# STRATEGIC ANALYSIS OF THE NEPAL ELECTRICITY AUTHORITY: A SWOT-AHP ANALYSIS BASED ON STAKEHOLDERS' PERCEPTIONS

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**ABSTRACT**

The Strength, Weakness, Opportunities & Threat (SWOT) analysis of an organization is a crucial method for assessing the most relevant internal (Strengths and Weaknesses) and external (Opportunities and Threats) factors affecting the organization. The purpose of this study is to rank the identified factors of strengths, weaknesses, opportunities and threats of the Nepal Electricity Authority (NEA), an undertaking of the Government of Nepal mandated for generation, transmission, and distribution of electricity throughout the country. This paper utilizes the Analytical Hierarchy Process (AHP), a Multicriteria Decision Making (MCDM) technique, to rank the SWOT factors for NEA strategic planning. The AHP method in combination with a SWOT analysis was utilized to conduct pairwise comparison among the identified factors in order to prioritize them using Eigen values. A structured questionnaire was used to collect data from the experts of the NEA, independent power producers, the Ministry of Energy, Water Resources and Irrigation, energy companies, and donor agencies. The study reveals that the monopoly business nature, the huge internal demand for energy and a nationwide electricity distribution network are the main strengths of the NEA whereas an inability to absorb all energy procured through "take or pay" contracts and an insufficient transmission and distribution network are the main threats and weaknesses. Similarly, long-term growth of electricity demand, trade of power and energy banking are the identified opportunities. The findings of the study will help the organization utilize its strengths and opportunities, tackle its weaknesses, and mitigate the threats.

Keywords: SWOT; AHP; Nepal Electricity Authority; electricity utility

## 1. Introduction

The Nepal Electricity Authority (NEA) is a vertically integrated power utility which is an undertaking of the Government of Nepal. The main objective of the NEA is planning and development of generation, transmission and distribution infrastructures for interconnected and isolated power systems for adequate, affordable and reliable power service within Nepal. It is also mandated to recommend short- and long-term plans and policies related to the energy sector of the Government (NEA, 2021).

The energy sector plays a very important role in the economic development of any nation. Evidence shows that expanding the electricity sector has contributed to economic growth in many countries (Gunatilake, Wijayatunga, & Roland-Holst, 2020). The electricity sector in Nepal has developed considerably in recent years. The currently installed power generation capacity of the country is about 2000MW as opposed to a mere 1000MW just four years ago. The number of consumers and the demand for energy are also increasing annually as shown in Tables 1 and 2.

The power sector in Nepal is largely dominated by hydro generation with over 99% of the annual generation from hydroelectricity. A small quantity of electricity is generated from other sources such as solar and thermal generation (NEA, 2021). Nepal's enormous technically viable hydropower potential of 43GW and its geographic proximity to India and resource-starved Bangladesh provide opportunities for cross-border electricity trade with its neighboring countries. Nepal is looking to tap into this trading opportunity by constructing cross-border transmission infrastructures and expanding the internal transmission network. However, the internal or domestic demand needs to be fulfilled before electricity can be sold to neighboring countries. Despite the huge potential, Nepal's sole state-owned electricity utility, NEA, has not been able to cater to the growing domestic demand (Dhakal, Karki, & Shrestha, 2019). On one hand, this is due to the lack of sufficient generation of electricity; while on the other hand, it is because of a lack of sufficient distribution infrastructures. Nepal still depends on the energy imported from India to fulfill its own needs in the winter season when the streamflow in rivers is reduced to almost a third of the full capacity. As depicted in Table 1, in 2021, Nepal fulfilled 31.8% of its total annual energy needs through imports from India (NEA, 2021). Most of the importing of energy happens in the dry winter season that lasts from October to March. However, during the monsoon season that lasts for around four months, excess energy is generated. This causes valuable energy to be wasted because of a lack of sufficient cross-border transmission infrastructures. Reliance on a single source of energy and the resulting mismatch of supply in dry and wet season energy into the national grid poses a great financial challenge to the NEA in the coming years.

Table 1
Total energy available and peak demand in the NEA system during the last five years

| Particular | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|
| Generated by NEA (GWh) | 2133 | 2305 | 2308 | 2548 | 3021 | 2811 |
| From IPPs (GWh) | 1166 | 1778 | 2168 | 2190 | 2991 | 3241 |
| Imported from India (GWh) | 1778 | 2175 | 2582 | 2813 | 1729 | 2826 |
| Total available energy (GWh) | 5077 | 6258 | 7058 | 7551 | 7741 | 8878 |
| Peak demand (GW) | 1.385 | 1.444 | 1.508 | 1.320 | 1.408 | 1.482 |

Source: (NEA, 2021)

The power sector in Nepal is practically vertically integrated with the NEA acting as the single buyer that purchases electricity from multiple generators or sellers, including the private or independent power producers (IPPs). As shown in Table 1, the contribution of electricity generation by the IPPs has been more than 30% in recent years. The NEA is also the single buyer of imported electricity from India. The


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electricity market has not opened up in a structured and functional manner for other players to enter the market. The NEA sells bulk energy to domestic and industrial consumers at a pre-determined rate. The transmission business is also solely operated by the NEA. It is mandated to construct, expand and operate the transmission network within the country. The distribution business is also operated by the NEA through its seven provincial distribution offices. The distribution offices sell bulk energy to consumers throughout the nation.

This vertically integrated and unbundled structure of the energy market in Nepal has resulted in several challenges in the energy sector. There is a lack of a competitive electricity market which results in consumers being forced to buy electricity at pre-determined and uncompetitive rates. In other words, the consumers have no choice of service provider. However, this is a strength for the NEA, as it has no competitors in the market. The growing demand for electricity as shown in Table 1 and the growing number of consumers as shown in Table 2 are areas of opportunity for the NEA to grow its business. However, the growing demand comes with the challenge of curtailing system losses (NEA, 2021).

Table 2
Growth of consumers and system loss of the NEA

| **Particular** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** |
|---|---|---|---|---|---|---|
| Growth of consumers (%) | 5 | 10 | 10 | 9 | 8 | 7 |
| Systems loss (%) | 25.78 | 22.90 | 20.45 | 15.32 | 15.27 | 17.18 |

Source: (NEA, 2021)

A review of previous works related to the energy sector in Nepal in general and about the NEA in particular shows that there is a lack of an integrated and detailed analysis of the strengths, opportunities, weaknesses and threats of the NEA. A study was conducted regarding the barriers and opportunities in cross border electricity trading opportunities for Nepal (Dhakal, Karki, & Shrestha, 2019). Several studies have been conducted regarding the need to unbundle the NEA and separate it into different business units (Necoechea-Porras & Lopez, 2021). However, there is a lack of an integrated SWOT analysis that is aimed at identifying the key areas of strength/opportunities and weaknesses/threats of Nepal's energy sector.

This study conducted a SWOT analysis of the NEA as a way to find out key decision supporting information that will enable the organization's resources and capabilities to be synchronized with the competitive environment in which it operates. This analysis is combined with the AHP to quantify the relative importance of each element among the groups and identify the prospective strategy crucial to its internal and external environment. The main objective of the research is to determine the key strengths, weaknesses, opportunities and threats of the NEA and their relative importance.

Similar studies on the energy sector have been conducted in other parts of the world. A SWOT analysis of power utilities in the South African Development Community (SADC) discovered that political instability, poor water management and corruption pose endemic threats to the South African energy market (Tshombe, 2013). The article, *Cross-border electricity trade for Nepal: a SWOT-AHP analysis of barriers and opportunities based on stakeholders' perception* (Dhakal, Karki, & Shrestha, 2019) identified the untapped hydro potential in Nepal, coupled with BBIN's complementary seasonal demand patterns, differences in peak load timing, and rapidly growing electricity demand in Bangladesh and India as favorable for regional electricity cooperation, especially for Nepal. The article, the *Analytical Hierarchy Process (AHP) approach to the challenges of electricity power generation in Nigeria* (Oluchukwu & Emmanuel, 2019) revealed a lack of maintenance, continuous use of obsolete equipment, a biased process of staff recruitment, insufficient staff training, shortage of qualified manpower, lack of staff welfare, absence of equipment upgrades, vandalism and community disturbances as the key challenges facing the energy sector in Nigeria.

## 2. SWOT and AHP model

### 2.1. SWOT analysis

A SWOT analysis is a universally used technique for analyzing internal and external environments related to an organization in order to identify a systematic approach for decision making and strategy formulation (Kurttila, Pesonen, Kangas, & Kajanus, 2000; Osuna & Aranda, 2007). It is a tool that supports decision making in the context of formulating strategies for any organization. A SWOT analysis involves systematic thinking and comprehensive identification of factors related to an organization, its management and planning. A SWOT framework provides an organized basis for insightful discussion and information sharing, which could improve the quality of the choices and decisions that managers subsequently make (Pearce & Robinson, 2005). A SWOT analysis involves the identification and summarization of internal and external environmental factors that are most important to the enterprise's future (Kahraman, Demirel, & Demirel, 2007). The internal environmental factors are the variables that are within the control of the organization, such as its strengths and weaknesses. The external environmental factors are the variables that are out of the control of the organization, such as the opportunities and threats to the organization arising from external factors. The objective of a SWOT analysis is to identify these variables in order to develop and adopt a strategy that is a good fit between the internal and external factors, which are also referred to as strategic factors. It helps achieve the strategic objectives that correspond to an organization's resources and environmental opportunities (Pike, 2008). This tool helps utilize the strengths, take advantage of the opportunities, tackle the weaknesses and mitigate the threats. A SWOT analysis helps an organization decide how it can utilize its strengths, take advantage of the opportunities, overcome weaknesses and deal with existing threats. (Lumaksuno, 2008). It is also an effective tool for achieving the strategic objectives that correspond with an organization's resources and environmental opportunities.

### 2.2. Analytical Hierarchy Process

The AHP is an approach that is widely used in ranking or prioritizing multiple alternatives based on Multi-Criteria Decision Analysis. In this process, weights are assigned to compare certain criteria or alternatives, which are identified as factors influencing the decision making (Gorener, Toker, & Ullucay, 2012). This process provides flexibility for decision making as well as for ranking and prioritizing problems. Researchers use this tool to manage and formulate the hierarchy model in prioritizing the available alternatives. With this approach, subjective criteria can be quantitatively analyzed.


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The AHP helps express the decision by decomposing a complicated problem into a multilevel hierarchical structure of objective or goal, criteria/sub-criteria and decision alternatives. In this process, pairwise comparisons of the criteria are done to derive the relative importance of the variable at each level of the hierarchy. The AHP is used to determine relative priorities on absolute scales from both discrete and continuous paired comparisons in multilevel hierarchic structures (Saaty & Vargas, 1996). The prioritization mechanism is executed by assigning a number from a comparison scale developed by Saaty (1980) to represent the relative importance of the criteria. Pairwise comparison matrices of these factors are analyzed to determine the importance of the factors (Sharma, Moon, & Bae, 2008). This method uses a reciprocal decision matrix obtained by pairwise comparisons so that the information is given in a linguistic form.

The AHP method is conducted in three steps. In the initial step, the AHP model structure is set up as a hierarchy of several levels using research goals, analysis criteria and sub-criteria and the decision alternatives (Gorener, Toker, & Ullucay, 2012). In the second step, a comparative judgment of decision alternatives is done based on the various elements of the criteria/sub-criteria based on the pairwise comparison table. In the third step, a synthesis of the priorities is done to identify the best decision alternative. The research objective, decision criteria and alternatives are arranged in a hierarchical structure similar to a family tree. A complete hierarchy has at least three levels as follows: goal of the problem at the top, multiple criteria based on which the decision is to be made in the middle, and decision alternatives at the bottom (Albayrk & Erensal, 2004).

In this study, we used the AHP for prioritization of the SWOT elements of the NEA (NEA, 2018) to recommend the best strategy formulation by identifying the most important element in each group of the criteria. For this, the problem has been decomposed and a hierarchy has been constructed (Dagdeviren & Yavuz, 2009). The prioritization procedure is carried out in order to determine the relative importance of each element in each set of the criteria and also the relative importance among the different sets of criteria. For each group of the identified criteria (Strength, Weakness, Opportunities and Threats), multiple pairwise comparisons of the elements within the criteria were done based on the standardized comparison scale of nine levels as shown in Table 3 (Albayrk & Erensal, 2004).

Table 3
Comparison scale for pairwise comparison matrix under the AHP model

| Importance | Explanation |
|---|---|
| 1 | Two criteria contribute equally to the objective |
| 3 | Importance of criteria i is slightly higher than that of j towards the objective |
| 5 | Importance of criteria i is strongly higher than that of j towards the objective |
| 7 | Importance of criteria i is very strongly higher than that of j towards the objective |
| 9 | Importance of criteria i is absolutely higher than that of j towards the objective |
| 2, 4, 6, 8 | Used to represent intermediate values |

Reciprocal values are used if criteria j is more important than criteria i.


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Let $C = \{C_j \mid j = 1, 2, . . . , n\}$ be a criteria set (one of the 4 criteria: Strength, Weakness, Opportunity, Threat of the NEA), where n is the number of elements in each criteria set. The pairwise comparison obtained from the respondents on *n* elements of each matrix can be summarized (by averaging the response values from each respondent) in a Paired Comparison Matrix of size *n* x *n*. This pairwise comparison can be shown by a square and reciprocal matrix $a_{ij}$ as shown in Equation 1.

$$A = a_{ij} = \begin{matrix} a_{11} & a_{12} \cdots & a_{1n} \\ a_{21} & a_{22} \cdots & a_{2n} \\ a_{n1} & a_{n2} & a_{nn} \end{matrix} \quad (1)$$

The pairwise comparison matrix is normalized by dividing each element in the matrix by the sum of the elements in the corresponding column. Normalization of the matrix gives relative weights of each sub-criterion on the basis of which, ranking of the sub-criteria can be done. This normalized relative weight of each element is obtained by calculating the normalized Eigen Vector of size n x 1 (w), corresponding to the largest Eigen Value as shown in Equation 2. The normalized Eigen Vector is also known as the Priority Vector. The sum of all elements of the priority vector is 1. It shows the relative weights among the elements within each criteria set.

$$Aw = \lambda_{max}.w \quad (2)$$

The quality of the output of an AHP analysis is dependent on the consistency of the pairwise comparison judgments. Consistency of the pairwise comparison is defined by the relation between the elements of matrix A as shown in Equation 3 (Dagdeviren & Yavuz, 2009).

$$a_{ij} \text{ x } a_{jk} = a_i \quad (3)$$

If a matrix is absolutely consistent or if it exists in the ideal case of total consistency, the principal eigenvalue ($\lambda_{max}$) is equal to n (Alonso & Lamata, 2006). For a pairwise comparison, the Consistency Index (CI) can be calculated using the following formula defined by Saaty as shown in Equation 4.

$$CI = \frac{\lambda max - n}{n-1} \quad (4)$$

This means that for an absolutely consistent matrix, CI=0; however, it is unrealistic to obtain such a comparison matrix due to the inherent nature of human responses. If the responses are not absolutely consistent, $\lambda_{max} > n$, then the level of inconsistency needs to be measured. For this purpose, Saaty defined the Consistency Ratio (CR) as depicted in Equation 5.

$$CR = \frac{CI}{RI} \quad (5)$$

In the above equation, RI is the average value of CI for randomly generated matrices using the Saaty scale (Forman, 1990). For n up to 10, the values of RI as shown in Table 4 were used in this study (Borajee & Yakchali, 2011).


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Table 4
Values of Random Index for n 1-10

| n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| RI | 0.00 | 0.00 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

Different values of RI for different values of n have been obtained by various studies (Forman, 1990) (Golden & Wang, 1990) (Saaty, 1980) (Alonso & Lamata, 2006) depending on the simulation method and the number of randomly generated matrices used for the study. In this study, for n > 10, the RI values obtained by using 500,000 randomly generated matrices in a study were used as shown in Table 5 (Alonso & Lamata, 2006). Only a matrix with CR < 0.1 is accepted (Alonso & Lamata, 2006). If the Consistency Ratio exceeds 0.1, the evaluation procedure needs to be repeated to improve consistency (Borajee & Yakchali, 2011).

Table 5
Values of Random Index for n > 10 (Alonso & Lamata, 2006)

| N | RI |
|---|---|
| 3 | 0.5247 |
| 4 | 0.8816 |
| 5 | 1.1086 |
| 6 | 1.2479 |
| 7 | 1.3417 |
| 8 | 1.4057 |
| 9 | 1.4499 |
| 10 | 1.4854 |
| 11 | 1.5140 |
| 12 | 1.5365 |
| 13 | 1.5551 |
| 14 | 1.5713 |
| 15 | 1.5838 |

**2.3. SWOT-AHP model**

The SWOT analysis has been widely used in various studies and research for identification of the critical factors in each group (Strength, Weakness, Opportunity and Threat) that influences an organization's strategy. The use of a SWOT analysis has some limitations. It only helps identify the important elements in each group, but does not prioritize the elements. It also does not suggest which element is most important or critical among all the identified elements. In other words, it does not indicate the weightage of the factors to determine the effect of each factor on the proposed alternatives (Yuksel & Dagdeviren, 2007). A SWOT analysis is subjective or qualitative and reflects the biases and experiences of the individuals. Therefore, it is impossible to obtain objective or quantitative data relating to the issue. To improve the usefulness of the results obtained from a SWOT analysis, the SWOT framework can be restructured into a hierarchic structure and integrated and analyzed using the AHP (Kurttila, Pesonen, Kangas, & Kajanus, 2000).

The AHP can provide a quantitative measure of the importance of each SWOT factor obtained during the study. The analysis based on the SWOT-AHP hybrid method has been used in various areas of study such as transportation, agriculture, tourism,


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management, manufacturing, etc. (Jaroslaw & Krzysztof, 2017; Wickramasinghe & Takano, 2010; Yuksek & Akin, 2006).

In a recent study, the AHP-SWOT model was used to make an assessment of opportunities and challenges for cross-border electricity trade with Bangladesh (Haque, Dhakal, & Mostafa, 2019). In another recent study regarding the electricity sector of EU and Ukraine, an AHP-based comparative analysis of electricity generating portfolios was conducted to explain which energy technology best meets the needs of the companies through the mechanism of quantitative assessment (Volodymyr & Pasichna, n.d.).

A SWOT analysis and the AHP are combined to create a hybrid SWOT-AHP model that utilizes the advantages of both methods. The steps of SWOT-AHP analysis are as follows (Gallego-Ayala & Juizo, 2011):

1. SWOT analysis considering the internal and external factors
2. Paired comparison between the elements of each SWOT group
3. Paired comparison between the four SWOT groups
4. AHP calculation to determine the priority vector for each element within the SWOT groups and also the relative priority for the four SWOT groups
5. Strategy formulation from the results

## 3. SWOT analysis of the NEA

Being the largest state-owned utility in Nepal, the NEA must deal with strength, weakness, opportunities, and threats factors. It is necessary to conduct a strategic analysis of the organization to fulfill the entire mandate from the government. It would be naive to develop a goal-setting strategy without considering the organization's strengths and shortcomings, as well as the competitive environment (Tshombe, 2013). From a review of several works of literature related to the energy sector in Nepal, such as plans and policies including periodical plans and annual budgets of the government, occasional medium- and long-term policies published by the Ministry of Energy, Water Resources and Irrigation, Annual Reports and the recently published five-year corporate development plan of the NEA, several factors were identified as internal and external factors influencing the overall operation and future strategies of the NEA. These findings were used to develop the questionnaire used in this research. The following strengths, weaknesses, opportunities and threats of the NEA have been referenced from the recent five-year corporate development plan of the NEA (NEA, 2018).

**Strengths:**

(a) Monopoly (single seller) and monopsony (single buyer) market of an essential service

Due to the vertically integrated and regulated structure of Nepal's energy sector, the NEA is the single buyer of electricity so far in the country. All Power Purchase Agreements (PPAs) with electricity generators are done with the NEA. Similarly, the NEA is the only retail supplier of electricity to consumers. All domestic and non-domestic consumers in Nepal have no other alternative for purchasing electricity.

(b) Huge domestic demand for electricity and energy services


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Nepal has very low electricity consumption. The per capita electricity consumption is below 300 kWh per annum. Currently, 22% of the Nepalese population is living without access to grid connected electricity. The Ministry of Energy, Water Resources and Irrigation has committed to increase the per capita energy consumption to 700 MW in the next five years (NEA, 2019). There is a huge amount of room for industrial and commercial growth in Nepal that will induce increased demand for electricity. This is an opportunity for the NEA to further expand its business in the future.

(c) Ability to access relatively cheaper sources of capital from Government, Public and international multilateral banks/donors
The NEA is a public entity with 100% shareholding of the Government of Nepal. This enables the NEA to access relatively cheaper sources of capital and funds in non-commercial terms from the Government and multilateral banks, such as World Bank, ADB, AIIB, etc.

(d) Nationwide electricity distribution network
One of the main business areas of the NEA is the transmission of electricity. For this purpose, the NEA has constructed a wide network of high voltage and low voltage transmission lines throughout the country. The government of Nepal and the NEA have made huge investments in the expansion of the existing network to cater to the increasing generation and electricity demand.

(e) Network of 4 million customers
Since it is a monopoly, the NEA has a huge customer base of over 4 million customers comprising both domestic and industrial customers. The number of consumers is expected to increase every year, creating further business opportunities for the NEA.

(f) Improved brand name and public good will
With recent operational and managerial improvements and the elimination of the chronic load shedding that had been hampering the country's economy for almost a decade, the public image of the NEA has improved. The organization has also gained the confidence of the government and multilateral donor agencies.

(g) Human resources with strong technical skills
The NEA recruits its employees through a competitive process to attract highly qualified and skilled human resources. This is a strength of the organization.

**Weaknesses:**

(a) Insufficient and inefficient transmission and distribution network
The existing transmission and distribution network operated by the NEA is not sufficient to cater to the electricity demand of all domestic and industrial customers in the whole country. Even though the electricity generation is sufficient, the NEA is not able to supply electricity to all prospective customers because of the lack of sufficient transmission and reliable distribution network.

(b) Poor and unsatisfactory quality of power particularly in rural areas
Due to the infrastructure that is poor and old, it is difficult to provide quality and reliable electricity, mainly in rural areas with low electricity demand.

(c) Lack of focus on customer service and customer experience


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The NEA has a considerable lack of focus on customer service and feedback on customer experience.

(d) Weak project management, procurement and contract management capacity
Past records show that most of the projects owned and executed by the NEA have not been completed within the stipulated time. There are several managerial and contractual weaknesses that hinder the organization in completing the projects on time and within a prefixed budget. Similarly, procurement processes take a long time and there are no procurement specialists within the organization.

(e) High internal construction and operation costs
The operational costs of the NEA are quite high mainly due to the large number of employees (over 12,000).

(f) Lack of automated data collection and analysis of its operations
The NEA does not have state of the art IT technology in all sectors of its operations. Many processes are still handled manually. However, there has been considerable improvement in the use of ICT in recent years.

(g) Mismatch between demand and supply
Currently, one of the main problems the organization is facing is the mismatch between the supply and demand of electricity. The energy demand in INPS is around 7,318 Gwh (NEA, 2021), but only 60% of the energy is available from domestic generation by IPPs and NEA hydro plants. The NEA has been importing the remaining 40% of the energy from different cross-border connections between Nepal and India. The total installed capacity (including NEA's own generation and power purchased from the IPPs) is around 2,000 MW, but the peak demand has been recorded to be just over 1,600 MW.

(h) Traditional operating and management system
The NEA has adopted the traditional bureaucratic management system. This is considered a weakness since the traditional approach of management causes delays in decision making and involves weak supervision and monitoring.

(i) Lack of energy storage capacity
Out of the total installed capacity of around 2,000 MW in Nepal, only 92 MW are operated as a reservoir based plant. All the remaining capacity is installed either as Runoff River or Peaking Runoff River power plants. This has severely handicapped the energy storage capacity of the nation.

(j) Limited transmission capacity with neighboring countries
Although Nepal has a huge prospect of energy trade with neighboring countries, primarily India and Bangladesh, the NEA has not been able to conduct cross-border energy banking or trading in real commercial terms. This is mainly because of the lack of interconnection infrastructure with India and Bangladesh.

(k) Rural electrification expense to expand network into remote, distant and disperse locations
Many rural and remote areas of Nepal have poor road access and low electricity demand. Due to the unfavorable geographic conditions, difficult terrain and low power demand of such places, it is cost intensive for the NEA to provide infrastructure for transmission and distribution to those places.

**Opportunities:**

(a) Long-term growth for demand of electricity
There is a huge prospect for an increase in electricity demand in Nepal, which is expected to grow rapidly with the increase in commercial and industrial activities in the future.

(b) Reduction of cost of energy through trade and economies of scale as the power system expands
The NEA has an opportunity to reduce the cost of electricity generation through economies of scale. The new technologies in electricity generation help reduce the cost of generation as the power sector expands.

(c) Export and trade of power
As mentioned in the previous section, Nepal has a huge prospect of energy trade with its neighboring countries. This is an opportunity for the NEA to expand its business across the national borders and contribute to decreasing Nepal's trade deficit.

(d) Energy banking to meet deficit demand in dry season
Given the seasonal variation, power plants in Nepal generate electricity above the demand in monsoon season (May-October); however, the generation of energy is reduced to almost a third of that in the dry season (November to April). Thus, the energy supply is short of the demand in the dry season. This provides an opportunity for Nepal to conduct energy banking with India which experiences an energy surplus in the dry season due to the easy availability of coal and deficit in the monsoon season.

(e) Improve utility efficiency through automation, digitization and use of centrally integrated software
The NEA has an opportunity to integrate the processes and data related to all of its business units by implementing efficient Enterprise Resources Planning software. Recently, the organization has gained considerable success in automation and digitization of its processes by the implementation of integrated software related to human resources, bookkeeping, revenue collection, etc.

(f) Improve profits and reduce cost of supply by decreasing aggregate technical and commercial losses
Due to recent improvement in transmission and the distribution technology and reduction of technical and non-technical losses, the NEA has the opportunity to improve its profits and reduce the cost of supply.

(g) Make energy system more efficient through demand side management tools
There is an opportunity for the NEA to adopt demand side management tools aimed at increasing energy efficiency, which is an important sector of priority for the organization.

(h) Expand market by adding 2 million customers
Due to the increasing commercial activities and prospects for industrialization of the country, the NEA has the opportunity to increase its customer base by at least 2 million in the near future.

(i) Increased operational and financial efficiency through restructuring


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The government has felt the need to restructure the current vertically integrated structure of the NEA and deregulate the energy market in Nepal (Karmacharya, 2012). There is an opportunity for the NEA to increase its operational and financial efficiency in the process of and after complete restructuring.

(j) Expand and upgrade transmission and distribution operations
The NEA has the opportunity to expand its transmission and distribution network to new load centers and upgrade the existing transmission and distribution infrastructure.

**Threats:**

(a) High cost of capital to finance capital expenditure plans
Hydropower and other energy projects (solar energy, transmission lines, etc.) are highly capital intensive projects and require funding from different national and international sources. The financial feasibility of any project is always a major concern for both debt and equity investors. The volatile nature of the cost of capital and the intrinsically high investment requirement of energy projects poses a threat to the NEA in arranging funds to finance such projects.

(b) Adverse effects of climate change and extreme weather patterns on hydrology and structures
Due to the rapidly increasing effects of climate change and global warming that cause unpredicted climate patterns and flow patterns in rivers, hydropower projects with which the NEA has signed a PPA may not be able to generate the contracted quantum of energy, thus hampering the financial condition of the NEA.

(c) New regulatory regime and delays in tariff reviews
In Nepal, electricity tariff review is done annually by the Electricity Regulatory Commission on the basis of recommendations from the NEA. Any delay caused by the Electricity Regulatory Commission (ERC) in reviewing the tariff will cause problems in the NEA's financial operations. Similarly, adverse changes in the regulatory regime, which generally happens in Nepal, also pose a threat to the NEA.

(d) Distribution and self-generation by customers reduces the quantum and increases variability of demand
Captive generation of energy by using alternative sources such as diesel generators in the domestic as well as industrial sector makes the forecasting of energy demand difficult and also reduces the quantum of energy that the NEA can sell to its consumers.

(e) Economic slowdown or failure of economy to grow as projected in the demand forecast will result in excess capacity
Nepal is a developing country with a very low level of industrial activities. There are no large manufacturing plants that can increase the demand of electricity. This failure of growth in the economy as predicted and desired by the government has caused the electricity demand to be less than the actual generation by plants under operation. This has resulted in excess supply and spillage of valuable energy.

(f) Inability to absorb all new generation that the NEA has signed take-or-pay contracts with IPPs


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Due to less demand of electricity as compared to generation, and a lack of sufficient transmission and distribution infrastructure, the NEA is not in a position to absorb the generation of all the projects with which it has signed a take-or-pay PPA. This will result in the NEA continuing to make payments to the IPPs without absorbing the power generated by them.

(g) New levies and taxes imposed by local, provincial and federal governments
The unchecked and unsystematic levies and taxes imposed by the local, provincial and federal governments under various headings are the cause of increasing expenses to energy projects and the NEA overall.

(h) Potential complications due to federal restructuring
Nepal has recently transitioned to the federal system of government from the centrally controlled unified form. The federal system is still in the process of complete institutionalization. This causes unforeseen complications in the operations of the NEA, which is still functioning as a centrally controlled entity of the government.

(i) Adverse movement in the dollar and other foreign currencies
Any adverse movement in foreign currencies will affect the financial condition of the NEA, especially with regard to international procurement and foreign currency denominated PPAs.

(j) Inability to engage in trade of electricity with neighboring countries due to political and economic reasons.
Apart from the lack of sufficient cross border transmission infrastructure, the NEA's plan to engage in electricity trading with neighboring countries is hampered by the geo-political complications in the region. For instance, India has not shown sufficient political willpower to purchase electricity generated in Nepal and is also reluctant to provide land to connect Nepal and Bangladesh.

(k) Theft and leakage of electricity and collection losses
Pilferage and leakage of electricity and collection losses is another major threat to the NEA. The annual losses from this amount to 15-20% of the actual generation of energy.

(l) Delay in construction of projects due to social and/or legal issues such as resettlement, right of way and local shares
The NEA faces social issues related to resettlement and compensation during construction of generation and transmission line projects. This causes unwarranted delays in project completion. Lengthy and difficult provisions related to forest clearance, lack of timely site availability, and high expectations of local people for the project are the main challenges faced by the NEA. (Regmi & Mandal, 2020). It is a major threat for the organization which hampers its overall business and functions.

## 4. Methodology and application

The purpose of utilizing the AHP with a SWOT analysis in this study is to qualify the SWOT factors and evaluate their intensities. In this study, a SWOT analysis and the AHP were combined to create a hybrid SWOT-AHP model that utilizes the advantages of both methods of research. The steps of the SWOT-AHP analysis used in this study are as follows:

1. SWOT analysis of the NEA by listing the important internal and external factors for strategic planning (NEA, 2018)
2. Paired comparison between the elements of each SWOT group
3. Paired comparison between the four SWOT groups
4. AHP calculation:
   a. Computation of the local priority vector for each element within the SWOT groups
   b. Computation of group relative priority for the 4 SWOT groups as a single matrix
   c. Calculation of overall priority of each element (local priority multiplied by the group priority)
5. Strategy formulation from the results

The AHP-SWOT combination is carried out in five stages as shown in Figure 1 (Fadim Yavuz, 2014).

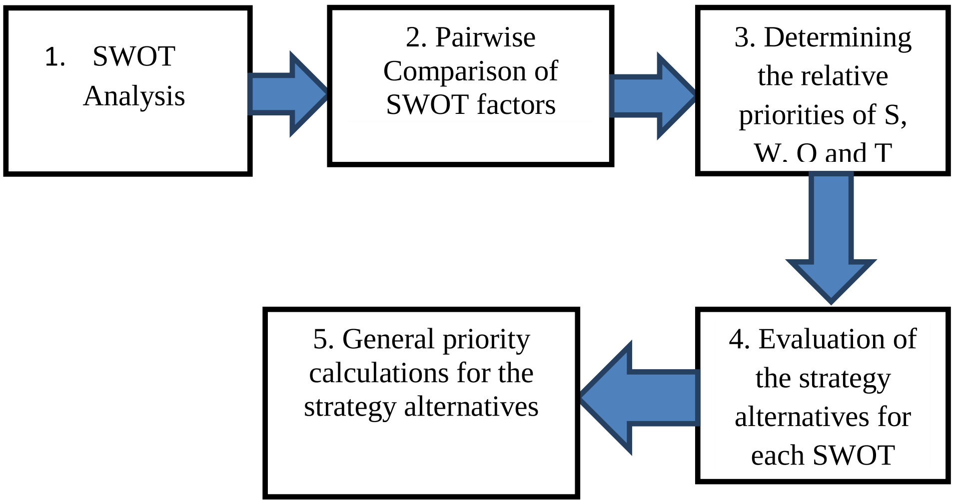


Figure 1 Stages of the study

In the first stage, a review of the literature relevant to the NEA, its business operations and factors influencing its current and future strategies was prepared. Based on the review, various factors related to the internal and external environment of the organization were identified. These factors are positive influencers (strengths and opportunities) and negative influencers (opportunities and threats) (explained in detail in Section 3). In the second stage, a SWOT analysis of the NEA was done by analyzing the elements identified in the previous stage. Table 6 shows the SWOT matrix or model of the NEA used in this study. The elements in each group have been briefly described.


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Table 6
SWOT analysis of the NEA

| STRENGTHS | WEAKNESSES |
|---|---|
| S1: Monopoly (single seller) and monopsony (single buyer) market of an essential service<br>S2: Huge domestic demand for electricity and energy services<br>S3: Ability to access relatively cheaper sources of capital from Government, Public and international multilateral banks/ donors<br>S4: Nationwide electricity distribution network<br>S5: Network of 4 million customers<br>S6: Improved brand name and public good will<br>S7: Human resources with strong technical skills | W1: Insufficient and inefficient transmission and distribution network<br>W2: Poor and unsatisfactory quality of power, particularly in rural areas<br>W3: Lack of focus on customer service and customer experience<br>W4: Weak project management, procurement and contract management capacity<br>W5: High internal construction and operation costs<br>W6: Lack of automated data collection and analysis of its operations<br>W7: Mismatch between demand and supply<br>W8: Traditional operating and management system<br>W9: Lack of energy storage capacity<br>W10: Limited transmission interconnection capacity with neighboring countries<br>W11: Rural electrification expense to expand network into remote, distant and disperse locations |
| OPPORTUNITIES | THREATS |
| O1: Long-term growth for demand of electricity<br>O2: Reduce cost of energy through trade and economies of scale as the power system expands<br>O3: Export and trade of power<br>O4: Energy banking to meet deficit demand in dry season<br>O5: Improve utility efficiency through automation, digitization and use of centrally integrated software<br>O6: Improve profits and reduce cost of supply via decrease in AT&C losses<br>O7: Make energy system more efficient through demand side management tools<br>O8: Expand market by adding 2 million new customers<br>O9: Increased operational and financial efficiency through restructuring<br>O10: Expand and upgrade transmission and distribution operations | T1: High cost of capital to finance capital expenditure plans<br>T2: Adverse effects of climate change and extreme weather patterns on hydrology and structures<br>T3: New regulatory regime and delays in tariff reviews<br>T4: Distribution and self-generation by customers reduces quantum and increases variability of demand<br>T5: Economic slowdown or failure of economy to grow as projected in the demand forecast will result in excess capacity<br>T6: Inability to absorb all new generation that NEA has signed take-or-pay contracts with IPPs<br>T7: New levies and taxes imposed by local, provincial and federal governments<br>T8: Potential complications due to federal restructuring<br>T9: Adverse movement in the dollar |

| | |
|---|---|
| | and other foreign currencies<br>T10: Inability to engage in trade of electricity with neighboring countries due to political and economic reasons<br>T11: Theft and leakage of electricity and collection losses<br>T12: Delay in construction of projects due to social and/or legal issues such as resettlement, right of way and local shares |

In the third stage of the study, a SWOT-AHP model was developed. The model used in this study is depicted in Figure 2.

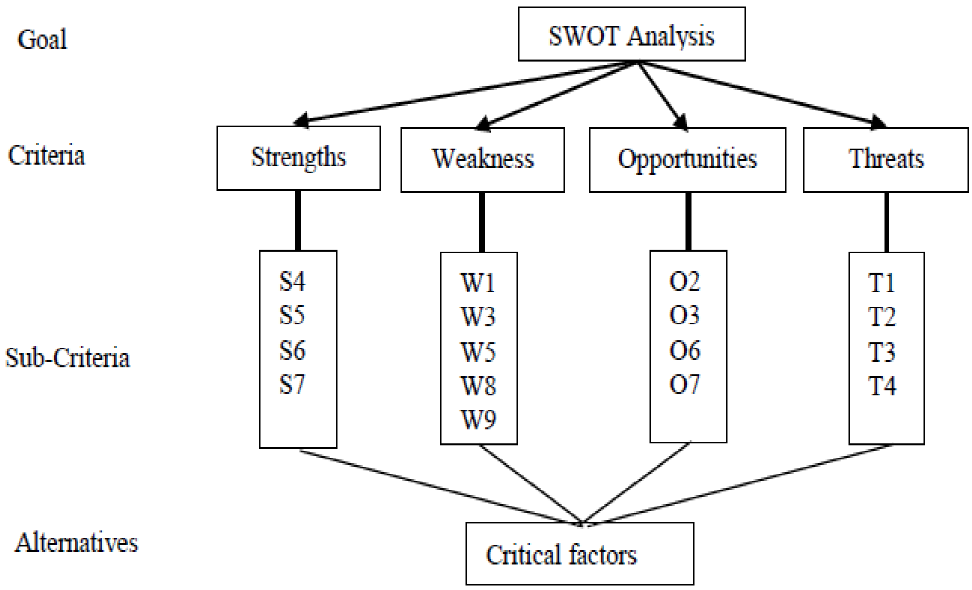


Figure 2 Hierarchical structure of the SWOT matrix

The hierarchical AHP structure is divided into 3 levels. The first level is the goal of the study which is to identify the major organizational strategies related to the internal and external environment of the NEA that it is recommended they follow. The second level comprises the criteria or factors under study. For the current study, these factors are the SWOT groups. The third level is the sub-criteria or the elements within each SWOT group. The AHP was applied to the SWOT matrix. For this purpose, a set of questions was developed. The questionnaire was distributed to 61 experts working in the energy sector in Nepal who are in decision making and managerial positions, as shown in Table 7. The questionnaire was completed by 38 respondents, with seven incomplete responses. These seven responses were rejected and only the 31 complete responses were considered for further analysis. The respondents include representatives of NEA employees, employees of the independent power producers of Nepal (IPPs), the Ministry of Energy, Water Resources and Irrigation (MoEWRI) and donor agencies. The experts were asked to conduct pairwise comparisons of the SWOT factors using Saaty's comparison scale. It was also used to make pairwise


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comparison between the four SWOT groups. After collecting the responses from the experts, all data were input in a MS-Excel spreadsheet for further analysis.

These pairwise calculations were then analyzed to obtain the following scores (Dhakal, Karki, & Shrestha, 2019) :

- Relative importance/weight of SWOT groups
- Local priority scores (the relative weights of factors within the same SWOT group)
- Global priority scores (the overall relative weights of a factor considering the weights of all four SWOT groups)
- Strategy formulation

The respondents were identified through purposive sampling. The professionals having significant years of relevant experience were selected for the questionnaire survey.

Table 7
List of respondents for questionnaire survey

| Category | Participants | Response received | Response percentage | Rejected | Responses used for further analysis |
|---|---|---|---|---|---|
| NEA | 30 | 21 | 70 | 3 | 18 |
| MoEWRI | 10 | 8 | 80 | 2 | 6 |
| IPPs | 15 | 7 | 46.7 | 2 | 5 |
| Donors | 6 | 2 | 33.3 | 0 | 2 |
| Total | 61 | 38 | 62.3 | 7 | 31 |

## 5. Results and Discussion

The results of the pairwise comparison and priority vectors (weightage) of all the elements in each SWOT group as well as the calculation of the Reliability Index are presented and discussed in Tables 9-20. Similarly, the comparison result along with the calculation of priority vectors (weightage) of the SWOT factors and the Reliability Index are depicted in Tables 21-24. Table 6 shows the calculations for validity and reliability in the survey.

Cronbach's coefficient alpha, "α" was used to test the reliability of the survey as shown in Table 8. The acceptable lower limit for Cronbach's alpha is usually considered to be 0.7, although values as low as 0.6 are sometimes acceptable for exploratory research (Hair et al., 1998).

Table 8
Validity and reliability of factors

| Group Factors | N of items | Cronbach's Alpha ($\alpha$) |
|---|---|---|
| Strength | 21 | 0.850 |
| Weakness | 55 | 0.900 |
| Opportunity | 45 | 0.940 |
| Threats | 66 | 0.960 |
| Cronbach's alpha ($\alpha$) | | 0.925 |


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Since the average value of coefficient of alpha is more than 0.7, i.e. 0.925, our survey is acceptable and the overall reliability of the questionnaire is found to be good.

Table 9
Pairwise Comparison Matrix of the elements within the strength criteria

| Factor | S1 | S2 | S3 | S4 | S5 | S6 | S7 |
|---|---|---|---|---|---|---|---|
| S1 | 1.00 | 2.68 | 1.64 | 2.50 | 2.57 | 2.58 | 3.24 |
| S2 | 0.37 | 1.00 | 0.31 | 1.96 | 2.50 | 3.01 | 3.08 |
| S3 | 0.61 | 3.25 | 1.00 | 2.72 | 2.86 | 2.47 | 3.69 |
| S4 | 0.40 | 0.51 | 0.37 | 1.00 | 3.15 | 3.55 | 3.90 |
| S5 | 0.39 | 0.40 | 0.35 | 0.32 | 1.00 | 3.26 | 3.06 |
| S6 | 0.39 | 0.33 | 0.40 | 0.28 | 0.31 | 1.00 | 2.43 |
| S7 | 0.31 | 0.33 | 0.27 | 0.26 | 0.33 | 0.41 | 1.00 |
| Sum | 3.47 | 8.50 | 4.34 | 9.04 | 12.72 | 16.28 | 20.39 |

Table 10
Normalized Pairwise Comparison Matrix of the elements within the strength criteria

| Factor | S1 | S2 | S3 | S4 | S5 | S6 | S7 | Priority Vector (PV) | Rank |
|---|---|---|---|---|---|---|---|---|---|
| S1 | 0.29 | 0.32 | 0.38 | 0.28 | 0.20 | 0.16 | 0.16 | 0.254 | 1 |
| S2 | 0.11 | 0.12 | 0.07 | 0.22 | 0.20 | 0.18 | 0.15 | 0.149 | 4 |
| S3 | 0.18 | 0.38 | 0.23 | 0.30 | 0.23 | 0.15 | 0.18 | 0.236 | 2 |
| S4 | 0.12 | 0.06 | 0.08 | 0.11 | 0.25 | 0.22 | 0.19 | 0.147 | 3 |
| S5 | 0.11 | 0.05 | 0.08 | 0.04 | 0.08 | 0.20 | 0.15 | 0.101 | 5 |
| S6 | 0.11 | 0.04 | 0.09 | 0.03 | 0.02 | 0.06 | 0.12 | 0.069 | 6 |
| S7 | 0.09 | 0.04 | 0.06 | 0.03 | 0.03 | 0.03 | 0.05 | 0.045 | 7 |
| Sum | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |

The results from Table 10 show that sub-criteria S1 (monopoly (single seller) and monopsony (single buyer) market of an essential service) account for over 25% of all the strength elements. The respondents perceive this element to be the most important element among the strength elements.


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Table 11
Calculation of Maximum Eigen Value (λ max) and Consistency Ratio for the strength criteria

| Factor | S1 (1) | S2 (2) | S3 (3) | S4 (4) | S5 (5) | S6 (6) | S7 (7) | Sum (8) | Sum/PV (9) |
|---|---|---|---|---|---|---|---|---|---|
| S1 | 0.25 | 0.40 | 0.39 | 0.37 | 0.26 | 0.18 | 0.15 | 1.99 | 7.83 |
| S2 | 0.09 | 0.15 | 0.07 | 0.29 | 0.25 | 0.21 | 0.14 | 1.20 | 8.05 |
| S3 | 0.16 | 0.49 | 0.24 | 0.40 | 0.29 | 0.17 | 0.17 | 1.90 | 8.07 |
| S4 | 0.10 | 0.08 | 0.09 | 0.15 | 0.32 | 0.24 | 0.18 | 1.15 | 7.82 |
| S5 | 0.10 | 0.06 | 0.08 | 0.05 | 0.10 | 0.22 | 0.14 | 0.75 | 7.46 |
| S6 | 0.10 | 0.05 | 0.10 | 0.04 | 0.03 | 0.07 | 0.11 | 0.49 | 7.21 |
| S7 | 0.08 | 0.05 | 0.06 | 0.04 | 0.03 | 0.03 | 0.05 | 0.33 | 7.37 |

λ max = Average of Column (9) = 7.7
Consistency Index CI = (λ max -n)/n-1 = 0.115 for n=7
Reliability Index (RI) (for n=7) =1.32
Consistency Ratio (CR) = $CI/RI$ = 0.087< 0.1

Table 12
Pairwise Comparison Matrix of the elements within the weakness criteria

| Factor | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| W1 | 1 | 2.06 | 2.43 | 2.18 | 2.41 | 2.12 | 2.85 | 2.19 | 2.57 | 1.04 | 2.38 |
| W2 | 0.48 | 1 | 2.38 | 0.94 | 1.21 | 1.09 | 1.63 | 2.24 | 2.06 | 2.44 | 0.96 |
| W3 | 0.41 | 0.42 | 1 | 0.46 | 1.17 | 1.84 | 2.16 | 1.35 | 1.52 | 1.13 | 1.68 |
| W4 | 0.46 | 1.06 | 2.16 | 1 | 2.18 | 2.08 | 2.24 | 2.33 | 2.43 | 2.31 | 2.86 |
| W5 | 0.42 | 0.83 | 0.85 | 0.46 | 1 | 2.36 | 1.99 | 1.27 | 1.42 | 2.29 | 1.51 |
| W6 | 0.47 | 0.92 | 0.54 | 0.48 | 0.42 | 1 | 1.87 | 1.76 | 1.63 | 2.24 | 2.92 |
| W7 | 0.35 | 0.61 | 0.46 | 0.45 | 0.50 | 0.53 | 1 | 2.84 | 3.34 | 3.41 | 3.08 |
| W8 | 0.46 | 0.45 | 0.74 | 0.43 | 0.79 | 0.57 | 0.35 | 1.00 | 2.80 | 3.09 | 3.55 |
| W9 | 0.39 | 0.48 | 0.66 | 0.41 | 0.70 | 0.62 | 0.30 | 0.36 | 1 | 2.87 | 3.18 |
| W10 | 0.97 | 0.41 | 0.88 | 0.43 | 0.44 | 0.45 | 0.29 | 0.32 | 0.35 | 1.00 | 1.55 |
| W11 | 0.42 | 1.04 | 0.60 | 0.35 | 0.66 | 0.34 | 0.33 | 0.28 | 0.31 | 0.64 | 1 |
| Sum | 5.82 | 9.29 | 12.71 | 7.60 | 11.49 | 13.00 | 15.00 | 15.95 | 19.44 | 22.47 | 24.66 |


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Table 13
Normalized Pairwise Comparison Matrix of the elements within the weakness criteria

| Factor | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | Priority Vector (PV) | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W1 | 0.17 | 0.22 | 0.19 | 0.29 | 0.21 | 0.16 | 0.19 | 0.14 | 0.13 | 0.05 | 0.10 | 0.168 | 1 |
| W2 | 0.08 | 0.11 | 0.19 | 0.12 | 0.11 | 0.08 | 0.11 | 0.14 | 0.11 | 0.11 | 0.04 | 0.109 | 3 |
| W3 | 0.07 | 0.05 | 0.08 | 0.06 | 0.10 | 0.14 | 0.14 | 0.08 | 0.08 | 0.05 | 0.07 | 0.084 | 7 |
| W4 | 0.08 | 0.11 | 0.17 | 0.13 | 0.19 | 0.16 | 0.15 | 0.15 | 0.12 | 0.10 | 0.12 | 0.135 | 2 |
| W5 | 0.07 | 0.09 | 0.07 | 0.06 | 0.09 | 0.18 | 0.13 | 0.08 | 0.07 | 0.10 | 0.06 | 0.091 | 4 |
| W6 | 0.08 | 0.10 | 0.04 | 0.06 | 0.04 | 0.08 | 0.12 | 0.11 | 0.08 | 0.10 | 0.12 | 0.085 | 6 |
| W7 | 0.06 | 0.07 | 0.04 | 0.06 | 0.04 | 0.04 | 0.07 | 0.18 | 0.17 | 0.15 | 0.12 | 0.091 | 5 |
| W8 | 0.08 | 0.05 | 0.06 | 0.06 | 0.07 | 0.04 | 0.02 | 0.06 | 0.14 | 0.14 | 0.14 | 0.079 | 8 |
| W9 | 0.07 | 0.05 | 0.05 | 0.05 | 0.06 | 0.05 | 0.02 | 0.02 | 0.05 | 0.13 | 0.13 | 0.062 | 9 |
| W10 | 0.17 | 0.04 | 0.07 | 0.06 | 0.04 | 0.03 | 0.02 | 0.02 | 0.02 | 0.04 | 0.06 | 0.052 | 10 |
| W11 | 0.07 | 0.11 | 0.05 | 0.05 | 0.06 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 | 0.04 | 0.044 | 11 |
| Sum | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |

It can be stipulated that sub-criteria W1 (Insufficient and inefficient transmission and distribution network) account for about 17% of the total weakness of the NEA. The respondents perceive this element to be the biggest weakness of the NEA.

Table 14
Calculation of Maximum Eigen Value (λ max) and Consistency Ratio for the weakness criteria

| Factor | W1 (1) | W2 (2) | W3 (3) | W4 (4) | W5 (5) | W6 (6) | W7 (7) | W8 (8) | W9 (9) | W10 (10) | W11 (11) | Sum (12) | Sum/PV (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| thW1 | 0.17 | 0.22 | 0.20 | 0.29 | 0.26 | 0.18 | 0.26 | 0.17 | 0.16 | 0.05 | 0.11 | 2.08 | 12.40 |
| W2 | 0.08 | 0.11 | 0.20 | 0.13 | 0.13 | 0.09 | 0.15 | 0.18 | 0.13 | 0.13 | 0.04 | 1.36 | 12.56 |
| W3 | 0.07 | 0.05 | 0.08 | 0.06 | 0.13 | 0.16 | 0.20 | 0.11 | 0.09 | 0.06 | 0.07 | 1.08 | 12.79 |
| W4 | 0.08 | 0.12 | 0.18 | 0.13 | 0.24 | 0.18 | 0.20 | 0.18 | 0.15 | 0.12 | 0.13 | 1.71 | 12.66 |
| W5 | 0.07 | 0.09 | 0.07 | 0.06 | 0.11 | 0.20 | 0.18 | 0.10 | 0.09 | 0.12 | 0.07 | 1.16 | 12.67 |
| W6 | 0.08 | 0.10 | 0.05 | 0.06 | 0.05 | 0.09 | 0.17 | 0.14 | 0.10 | 0.12 | 0.13 | 1.08 | 12.64 |
| W7 | 0.06 | 0.07 | 0.04 | 0.06 | 0.05 | 0.05 | 0.09 | 0.22 | 0.21 | 0.18 | 0.14 | 1.16 | 12.77 |
| W8 | 0.08 | 0.05 | 0.06 | 0.06 | 0.09 | 0.05 | 0.03 | 0.08 | 0.17 | 0.16 | 0.16 | 0.98 | 12.48 |
| W9 | 0.07 | 0.05 | 0.06 | 0.06 | 0.08 | 0.05 | 0.03 | 0.03 | 0.06 | 0.15 | 0.14 | 0.76 | 12.30 |
| W10 | 0.16 | 0.04 | 0.07 | 0.06 | 0.05 | 0.04 | 0.03 | 0.03 | 0.02 | 0.05 | 0.07 | 0.62 | 11.87 |
| W11 | 0.07 | 0.11 | 0.05 | 0.05 | 0.07 | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 | 0.04 | 0.53 | 12.00 |

λ max = Average of Column (13) = 12.47
Consistency Index CI = (λ max -n)/n-1 = 0.147 for n=11
Reliability Index (RI) (for n=11) =1.514
Consistency Ratio (CR) = $CI/RI$ = 0.097< 0.1


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Table 15
Pairwise Comparison Matrix of the elements within the opportunity criteria

| Factor | O1 | O2 | O3 | O4 | O5 | O6 | O7 | O8 | O9 | O10 |
|---|---|---|---|---|---|---|---|---|---|---|
| O1 | 1 | 3.45 | 3.74 | 3.25 | 3.28 | 2.73 | 2.79 | 3.32 | 1.18 | 3.00 |
| O2 | 0.29 | 1 | 3.94 | 0.56 | 0.97 | 1.53 | 1.91 | 0.99 | 2.44 | 2.87 |
| O3 | 0.27 | 0.25 | 1 | 2.44 | 2.87 | 2.66 | 2.71 | 2.58 | 2.55 | 2.84 |
| O4 | 0.31 | 1.79 | 0.41 | 1 | 2.62 | 2.67 | 2.91 | 3.05 | 2.70 | 2.64 |
| O5 | 0.31 | 1.03 | 0.35 | 0.38 | 1 | 2.34 | 2.62 | 2.68 | 2.76 | 2.91 |
| O6 | 0.30 | 0.66 | 0.38 | 0.37 | 0.43 | 1 | 2.28 | 2.98 | 3.26 | 2.68 |
| O7 | 0.37 | 0.52 | 0.37 | 0.34 | 0.38 | 0.44 | 1 | 2.14 | 2.92 | 2.66 |
| O8 | 0.36 | 1.01 | 0.39 | 0.33 | 0.37 | 0.34 | 0.47 | 1 | 2.12 | 2.24 |
| O9 | 0.30 | 0.41 | 0.39 | 0.37 | 0.36 | 0.31 | 0.47 | 0.47 | 1 | 2.73 |
| O10 | 0.84 | 0.35 | 0.39 | 0.38 | 0.34 | 0.37 | 0.38 | 0.45 | 0.37 | 1 |
| Sum | 4.35 | 10.47 | 11.36 | 9.42 | 12.62 | 14.39 | 17.54 | 19.66 | 21.3 | 25.57 |

Table 16
Normalized Pairwise Comparison Matrix of the elements within the opportunity criteria

| Factor | O1 | O2 | O3 | O4 | O5 | O6 | O7 | O8 | O9 | O10 | Priority Vector (PV) | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O1 | 0.23 | 0.33 | 0.33 | 0.35 | 0.26 | 0.19 | 0.16 | 0.17 | 0.06 | 0.12 | 0.219 | 1 |
| O2 | 0.07 | 0.10 | 0.35 | 0.06 | 0.08 | 0.11 | 0.11 | 0.05 | 0.11 | 0.11 | 0.114 | 4 |
| O3 | 0.06 | 0.02 | 0.09 | 0.26 | 0.23 | 0.18 | 0.15 | 0.13 | 0.12 | 0.11 | 0.136 | 2 |
| O4 | 0.07 | 0.17 | 0.04 | 0.11 | 0.21 | 0.19 | 0.17 | 0.15 | 0.13 | 0.10 | 0.133 | 3 |
| O5 | 0.07 | 0.10 | 0.03 | 0.04 | 0.08 | 0.16 | 0.15 | 0.14 | 0.13 | 0.11 | 0.101 | 5 |
| O6 | 0.07 | 0.06 | 0.03 | 0.04 | 0.03 | 0.07 | 0.13 | 0.15 | 0.15 | 0.10 | 0.085 | 6 |
| O7 | 0.08 | 0.05 | 0.03 | 0.04 | 0.03 | 0.03 | 0.06 | 0.11 | 0.14 | 0.10 | 0.067 | 7 |
| O8 | 0.08 | 0.10 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | 0.05 | 0.10 | 0.09 | 0.056 | 8 |
| O9 | 0.07 | 0.04 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.02 | 0.05 | 0.11 | 0.044 | 10 |
| O10 | 0.19 | 0.03 | 0.03 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.04 | 0.046 | 9 |
| Sum | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |

It can be interpreted that sub-criteria O1 (Long-term growth for demand of electricity) account for about 22% importance of all the opportunities for the NEA. The respondents perceive this to be the most important opportunity for the NEA among all the identified opportunities.


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Table 17
Calculation of Maximum Eigen Value (λ max) and Consistency Ratio for the opportunity criteria

| Factor | O1 (1) | O2 (2) | O3 (3) | O4 (4) | O5 (5) | O6 (6) | O7 (7) | O8 (8) | O9 (9) | O10 (10) | Sum (11) | Sum/PV (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O1 | 0.22 | 0.38 | 0.50 | 0.43 | 0.33 | 0.23 | 0.19 | 0.19 | 0.13 | 0.14 | 2.60 | 11.90 |
| O2 | 0.07 | 0.11 | 0.45 | 0.41 | 0.28 | 0.25 | 0.22 | 0.19 | 0.11 | 0.13 | 2.08 | 18.30 |
| O3 | 0.06 | 0.03 | 0.14 | 0.32 | 0.29 | 0.23 | 0.18 | 0.15 | 0.11 | 0.13 | 1.51 | 11.09 |
| O4 | 0.07 | 0.04 | 0.06 | 0.13 | 0.27 | 0.23 | 0.20 | 0.17 | 0.12 | 0.12 | 1.27 | 9.56 |
| O5 | 0.07 | 0.04 | 0.05 | 0.05 | 0.10 | 0.20 | 0.18 | 0.15 | 0.12 | 0.13 | 0.95 | 14.22 |
| O6 | 0.07 | 0.04 | 0.05 | 0.05 | 0.04 | 0.08 | 0.15 | 0.17 | 0.14 | 0.12 | 0.80 | 14.11 |
| O7 | 0.08 | 0.03 | 0.05 | 0.05 | 0.04 | 0.04 | 0.07 | 0.12 | 0.13 | 0.12 | 0.60 | 8.96 |
| O8 | 0.08 | 0.03 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.06 | 0.09 | 0.10 | 0.46 | 8.07 |
| O9 | 0.07 | 0.05 | 0.05 | 0.05 | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.12 | 0.38 | 8.68 |
| O10 | 0.07 | 0.04 | 0.05 | 0.05 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.05 | 0.35 | 7.65 |

λ max = Average of Column (12) = 11.25
Consistency Index CI = (λ max -n)/n-1 = 0.139 for n=10
Reliability Index (RI) (for n=10) =1.49
Consistency Ratio (CR) = $CI/RI$ = 0.094< 0.1

Table 18
Pairwise Comparison Matrix of the elements within the threat criteria

| Factor | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 | T11 | T12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 1 | 2.13 | 0.45 | 1.25 | 1.02 | 0.24 | 1.32 | 2.70 | 1.77 | 0.75 | 2.76 | 0.30 |
| T2 | 0.47 | 1.00 | 0.55 | 0.74 | 0.53 | 1.59 | 2.48 | 2.32 | 2.25 | 0.53 | 2.20 | 2.15 |
| T3 | 2.22 | 1.80 | 1 | 3.27 | 1.00 | 1.04 | 2.72 | 2.15 | 2.82 | 1.37 | 2.61 | 2.49 |
| T4 | 0.80 | 1.35 | 0.31 | 1 | 2.32 | 0.77 | 2.21 | 2.20 | 2.40 | 1.85 | 2.56 | 1.78 |
| T5 | 0.98 | 1.87 | 1.00 | 0.43 | 1 | 2.52 | 2.92 | 2.66 | 2.58 | 2.29 | 2.37 | 1.69 |
| T6 | 4.11 | 0.63 | 0.96 | 1.29 | 0.40 | 1 | 3.31 | 3.04 | 3.29 | 4.35 | 3.27 | 3.97 |
| T7 | 0.76 | 0.40 | 0.37 | 0.45 | 0.34 | 0.30 | 1 | 1.33 | 1.50 | 1.42 | 0.46 | 1.81 |
| T8 | 0.37 | 0.43 | 0.47 | 0.45 | 0.38 | 0.33 | 0.75 | 1 | 1.20 | 1.52 | 1.26 | 2.69 |
| T9 | 0.56 | 0.45 | 0.35 | 0.42 | 0.39 | 0.30 | 0.67 | 0.83 | 1 | 2.13 | 0.57 | 2.57 |
| T10 | 1.33 | 1.89 | 0.73 | 0.54 | 0.44 | 0.23 | 0.70 | 0.66 | 0.47 | 1.00 | 1.21 | 1.58 |
| T11 | 0.36 | 0.45 | 0.38 | 0.39 | 0.42 | 0.31 | 2.15 | 0.79 | 1.76 | 0.82 | 1.00 | 1.18 |
| T12 | 3.33 | 0.47 | 0.40 | 0.56 | 0.59 | 0.25 | 0.55 | 0.37 | 0.39 | 0.63 | 0.85 | 1 |
| Sum | 16.30 | 12.87 | 6.98 | 10.81 | 8.83 | 8.89 | 20.79 | 20.05 | 21.45 | 18.67 | 21.13 | 23.19 |

Table 19
Normalized Pairwise Comparison Matrix of the elements within the threat criteria

| Factor | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 | T11 | T12 | Priority Vector (PV) | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 0.06 | 0.17 | 0.06 | 0.12 | 0.12 | 0.03 | 0.06 | 0.13 | 0.08 | 0.04 | 0.13 | 0.01 | 0.085 | 6 |
| T2 | 0.03 | 0.08 | 0.08 | 0.07 | 0.06 | 0.18 | 0.12 | 0.12 | 0.10 | 0.03 | 0.10 | 0.09 | 0.088 | 5 |
| T3 | 0.14 | 0.14 | 0.14 | 0.30 | 0.11 | 0.12 | 0.13 | 0.11 | 0.13 | 0.07 | 0.12 | 0.11 | 0.136 | 2 |
| T4 | 0.05 | 0.10 | 0.04 | 0.09 | 0.26 | 0.09 | 0.11 | 0.11 | 0.11 | 0.10 | 0.12 | 0.08 | 0.105 | 4 |
| T5 | 0.06 | 0.15 | 0.14 | 0.04 | 0.11 | 0.28 | 0.14 | 0.13 | 0.12 | 0.12 | 0.11 | 0.07 | 0.124 | 3 |
| T6 | 0.25 | 0.05 | 0.14 | 0.12 | 0.04 | 0.11 | 0.16 | 0.15 | 0.15 | 0.23 | 0.15 | 0.17 | 0.145 | 1 |
| T7 | 0.05 | 0.03 | 0.05 | 0.04 | 0.04 | 0.03 | 0.05 | 0.07 | 0.07 | 0.08 | 0.02 | 0.08 | 0.050 | 11 |
| T8 | 0.02 | 0.03 | 0.07 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.06 | 0.08 | 0.06 | 0.12 | 0.054 | 8 |
| T9 | 0.03 | 0.03 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.04 | 0.05 | 0.11 | 0.03 | 0.11 | 0.051 | 10 |
| T10 | 0.08 | 0.15 | 0.10 | 0.05 | 0.05 | 0.03 | 0.03 | 0.03 | 0.02 | 0.05 | 0.06 | 0.07 | 0.061 | 7 |
| T11 | 0.02 | 0.04 | 0.05 | 0.04 | 0.05 | 0.03 | 0.10 | 0.04 | 0.08 | 0.04 | 0.05 | 0.05 | 0.050 | 11 |
| T12 | 0.20 | 0.04 | 0.06 | 0.05 | 0.07 | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 | 0.04 | 0.04 | 0.052 | 9 |
| Sum | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1 | |

It can be interpreted that the sub-criteria T6 (Inability to absorb all new generation that the NEA has signed take-or-pay contracts with IPPs) account for about 15% of the total threats of the NEA. The respondents perceive this to be the biggest threat for the NEA.

Table 20
Calculation of Maximum Eigen Value (λ max) and Consistency Ratio for the threat criteria

| Factor | T1 (1) | T2 (2) | T3 (3) | T4 (4) | T5 (5) | T6 (6) | T7 (7) | T8 (8) | T9 (9) | T10 (10) | T11 (11) | T12 (12) | Sum (13) | Sum/PV (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 0.08 | 0.19 | 0.06 | 0.13 | 0.13 | 0.04 | 0.07 | 0.14 | 0.09 | 0.05 | 0.14 | 0.02 | 1.13 | 13.33 |
| T2 | 0.04 | 0.09 | 0.08 | 0.08 | 0.07 | 0.23 | 0.13 | 0.12 | 0.11 | 0.03 | 0.11 | 0.11 | 1.20 | 13.55 |
| T3 | 0.19 | 0.16 | 0.14 | 0.35 | 0.12 | 0.15 | 0.14 | 0.12 | 0.14 | 0.08 | 0.13 | 0.13 | 1.84 | 13.58 |
| T4 | 0.07 | 0.12 | 0.04 | 0.11 | 0.29 | 0.11 | 0.11 | 0.12 | 0.12 | 0.11 | 0.13 | 0.09 | 1.42 | 13.44 |
| T5 | 0.08 | 0.17 | 0.14 | 0.05 | 0.12 | 0.36 | 0.15 | 0.14 | 0.13 | 0.14 | 0.12 | 0.09 | 1.68 | 13.59 |
| T6 | 0.35 | 0.06 | 0.13 | 0.14 | 0.05 | 0.14 | 0.17 | 0.16 | 0.17 | 0.26 | 0.16 | 0.21 | 1.99 | 13.76 |
| T7 | 0.06 | 0.04 | 0.05 | 0.05 | 0.04 | 0.04 | 0.05 | 0.07 | 0.08 | 0.09 | 0.02 | 0.09 | 0.68 | 13.57 |
| T8 | 0.03 | 0.04 | 0.06 | 0.05 | 0.05 | 0.05 | 0.04 | 0.05 | 0.06 | 0.09 | 0.06 | 0.14 | 0.72 | 14.32 |
| T9 | 0.05 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 | 0.03 | 0.04 | 0.05 | 0.13 | 0.03 | 0.13 | 0.69 | 12.88 |
| T10 | 0.11 | 0.17 | 0.10 | 0.06 | 0.05 | 0.03 | 0.04 | 0.04 | 0.02 | 0.06 | 0.06 | 0.08 | 0.82 | 16.20 |
| T11 | 0.03 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 | 0.11 | 0.04 | 0.09 | 0.05 | 0.05 | 0.06 | 0.66 | 10.94 |
| T12 | 0.28 | 0.04 | 0.05 | 0.06 | 0.07 | 0.04 | 0.03 | 0.02 | 0.02 | 0.04 | 0.04 | 0.05 | 0.75 | 14.99 |

λ max = Average of Column (14) = 13.68
Consistency Index CI = (λ max -n)/n-1 = 0.153 for n=12
Reliability Index (RI) (for n=12) =1.5365
Consistency Ratio (CR) = $CI/RI$ = 0.099< 0.1


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Table 21
Pairwise Comparison Matrix of the SWOT factors

| Factor | Strengths (S) | Weaknesses (W) | Opportunities (O) | Threats (T) |
|---|---|---|---|---|
| Strengths (S) | 1.00 | 2.00 | 1.06 | 0.63 |
| Weaknesses (W) | 0.50 | 1.00 | 1.01 | 1.67 |
| Opportunities (O) | 0.94 | 0.99 | 1.00 | 0.99 |
| Threats (T) | 1.59 | 0.60 | 1.01 | 1.00 |
| Sum | 4.03 | 4.59 | 4.08 | 4.29 |

Table 22
Normalized Pairwise Comparison Matrix of the SWOT factors

| Factor | S | W | O | T | Group Priority Vector (PV) | Rank |
|---|---|---|---|---|---|---|
| Strengths (S) | 0.25 | 0.44 | 0.26 | 0.15 | 0.273 | 1 |
| Weaknesses (W) | 0.12 | 0.22 | 0.25 | 0.39 | 0.245 | 3 |
| Opportunities (O) | 0.23 | 0.22 | 0.24 | 0.23 | 0.231 | 4 |
| Threats (T) | 0.39 | 0.13 | 0.25 | 0.23 | 0.251 | 2 |
| Sum | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |

The findings show the following ranking of each SWOT group priority: Strengths (group weight 27.3%), Opportunities (24.5%), Weaknesses (23.1%) and Threats (25.1%). The results indicate that the 4 factors (Strength, Weakness, Opportunities and Threats) carry almost equal weightage with regards to future strategy formulation for the NEA.

Table 23
Calculation of Maximum Eigen Value (λ max) and Consistency Ratio for the SWOT factors

| Factor | S (1) | W (2) | O (3) | T (4) | Sum (5) | Sum/PV (6) |
|---|---|---|---|---|---|---|
| Strengths (S) | 0.27 | 0.49 | 0.25 | 0.16 | 1.17 | 4.27 |
| Weaknesses (W) | 0.14 | 0.24 | 0.23 | 0.42 | 1.03 | 4.23 |
| Opportunities (O) | 0.26 | 0.24 | 0.23 | 0.25 | 0.98 | 4.23 |
| Threats (T) | 0.43 | 0.15 | 0.23 | 0.25 | 1.06 | 4.24 |

λ max = Average of Column (6) = 4.24
Consistency Index CI = (λ max -n)/n-1 = 0.089 for n=4
Reliability Index (RI) (for n=4) =0.9
Consistency Ratio CR= 0.13/1.32=0.098 < 0.1

Finally, the overall priority scores of the SWOT factors are calculated as shown in Table 24.


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Table 24
Calculation of local and global priority scores of the SWOT factors

| SWOT Group | Group Priority | SWOT Factors | Factor Priority within the Group (Local Priority) | Overall (Global) Priority of factor |
|---|---|---|---|---|
| Strengths | 0.273 | Monopoly (single seller) and monopsony (single buyer) market of an essential service (S1) | 0.254 | 0.069 |
| | | Huge domestic demand for electricity and energy services (S2) | 0.149 | 0.041 |
| | | Ability to access relatively cheaper sources of capital from Government, Public and International Multilateral Banks/ donors (S3) | 0.236 | 0.064 |
| | | Nationwide electricity distribution network (S4) | 0.147 | 0.040 |
| | | Network of 4 million customers (S5) | 0.101 | 0.028 |
| | | Improved brand name and public good will (S6) | 0.069 | 0.019 |
| | | Human resources with strong technical skills (S7) | 0.045 | 0.012 |
| Weakness | 0.245 | Insufficient and inefficient transmission and distribution network (W1) | 0.168 | 0.041 |
| | | Poor and unsatisfactory quality of power, particularly in rural areas (W2) | 0.109 | 0.027 |
| | | Lack of focus on customer service and customer experience (W3) | 0.084 | 0.021 |
| | | Weak project management, procurement and contract management capacity (W4) | 0.135 | 0.033 |
| | | High internal construction and operation costs (W5) | 0.091 | 0.022 |
| | | Lack of automated data collection and analysis of its operations (W6) | 0.085 | 0.021 |
| | | Mismatch between demand and supply (W7) | 0.091 | 0.022 |
| | | Traditional operating and management system (W8) | 0.079 | 0.019 |
| | | Lack of energy storage capacity (W9) | 0.062 | 0.015 |


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| | | | | |
|---|---|---|---|---|
| | | Limited transmission interconnection capacity with neighboring countries (W10) | 0.052 | 0.013 |
| | | Rural electrification expense to expand network into remote, distant and disperse locations (W11) | 0.044 | 0.011 |
| Opportunities | 0.231 | Long-term growth for demand of electricity (O1) | 0.219 | 0.051 |
| | | Reduce cost of energy through trade and economies of scale as the power system expands (O2) | 0.114 | 0.026 |
| | | Export and trade of power (O3) | 0.136 | 0.031 |
| | | Energy banking to meet deficit demand in dry season (O4) | 0.133 | 0.031 |
| | | Improve utility efficiency through automation, digitization and use of centrally integrated software (O5) | 0.101 | 0.023 |
| | | Improve profits and reduce cost of supply by decreasing AT&C losses (O6) | 0.085 | 0.020 |
| | | Make energy system more efficient through demand side management tools (O7) | 0.067 | 0.015 |
| | | Expand market by adding 2 million new customers (O8) | 0.056 | 0.013 |
| | | Increased operational and financial efficiency through restructuring (O9) | 0.044 | 0.010 |
| | | Expand and upgrade transmission and distribution operations (O10) | 0.046 | 0.011 |
| Threats | 0.251 | High cost of capital to finance capital expenditure plans (T1) | 0.085 | 0.021 |
| | | Adverse effects of climate change and extreme weather patterns on hydrology and structures (T2) | 0.088 | 0.022 |
| | | New regulatory regime and delays in tariff reviews (T3) | 0.136 | 0.034 |
| | | Distribution and self-generation by customers reduces quantum and increases variability of demand (T4) | 0.105 | 0.026 |
| | | Economic slowdown or failure of economy to grow as projected in the demand forecast will result in excess capacity (T5) | 0.124 | 0.031 |
| | | Inability to absorb all new generation that the NEA has signed take-or-pay contracts with IPPs (T6) | 0.145 | 0.036 |


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| | | | |
|---|---|---|---|
| | New levies and taxes imposed by local, provincial and federal governments (T7) | 0.050 | 0.013 |
| | Potential complications due to federal restructuring (T8) | 0.054 | 0.014 |
| | Adverse movement in the dollar and other foreign currencies (T9) | 0.051 | 0.013 |
| | Inability to engage in trade of electricity with neighboring countries due to political and economic reasons (T10) | 0.061 | 0.015 |
| | Theft and leakage of electricity and collection losses (T11) | 0.050 | 0.013 |
| | Delay in construction of projects due to social and/or legal issues such as resettlement, right of way and local shares (T12) | 0.052 | 0.013 |

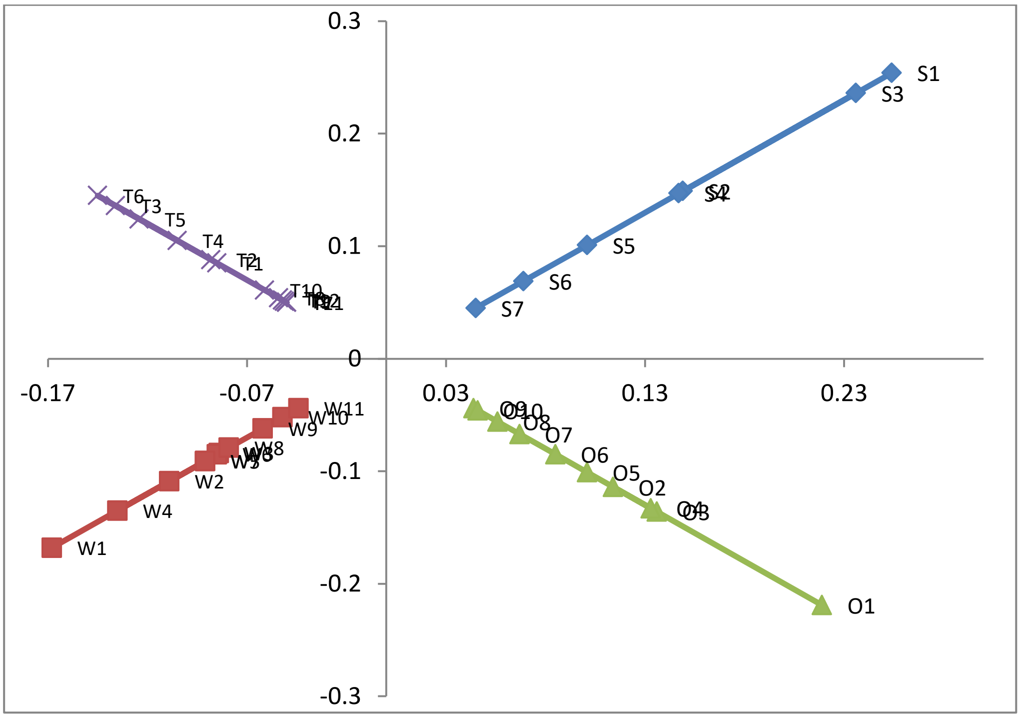


Figure 3 Perceptual mapping of the SWOT factors

As shown in Table 24 and Figure 3, the analysis suggests that 'Monopoly (single seller) and monopsony (single buyer) market of an essential service' (S1) is the most important factor in the SWOT analysis with an overall priority value of 6.9% among the 40 factors under study. Other considerable factors in order are 'Ability to access relatively cheaper sources of capital from Government, Public and International multilateral banks/donors' (S3) with a priority value of 6.4%, 'Long-term growth for demand of electricity (O1)' with a priority value of 5.1%, 'Insufficient and inefficient transmission and distribution network' (W1) with a priority value of 4.1%, 'Huge domestic demand for electricity and energy services' (S2) with a priority value of 4.1%, 'Nationwide electricity distribution network' (S4) with a priority value of 4%, and 'Inability to absorb all new generation that NEA has signed take-or-pay contracts with IPPs' (T6) with a priority value of 3.6%. This study shows the strength factors of the NEA are stronger than any other factors of SWOT. Therefore, the NEA should develop future strategies that reap benefits by utilizing the strength parameters and eliminating the effects of the identified threats and weaknesses.

## 6. Conclusion

This study has analyzed the external and internal factors relevant to the strategies and operations of the NEA. The internal factors have been categorized as the strengths and weaknesses of the organization while the external factors have been categorized as its opportunities and threats. The entire study was done through a SWOT–AHP analysis. The findings show that weightage or importance of all groups of factors is almost the same, with the weightage of the strengths criteria being slightly higher (27.3%) than the others. The analysis suggests that 'Monopoly (single seller) and monopsony (single buyer) market of an essential service' is the most important factor in the SWOT analysis with an overall priority value of 6.9% among the 40 factors under study. Other considerable factors are 'Ability to access relatively cheaper sources of capital from government, public and International multilateral banks/donors' as a strength and 'Long-term growth for demand of electricity' as the most important opportunity, 'Insufficient and inefficient transmission and distribution network' as the most critical weaknesses and 'Inability to absorb all new generation that the NEA has signed take-or-pay contracts with IPPs' as the most important threat to the NEA. The strength factors of the NEA are more dominant than the other factors as perceived by the respondents.

It is recommended that the NEA formulate its future strategies by considering these important factors. The NEA should be able to take advantage of its monopolistic business nature while ensuring delivery of safe and reliable electricity to consumers. It also needs to continue accessing the relatively easily available capital from the government and donor agencies to expand its business and cater to the growing electricity demand in the country. However, it has the challenge of rapidly expanding the existing transmission and distribution network to absorb the growing generation capacity within the country, which is also necessary to decrease Nepal's reliance on imported electricity from India.

The approach of integrating a SWOT analysis with the AHP to rank the criteria or factors is an efficient method in decision making and strategy selection for the organization. Future research can improve on this approach by using a fuzzy logic framework with the AHP method to analyze cases with uncertainty.


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