

# Application of the PSI Method for Selecting Small-Scale Generators

Nguyen Hoang Giang<sup>1</sup>, Tran Thi Thu Hang<sup>2</sup>  
College of Economics and Techniques, Thainguyen University, Vietnam

---

## Abstract

In all fields, selecting one alternative from many available options must be based on multiple parameters (called criteria). Multi-Criteria Decision-Making (MCDM) methods are increasingly being used to solve these types of problems. Common difficulties when applying MCDM methods include selecting a data normalization method and determining the weights of criteria, as these are two important factors that greatly influence the ranking results. This study applies the PSI method to the selection of small-scale generators. PSI is an MCDM method in which users are not required to calculate weights for the criteria. Seven types of small-scale generators commonly sold in the Vietnamese market were investigated in this study and denoted from A1 to A7. The application of the PSI method confirmed that A3 is the best generator type.

**Keywords:** small-scale generator selection, MCDM, PSI method

---

Date of Submission: 17-05-2026

Date of acceptance: 31-05-2026

---

## I. Introduction

Small-scale generators, also known as mini generators, play an important role in daily life, especially in household activities, livestock farming, and crop cultivation. They are an effective solution when the national power grid fails, ensuring that essential devices such as refrigerators, water pumps, lighting systems, and fans continue operating continuously. In livestock farming, generators help maintain ventilation and heating systems for barns, protecting animals from sudden weather changes. In crop cultivation, generators can supply energy for automatic irrigation systems, water pumps, and other agricultural equipment, ensuring uninterrupted production processes.

The mini-generator market today is highly diverse with many models and brands. Consumers can easily find generators powered by gasoline, diesel, or even gas. To select a suitable generator, many important criteria must be considered. Power output is the primary factor, determining whether the generator is strong enough to operate all required devices. The type of fuel affects operating costs and environmental friendliness. In addition, origin and price are also important considerations. A generator from a reputable manufacturer usually ensures higher quality and durability, but it may come with a higher price. Careful consideration of these criteria helps users make informed decisions and choose the most suitable product. MCDM methods are techniques widely applied to solve such complex problems.

## II. PSI Method

To rank alternatives using the PSI method, the following steps are required:

- Normalize the data.

+ For beneficial criteria (the larger, the better).

$$n_{ij} = \frac{y_{ij}}{y_j^{max}} \quad (1)$$

+ For non-beneficial criteria (the smaller, the better).

$$n_{ij} = \frac{y_j^{min}}{y_{ij}} \quad (2)$$

- Calculate the average value of normalized data.

$$n = \frac{1}{m} \sum_{i=1}^m n_{ij} \quad (3)$$

- Determine preference values from the average values.

$$\varphi_j = \sum_{i=1}^m [n_{ij} - n]^2 \quad (4)$$

- Determine deviation in preference values.

$$\phi_j = [1 - \varphi_j] \tag{5}$$

- Determine the overall preference value for criteria.

$$\beta_j = \frac{\phi_j}{\sum_{j=1}^n \phi_j} \tag{6}$$

- Calculate the Preference Selection Index (PSI) for each alternative.

$$\theta_i = \sum_{j=1}^n n_{ij} \cdot \beta_j \tag{7}$$

- Rank the alternatives according to the principle that the best alternative has the highest PSI value.

### III. Small-Scale Generator Types

A local electronics store currently sells seven generator models. According to the accompanying product documents, the criteria describing each generator include Price, Continuous Operating Time, Cylinder Capacity, Rated Power, Maximum Power, Length, Width, Height, and Weight. Although generator selection should also consider other factors such as warranty period, maintenance costs, and after-sales service, these factors are identical for all seven generators under consideration. Therefore, only the criteria with differing values among the seven alternatives are considered.

**Table 1.** Small-Scale Generator Types(*Source: compiled by the author*)

Type	Price	Continuous Operating Time	Engine Displacement	Operating Power	Max Power	Length	Width	Height	Weight
Alt.	C1	C2	C3	C4	C5	C6	C7	C8	C10
A1	8.99	10	96	2.3	2.6	610	490	490	54
A2	23.9	16	420	2.5	2.8	670	540	555	86
A3	21.9	22	389	5	5.5	670	540	555	82
A4	11.9	22	196	2.5	2.8	610	490	490	43
A5	38.9	16	212	5	5.5	920	520	760	160
A6	35.45	13	456	5	5.8	720	480	600	116
A7	17.31	12	163	2	2.3	635	425	475	34
	min	max	max	max	max	min	min	min	max

### IV. Results and Discussion

By applying Equations (1) and (2), the normalized values shown in Table 2 were obtained.

**Table 2.** Normalized Values

Alt.	Price	Continuous Operating Time	Engine Displacement	Operating Power	Max Power	Length	Width	Height	Weight
A1	1.000	0.455	0.211	0.460	0.448	1.000	0.867	0.969	0.338
A2	0.376	0.727	0.921	0.500	0.483	0.910	0.787	0.856	0.538
A3	0.411	1.000	0.853	1.000	0.948	0.910	0.787	0.856	0.513
A4	0.755	1.000	0.430	0.500	0.483	1.000	0.867	0.969	0.269
A5	0.231	0.727	0.465	1.000	0.948	0.663	0.817	0.625	1.000
A6	0.254	0.591	1.000	1.000	1.000	0.847	0.885	0.792	0.725
A7	0.519	0.545	0.357	0.400	0.397	0.961	1.000	1.000	0.213

By applying Equation (3), the average normalized values shown in Table 3 were calculated.

**Table 3.** Average Normalized Values

Price	Continuous Operating Time	Engine Displacement	Operating Power	Max Power	Length	Width	Height	Weight
0.507	0.721	0.605	0.694	0.672	0.899	0.859	0.867	0.513

By applying Equation (4), the preference values from the average values shown in Table 4 were obtained.

**Table 4.** Preference Values from Average Values

Price	Continuous Operating Time	Engine Displacement	Operating Power	Max Power	Length	Width	Height	Weight
0.4717	0.2745	0.5847	0.4974	0.4578	0.0828	0.0328	0.1031	0.4635

By applying Equation (5), the deviations in preference values shown in Table 5 were calculated.

**Table 5.** Deviation in Preference Values

Price	Continuous Operating Time	Engine Displacement	Operating Power	Max Power	Length	Width	Height	Weight
0.5283	0.7255	0.4153	0.5026	0.5422	0.9172	0.9672	0.8969	0.5365

By applying Equation (6), the overall preference values for the criteria shown in Table 6 were obtained.

**Table 6.** Overall Preference Values for the Criteria

Price	Continuous Operating Time	Engine Displacement	Operating Power	Max Power	Length	Width	Height	Weight
0.088	0.120	0.069	0.083	0.090	0.152	0.160	0.149	0.089

By applying Equation (7), the PSI values for the alternatives shown in Table 7 were calculated. The final column of Table 7 also presents the ranking order of the alternatives.

**Table 7.** Preference Selection Index and Ranking of Alternatives

Type	PSI	Rank
A1	0.700682	6
A2	0.708619	5
A3	0.821039	1
A4	0.76029	3
A5	0.722065	4
A6	0.788376	2
A7	0.678703	7

According to the results in Table 7, the ranking order is  $A3 > A6 > A4 > A5 > A2 > A1 > A7$ . Therefore, among the seven investigated generators, A3 is identified as the best alternative when simultaneously considering the nine criteria: Price, Continuous Operating Time, Cylinder Capacity, Rated Power, Maximum Power, Length, Width, Height, and Weight.

## V. Conclusion

The PSI method was applied for the first time to rank generator types in this study. Among the seven generator models introduced by the supplier and denoted from A1 to A7, A3 was identified as the best alternative.

For a more comprehensive selection of small-scale generators, future studies should consider additional criteria when evaluating each product. Furthermore, improving the PSI method so that it can incorporate the importance of criteria would help produce results that better satisfy user requirements.

### References

- [1] <https://fptshop.com.vn/tin-tuc/dien-may/may-phat-dien-mini-184954>
- [2] <https://mayphatdienhd.vn/may-phat-dien-mini/>
- [3] DUA, T.V. (2024). Optimal Selection for Machining Processes Using the PSI-R-PIV Method, *Applied Engineering Letters*.
- [4] TRUONG, N. X., AŞONJA, A., TRUNG, D. D. (2023). Enhancing Handheld Polishing Machine Selection.
- [5] UYEN, V. T. N., THU, P. X. (2023). The multi-criteria decision-making method.
- [6] TRUNG, D. D. (2024). Using RAM method for optimal selection.
- [7] TRUNG, D. D. et al. (2024). Comparison of SRP and FUCA methods.
- [8] TRUNG, D. D., THINH, H. X., HA, L. D. (2022). Comparison of RAFSI and PIV methods.
- [9]. HA, L. D. (2023). Selection of suitable data normalization method to combinewith the CRADIS method for making multi-criteria decision, *Applied Engineering Letters*, vol. 8, no.1, pp. 24-35.
- [10]. DUA, T. V. (2022). Application of the collaborative unbiased rank list integration method to select the materials, *Applied Engineering Letters*, vol.7, no.4, pp.133-142.
- [11]. PARTHASARATHY, T.N., NARAYANAMOORTHY, S., AARTHI, K. (2025). Correction: A Fuzzy-Based Normalized Unified Objective Attribute Relative Weight Assessment (NARA) Decision-Making Approach for Navigating Green Aviation Fuel Selection. *Int. J. Fuzzy Syst.*
- [12]. MOHAMED, M., EL-SABER, N. (2023). Toward Energy Transformation: Intelligent Decision-Making Model Based on Uncertainty Neutrosophic Theory, *Neutrosophic Systems with Applications*, vol. 9, pp. 13-23.
- [13]. WEN, Z., LIAO, H., ZAVADSKAS, E. K. (2020). MACONT: Mixed Aggregation by Comprehensive Normalization Technique for Multi-Criteria Analysis, *Informatica*, vol. 31, no. 4, pp. 857–880.
- [14]. TRUNG, D. D., ERSOY, N., DUA, T. V., THINH, H. X. (2025).A comparative evaluation of data normalization techniques using different metrics: practical application to a MCDM method, *Manufacturing review*, vol.12, no. 19.
- [15]. LINH, N. T. D., SON, N. H., THAO, D. X. (2025). Evaluating the Impact of Weighting Methods on the Stability of Scores for Alternatives in MultiCriteria Decision-Making Problems, *Engineering, Technology & Applied Science Research*, vol. 15, no. 1, pp. 19998-20004.
- [16]. DUA, T.V., DUC, D. V., BAO, N. C., TRUNG, D. D. (2024). Integration of objective weighting methods for criteria and mcdm methods: Application in material selection, *EUREKA: Physics and Engineering*, vol. 2024, no. 2, pp. 131–148.
- [17]. DO, D. T., TRAN, V. D., DUONG, V. D., NGUYEN, N. -T. (2023). *Operational Research in Engineering Sciences: Theory and Applications*, vol. 6, no. 1, pp. 44-64.
- [18]. R. N. WARDANY, ZAHEDI. (2024). A study comparative of PSI, PSI-TOPSIS, and PSI-MABAC methods in analyzing the financial performance of state-owned enterprises companies listed on the Indonesia stock exchange, *Yugoslav Journal of Operations Research*.