e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.1, 2022

A Combined Approach of AHP and TOPSIS for Realiability

Anurag Tiwari
Department of Computer Science & Engineering
Maharishi University of Information Technology
Lucknow, India
anuragonweb@gmail.com

Ajay Kumar Bharti
Department of Computer Science & Engineering
Maharishi University of Information Technology
Lucknow, India
ajay_bharti@hotmail.com

Himanshu Pandey
Department of Computer Science & Engineering
Institute of Engineering and Technology, University of Lucknow
Lucknow, India
hpandey010@gmail.com

Abstract— **With more corporate industries utilizing internet services to communicate vital information over the World Wide Web, reliability has become a demanding topic. Systems that are dependable are crucial in this scenario. Therefore, the majority of the industry is concerned with system reliability. The high dependability of systems has been addressed by numerous strategies over the past ten years, yet the majority of these methodologies are either speculative or impractical. The motivation behind the review was to investigate the legitimacy and plausibility of the model utilizing AHP & TOPSIS. Here, we employed a particular multi-criteria decision-making technique known as the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). This framework will help the development team to choose the best reliability mode for each situation the basis of predictability**.

Keywords—Reliability, AHP methods, TOPSIS, SOA.

I. INTRODUCTION

Reliability is a key issue of the service-oriented architecture (SOA) which is widely employed in critical domains such as e-commerce and e-government [1]. Due to the growing demand for services, customers can now choose between receiving equal value from different vendors. Different models are used to categorise services according to their quality, which is generally referred to as nonfunctional features or nature of administration [2]. Finding the best help based on a client's needs is the next apparent problem. This paper delineates how powerful contentions were utilized to approve a proposed model utilizing the inductive-subjective TOPSIS technique[3-7]. The suggested model will include a variety of innovations. Each progression will take the information from the information cradle, after which the knowledge will be passed on to succeeding phases. The steps will play out the activity and provide the result each time the information is made. Each result will be sent to other modules for decision-making and reliability computation [8-10].

II. Techniques & Tools (TOPSIS, AHP)

A. RELIABILITY PERSPECTIVE: AHP APPROACH

Generally speaking, the item improvement measure has several steps. Used plan is one of them. It consists of three

cycles: concept or idea development, idea evaluation, and idea promotion. Whatever the case, this paper discusses concept evaluation or selection. to select the most logical method for organizing nanoparticles. Choosing the optimum method for the readiness of nanoparticles is linked to a contextual analysis for this evaluation. There are seven potential ways left after a few iterations of technique selection, as listed below. As a result, utilizing AHP, it is required to select the best of these strategies.

B. *TOPSIS SIGNIFICANCE*

In An expansion of TOPSIS (a strategy for request execution by closeness to ideal arrangement), a multi-quality decision-production method, to a collective choice climate is explored. TOPSIS is a functional and helpful procedure for positioning and choice of not set in stone choices through distance measures. To get an expansive perspective on the strategies utilized, we give a couple of choices to the activities, like standardization, distance measures, and mean administrators, at every one of relating steps of TOPSIS. Moreover, the inclinations of more than one decision-creator are inside accumulated into the TOPSIS system. We propose an elective novel strategy dependent on the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to take care of the issue of positioning and contrasting calculations. In

e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.1, 2022

developmental calculation, calculations are executed a few times and afterward a measurement as far as mean qualities and standard deviations are determined. To analyze calculation's exhibition, it is exceptionally normal to deal with such issues through factual tests. Positioning calculations, e.g., through the Friedman test may likewise introduce restrictions since they think about just the mean worth and not the standard deviation of the outcomes. Since the TOPSIS can't deal with straightforwardly such an information, we foster a methodology dependent on TOPSIS for calculation positioning named A-TOPSIS. For this situation, the choices comprise of the calculations and the standards are the benchmarks. The rating of the choices

concerning the measures is communicated through a decision matrix as far as mean qualities and standard deviations.

III. MODEL FOR RELIABILITY

As a rule, the interaction for the TOPSIS computation starts with outlining the choice matrix tending to the satisfaction worth of each action with each and every other choice. Then, at that point, the matrix is normalized with an ideal normalizing plan, and the characteristics are copied by the actions loads. Subsequently, the positive-ideal and negative-ideal game not set in stone, and the distance of each choice as opposed to these game still up in the air with a distance measure. Finally, the choices are situated ward on their overall closeness to the best plan. The TOPSIS technique is valuable for choice makers to structure the issues to be tended to, lead examinations, correlations, and situating of different choices. The old style TOPSIS strategy deals with issues in which all choice data are known and tended to by new numbers. The idea of classical TOPSIS procedure can be expressed in a series of following:

A. *Step 1. Construct the decision matrix and determine the* weight of the criteria:

In Let X=(x ij) be a decision matrix and

W = {w1, w2, ……wn} a weight vector,

where xij∈ℜ, wj∈ℜ and w1 + w2 +……… + wn = 1

Criteria of the functions can be: benefit functions (more is better) or cost functions (less is better), as shown in TABLE 1.

TABLE I. Decision Matrix and Weight Criteria

Weightage		Low	Mid	High
0.4625905	**Success Ability**	1.2	2.3	5.1
0.232871	**Response Time**	1.4	2.5	5.3
0.14623	**Maximum Throughput**	1.6	2.7	5.5
0.090843	**Availability**	1.8	2.9	5.7
0.067465	**Accessibility**	2	3.1	5.9

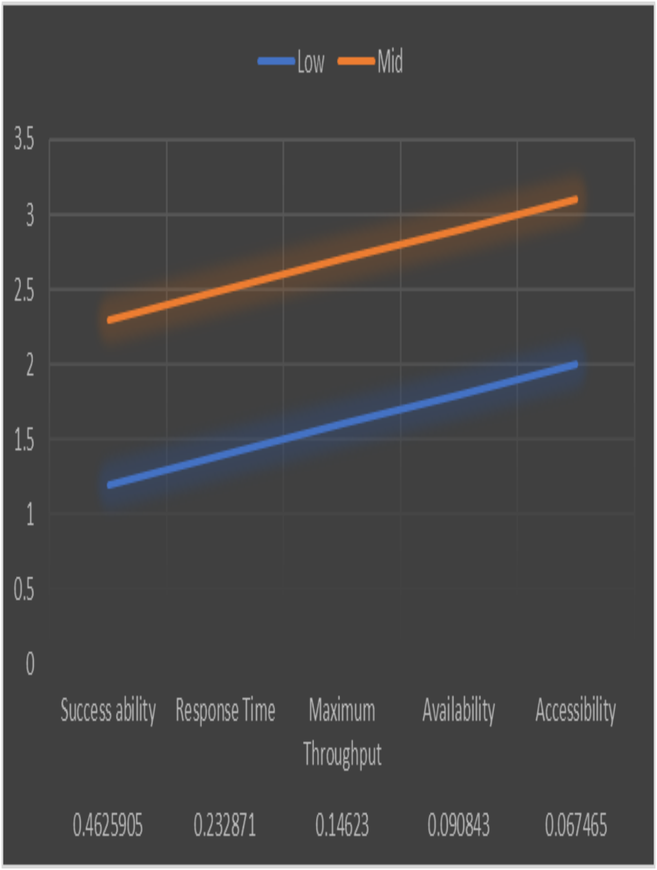


Fig. 1. Graphical-based Evaluation Decision Matrix and weight Criteria Significance

B. *Step 2. Calculate the normalized decision matrix:*

This progression changes different attribute(.) dimensions into non-dimensional properties which permit correlations across criteria (Low, Mid, and High). Since different rules are typically estimated in different units, the scores in the assessment matrix TABLE I have to be transformed to a normalized scale. The normalization of qualities can be done by one of the few known normalized equations (Eq 1 and 2). The absolute most as often as possible utilized techniques for working out the standardized worth nij are the accompanying

$$nij = \frac{xij}{\sqrt{\sum_{i=1}^{m} xij}} \qquad (1)$$

$$nij = \frac{xij}{\max xij} \qquad (2)$$

C. *Step 3. Calculate the weighted normalized decision matrix:*

The weighted normalized value Vij is calculated in the following way as shown in TABLE II.

$$V_{ij} = w_j\, n_{ij} \text{ for } i = 1, \ldots, m;\ j = 1, \ldots, n. \qquad (3)$$

where w_j is the weight of the j-th criterion, $\sum_{j=1}^{n} w_j = 1$

e-ISSN 2320 -7876 www.ijfans.org
Vol.11,S Iss.1, 2022

	Low	Mid	High
Success Ability	0.209721	0.401965	0.891314
Response Time	0.232367	0.414941	0.879676
Maximum Throughput	0.252667	0.426375	0.868541
Availability	0.27093	0.436498	0.857944
Accessibility	0.28742	0.445502	0.84789

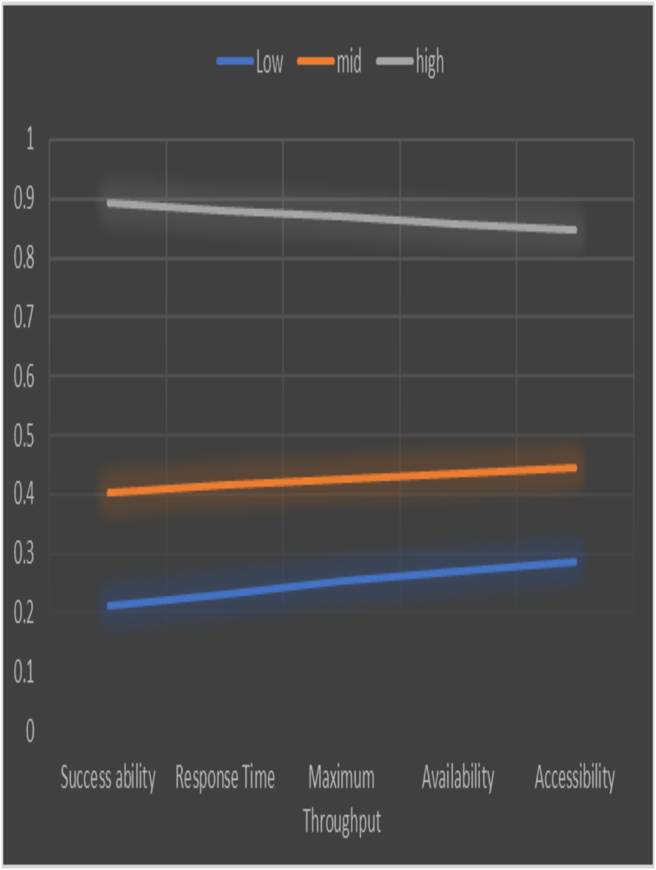


TABLE II. Normalized Matrix Calculation
Fig. 2. Graphical-based Evaluation Calculate Normalized Matrix Calculation

D. Step 4. Determine the positive ideal and negative ideal solutions:

Distinguish the positive ideal alternative (outrageous execution on every basis) and recognize the negative ideal alternative (turn around outrageous execution on every rule). The ideal positive solution is the solution that boosts the advantage measures and limits the expense rules while the negative ideal solution augments the expense standards and limits the advantage measuress. Positive ideal solution Si+ has the structure, displayed in TABLE III.

$$v_i^+ = ((v_1)^+, (v_2)^+, (v_2)^+ \ldots\ldots \ldots(v_n)^+) = \{(\max_i (v_{ij} \mid j \in I)), (\min_i (v_{ij} \mid j \in J)) \quad (4)$$

$$v_i^- = ((v_1)^-, (v_2)^-, (v_2)^- \ldots\ldots \ldots(v_n)^-) = \{(\min_i (v_{ij} \mid j \in I)), (\max_i (v_{ij} \mid j \in J))\} \quad (5)$$

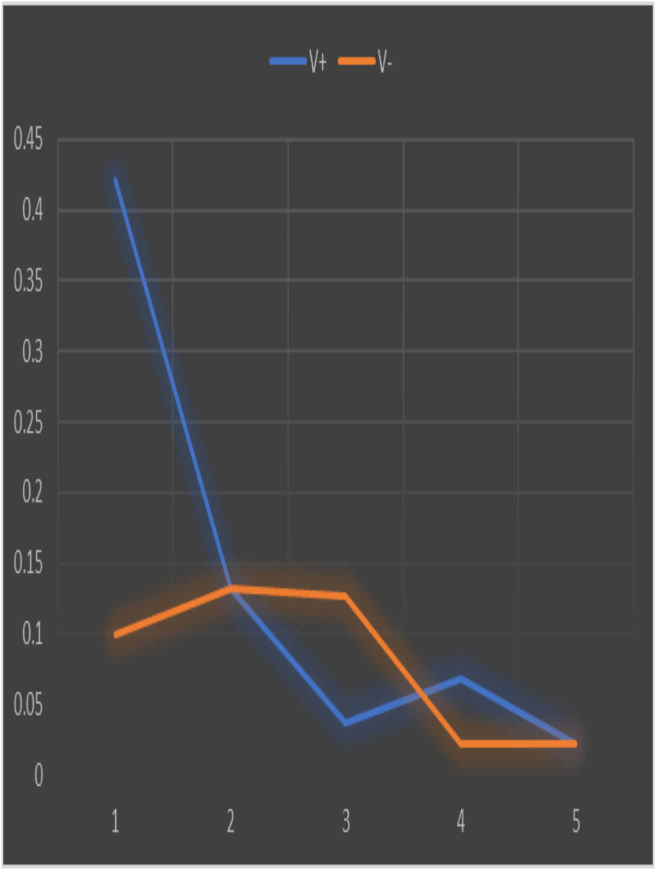
where I is associated with benefit criteria and J with the cost criteria, i = 1, …, m; j = 1, …, n

TABLE III. Calculate the Ideal Best and Ideal Worst Value

V^+	V^-
0.412314	0.097015
0.11853	0.11853
0.036948	0.127007
0.077938	0.024612
0.03555	0.03555

e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.1, 2022

Fig. 3. Graphical-based Evaluation Ideal Best and Worst Value



E. *Step 5. Calculate the separation measures from the positive and negative ideal solution:*

A number of distance measures can be used in the TOPSIS approach. TABLE IV shows the separation of each alternative from the positive ideal solution.

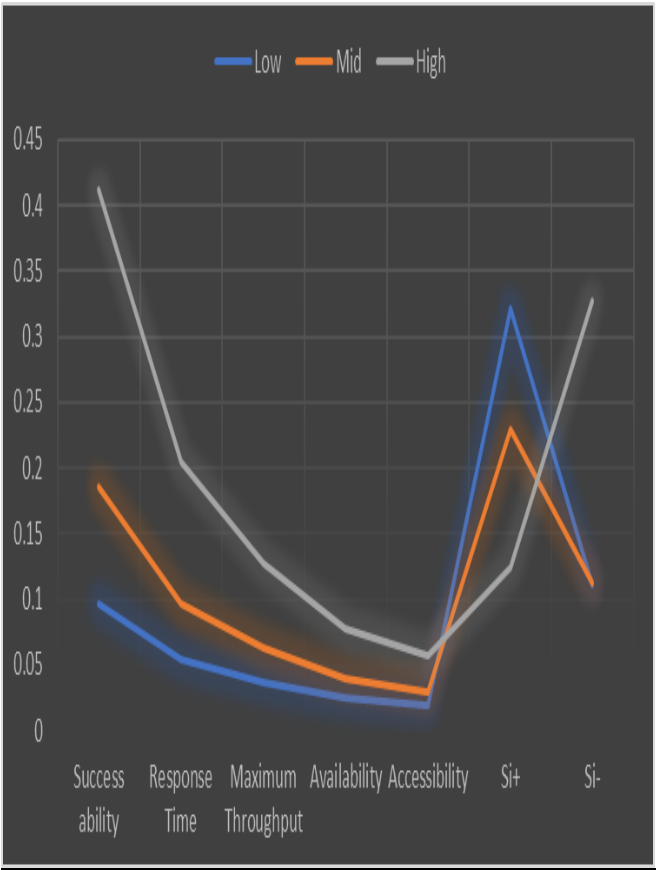
$$s_i^+ = \left(\sum_{j=1}^{n}\left(s_{ij-}s_j^+\right)^p\right)^{1/p}, i = 1, 2, \ldots, m \qquad (6)$$

The separation of each alternative from the negative ideal solution is given as

$$s_i^- = \left(\sum_{j=1}^{n}\left(s_{ij-}s_j^-\right)^p\right)^{1/p}, i = 1, 2, \ldots, m \qquad (7)$$

Where p ≥1. For p= 2 we have the most used traditional n-dimensional Euclidean metric shown in TABLE IV.

e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.1, 2022



	Low	Mid	High
Success Ability	0.097015	0.185945	0.412314
Response Time	0.054112	0.096628	0.204851
Maximum Throughput	0.036948	0.062349	0.127007
Availability	0.024612	0.039653	0.077938
Accessibility	0.019391	0.030056	0.057203
Si+	0.321812	0.228839	0.124748
Si-	0.110727	0.112112	0.326901

TABLE IV. Euclidean Matrix

Fig. 4. Graphical-based Evaluation Euclidean Matrix

F. Step 6.Calculate the relative closeness to the positive ideal solution

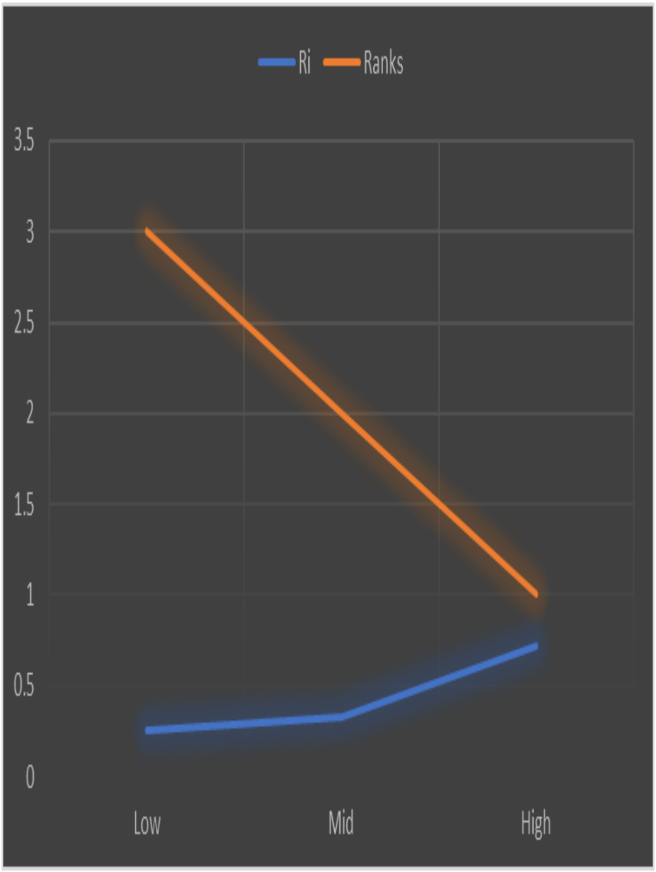
The relative closeness of the i-th alternative Aj with respect to Si+ is defined as shown in TABLE IV,

$$R_i = \frac{s_i^-}{(s_i^- + s_i^+)} \quad (8)$$

where $0 \leq R_i \leq 1$, i = 1,2, … , m.

G. Step 7. Rank the preference order or select the alternative closest to 1

The descending order of the value of Ri can now be used to rate a collection of options. TABLE V is shown.



Alternatives	Ri	Ranks
Low	0.255993	3
Mid	0.32882	2
High	0.723795	1

TABLE V. Ri and Rank

Fig. 5. Graphical-based Evaluation Ri and Rank Evaluation Significance

IV. CONCLUSION

In The AHP enjoys the benefits of decreasing the quantity of comparisons and intellectual blunders and affirming the reaction consistency by contrasting items and numerous traits, upon progressive organizing and gathering as per their elements and characters.

Notwithstanding, simultaneously, the AHP has the hindrances that qualities are differed relying upon the state of the hierarchy structure, just as the trouble in keeping up with consistency. Subsequently, we were incited to devise a strategy to address those burdens. In the event that the hierarchy isn't made and various characteristics can measure up at a time, those problems might be effortlessly settled. Nonetheless, all things considered, the quantity of comparisons is expanded dramatically, and it is amazingly hard to keep up with the response consistency. Hence, in this review, we proposed a strategy to initially decide the need to keep up with consistency and compute loads while decreasing the quantity of comparisons.

REFERENCES

[1] Zibin Zheng,; Michael R. Lyu (2008), A QoS-Aware Middleware for Fault Tolerant Web Services, 2008 19th International Symposium on Software Reliability Engineering (ISSRE), **Print ISSN:** 1071-9458

[2] Anurag Tiwari , Ajay kumar Bharti, A Comprehensive Framework for Fault Tolerant Reliable Web Services, 2022, Journal of Huazhong University of Science and Technology, ISSN-1671-4512

[3] Chen Y., Fuzzy AHP-based method for project risk assessment 2010 Seventh International Conference on Fuzzy Systems and Knowledge Discovery, 2010, pp. 1249-1253, doi: 10.1109/FSKD.2010.5569128.

[4] Putra M., Andryana S., Fauziah, Gunaryati A., Fuzzy Analytical Hierarchy Process Method to Determine the Quality of Gemstones", Advances in Fuzzy Systems, vol. 2018, 2018, 6 pages. https://doi.org/10.1155/2018/9094380

[5] Jiang P., Elag M., Kumar P., Peckham S., Luigi Marini, Liu Rui, A service-oriented architecture for coupling web service models using the Basic Model Interface (BMI),Environmental Modelling & Software,Volume 92, 2017, Pages 107-118, https://doi.org/10.1016/j.envsoft.2017.01.021

[6] Octavianus R. and Mursanto P., The Analysis of Critical Success Factor Ranking for Software Development and Implementation Project Using AHP, 2018 International Conference on Advanced Computer Science and Information Systems (ICACSIS), 2018, pp. 313-318, doi: 10.1109/ICACSIS.2018.8618147.

[7] Thuraisingham B., Zhang L. and Moser L., Emerging Web Services [Guest editorial]" in IEEE Transactions on Services Computing, vol. 8, no. 03, 2015, pp. 341-342, doi: 10.1109/TSC.2015.2424612

[8] Mitra, J., Making connections: innovation and collective learning in small businesses", Education+Training, Vol. 42 No. 4/5, 2000, pp. 228-237. https://doi.org/10.1108/00400910010373679

[9] Vaidya O., Kumar S., Analytic hierarchy process: An overview of applications, European Journal of Operational Research, Volume 169, Issue 1, 2006, Pages 1-29,

[10] Singh, N., Tyagi, K., Ranking of services for reliability estimation of SOA system using fuzzy multicriteria analysis with similarity-based approach. Int J Syst Assur Eng Manag 8, 2017, 317–326. https://doi.org/10.1007/s13198-015-0339-5