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# Supporting Information Management in Selecting Scientific Research Projects

Ramadan A. ZeinEldin[1], Alhuseen O. Alsayed[2]
[1](*Deanship of Scientific Research,King AbdulAziz University, Kingdom of Saudi Arabia; ISSR, Cairo University, Egypt.)*
[2](*Deanship of Scientific Research,King AbdulAziz University, Kingdom of Saudi Arabia.)*

***Abstract:*** *The information management in KAU (King Abdulaziz University) face a critical problem when selecting the suitable research projects. Most of faculty members in all faculties and research institutes submit scientific research proposals with the hope to be accepted. The management needs to set a scientific approach to help in selecting suitable proposals. TOPSIS (The Technique for Order of Preference by Similarity to Ideal Solution Method) is a powerful a multi-criteria approach in ranking alternatives with different criteria and selecting the best alternatives. Applying the TOPSIS solved the problem that the Information management faces.*
***Keywords:*** *Research Projects, Selection, Information, Management, TOPSIS, Multi-Criteria*

## I. Introduction

Scientific research refers to a systematic approach for gathering data based on an organized and creative mechanism to reach a predefined goal. A scientific researcher is a scientist or any individual who has the passion and desire to contribute to the body of work. Therefore, a scientific research requires a systematic and well organized methods based on specific standard related to the body of science. Due to the significance relationship between research and science, the term "science" is viewed as the body of knowledge in any area that is acquired using the scientific method [1]. Therefore, it is essential that a scientific research is conducted to contribute to the body of science and it should follow the scientific method [2]. There will not be such a development and a continues enhancement in any area, if there is not demand and care by educational institutes for scientific research projects. Academic and educational institutions have made their decisions by investing manpower and funding research projects process in order to fulfill their needs for scientific knowledge and increase educational and scientific outputs. Thus, exploring and reaching scientific facts have been considerably significant. Because of the large number of the KAU faculty members, research management center of Deanship of Scientific Research has implemented a new mechanism based on the TOPSIS for ranking and selecting research applicants, using five selection project criteria namely, similarity rate based on plagiarism (S.R), evaluation score (E.S), research team members (PI+COI), number of published research and research (P.R.) and the budget for decision making support.

The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), proposed by Hwang and Yoon in 1981[3], is one of the most used methods to support multi criteria decision making. TOPSIS is built on the base of selecting the alternative that has the shortest distance from the ideal solution and the longest distance from the negative ideal solution. The positive ideal solution maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria [4].TOPSIS is simple to understand and apply; it does not require building a specific software or mathematical model, it can be built easily in a spreadsheet. TOPSIS can be used and applied in different areas. Behzadian et al. [5] developed a survey on TOPSIS applications from 266 papers and classified the use of TOPSIS to nine areas including supply chain management and logistics, design, engineering and manufacturing systems, business and marketing management, health, safety and environment management, human resources management, energy management, chemical engineering, water resources management and other topics. Christian et al. [6] used TOPSIS to select the best suitable country among five African emerging markets for the expansion. Keshtkar [7] used TOPSIS to evaluate and select the best alternative of a counter flow wet cooling tower. Safari et al. [8] used fuzzy TOPSIS for facility location selection. Joshi et al. [9] used TOPSIS to assess of possible alternatives for the continuous improvement of the company's cold chain performance. Peng et al. [10] used TOPSIS to choose a set of the optimum cutting parameters in machining processes. Li et al. [11] used TOPSIS for selection of Knowledge management system from the user's perspective. Kannan and Jabbour [12] used fuzzy TOPSIS to select green suppliers for a Brazilian electronics firm. Onu et al. [13] used fuzzy TOPSIS with linguistic scales to solicit expert opinions to rank acid rain control options. Other researchers developed updates in TOPSIS like [14] defined a new ranking index superior to the ranking index of the original TOPSIS to find compromised solutions. Shih et al. [15] proposed a group TOPSIS model for decision making. Aloini et

al. [16] developed a modified version of IF-TOPSIS to fuzzy multi-criteria group decision making and applied it to a packaging machine selection problem. Some researchers used TOPSIS with other techniques such as [17] used fuzzy TOPSIS with fuzzy AHP to rank the solutions of Knowledge Management adoption in Supply. Chain. Thor et al. [18] used four techniques (AHP, ELECTRE, SAW, and TOPSIS) in maintenance decision making. Junior et al. [19] used and compared the Fuzzy AHP and the Fuzzy TOPSIS methods in the context for supplier selection. Alkhawlani [20] used SMART, TOPSIS, and VIKOR methods to develop decision support systems to the Joint Admission Control problem in the heterogeneous networks. Pangsri [21] used Delphi method, AHP and TOPSIS to help the project managers to prioritize project tend for project selection problem in construction companies. Brito and Evers [22] reviewed TOPSIS and other multi-criteria decision-making methods in flood risk management. Önay and Yıldırım [23] used TOPSIS and other multi criteria methods to evaluate 26 alternatives of the Nomenclature of Units for Territorial Statistics in Turkey. Rosic et al. [24] used DEA and TOPSIS for risk evaluation in road safety in Serbia. The objective of this article is to use TOPSIS to rank the submitted research proposals and selecting the best ones that satisfy all the criteria simultaneously. The paper is organized as follows; in section 2, Scientific Research Projects criteria are presented, section 3 is assigned to describing the used approach TOPSIS, using TOPSIS in ranking and selecting best proposals is presented in section 4, finally conclusions and further research are mentioned in section 5.

## II. Scientific Research Projects

With the advancement of research and the growing number of demands on conducting research projects, a scientific research has become a well-known contributor to science. A scientific research is defined as searching for facts about unsolved or unknown problems. Moreover, it is a systematic approach for collecting data based on an organized and creative mechanism to reach a predefined goal [2]. Therefore, academic and educational institutions have made their decisions by investing manpower and funding research projects process in order to fulfill their needs for scientific knowledge and increase educational and scientific outputs. Thus, exploring and reaching scientific facts have been considerably significant. As a result, King Abdul Aziz university is like any other academic institutions which one of their objective is the development and research activities. King Abdul-Aziz University contains several scientific research centers and deanships. Deanship of Scientific Research (DSR) has been one of the most funding research center for planning, managing scientific researches. Therefore, it provides a stimulating environment and continuous support that reinforce its faculty members to enhance their knowledge and increase their contributions in managements and related educational fields of significant importance to the university and the kingdom worldwide
(http://dsr.kau.edu.sa/Default.aspx?Site_ID=305&Lng=AR). DSR has to implement a systematic approach in selecting and funding research projects due to the large number of research applicants and the importance of equal chances for research funding. Thus, the process of project selection and research quality management has to be implemented through selection criteria. It has been found that Plagiarism, evaluation, team members, published research work and proposed budget may have a substantial role for decision makers for research project selection. These selection criteria are illustrated below.

**1. Research Project Selection Criteria:**

**1.1 Similarity rate based on plagiarism (S.R).**

Since the introduction of information and communication technology variety of information sources are becoming available. The thirst of research and development activity are becoming bigger and rapidly growing. Abundant information is becoming more digital and people are easily accessing to those information. This leads to using and copying it and stealing other ideas without knowing the implications and without acknowledging the original authors by using appropriate references or citation in completion of their work [25]. According to [26] plagiarism refers to the act of copying somebody's work materials from different sources such as electronic journal, conference papers or internet websites without giving appropriate reference or acknowledgment to the original authors. Moreover, Mohammed et al. [27] defines a plagiarism as a form of scientific misconduct that is excessively used today. Thus, this form of misconduct means that someone is breaching the research integrity and it is an important reason leads to research rejection based on scientific research code of ethics. As a result, organization and scientific institutions has adopted iThenticate service as one of detection software to prevent misrepresentation of others work and to adhere to academic integrity and code of ethics. iThenticate is a software service that is used to check someone's own work for similarity with other manuscript and previously published research work [28]. Thus, in research project selection, checking applicant's research proposal using iThenticate is a mandatory evidence for research funding eligibility. This software application has been used by DSR management for checking research proposal against plagiarism. Applicants submit their proposal application which in turn the research committee check all proposals. After this check is completed, iThenticate generates a similarity report, which provides detailed information about the original source of any text from a

given proposal that matches previously-published material. After receiving similarity report, research proposals with low similarity rate is preferred.

**1.2 Evaluation Score (E.S)**

Peer review is the process in which a research or publication is evaluated to meet specific criteria by an expert in the same field. It is considered as a fundamental evaluation task for academic scientific research work [29]. Due to its highly significant contribution in decision making, most of scientific research institutions and journals have adopted it as a valid evaluation process. Moreover, peer review is based on the concept that a larger number of people involved in detecting the weakness and errors of assigned research work or performance will usually provide a great chance to find those weakness and errors. Thus, it will provide well appropriate feedback. The peer review process depends on trust of the reviewers, it can affect the research's personal and professional life [30]. Therefore, considering the research's personal and professional integrity, confidentiality of the assessment process and the equity and the equity to assess all research are critical consideration for both research organization and reviewers [https://www.elsevier.com/reviewers/what-is-peer-review]. Peer review maintains and enhance research proposal's quality both directly and indirectly. Reviewers directly detect areas in which the research proposal is evaluated. In addition, peer review has indirect effect by providing evidence for making decision about accepting or rejecting of applicant eligibility, thus it will help research committee to finalize their decisions for funding [http://www.linfo.org/peer_review.html]. Although peer review has received many criticism, it is still widely used by scientific institutions as a valid evaluation process for research funding project [31]. As stated earlier, peer review is a significant and well known evaluation process, in this research, peer review is used to examine applicant's research proposal for research fund. Different scientific institutions follow different types of peer review based on the kind of research they fund and their management style. There are several different types of peer review namely, a single blind, double blind, an open access peer review. A single blind, double blind are commonly used types of peer review in most of the scientific journal and education centers. In a single blind peer review, authors are unaware of who reviewed their research proposal, but reviewers are aware of authors' identity [32]. Thus, this type of peer review helps maintain reviewers' identity invisible to authors. While in a single blind review, reviewers are aware of authors' identity, in double blind review both authors and reviewers are anonymous [https://www.elsevier.com/reviewers/what-is-peer-review]. Therefore, it may sometimes allow reviewers to provide inaccurate or irresponsible feedback. Irrespective of the method adopted, the peer review process functions as a screening mechanism to clarify bad science and to help authors enhance the quality of applicants research proposal [31]. In regard with research proposals, a double blind peer review are used to evaluate research applicants' proposal. The evaluation process consist of two phases. In first phase, research proposals are sent to reviewers who are highly qualified academic professors. In turn, the reviewers evaluate assigned research proposals and return their evaluation feedback to the research committee board. After receiving the feedback evaluation, proposals with higher evaluation score or equal to 70% out of 100% are preferred.

**1.3 Research team members (PI+COI).**

In scientific research, teamwork has a considerable influence in achieving research work. A research project may include one principle investigator with at least two coworkers who both would cooperate effectively and efficiently in their project's completion. Although, the research project size and effort play an important role in conducting the required research objectives, the number of team members should not be more than three people. As a result, in research project selection, research proposal with more than three members will be excluded based on research committee requirements.

**1.4 Number of published research (P.R.).**

The number of published research papers could have a substantial influence in selecting research project for fund. Due to the collaborative work with different researchers, every applicants could choose the research team whom members have published lot of research projects in order to gain experience. Some applicants have worked effectively for publication and of course their scientific research ability has increased. Therefore, it is important to understand that the number of scientific research experience in term of team members publication would have an influence in proposal selection. Thus, a research committee considers all applicants' proposal whom publications number over or equal to 10 publications.

**1.5 Research budget.**

Due to the fact that most of the research project would have a high research budget based on the requirement of the research and its efforts needed, research committee needs to fund proposal whom budget is considerable. In

this regard, the lower research budget is set the more research projects would be available to fund. Thus, a research committee prefer applicants' with lower proposed budget.

Graaf and Postmusa [33] used a stochastic Multi-criteria Acceptability Analysis for ordinal data in research projects selection and resource allocation.

## III. The TOPSIS Approach Steps

TOPSIS method is built on the assumption that $mxn$ decision-making matrix $X$ includes $m$-alternatives and $n$-criteria (each criteria must have a weight $w_j$ assigned to it). Let $x_{ij}$ be the score of alternative $i$ with respect to criterion $j$, then the will be $X = (x_{ij})_{mxn}$. The TOPSIS procedure consists of the following steps ([4], [34], [10], [14], [35]):

**Step1**: Calculate the normalized decision matrix.

To transform the various attribute dimensions into non-dimensional attributes, which allows comparison across the attributes all the $x_{ij}$ values in the decision matrix $(x_{ij})_{mxn}$ have to be normalized to form the matrix $R = (r_{ij})_{mxn}$. The normalized value $r_{ij}$ is calculated as:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad , j = 1,2,\dots,n \qquad (1)$$

**Step 2:** Calculate the weighted normalized decision matrix: by multiplying the normalized matrix by the weight $w_j$ of the $j^{th}$ criterion. The weighted normalized value $v_{ij}$ is calculated as:

$$v_{ij} = w_j\, r_{ij}, i = 1,2,,m,j = 1,2,\dots,n, \qquad (2)$$

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

**Step 3:** Determine the positive and negative-ideal solutions.

Positive ideal alternative is the one which has the best level for all attributes considered. Negative ideal alternative is the one which has the worst attribute values. The preferred alternative is the one having the shortest distance from an ideal solution $A^+$ and the farthest distance from a negative-ideal solution $A^-$. Determine the ideal solution $A^+$ and negative-ideal solution $A^-$ the ideal solution $A^+ = \{v_1^+,\dots, v_n^+\}$, where, $v^+ = \{max\ (v_{ij})\}$. Negative-ideal solution $A^- = \{\ v_1^-,\ \dots,\ v_n^-\ \}$, where $v^- = \{\ min\ (v_{ij})\}$.

**Step 4:** Calculate the separation measures, using the $n$ dimensional Euclidean distance. The separation of each alternative from the positive ideal solution is given as:

$$D_i^+ = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^+\right)^2}, i = 1,2,\dots\dots m \qquad (3)$$

Similarly, the separation from the negative ideal solution is given as:

$$D_i^- = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^-\right)^2}, i = 1,2,\dots\dots m \qquad (4)$$

**Step 5:** Calculate the relative closeness to the ideal solution. The relative closeness of the alternative $a_i$ with respect to$A^+$ is defined as following:

$$C_i = D_i^- / (D_i^+ + D_i^-), \quad 0 < C_i < 1, i = 1,2,\dots\dots m \qquad (5)$$

**Step 6:** Rank the preference order.

A set of alternatives can now be preference ranked according to the descending order of$C_i$. An alternative with the higher score of $C_i$ is the better decision alternative.

## IV. Using TOPSIS To Select The Research Projects

The TOPSIS steps are applied on a real data research projects. Table 1 shows the decision matrix which has the original data of the research projects.

Step1: Calculate the normalized decision matrix. Equation (1) is used to transform the decision matrix in table 1 to the normalized decision matrix.

Step 2: Calculate the weighted normalized decision matrix: we interact with the decision maker to assign a weight for each criteria and show him the results of its assigned weight. If the decision maker needs to change the weight to see other results, TOPSIS gives new results according to the new assigned weight. This process is continuing until the decision maker assigns the suitable weights from his point of view. The weighted normalized decision matrix is computed using equation 2.

Step 3: Determine the positive and negative-ideal solutions: as mentioned in section 3, it is very important to determine the positive and negative ideal solutions. Equation (3) is used to determine theses solutions.

Step 4: Calculate the separation measures: equations (4) and (5) are used to calculate the separation measures.
Step 5: Calculate the relative closeness to the ideal solution using equation (6).
Step 6: Rank the preference order. The relative closeness to the ideal solution computed from step 5 is ordered in descending order from the highest value to the lowest value. This rank helps the decision maker to select the suitable projects according to his predetermined criteria. Table 2 shows the rank of the research projects. From table 2 it is found that the first 59th projects satisfy all the criteria together. If the management will finance the first 50th projects, it has no problem. And if the management can fund more, it has 100 sorted projects (only 6 projects don't satisfy the budget limitation) so the management can negotiate with the owners of these projects to reduce the budget or select the successors.

**Table 1:** Decision matrix (projects data)

| Proj. NO. | S. R. | Score | PI+COI | P. R. | Budget | Proj. NO. | S. R. | Score | PI+COI | P. R. | Budget |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.15 | 90 | 3 | 6 | 40000 | 81 | 0.15 | 85 | 3 | 21 | 54000 |
| 2 | 0.18 | 97.5 | 3 | 3 | 35000 | 82 | 0.29 | 75 | 2 | 25 | 40000 |
| 3 | 0.14 | 96.6 | 3 | 15 | 40000 | 83 | 0.16 | 80 | 3 | 23 | 40000 |
| 4 | 0.01 | 96.6 | 3 | 40 | 40000 | 84 | 0.20 | 85 | 3 | 14 | 34500 |
| 5 | 0.07 | 95.2 | 3 | 27 | 45000 | 85 | 0.40 | 70 | 2 | 13 | 25600 |
| 6 | 0.15 | 94.8 | 3 | 22 | 35000 | 86 | 0.16 | 75 | 3 | 12 | 85000 |
| 7 | 0.04 | 94 | 3 | 10 | 38000 | 87 | 0.17 | 80 | 3 | 25 | 40000 |
| 8 | 0.11 | 92.1 | 1 | 25 | 38000 | 88 | 0.15 | 75 | 3 | 15 | 36000 |
| 9 | 0.19 | 91.6 | 1 | 12 | 50000 | 89 | 0.12 | 89 | 3 | 22 | 49000 |
| 10 | 0.09 | 91.2 | 1 | 12 | 45000 | 90 | 0.13 | 75 | 3 | 15 | 75000 |
| 11 | 0.03 | 91.1 | 1 | 15 | 45000 | 91 | 0.08 | 89 | 2 | 11 | 45200 |
| 12 | 0.17 | 88.2 | 2 | 14 | 40000 | 92 | 0.10 | 89 | 3 | 13 | 85000 |
| 13 | 0.11 | 87.7 | 2 | 15 | 39000 | 93 | 0.17 | 95 | 2 | 15 | 58000 |
| 14 | 0.05 | 87.2 | 2 | 12 | 36000 | 94 | 0.17 | 85 | 3 | 13 | 45000 |
| 15 | 0.02 | 87.2 | 3 | 8 | 40000 | 95 | 0.15 | 85 | 3 | 11 | 42300 |
| 16 | 0.18 | 86.8 | 3 | 15 | 37000 | 96 | 0.05 | 43.2 | 2 | 17 | 85600 |
| 17 | 0.37 | 86.2 | 2 | 6 | 60000 | 97 | 0.16 | 98 | 3 | 16 | 49000 |
| 18 | 0.06 | 85.5 | 3 | 19 | 40000 | 98 | 0.14 | 75 | 2 | 20 | 45000 |
| 19 | 0.18 | 84.8 | 3 | 22 | 42000 | 99 | 0.15 | 85 | 3 | 22 | 54000 |
| 20 | 0.13 | 84.7 | 3 | 23 | 59000 | 100 | 0.13 | 75 | 2 | 25 | 40000 |
| 21 | 0.19 | 84.7 | 3 | 18 | 65000 | 101 | 0.16 | 80 | 3 | 23 | 40000 |
| 22 | 0.06 | 83.7 | 3 | 24 | 45000 | 102 | 0.20 | 85 | 3 | 14 | 34500 |
| 23 | 0.03 | 83.4 | 3 | 22 | 50000 | 103 | 0.14 | 70 | 2 | 13 | 25600 |
| 24 | 0.18 | 83.3 | 3 | 19 | 50000 | 104 | 0.16 | 75 | 3 | 12 | 85000 |
| 25 | 0.04 | 80.8 | 2 | 19 | 38500 | 105 | 0.17 | 80 | 3 | 25 | 40000 |
| 26 | 0.17 | 80.7 | 2 | 18 | 39000 | 106 | 0.25 | 75 | 3 | 15 | 36000 |
| 27 | 0.17 | 80.3 | 3 | 16 | 45000 | 107 | 0.12 | 89 | 3 | 22 | 49000 |
| 28 | 0.05 | 79.9 | 3 | 15 | 45000 | 108 | 0.13 | 75 | 3 | 15 | 75000 |
| 29 | 0.19 | 79.8 | 3 | 12 | 39000 | 109 | 0.08 | 89 | 2 | 14 | 45200 |
| 30 | 0.05 | 79.8 | 3 | 18 | 65000 | 110 | 0.10 | 89 | 3 | 12 | 85000 |
| 31 | 0.08 | 79.1 | 3 | 14 | 50000 | 111 | 0.17 | 95 | 2 | 12 | 58000 |
| 32 | 0.18 | 78.9 | 3 | 15 | 39000 | 112 | 0.17 | 85 | 3 | 13 | 45000 |
| 33 | 0.06 | 78.4 | 3 | 13 | 35000 | 113 | 0.15 | 85 | 3 | 15 | 42300 |
| 34 | 0.04 | 78.3 | 2 | 14 | 45000 | 114 | 0.14 | 70 | 2 | 13 | 25600 |
| 35 | 0.18 | 78.3 | 2 | 16 | 65000 | 115 | 0.16 | 75 | 3 | 12 | 40000 |
| 36 | 0.19 | 77.8 | 3 | 14 | 89000 | 116 | 0.17 | 80 | 3 | 25 | 40000 |
| 37 | 0.16 | 77.5 | 2 | 12 | 39000 | 117 | 0.25 | 75 | 3 | 15 | 36000 |
| 38 | 0.02 | 77 | 2 | 25 | 32000 | 118 | 0.12 | 89 | 3 | 22 | 49000 |
| 39 | 0.04 | 76.8 | 2 | 16 | 45000 | 119 | 0.13 | 75 | 3 | 15 | 40000 |
| 40 | 0.03 | 76.4 | 2 | 15 | 48000 | 120 | 0.08 | 89 | 2 | 14 | 45200 |
| 41 | 0.06 | 75.8 | 2 | 15 | 34000 | 121 | 0.10 | 89 | 3 | 12 | 35500 |
| 42 | 0.05 | 75.1 | 3 | 15 | 60000 | 122 | 0.17 | 95 | 2 | 12 | 50000 |
| 43 | 0.15 | 75 | 3 | 12 | 40000 | 123 | 0.17 | 85 | 3 | 13 | 45000 |
| 44 | 0.07 | 74.4 | 3 | 15 | 50000 | 124 | 0.15 | 85 | 3 | 15 | 42300 |
| 45 | 0.26 | 73.7 | 3 | 10 | 50000 | 125 | 0.12 | 70 | 3 | 16 | 46000 |
| 46 | 0.07 | 73 | 3 | 15 | 34000 | 126 | 0.17 | 80 | 3 | 17 | 44000 |
| 47 | 0.43 | 71.8 | 3 | 7 | 45000 | 127 | 0.16 | 86 | 3 | 19 | 46000 |
| 48 | 0.25 | 71.6 | 3 | 5 | 60000 | 128 | 0.14 | 89 | 3 | 15 | 47000 |
| 49 | 0.16 | 74.4 | 3 | 14 | 39000 | 129 | 0.15 | 89 | 3 | 16 | 50000 |
| 50 | 0.01 | 70 | 3 | 12 | 39000 | 130 | 0.16 | 85 | 2 | 14 | 42000 |
| 51 | 0.03 | 74.4 | 3 | 16 | 50000 | 131 | 0.14 | 89 | 3 | 15 | 43000 |
| 52 | 0.08 | 74.4 | 3 | 14 | 50000 | 132 | 0.16 | 87 | 2 | 19 | 43000 |
| 53 | 0.42 | 66.6 | 3 | 8 | 32000 | 133 | 0.14 | 89 | 3 | 16 | 49500 |
| 54 | 0.55 | 66.2 | 3 | 14 | 58000 | 134 | 0.16 | 89 | 2 | 14 | 45200 |
| 55 | 0.34 | 65.8 | 3 | 13 | 65000 | 135 | 0.17 | 90 | 3 | 18 | 44300 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | 0.03 | 85 | 3 | 17 | 41000 | 136 | 0.17 | 90 | 2 | 19 | 33500 |
| 57 | 0.02 | 85 | 3 | 16 | 48500 | 137 | 0.17 | 90 | 3 | 25 | 36000 |
| 58 | 0.05 | 96 | 2 | 13 | 35000 | 138 | 0.17 | 95 | 2 | 23 | 50000 |
| 59 | 0.15 | 96 | 3 | 14 | 56000 | 139 | 0.17 | 86 | 3 | 20 | 36000 |
| 60 | 0.03 | 85 | 3 | 11 | 45000 | 140 | 0.16 | 87 | 2 | 24 | 54000 |
| 61 | 0.01 | 86 | 3 | 19 | 45000 | 141 | 0.14 | 85 | 2 | 23 | 35000 |
| 62 | 0.20 | 63 | 3 | 15 | 65000 | 142 | 0.15 | 86 | 2 | 21 | 45000 |
| 63 | 0.20 | 80 | 2 | 18 | 43500 | 143 | 0.16 | 90 | 3 | 25 | 35000 |
| 64 | 0.36 | 58.9 | 3 | 10 | 75000 | 144 | 0.14 | 85 | 3 | 25 | 50000 |
| 65 | 0.03 | 90 | 3 | 19 | 50000 | 145 | 0.16 | 95 | 3 | 26 | 50000 |
| 66 | 0.05 | 94 | 2 | 19 | 42500 | 146 | 0.14 | 90 | 3 | 23 | 40000 |
| 67 | 0.04 | 86 | 3 | 15 | 40000 | 147 | 0.16 | 80 | 3 | 25 | 37500 |
| 68 | 0.09 | 86 | 2 | 13 | 43000 | 148 | 0.13 | 85 | 3 | 24 | 36500 |
| 69 | 0.10 | 52.2 | 3 | 15 | 45000 | 149 | 0.13 | 80 | 3 | 21 | 39000 |
| 70 | 0.28 | 84 | 2 | 11 | 56000 | 150 | 0.13 | 75 | 3 | 25 | 41000 |
| 71 | 0.25 | 81 | 3 | 14 | 75000 | 151 | 0.14 | 70 | 3 | 23 | 42300 |
| 72 | 0.03 | 85 | 3 | 14 | 45000 | 152 | 0.13 | 75 | 3 | 22 | 39000 |
| 73 | 0.18 | 88 | 3 | 14 | 45200 | 153 | 0.14 | 84 | 3 | 21 | 39000 |
| 74 | 0.48 | 44.4 | 3 | 12 | 52000 | 154 | 0.14 | 89 | 3 | 6 | 35400 |
| 75 | 0.20 | 44.2 | 3 | 14 | 54000 | 155 | 0.13 | 85 | 3 | 11 | 35000 |
| 76 | 0.32 | 44.2 | 3 | 12 | 45200 | 156 | 0.10 | 86 | 3 | 12 | 36000 |
| 77 | 0.08 | 43.4 | 3 | 23 | 49600 | 157 | 0.13 | 94 | 3 | 10 | 35000 |
| 78 | 0.05 | 43.2 | 2 | 21 | 85600 | 158 | 0.14 | 92 | 3 | 10 | 34000 |
| 79 | 0.28 | 98 | 3 | 23 | 49000 | | | | | | |
| 80 | 0.25 | 75 | 2 | 25 | 45000 | | | | | | |

**Table 2:** Ranking of the research projects using TOPSIS

| Ser. No. | Proj. NO. | Ratio | S. R. | E. S. | PI+COI | P. R. | Budget |
|---|---|---|---|---|---|---|---|
| 1 | 4 | 0.97948 | 0.01 | 96.60 | 3 | 40 | 40000 |
| 2 | 5 | 0.93834 | 0.07 | 95.20 | 3 | 27 | 45000 |
| 3 | 38 | 0.93393 | 0.02 | 77. | 2 | 25 | 32000 |
| 4 | 22 | 0.92922 | 0.06 | 83.70 | 3 | 24 | 45000 |
| 5 | 8 | 0.92345 | 0.11 | 92.10 | 1 | 25 | 38000 |
| 6 | 23 | 0.92201 | 0.03 | 83.40 | 3 | 22 | 50000 |
| 7 | 18 | 0.92199 | 0.06 | 85.50 | 3 | 19 | 40000 |
| 8 | 66 | 0.92177 | 0.05 | 94 | 2 | 19 | 42500 |
| 9 | 61 | 0.92108 | 0.01 | 86 | 3 | 19 | 45000 |
| 10 | 25 | 0.92073 | 0.04 | 80.80 | 2 | 19 | 38500 |
| 11 | 56 | 0.91909 | 0.03 | 85 | 3 | 17 | 41000 |
| 12 | 65 | 0.91799 | 0.03 | 90 | 3 | 19 | 50000 |
| 13 | 63 | 0.91699 | 0.02 | 80 | 2 | 18 | 43500 |
| 14 | 67 | 0.91626 | 0.04 | 860 | 3 | 15 | 40000 |
| 15 | 148 | 0.91484 | 0.13 | 85 | 3 | 24 | 36500 |
| 16 | 58 | 0.91469 | 0.05 | 96 | 2 | 13 | 35000 |
| 17 | 57 | 0.91333 | 0.02 | 85 | 3 | 16 | 48500 |
| 18 | 72 | 0.91255 | 0.03 | 85 | 3 | 14 | 45000 |
| 19 | 41 | 0.91245 | 0.06 | 75.80 | 2 | 15 | 34000 |
| 20 | 11 | 0.91217 | 0.03 | 91.10 | 1 | 15 | 45000 |
| 21 | 14 | 0.91198 | 0.05 | 87.20 | 2 | 12 | 36000 |
| 22 | 7 | 0.91188 | 0.04 | 94 | 3 | 10 | 38000 |
| 23 | 28 | 0.91186 | 0.05 | 79.90 | 3 | 15 | 45000 |
| 24 | 150 | 0.91177 | 0.13 | 75 | 3 | 25 | 41000 |
| 25 | 46 | 0.91177 | 0.07 | 73 | 3 | 15 | 34000 |
| 26 | 33 | 0.91161 | 0.06 | 78.40 | 3 | 13 | 35000 |
| 27 | 39 | 0.91153 | 0.04 | 76.80 | 2 | 16 | 45000 |
| 28 | 100 | 0.91088 | 0.13 | 75 | 2 | 25 | 40000 |
| 29 | 89 | 0.91028 | 0.12 | 89 | 3 | 22 | 49000 |
| 30 | 107 | 0.91028 | 0.12 | 89 | 3 | 22 | 49000 |
| 31 | 118 | 0.91028 | 0.12 | 89 | 3 | 22 | 49000 |
| 32 | 34 | 0.90923 | 0.04 | 78.30 | 2 | 14 | 45000 |
| 33 | 60 | 0.90890 | 0.03 | 85 | 3 | 11 | 45000 |
| 34 | 109 | 0.90885 | 0.08 | 89 | 2 | 14 | 45200 |
| 35 | 120 | 0.90885 | 0.080 | 89 | 2 | 14 | 45200 |
| 36 | 15 | 0.90884 | 0.020 | 87.20 | 3 | 8 | 40000 |
| 37 | 51 | 0.90881 | 0.030 | 74.40 | 3 | 16 | 50000 |
| 38 | 40 | 0.90842 | 0.030 | 76.40 | 2 | 15 | 48000 |
| 39 | 50 | 0.90798 | 0.010 | 70 | 3 | 12 | 39000 |
| 40 | 121 | 0.90732 | 0.100 | 89 | 3 | 12 | 35500 |
| 41 | 146 | 0.90724 | 0.140 | 90 | 3 | 23 | 40000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 42 | 152 | 0.90707 | 0.130 | 75 | 3 | 22 | 39000 |
| 43 | 149 | 0.90705 | 0.130 | 80 | 3 | 21 | 39000 |
| 44 | 156 | 0.90660 | 0.100 | 86 | 3 | 12 | 36000 |
| 45 | 68 | 0.90647 | 0.090 | 86 | 2 | 13 | 43000 |
| 46 | 141 | 0.90631 | 0.140 | 85 | 2 | 23 | 35000 |
| 47 | 13 | 0.90621 | 0.110 | 87.70 | 2 | 15 | 39000 |
| 48 | 44 | 0.90534 | 0.070 | 74.40 | 3 | 15 | 50000 |
| 49 | 91 | 0.90526 | 0.080 | 89 | 2 | 11 | 45200 |
| 50 | 77 | 0.90451 | 0.080 | 43.40 | 3 | 23 | 49600 |
| 51 | 31 | 0.90440 | 0.080 | 79.10 | 3 | 14 | 50000 |
| 52 | 144 | 0.90388 | 0.140 | 85 | 3 | 25 | 50000 |
| 53 | 10 | 0.90356 | 0.090 | 91.20 | 1 | 12 | 45000 |
| 54 | 52 | 0.90291 | 0.080 | 74.40 | 3 | 14 | 50000 |
| 55 | 153 | 0.90280 | 0.140 | 84 | 3 | 21 | 39000 |
| 56 | 6 | 0.90087 | 0.150 | 94.80 | 3 | 22 | 35000 |
| 57 | 151 | 0.90032 | 0.140 | 70 | 3 | 23 | 42300 |
| 58 | 143 | 0.89757 | 0.160 | 90 | 3 | 25 | 35000 |
| 59 | 125 | 0.89719 | 0.120 | 70 | 3 | 16 | 46000 |
| 60 | 42 | 0.89683 | 0.050 | 75.10 | 3 | 15 | 60000 |
| 61 | 20 | 0.89617 | 0.130 | 84.70 | 3 | 23 | 59000 |
| 62 | 119 | 0.89609 | 0.130 | 75 | 3 | 15 | 40000 |
| 63 | 157 | 0.89594 | 0.130 | 94 | 3 | 10 | 35000 |
| 64 | 69 | 0.89559 | 0.100 | 52.20 | 3 | 15 | 45000 |
| 65 | 155 | 0.89549 | 0.130 | 85 | 3 | 11 | 35000 |
| 66 | 3 | 0.89548 | 0.140 | 96.60 | 3 | 15 | 40000 |
| 67 | 98 | 0.89503 | 0.140 | 75 | 2 | 20 | 45000 |
| 68 | 147 | 0.89472 | 0.160 | 80 | 3 | 25 | 37500 |
| 69 | 30 | 0.89459 | 0.050 | 79.80 | 3 | 18 | 65000 |
| 70 | 131 | 0.89359 | 0.140 | 89 | 3 | 15 | 43000 |
| 71 | 142 | 0.89348 | 0.150 | 86 | 2 | 21 | 45000 |
| 72 | 145 | 0.89314 | 0.160 | 95 | 3 | 26 | 50000 |
| 73 | 128 | 0.89164 | 0.140 | 89 | 3 | 15 | 47000 |
| 74 | 133 | 0.89133 | 0.140 | 89 | 3 | 16 | 49500 |
| 75 | 158 | 0.89108 | 0.140 | 92 | 3 | 10 | 34000 |
| 76 | 83 | 0.89093 | 0.160 | 80 | 3 | 23 | 40000 |
| 77 | 101 | 0.89093 | 0.160 | 80 | 3 | 23 | 40000 |
| 78 | 99 | 0.88946 | 0.150 | 85 | 3 | 22 | 54000 |
| 79 | 137 | 0.88864 | 0.170 | 90 | 3 | 25 | 36000 |
| 80 | 103 | 0.88835 | 0.140 | 70 | 2 | 13 | 25600 |
| 81 | 114 | 0.88835 | 0.140 | 70 | 2 | 13 | 25600 |
| 82 | 81 | 0.88802 | 0.150 | 85 | 3 | 21 | 54000 |
| 83 | 154 | 0.88765 | 0.140 | 89 | 3 | 6 | 35400 |
| 84 | 113 | 0.88732 | 0.150 | 85 | 3 | 15 | 42300 |
| 85 | 124 | 0.88732 | 0.150 | 85 | 3 | 15 | 42300 |
| 86 | 88 | 0.88650 | 0.150 | 75 | 3 | 15 | 36000 |
| 87 | 87 | 0.88551 | 0.170 | 80 | 3 | 25 | 40000 |
| 88 | 105 | 0.88551 | 0.170 | 80 | 3 | 25 | 40000 |
| 89 | 116 | 0.88551 | 0.170 | 80 | 3 | 25 | 40000 |
| 90 | 129 | 0.88528 | 0.150 | 89 | 3 | 16 | 50000 |
| 91 | 140 | 0.88481 | 0.160 | 87 | 2 | 24 | 54000 |
| 92 | 132 | 0.88472 | 0.160 | 87 | 2 | 19 | 43000 |
| 93 | 127 | 0.88418 | 0.160 | 86 | 3 | 19 | 46000 |
| 94 | 95 | 0.88318 | 0.150 | 85 | 3 | 11 | 42300 |
| 95 | 43 | 0.88240 | 0.150 | 75 | 3 | 12 | 40000 |
| 96 | 1 | 0.88126 | 0.150 | 90 | 3 | 6 | 40000 |
| 97 | 139 | 0.88086 | 0.170 | 86 | 3 | 20 | 36000 |
| 98 | 97 | 0.88006 | 0.160 | 98 | 3 | 16 | 49000 |
| 99 | 136 | 0.87965 | 0.170 | 90 | 2 | 19 | 33500 |
| 100 | 138 | 0.87955 | 0.170 | 95 | 2 | 23 | 50000 |

## V. Conclusion And Further Research

From our study, we concluded that the selection criteria are contradicted and it is too difficult to satisfy all the criteria which is the desire of the decision maker. TOPSIS considers all the criteria in one value, so, it is the most suitable approach for ranking and selecting the best alternatives that satisfy all the criteria. As a further research, TOPSIS needs to be investigated when some criteria have time window. Also, it can be merged with meta-heuristics techniques such as genetic algorithm, particle swarm, and ant colony. Sometimes the decision maker does not have the ability to determine the criteria weights, so it will be fruitful are for research to update the TOPSIS to delete the weights or find other ways to create weights.

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