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Analytic Hierarchy Process and Multi-Factor Evaluation Process Methods for Proposal Research Evaluation

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ABSTRACT

Evaluation of scientific research proposals is one of the most important factors in determining the quality of research results to be obtained so that they can contribute to the development of science and technology in harmony with people's lives, so this needs to be considered. However, the process of evaluating scientific research proposals is not an easy matter because it involves a variety of complex causal factors and sub-factors in conducting evaluations in a consistent and objective manner. Therefore, we propose the AHP and MFEP methods with causal factors, namely originality, novelty, contribution, methodology, reputation journal references, research roadmap, research member, up-to-date references, percentage of references, tools references, references styles, proposal format, and thirty-three (33) other sub-factors. This study aims to provide knowledge about how the AHP and MFEP methods can be combined to evaluate scientific research Proposals. The AHP method is used to calculate the weight of the priority level values for each causal factor and sub-factor that will be used by the MFEP method, while the MFEP method is used to calculate the evaluation weight value for each alternative by utilizing the value of the priority level of causal factors and sub-determining factors resulting from AHP, as well as calculating the total value of the evaluation weight for each alternative. The results showed that both methods can be used to evaluate scientific research proposals by obtaining five (5) alternative candidates for research grant winners from CARPS-CS with a total evaluation weight value of = 50% out of ten (10) alternative candidates.

Keywords: *Analytical hierarchy process, Multi-factor Evaluation Process, Proposal research evaluation*

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1. Introduction

The quality of scientific research results is very important to note, so various mechanisms are needed to guarantee it (Yuniangga, 2020). One of the mechanisms needed to guarantee the quality of scientific research is to evaluate scientific research proposals based on certain parameters before conducting research in the field (Spaapen, Dijstelbloem and Wamelink, 2007). This mechanism is needed to determine the good or bad quality of the results of scientific research later (Kellaghan, 2010). However, the process of evaluating scientific research proposals is not an easy matter because it involves various factors and sub-determinants that are capable of conducting evaluations in a consistent, transparent, and quality manner in order to guarantee the quality of research results.

Thus, we propose the analytical hierarchy process (AHP) method and the multi-factor evaluation process (MFEP) method to evaluate scientific research proposals based on several determining factors in research Meidelfi *et al.* (2021) and Sundari *et al.* (2019), such as originality factors, novelty factors, contribution factors, methodology factors, and other internal requirements factors, such as the reputation journal references factor, the roadmap researcher factor, the research member factor, the up-to-date reference factor, the percentage of reference factor, the tools reference factor, the reference styles factor, the proposal format factor (CARPS_CS, 2023), along with thirty-three (33) other sub-factors to obtain research grants.

Previous research related to the evaluation of research projects as carried out by Meidelfi *et al.*, (2021) utilized the Simple Additive Weighting (SAW) and BORDA methods to determine the title of student project research with the criteria of originality, novelty, target and topic contribution, methodology, and similarity in the Department of Information Technology (IT), Padang State Polytechnic. Meanwhile, Sundari *et al.* (2019) uses the Preferences Selection Index with the criteria of problem formulation, research output opportunities, research method, literature review, and research feasibility to provide research grants for researchers.

Vol.4, Issue.2, pp. 28-38, 2024
Available online at: http://tljes.org/index.php/tljes/data

In addition, there are several studies that use the Multi Factor Evaluation Process (MFEP) method with different parameters, such as that conducted by Warnilah *et al.* (2020) to evaluate the cooperative learning model with the parameters learning objectives, learning materials, students, situation or condition, infrastructure, and Pujiastuti *et al.* (2021) for the evaluation of the best lemosin cows with the parameters of origin, price, age, weight, and size, and also Que *et al.* (2021) for evaluating nurse performance from the best to the worst with the parameters performance, hospitality, discipline, knowledge, patient assessment, and Jayady *et al.* (2021) Determine the assistant that is most suitable for the parameters Education, Ride, Marital Status, Location, Overtime, then Handayani and Kifti (2020) Determine the best laboratory assistant with the parameters of discipline, years of service, expertise competencies, personality competencies, and social competencies.as well as Limbong *et al.* (2020) Helps accelerate employee performance evaluation with the criteria of testing value, discipline, length of work, and loyalty, and Susanti (2021) Helps determine students who are eligible to receive scholarship assistance for the underprivileged with the Parents' Income parameter, Number of Parent Dependents, Certificate of Incapacity, Orphan Status, Status Description Pkh, and Attendance Status.

Furthermore Sahoo, Pattnaik & Behera (2022), Fernando and Siagian (2021) and Leite *et al.* (2019) use the analytical hierarchy process (AHP) method, but Sahoo, Pattnaik & Behera (2022) are used to evaluate the use of egovernance with the criteria of Parliament Criteria, Ministerial Criteria, Administrative Criteria, Opportunities Criteria, Technical Criteria, Non-Technical Criteria, Promotion Criteria, Advertisement, whereas Fernando and Siagian (2021) to determine the granting of credit to consumers with the criteria of Character, Capacity, Capital, Conditions of economy, Collateral, and Leite *et al.* (2019) to evaluate intellectual/academic patent rights with the Parementary Technology transformed into Product, Market Risk, Technology licensed with the patent, Litigation, Economic Relevance, Market Size, Patent Strategy, Impact of Technology on Industry, Superiority or Substitutes, Number of Claims, Formal Marketing Limitations, Size of the Patent Family (Geographic Scope of Protection), Need for High Initial Investment, Need for Certifications, Market Acceptance Risk, Number of Citations, Market Trends, The term of the patent expires.

In addition, Adriyendi and Melia (2021) uses the SMART, MFEP, MOORA, SAW, and WP methods to determine the best alternative fashion (rayon) for consumers and production with the parameters Fiber Material, Smooth Texture, Faded Color, Elastic Clothing,
Useful Long, Chilly, and Comfortable, and Afolabi *et al*, (2019) uses Nave Bayes prediction, Data Mining, Cumulative Grade Point Average (CGPA) parameters, Result of the Courses, Project supervisor, Area specialization supervisor, Area of interest of student and Topic research student to develop a system to accelerate supervisor allocation by title of student research project, then Setiawan, Dhamayanti & Tasmi (2022) combines AHP, TOPSIS and Copeland Score with parameters Project Schedule, Project Cost, Project Scope, Project Risk, Project Performance, Project Effectiveness, and Project User Satisfaction to build a system to accelerate local government project evaluation from the best to the worst, and Wu *et al.* (2022) using AHP and Fuzzy Comprehensive Evaluation with the criteria of Academic performance,

Primary index, Practical Ability, learning efficiency, Learning Attitude to evaluate student learning systems, and Soares *et al.* (2023) using AHP and SAW with criteria for Education level, Educational background, guiding experience, Lecturer experience area, Publication, Guide quota, and Student concentration to determine promoters and co-promoters for student research projects.

From some of the previous research that has been described above, it can be concluded that there is no research that has combined the analytical hierarchy process (AHP) method and the multi-factor evaluation process (MFEP) method together by using causal factors and other supporting sub-factors to evaluate research proposals.

The AHP method is used to determine the weight value of the priority level for each factor causing the problem and other supporting sub-factors and to determine the consistency value of each causal factor and sub-factor. While the multi-factor evaluation process (MFEP) method is used to determine the value of the evaluation weight and the total value of the evaluation weight and to rank the values for each alternative.

2. Literature Review

2.1. Analytic Hierarchy Process (AHP) Method

In solving this case using AHP, several stages were passed, namely.

a) Develop a hierarchical process structure forexisting problems, as shown in Figure 1.

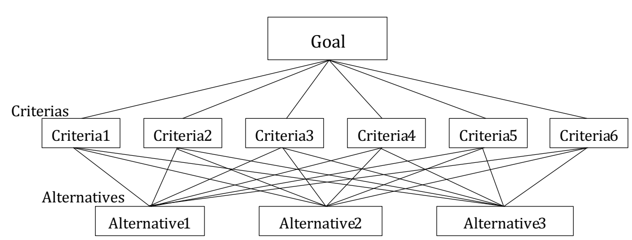

Figure 1. Structure of AHP (Saaty and Vargas, 2012)

Vol.4, Issue.2, pp. 28-38, 2024
Available online at: http://tljes.org/index.php/tljes/data

b) Determine the pairwise comparison scale value of each parameter in each criterion with Table 1.

Table 1. The fundamental scale of absolute numbers (Sasty, 1990)

Intensity of Importance	Definition Explanation	Definition Explanation
1	Equal Importance	Two activities contribute equally to the objective
Intensity of Importance	Definition Explanation	Definition Explanation
3	Moderate importance of one over another	Experience and judgment slightly favor one activity over another
5	Essential of Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	The intermediate value between the two adjacent judgments	When compromise is needed
Reciprocals of above	If activity I have one of the above non-zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.	A reasonable assumption

c) Perform matrix comparison calculations for each parameter with equation (1) (Saaty, 2008)

$$\begin{bmatrix} & A_1 & A_2 & \cdots & \cdots & A_n \\ A_1 & \frac{w_1}{w_1} & \frac{w_1}{w_2} & \cdots & \cdots & \frac{w_1}{w_n} \\ A_2 & \frac{w_2}{w_1} & \frac{w_2}{w_2} & \cdots & \cdots & \frac{w_2}{w_n} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ . & . & . & \cdots & \cdots & . \\ A_n & \frac{w_1}{w_1} & \frac{w_1}{w_1} & \cdots & \cdots & \frac{w_n}{w_n} \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ . \\ \vdots \\ . \\ w_n \end{bmatrix} = n \begin{bmatrix} w_1 \\ w_2 \\ . \\ \vdots \\ . \\ w_n \end{bmatrix} \quad (1)$$

Where:
$A_1 \ldots . A_n$= kriteria / sub kriteria / alternatif program.
$W_1 \ldots . W_n$= bobot dari kriteria / sub kriteria / alternatif program.

d) As well as determining the value of the consistency ratio from the results of the comparison of each criterion, with equations (2) and (3) as follows (Saaty and Vargas, 2012), where there is equation (2) calculates the consistency index (CI).

$$\boldsymbol{CI = \left(\frac{\lambda max - n}{n - 1}\right)} \quad (2)$$

Where:
CI = Consistency Index
λmax = Eigenvalue Max
n = Ordos Matrix

While equation (3) calculates the consistency ratio of the value of each criterion

$$\boldsymbol{R = \frac{CI}{RI}} \quad (3)$$

Where:
CR = Consistency Ratio.
CI = Consistency Index.
RI = Random Index (seen Table 3).

If the CR value is more than 10%, then the data judgment must be corrected. However, if the consistency ratio value is ≤0.1, then the calculation results can be declared feasible or consistent to proceed to the next process. Where the Random Index can be obtained from Table 2

Table 2**.** Random consistency index (R.I.) (Saaty and Vargas, 2012).

N	1	2	3	4	5	6	7	8	..	15
R.I.	0	0	0.52	0.89	1.11	1.25	1.35	1.40	..	1.58

2.2. Multi-Factor Evaluation Process (MFEP) Method

The multi-factor evaluation process (MFEP) is a basic method used for the development of decision support systems (Tarifu *et al.*, 2021), in addition to being a quantitative technique using the "Weighting System"

Vol.4, Issue.2, pp. 28-38, 2024
Available online at: http://tljes.org/index.php/tljes/data

framework" (Susanti, 2021). Where the assessment system is carried out subjectively and intuitively based on several factors that have an important influence on a problem (Susanti, 2021), (Tarifu *et al.*, 2021). The value weighting system is based on the priority scale of each factor, taking into account the level of importance (Warnilah *et al.*, 2020), (Limbong *et al.*, 2020), (Tarifu *et al.*, 2021)

There are several steps that must be met to solve problems using the MFEP method, as follows (Warnilah *et al.*, 2020), (Limbong *et al.*, 2020), (Tarifu *et al.*, 2021):

1) Determine the criteria or factors causing the problem and the value of priority and importance.
2) Calculating the evaluation weight value (NBE)
3) Calculating the total value of the evaluation weight (TBE)
4) Rating for decision

To calculate the value of the evaluation weight (NBE), you can use the following equation (4):

$$\boldsymbol{NBE = NFB * NEF} \qquad (4)$$

Where:

NBE = Evaluation weight score
NFB = Value weight factor
NEF = Factor evaluation value

Furthermore, to calculate the total evaluation weight value (TBE), you can use Equation (5) as follows:

$$\boldsymbol{TBE = NBE1 + NBE2 + NBE3 + \cdots NBEn} \qquad (5)$$

Where:

TBE = Total evaluation weight

3. Research Methodology
3.1. Materials

This study uses secondary data that has been provided by the CARPS-CS unit in the form of scientific research proposal manuscript data and causal factor data for the 2023 academic year. By involving twelve (12) causal factors in modifications of research (Meidelfi *et al.*, 2021) and (Sundari *et al.*, 2019) according to conditions at the current research location with thirty-three (33) other subfactors according to the needs of the CARPS-CS unit, as shown in Table 3.

Table 3. Causative Factor and Sub-factors

No	Code of factor	Name of factor	Code of Sub factor	Description
1	OY	Originality	oy_1	Justify with the literature reviews
2	NY	Novelty	ny_1	Justify with the literature reviews
3	CN	Contribution	cn_1	Clear for theoretical and applicable
			cn_2	Clear for theoretical only
			cn_3	Clear for applicable only
			cn_4	Not Clear
4	MY	Methodology	my_1	very Clear
			my_2	Clear
			my_3	Not Clear
5	RJ	Reputation Journal references	rjr_1	Scopus
			rjr_2	EBSCO, Copernicus, DOAJ, Thomson
			rjr_3	Others
6	RR	Roadmap Researcher	rr_1	Based on field research interest
			rr_2	Cross on field research interest
			rr_3	Not Provide
7	RM	Research Member	rm_1	Minimum 3 Actors
			rm_2	Maximum 5 Actors
			rm_3	More the 5 Actors
8	UR	Up-to-date References	ur_1	Last 3 years
			ur_2	Last 5 years
			ur_3	Last 7 years
9	PR	Percentage of Reference	pr_1	Scientific Journals 75%
			pr_2	Books 10%
			pr_3	Link/Website 10%
			pr_4	Others 5%
10	TR	Tools References	tr_1	Mendeley
			tr_2	Others
11	RS	References Styles	rs_1	Harvard styles
			rs_2	Others styles
12	PF	Proposal Format	pf_1	Based on format CARPS_CS
			pf_2	Others format

Evaluation of scientific research proposals begins with the submission of proposal texts from lecturers and students to the DIT CARPS-CS unit according to the specified dateline, and then the CARPS-CS executive director and his team will

Vol.4, Issue.2, pp. 28-38, 2024
Available online at: http://tljes.org/index.php/tljes/data

carry out an evaluation based on predetermined determinants. The results of the evaluation will be announced in a circular letter to the research grant winners.

3.2. State of Art Approach

In this study, we propose the analytical hierarchy process (AHP) method and the multi-factor evaluation process (MFEP) method as state-of-the art approaches for evaluating scientific research proposals through several stages to arrive at a decision, as shown in Figure 2

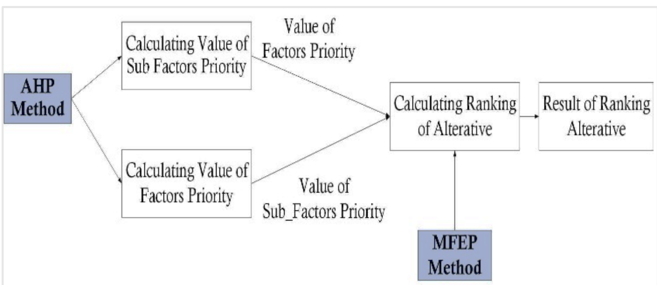

Figure 2. Propose model Process

4. Results

4.1. Method Analytical Hierarchy Process (AHP)

4.1.1. Develop a hierarchical process structure

The process of interpreting the results of this research is based on the stages described in figure 1, which begin with the preparation of a hierarchical process structure (figure 3) for the problems that have been described in the research background.

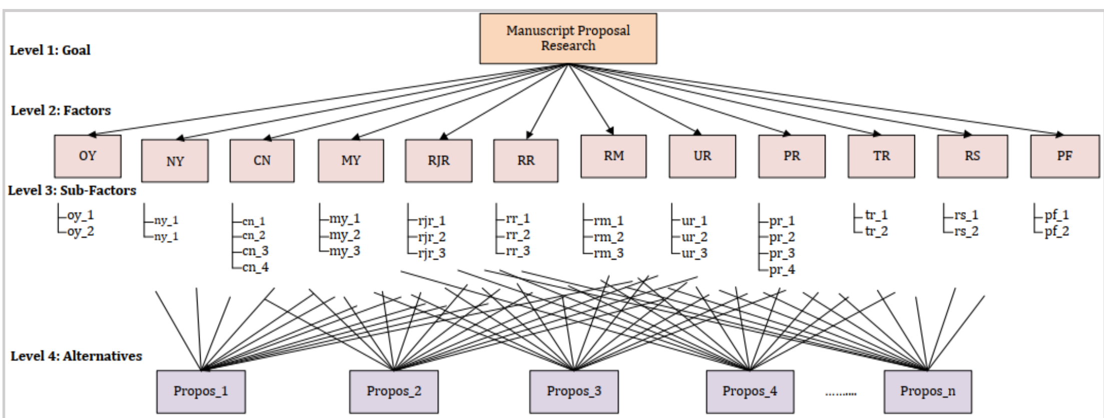

Figure 3. Proposal research evaluation hierarchy processes

In figure 3, proposal texts are presented as alternatives or candidates, which will be determined based on twelve (12) causal factors, namely originality, novelty, contribution, methodology, reputation journal references, roadmap researcher, research member, up-to-date references, percentage of references, tools references, reference styles, and proposal format, along with thirty-three (33) other supporting sub-factors, to determine which scientific research proposals are eligible to obtain research grants from CARPS-CS DIT.

4.1.2. Comparison of the determining factor matrix

The matrix comparison between causal factor values in this study is in accordance with the concept of the analytical hierarchy process method with equation (1). Where the causal factor value scale is given based on the level of interest between the causal factors in Table 2, the results are shown in Table 4.

Table 4. The priority value of each causal factor

Factors	OY	NY	CN	MY	RJR	RR	RM	UR	PR	TR	RS	PF
OY	1	1	2	3	3	3	3	5	5	7	7	9
NY	1,00	1	2	3	3	3	3	5	5	7	7	9
CN	0,50	0,50	1	3	3	3	3	5	5	5	5	7
MY	0,33	0,33	0,33	1	3	3	3	3	3	3	3	3
RJR	0,33	0,33	0,33	0,33	1	3	3	3	3	3	3	3
RR	0,33	0,33	0,33	0,33	0,33	1	2	2	2	2	2	2
RM	0,33	0,33	0,33	0,33	0,33	0,50	1	2	2	2	2	2
UR	0,20	0,20	0,20	0,33	0,33	0,50	0,50	1	2	2	2	2
PR	0,20	0,20	0,20	0,33	0,33	0,50	0,50	0,50	1	2	2	2
TR	0,14	0,14	0,20	0,33	0,33	0,50	0,50	0,50	0,50	1	2	2
RS	0,14	0,14	0,20	0,33	0,33	0,50	0,50	0,50	0,50	0,50	1	1
PF	0,11	0,11	0,14	0,33	0,33	0,50	0,50	0,50	0,50	0,50	1,000	1
Totals	4,63	4,63	7,28	12,67	15,33	19,00	20,50	28,00	29,50	35,00	37,00	43,00

Comparison of the matrix values in Table IV shows that the causative factors of OY and NY have the same importance value, have intermediate values with the causal factors of CN, have moderate importance compared to the causal factors of MY, RJ, RR, and RM, but have an essential importance of Strong importance compared to the causative factors of UR and PR and very strong importance compared to the causal factors of TR and RS, but has extreme importance compared to the causal factors of PF.

4.3.1. Calculation of the priority value of the importance of causal factors.

To obtain priority values for each causal factor, you can use Equation (1). The priority value of each causal factor can be seen in Table 5.

Table 5. The priority value of each causal factor

Factors	OY	NY	CN	MY	RJR	RR	RM	UR	PR	TR	RS	PF	Total Rows	Mark Priority	Result
OY	0,22	0,22	0,27	0,24	0,20	0,16	0,15	0,18	0,17	0,20	0,19	0,21	2,39	0,20	12,76
NY	0,22	0,22	0,27	0,24	0,20	0,16	0,15	0,18	0,17	0,20	0,19	0,21	2,39	0,20	12,76
CN	0,11	0,11	0,14	0,24	0,20	0,16	0,15	0,18	0,17	0,14	0,14	0,16	1,88	0,16	13,00
MY	0,07	0,07	0,05	0,08	0,20	0,16	0,15	0,11	0,10	0,09	0,08	0,07	1,21	0,10	13,03
RJR	0,07	0,07	0,05	0,03	0,07	0,16	0,15	0,11	0,10	0,09	0,08	0,07	1,03	0,09	12,55
RR	0,07	0,07	0,05	0,03	0,02	0,05	0,10	0,07	0,07	0,06	0,05	0,05	0,68	0,06	12,37
RM	0,07	0,07	0,05	0,03	0,02	0,03	0,05	0,07	0,07	0,06	0,05	0,05	0,61	0,05	12,33
UR	0,04	0,04	0,03	0,03	0,02	0,03	0,02	0,04	0,07	0,06	0,05	0,05	0,47	0,04	12,36
PR	0,04	0,04	0,03	0,03	0,02	0,03	0,02	0,02	0,03	0,06	0,05	0,05	0,42	0,04	12,31
TR	0,03	0,03	0,03	0,03	0,02	0,03	0,02	0,02	0,02	0,03	0,05	0,05	0,35	0,03	12,39
RS	0,03	0,03	0,03	0,03	0,02	0,03	0,02	0,02	0,02	0,01	0,03	0,02	0,29	0,02	12,64
PF	0,02	0,02	0,02	0,03	0,02	0,03	0,02	0,02	0,02	0,01	0,03	0,02	0,27	0,02	12,69
Totals	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	12,00	1,00	1,00	151,20

Calculating the value of the consistency ratio (CR) with equations (2) and (3), where the total causal factor is 12, so that the value of I.R. 1.55 is obtained from Table 3, thus the CR value is 0.04, in the following way:

$$\lambda max = \frac{Nilai\ Total\ Hasil}{n} = \frac{151{,}20}{12} = 12{,}60$$

$$CI = \frac{(\lambda max - n)}{(n-1)} = \frac{12{,}60 - 12}{12 - 1} = 0{,}05$$

$$CR = \frac{CI}{IR} = \frac{0{,}05}{1{,}55}$$

Vol.4, Issue.2, pp.28-38, 2024
Available online at: https://tljbm.org/jurnal/index.php/tljbm

CR = 0,04.

The value of the consistency ratio (CR) is ≤ 0.1, so it is said to be consistent to proceed to the next process.

4.1.4. Comparison of the Sub-Factor Contribution matrix

The matrix comparison between the sub-factor contribution values is carried out in the same way as the matrix comparison between factor values with equation (1), with the factor value scale given based on the level of importance between the criteria in Table 2, here is the matrix between the sub-factor values of the factor contribution as shown in Table VI.

Table 6. Comparison of the Sub-Factor Contribution Matrix

Sub-Factor Contribution	cn_1	cn_2	cn_3	cn_4
cn_1	1	3	3	5
cn_2	0,33	1	1	3
cn_3	0,33	1	1	3
cn_4	0,20	0,33	0,33	1
Totals	1,87	5,33	5,33	12

Comparison of matrix values in Table 6 shows that subfactor contribution cn_1 has moderate importance compared to sub-factor cn_2 and sub-factor cn_3, but has essential or strong importance compared to sub-factor cn_4, while sub-factor cn_2 and sub-factor cn_3 have the same importance, and sub-factor cn_3 has moderate importance compared to sub-factor cn_4.

4.1.5 Sub-contribution priority value calculation

To obtain a priority value for each sub-factor contribution, you can use equation (1). Following are the results of the priority value for the sub-factor contribution, which can be seen in Table 7.

Next, calculate the value of the consistency ratio (CR) with equations (2) and (3), where the total value of the sub_factor contribution is 4, so that the value of I.R. 0.89 is obtained from Table 3, thus the CR value is 0.02 in the following way:

$$\lambda max = \frac{Nilai\ Total\ Hasil}{n} = \frac{16{,}17}{4} = 4{,}04$$

$$CI = \frac{(\lambda max - n)}{(n-1)} = \frac{4{,}04 - 4}{4-1} = 0{,}01$$

$$CR = \frac{CI}{IR} = \frac{0{,}01}{0{,}89}$$

CR = 0,02

The value of the consistency ratio (CR) is ≤ 0.1, so it is said to be consistent to proceed to the next process. Do the same process to calculate the priority values for each other sub-factor, so as to obtain priority values for the other sub-factors as shown in Table 8.

Table 7. Calculation of the priority value of the subfactor contribution

Sub-Factor Contribution	cn_1	cn_2	cn_3	cn_4	Total Rows	Priority	Result
cn_1	0,54	0,56	0,56	0,42	2,08	0,52	4,08
cn_2	0,18	0,19	0,19	0,25	0,80	0,20	4,04
cn_3	0,18	0,19	0,19	0,25	0,80	0,20	4,04
cn_4	0,11	0,06	0,06	0,08	0,32	0,08	4,02
Totals	1	1	1	1	4	1	16,17

Table 8. Mark priority for each sub-factor

Code Factor	Factor Name	Code Sub_ Factor	Sub Factor	Mark
OY	Originality	oy_1	Justify with the literature review	83
		oy_2	Not Justify	17
NY	Novelty	ny_1	Justify with the literature review	83
		ny_2	Not Justify	17
CN	Contribution	cn_1	Clear for theoretical and applicable	52
		cn_2	Clear for theoretical only	20

Vol.4, Issue.2, pp.28-38, 2024
Available online at: https://tljbm.org/jurnal/index.php/tljbm

		cn_3	Clear for applicable only	20
		cn_4	Not Clear	8
MY	Methodology	my_1	very Clear	61
		my_2	Clear	30
		my_3	Not Clear	9
RJR	Reputation Journal References	rjr_1	Scopus	61
		rjr_2	EBSCO, Copernicus, DOAJ, Thomson	30
		rjr_3	Others	9
RR	Roadmap Researcher	rr_1	Based on field research interest	61
		rr_2	Cross on field research interest	30
		rr_3	Not Provide	9
RM	Research Member	rm_1	Minimum 3 Actors	45
		rm_2	Maximum 5 Actors	45
		rm_3	More the 5 Actors	10
UR	Up-to-date References	ur_1	Last 3 years	64
		ur_2	Last 5 years	28
		ur_3	Last 7 years	8
PR	Percentage of Reference	pr_1	ScientificJournals 75%	25
		pr_2	Books 10%	25
		pr_3	Link/Website 10%	25
		pr_4	Others 5%	25
TR	Tools References	tr_1	Mendeley	83
RS	References Styles	rs_1	Harvard styles	83
		rs_2	Others styles	17
PF	Proposal Format	pf_1	Based on format CARPS_CS	83
		pf_2	Others format	17

4.2. Method Multi-Factor Evaluation Process

4.2.1. Determine the factors causing the problem and value their level of priority and importance.

To obtain the value of the priority level of importance for each factor causing the problem in this case, use the AHP method with equation (1) as in Table V above. So that the value of the priority level of importance for each factor can be seen in Table 9. In addition, the causal factor evaluation results for each alternative can be given based on the priority value of each sub-factor from the calculation results of the AHP method in Table 8. So that the causal factor evaluation results for each alternative can be seen in Table 10.

Table 9**.** Assess the level of importance of each causal factor.

No	Code Factor	Mark Priority
1	OY	0,20
2	NY	0,20
3	CN	0,16
4	MY	0,10
5	RJR	0,09
6	RR	0,06
7	RM	0,05
8	UR	0,04
9	PR	0,04
10	TR	0,03
11	RS	0,02
12	PF	0,02

4.2.2. Calculating the evaluation weight value

The evaluation weight value can be calculated using Equation (4) by means of $NBE = NFB * NEF,$ where NFB is the value of the importance level of each causal factor from Table 9, while is the value of the evaluation results of each alternative from each causal

Vol.4, Issue.2, pp.28-38, 2024
Available online at: https://tljbm.org/jurnal/index.php/tljbm

Table 10. The Value of Proposal Evaluation Results from each causal factor.

Factor/ id_propos	OY	NY	CN	MY	RJR	RR	RM	UR	PR	TR	RS	PF
Propos_1	83	83	20	61	30	61	45	26	25	83	83	83
Propos_2	17	17	8	30	30	30	45	26	25	83	83	83
Propos_3	17	17	20	30	30	30	45	26	25	83	83	83
Propos_4	83	83	8	30	30	30	45	26	25	83	83	83
Propos_5	83	83	20	30	30	30	45	26	25	17	17	83
Propos_6	17	17	20	30	30	61	45	26	25	17	17	83
Propos_7	17	17	8	30	30	61	45	26	25	17	17	83
Propos_8	83	83	52	30	61	61	45	26	25	83	83	83
Propos_9	17	17	20	30	30	30	45	26	25	83	83	83
Propos_10	83	83	20	30	30	30	45	26	25	17	17	83

factor in Table 10. Thus, the weight value of the OY causative factor evaluation for alternative Propos_1 = 16.63 can be obtained from $NBE = 0.20 * 83 = 16,53$ Do the same steps so that you can get the weight value of the evaluation of the causal factors for each alternative, which can be seen in Table 11.

Table 11. The causal factor evaluation weight value

Factor/ id_propos	OY	NY	CN	MY	RJR	RR	RM	UR	PR	TR	RS	PF
Propos_2	3,39	3,39	1,25	3,04	2,58	1,71	2,29	1,03	0,88	2,43	1,99	1,84
Propos_3	3,39	3,39	3,13	3,04	2,58	1,71	2,29	1,03	0,88	2,43	1,99	1,84
Propos_4	16,53	16,53	1,25	3,04	2,58	1,71	2,29	1,03	0,88	2,43	1,99	1,84
Propos_5	16,53	16,53	3,13	3,04	2,58	1,71	2,29	1,03	0,88	0,50	0,41	1,84
Propos_6	3,39	3,39	3,13	3,04	2,58	3,48	2,29	1,03	0,88	0,50	0,41	1,84
Propos_7	3,39	3,39	1,25	3,04	2,58	3,48	2,29	1,03	0,88	0,50	0,41	1,84
Propos_8	16,53	16,53	8,14	3,04	5,24	3,48	2,29	1,03	0,88	2,43	1,99	1,84
Propos_9	3,39	3,39	3,13	3,04	2,58	1,71	2,29	1,03	0,88	2,43	1,99	1,84
Propos_10	16,53	16,53	3,13	3,04	2,58	1,71	2,29	1,03	0,88	0,50	0,41	1,84

4.2.3. Calculate the total value of the evaluation weight

The total evaluation weight value for each alternative can be calculated through equation (5) by adding up the evaluation weight value for each causal factor from each alternative in table 11, namely:

$$TBE = 16,53 + 16,53 + 3,13 + 6,17 + 2,58 + ,48 + 2,29 + 1,03 + 0,88 + 2,43 + 1,99 + 1,84$$

$$TBE = 58,88$$

Take the same steps to determine the total value of the evaluation weight for each alternative, so that it can be seen in Table 12.

Table 12. The total value of the evaluation weight of each alternative

Factor/ id_propos	OY	NY	CN	MY	RJR	RR	RM	UR	PR	TR	RS	PF
Propos_1	16,53	16,53	3,13	6,17	2,58	3,48	2,29	1,03	0,88	2,43	1,99	1,84
Propos_2	3,39	3,39	1,25	3,04	2,58	1,71	2,29	1,03	0,88	2,43	1,99	1,84
Propos_3	3,39	3,39	3,13	3,04	2,58	1,71	2,29	1,03	0,88	2,43	1,99	1,84
Propos_4	16,53	16,53	1,25	3,04	2,58	1,71	2,29	1,03	0,88	2,43	1,99	1,84
Propos_5	16,53	16,53	3,13	3,04	2,58	1,71	2,29	1,03	0,88	0,50	0,41	1,84
Propos_6	3,39	3,39	3,13	3,04	2,58	3,48	2,29	1,03	0,88	0,50	0,41	1,84
Propos_7	3,39	3,39	1,25	3,04	2,58	3,48	2,29	1,03	0,88	0,50	0,41	1,84
Propos_8	16,53	16,53	8,14	3,04	5,24	3,48	2,29	1,03	0,88	2,43	1,99	1,84
Propos_9	3,39	3,39	3,13	3,04	2,58	1,71	2,29	1,03	0,88	2,43	1,99	1,84

Vol.4, Issue.2, pp.28-38, 2024
Available online at: https://tljbm.org/jurnal/index.php/tljbm

4.2.4. Ranking for decisions

Ranking is done to sort the total value of the evaluation weight for each alternative in Table 12 from the highest order to the smallest order, so that it can be seen in Table 13.

Table 13. Ranking the end result

No	Alternative	Ranking Mark
1	Propos_8	63,42
2	Propos_1	58,88
3	Propos_4	52,09
4	Propos_5	50,46
5	Propos_10	50,46
6	Propos_9	27,68
7	Propos_3	27,68
8	Propos_6	25,93
9	Propos_2	25,80
10	Propos_7	24,06

5. Conclusion and Implication

The results of the study show that the combination of the analytical hierarchy process (AHP) and multi-factor evaluation process (MFEP) methods is able to determine scientific research proposal candidates at CARPS-CS, Dili Institute of Technology (DIT). With a consistent ratio value of twelve (12), the causative factor gets 0.04, which is supported by thirty-three (33) other sub-factors. Of the ten (10) candidate scientific research proposals, there are five (5) candidates who are eligible to receive research grants from CARPS-CS with a total evaluation score of ≥ 50%, while five (5) candidates are considered ineligible because they have a total evaluation score of <50 %.

6. Recommendation and Future Research

This research is a basis so that in the future it can be developed into a system to help manage evaluations, and it requires other methods and determining factors in order to obtain good results. In the future, this research needs to be developed using a machine learning approach to classify whether or not it is appropriate to obtain a research grant.

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Vol.4, Issue.2, pp.28-38, 2024
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