC_{13}
ENA_1	2	3	5	4	7	8	9	4	5	6	2	3	4
ENA_2	5	3	2	6	2	4	7	2	9	6	3	2	1
ENA_3	6	1	2	5	5	3	2	5	4	5	2	1	4
ENA_4	7	2	5	2	6	2	2	6	1	2	5	4	2
ENA_5	8	5	6	5	7	5	5	7	2	5	6	2	5
ENA_6	2	6	7	6	8	6	6	8	5	6	7	5	6
ENA_7	3	7	8	7	2	7	7	2	6	7	8	6	7
ENA_8	1	8	2	8	3	8	8	3	7	8	2	7	8
ENA_9	6	2	3	2	1	2	2	1	8	2	3	8	2
ENA_{10}	4	3	1	3	9	3	3	1	2	3	1	2	3
ENA_{11}	5	1	1	1	5	1	1	2	3	1	6	3	1
ENA_{12}	2	5	5	8	9	6	5	2	1	5	4	1	5

Table A4. The decision matrix by the fourth expert.

	ENC_1	ENC_2	ENC_3	ENC_4	ENC_5	ENC_6	ENC_7	ENC_8	ENC_9	ENC_{10}	ENC_{11}	ENC_{12}	ENC_{13}
ENA_1	6	3	5	4	7	2	1	4	5	6	2	2	1
ENA_2	5	3	6	6	1	4	7	6	9	6	3	6	1
ENA_3	3	6	5	5	6	6	2	5	4	5	6	5	6
ENA_4	5	5	3	6	2	5	6	3	6	6	5	3	5
ENA_5	6	3	5	5	9	3	5	5	5	5	3	5	3
ENA_6	9	5	6	3	8	5	3	6	3	3	5	6	5
ENA_7	8	6	9	5	7	6	5	9	5	5	6	9	6
ENA_8	7	9	8	6	8	9	6	8	6	6	9	8	9
ENA_9	6	8	7	9	7	8	9	7	9	9	8	7	8
ENA_{10}	4	7	7	8	9	7	8	6	8	8	7	6	7
ENA_{11}	5	5	9	7	5	6	7	2	7	7	6	2	6
ENA_{12}	2	5	5	8	9	6	6	2	6	6	4	8	5

Table A5. The decision matrix by the fifth expert.

	ENC_1	ENC_2	ENC_3	ENC_4	ENC_5	ENC_6	ENC_7	ENC_8	ENC_9	ENC_{10}	ENC_{11}	ENC_{12}	ENC_{13}
ENA_1	4	9	6	1	2	3	4	5	2	9	8	3	4
ENA_2	4	3	2	6	1	4	7	8	9	6	4	2	4
ENA_3	1	4	4	4	6	4	4	4	4	5	1	4	1
ENA_4	4	1	1	1	2	1	1	1	4	5	4	1	4
ENA_5	5	4	4	4	4	4	4	4	1	4	5	4	5
ENA_6	6	5	5	5	1	5	5	5	4	1	6	5	6
ENA_7	9	6	6	6	4	6	6	6	5	4	9	6	9
ENA_8	8	9	9	9	5	9	9	9	6	5	8	9	8
ENA_9	9	8	8	8	6	8	8	8	9	6	3	8	1
ENA_{10}	8	4	7	8	9	3	2	1	8	9	6	9	2
ENA_{11}	5	5	9	7	8	6	3	2	4	8	6	2	6
ENA_{12}	2	5	5	8	9	6	5	2	6	5	4	1	5