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The 6th International Conference on Energy, Environment, Epidemiology and Information System (ICENIS) 2021

Topic of Energy, Environment, Epidemiology, and Information System

Semarang, Indonesia • 4–5 August 2021

Editors • Tri Retnaningsih Soeprobowati, Budi Warsito and Thomas Triadi Putranto

The 6th International Conference on Energy, Environment, Epidemiology, and Information System

Topic of Energy, Environment, Epidemiology, and Information System

AIP Publishing

RESEARCH ARTICLE | MAY 16 2023

Editors ICENIS 2021: The 6th International Conference on Energy, Environment, Epidemiology and Information System (ICENIS) 2021: Topic of Energy, Environment, Epidemiology, and Information System

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Editors ICENIS 2021

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RESEARCH ARTICLE | MAY 16 2023

Preface: The 6th International Conference on Energy, Environment, Epidemiology and Information System (ICENIS) 2021: Topic of Energy, Environment, Epidemiology, and Information System

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PREFACE

The 6th International Conference on Energy, Environment, Epidemiology and Information System (ICENIS) 2021, with a theme "***The Impacts of Covid-19 Pandemic on Water, Environment, Energy, Epidemiology, Information System and Strategies for their Adaptation and Mitigation***". This conference is expected to designate an interactive international forum to provide a platform for sharing and exchanging information on the latest research on energy, environment, epidemiology, and information system. The ICENIS was conducted annually by the School of Postgraduate Studies Diponegoro University, Semarang, Indonesia, to stimulate collaboration between researchers, government, and industries to increase community welfare. This conference also facilitates the formation of a network among participants to enhance the quality and benefit of research and development. Although the current situation is uncertain due to the pandemic COVID-19, however, the conference is rich and varied, with 10 keynote speakers who came from 5 continents: South Africa, America, Australia, Asia (Indonesia, Malaysia), and Europe (Netherlands). The 426 papers were presented via online conference within 14 parallel oral sessions each day (4-5 August 2021) that come from various countries, i.e. Japan, Czech Republic, Algeria, Sudan, Uganda, Malaysia, Tanzania, Timor Leste, West Africa, Turkey, Uzbekistan, Taiwan, United Kingdom, and the United States, and from all over Indonesia consisting of researchers, lecturers, practitioners, post and undergraduate students belonging to various institutions. There were 150 articles selected to be published in the conference proceeding on the topic of Energy, Environment, Epidemiology, and Information Systems. We would like to express our gratitude to all authors, members of scientific committee, and members of organizing committee for their contribution to the success of the conference.

The Editors
Prof. Dr. Tri Retnaningsih Soeprobowati
Dr. Budi Warsito
Dr. Thomas Triadi Putranto

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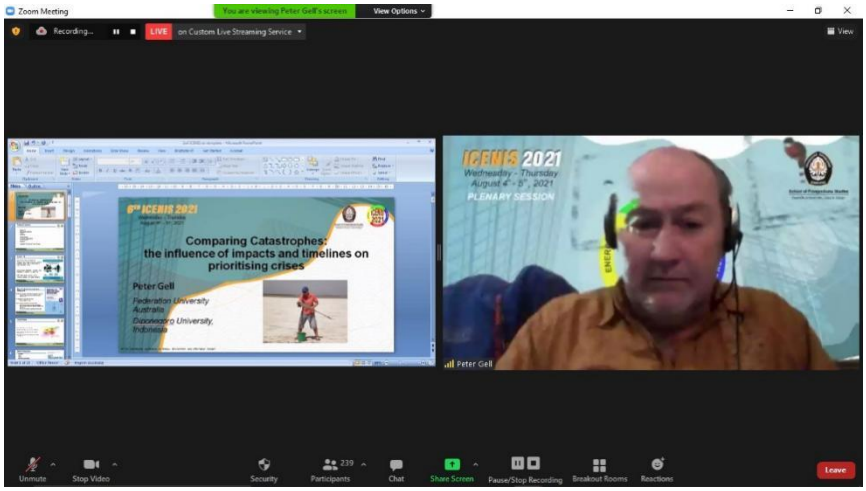
CONFERENCE PHOTOGRAPH

Welcome speech Chairperson Organizing committee: Prof. Tri Retnaningsih Soeprobowati

Opening remark by Vice Rector research, innovation, and collaboration Universitas Diponegoro

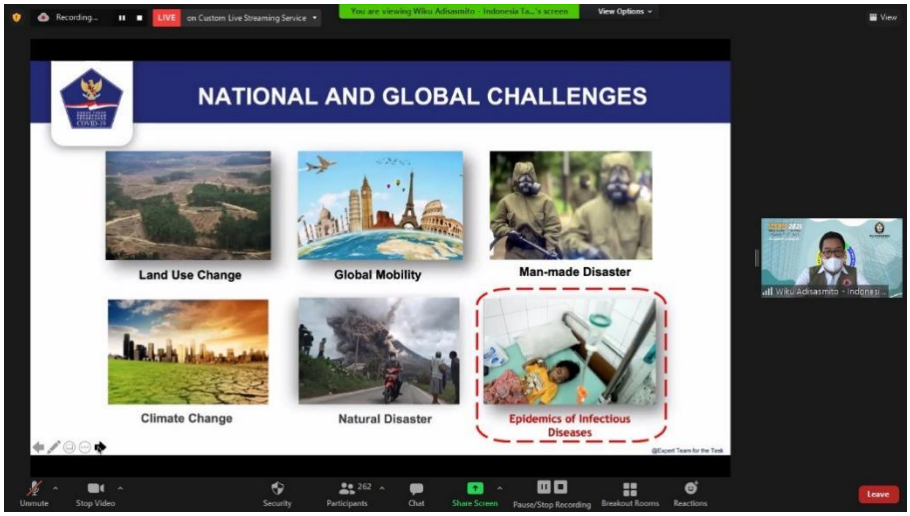
Opening ceremony



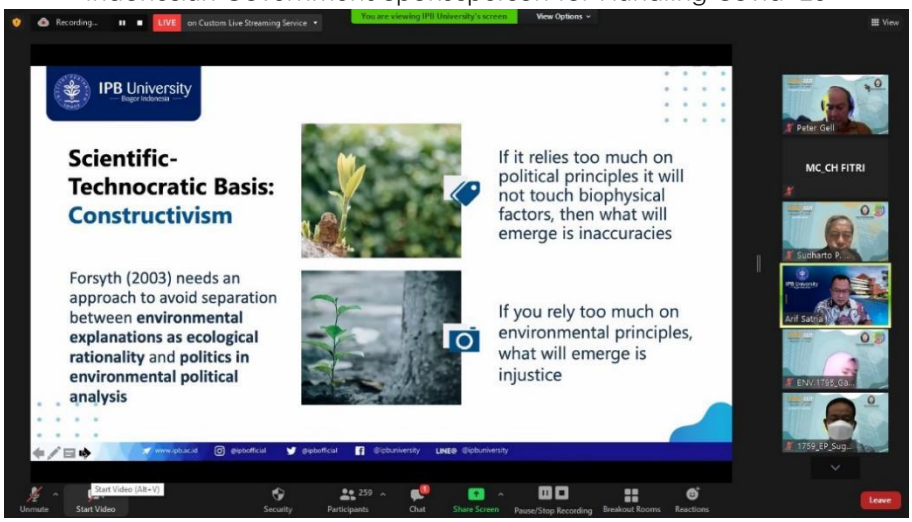
Keynote speaker: Prof. Peter Gell, Federation University, Australia

Keynote speaker: Prof. Magaly Koch, Boston University, USA

Attendees

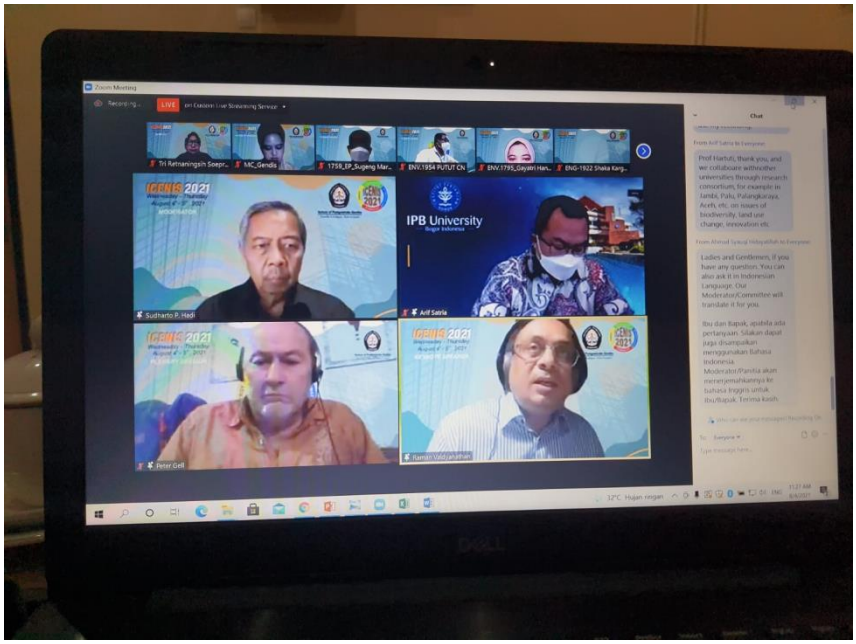


Keynote speaker: Prof. Wiku Adisasmita
Indonesian Government Spokesperson for Handling Covid-19

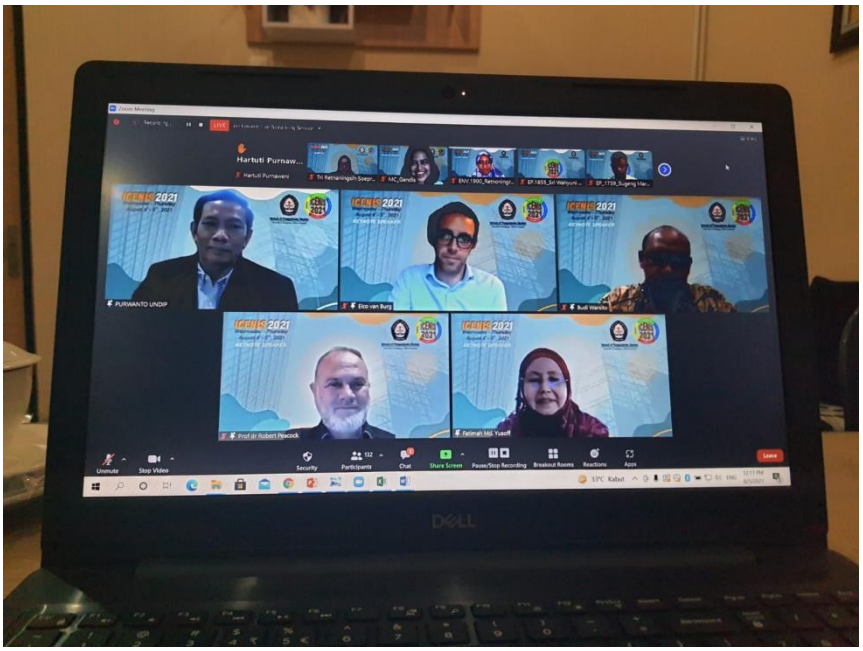


Prof. Arif Satria, Rector of IPB University, Indonesia

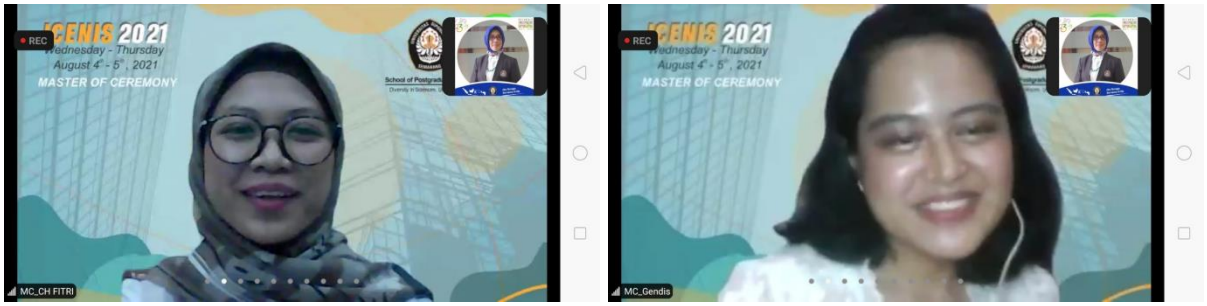
Dr. Seetharaman Vaidyanathan, The University of Sheffield, UK



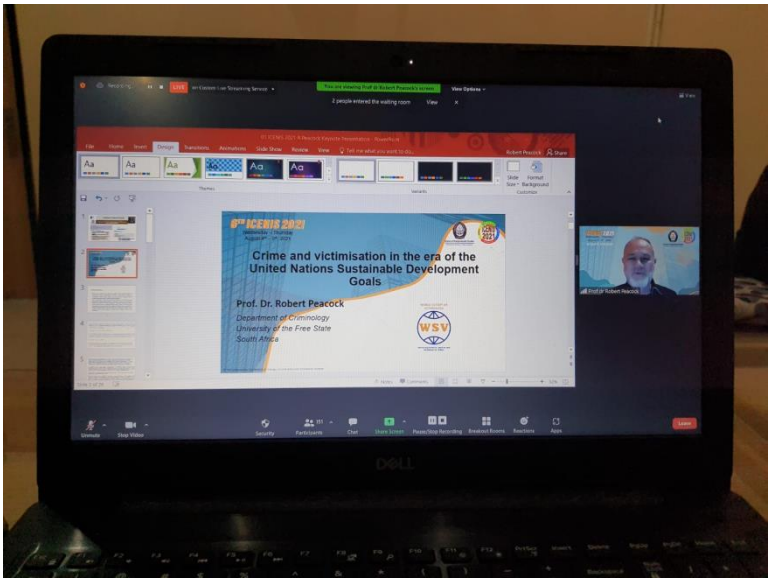
Moderator and keynote speakers day 1



Moderator and keynote speakers day 2

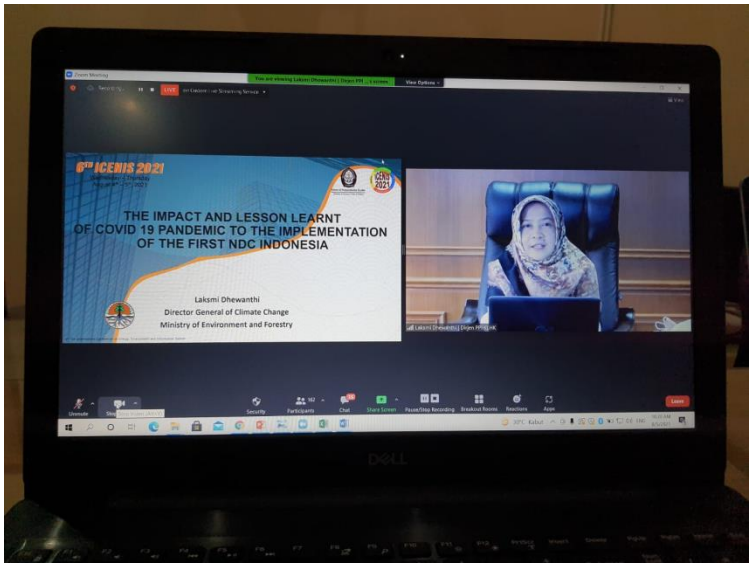


Master of Ceremony: CH. And Gendis Pitaloka, students of Universitas Diponegoro

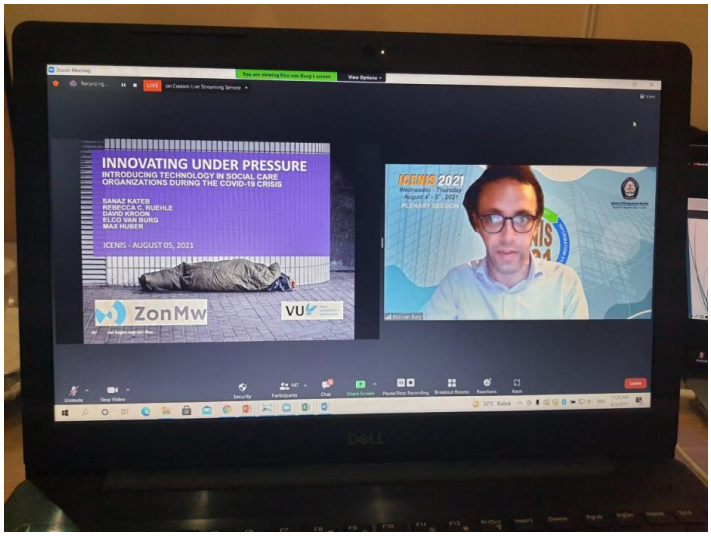


Keynote speaker: Prof. Robert Peacock, University of the Free State South Africa

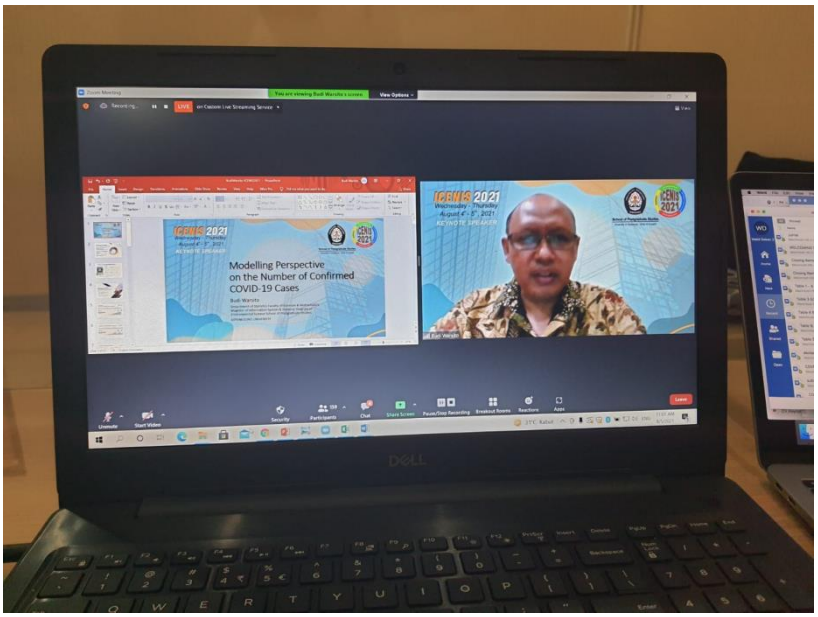
Keynote speaker: Prof Fatimah Md. Yusoff, University Putra Malaysia



Keynote speaker: **Ir. Laksmi Dhewanthi, MA**
The Indonesian Ministry of Environment and Forestry (Director Generale Climate Change)



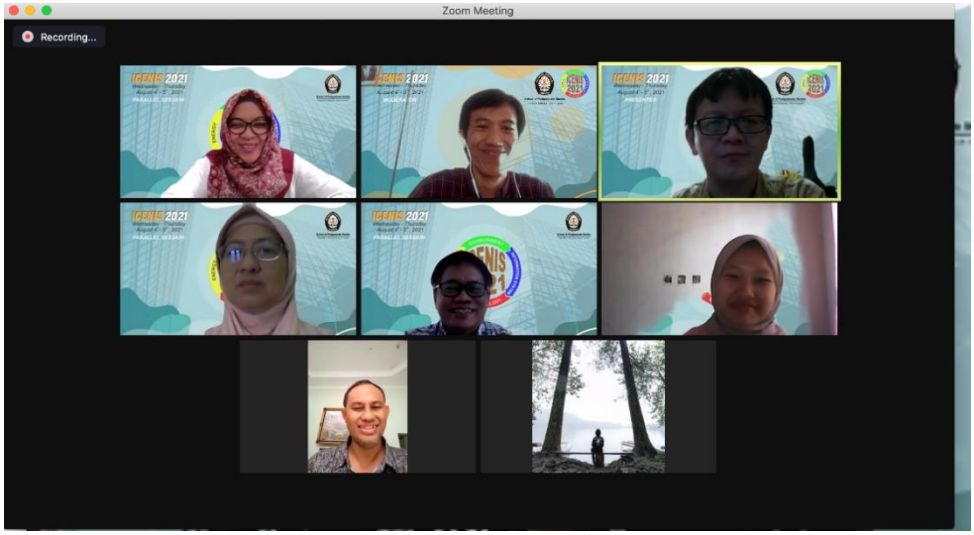
Keynote speaker Prof. Elco van Burg**,** School of Business and Economics Vrije Universiteit Amsterdam



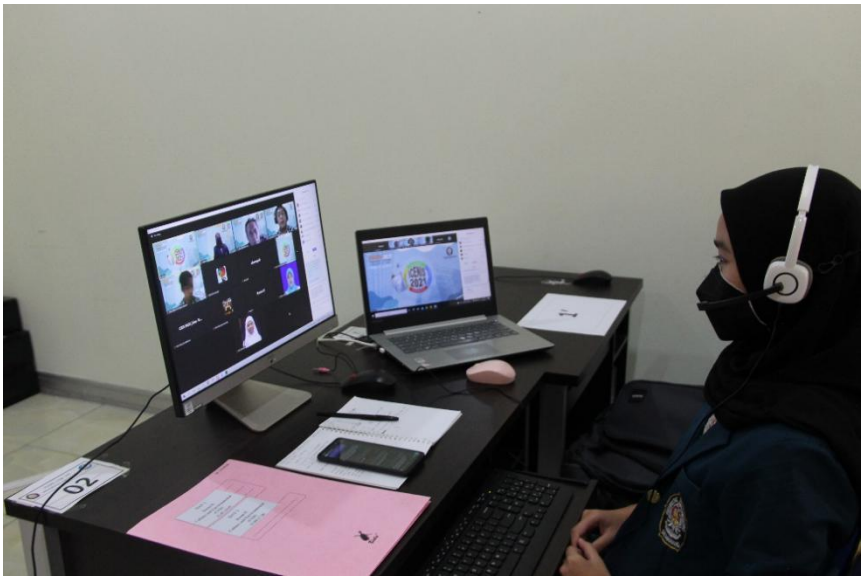
Keynote speaker Dr. Budi Warsito, School of Postgraduate Studies, Universitas Diponegoro, Indonesia

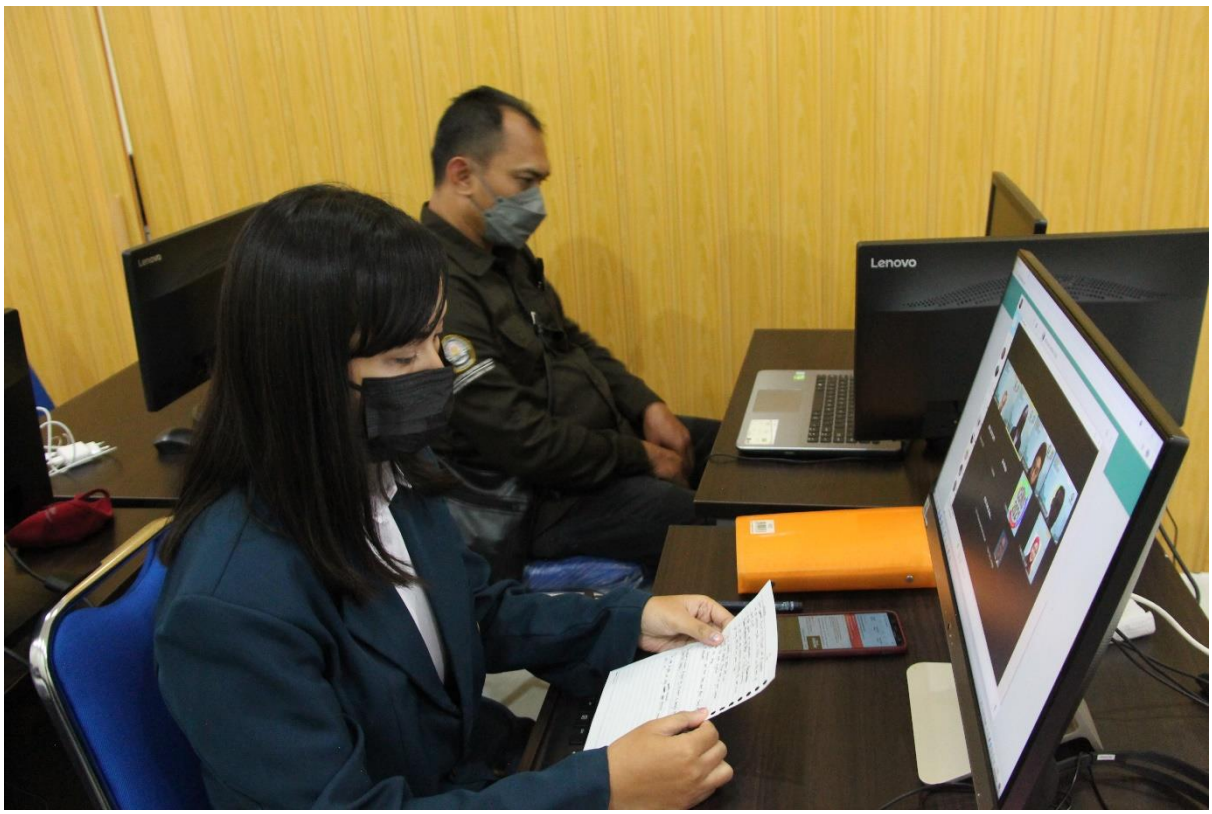
Closing ceremony: Prof. Hadiyanto,
Vice Dean of Academic and Student Affair, School of Postgraduate Studies, Universitas Diponegoro

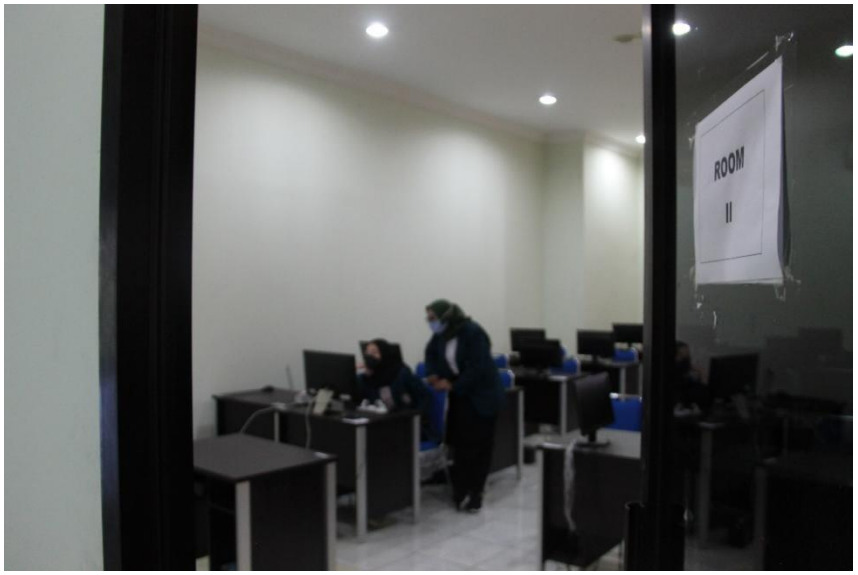
PARALLEL CLASS

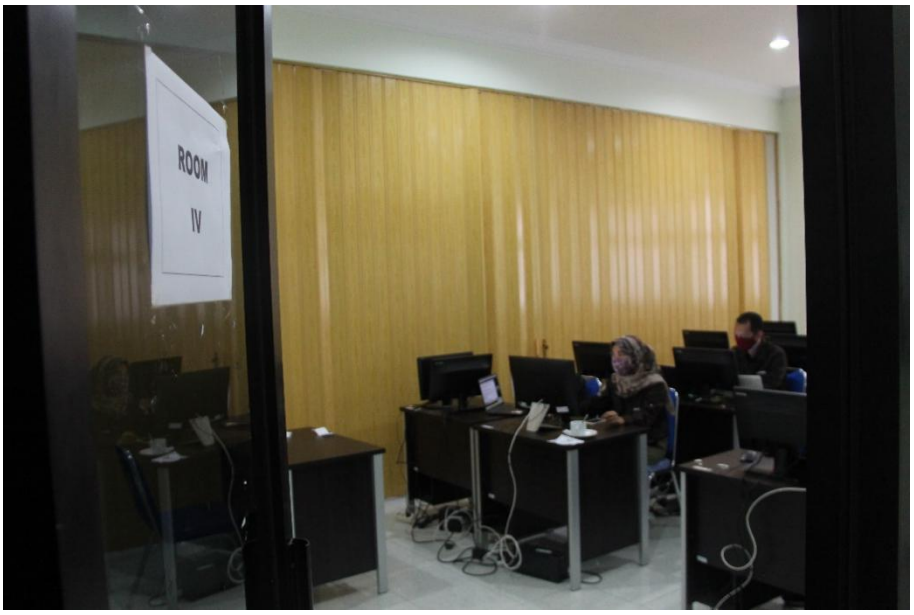


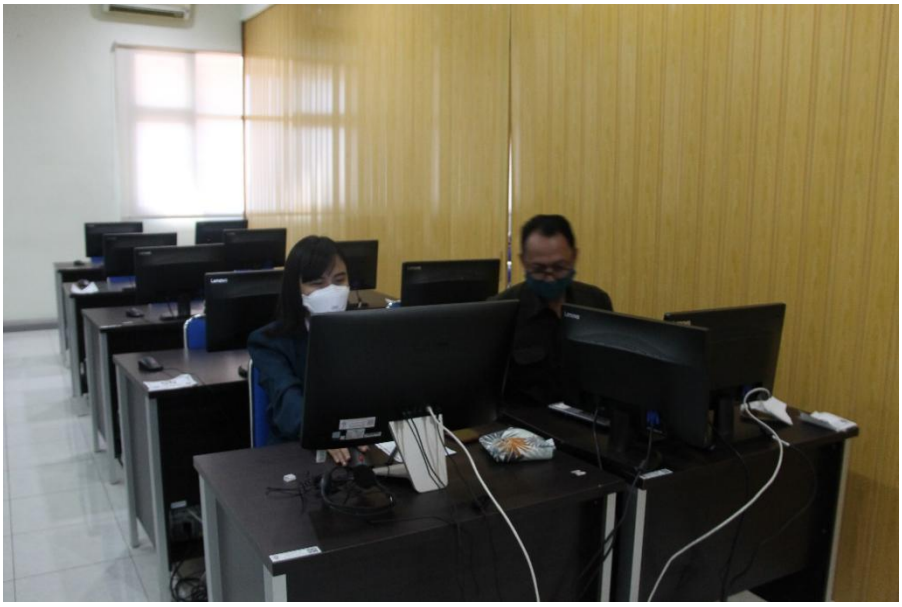
BEHIND THE SCENE











RESEARCH ARTICLE | MAY 16 2023

The group decision support system model of research proposal assessment using researcher track record and research output

Yevi Dwitayanti ✉; M. Miftakul Amin

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The Group Decision Support System Model of Research Proposal Assessment Using Researcher Track Record and Research Output

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Abstract. The Center of Research and Community Service (P3M) Sriwijaya State Polytechnic is one of the implementer elements in college, which coordinates, monitor, and assess research activity and implementation conducted by research centres or research groups from various majors and study programs. Nowadays, P3M Polsri has mostly conducted research schemes funded internally by the college. The research proposal assessment was conducted by looking at the substance of the proposal itself, without further consideration on the research output produced and the track record of the researchers' profiles. This research makes Group Decision Support System (GDSS) model assist the research proposal reviewers in increasing their assessment quality. The model used in this research was Smart (Simple Multi-Attribute Rating Technique) to conduct ranking individually from the decision-makers, in this case, are the research proposal reviewers. Further, the aggregation process was conducted on the recommendation result from the decision-makers to obtain the final value recommendation in the GDSS process. The examination shows that the model developed is quite reliable in assisting the research proposal reviewer team in giving an objective assessment.

INTRODUCTION

One of the pillars of the tri dharma of higher education as an activity carried out by lecturers is research and carrying out the teaching process and community service. This research activity can give birth to new solutions to various problems faced by the wider community. Research also needs to be directed to produce innovative products and respond quickly to community needs. By the research master plan (RIP) established by the Center for Research and Community Service (P3M) of the Sriwijaya State Polytechnic, which stipulates eight research focuses, namely energy technology and management, food technology and management, information and communication technology, advanced material technology and management, water technology and management, social humanities-arts-culture-education, transportation technology and management, and disaster management technology and management [1]. With the existence of this RIP, it will become a research roadmap that will be carried out on an institutional scale from each research activity within the Sriwijaya State Polytechnic (Polsri).

In carrying out research activities, each lecturer must go through the selection stages, both administrative selection and substance selection. This selection was carried out by reviewers appointed by P3M Polsri through a decree signed by the Director of the Sriwijaya State Polytechnic. This selection stage aims to ensure that the research proposal meets the standards and is eligible for funding. At this selection stage, there are obstacles in determining the weight and assessment of proposals carried out by reviewers, which tend to be subjective and less measurable. In addition, the assessment of research proposals has only focused on the substance of the research without considering the aspects of the researcher's track record and research outputs.

This research is important to present an alternative assessment of research proposals by taking into account the aspects of the researcher's profile and the outputs generated from the research. It aims to improve the quality of research and the productivity of research activities carried out.

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Research related to decision support systems using the SMART method was carried out by Fitriani [4], who researched monitoring and evaluation applications using the SMART method to conduct an objective assessment of students' activity of students living in Trunojoyo University dormitories. This study uses four criteria in its application to produce recommendations for monitored students. Oktavianti's research [5] uses the SMART method to provide employee promotion recommendations. This study also uses four criteria for the weighting process: work experience, potential academic test, performance value, and supervisor's assessment. Sihombing's research [6] uses the SMART method to determine outstanding employees. This study uses 13 criteria used as the basis for making judgments to determine high achieving employees. Mahdiana's research [8] combined the SMART and AHP methods to determine the selection of the best lecturers, using 12 criteria.

METHOD

The model developed in this study is a group decision support system (GDSS) to assist P3M at the Sriwijaya State Polytechnic. The initial stage is the administrative selection carried out by the P3M administrative staff and ensuring that the administrative requirements have been met. After the administrative evaluation stage is sufficient, the evaluation stage of the research proposal is carried out.

System Architecture

Figure. 1 is a system architecture model developed in this study. The system consists of a group of decision-makers consisting of reviewers as decision-makers (DM). There is also an entity in the form of a researcher who proposes a research proposal in the system. Through the LAN/internet network, the proposal will then be entered into the system and managed by P3M, who also acts as a system administrator. Then it will be processed by the GDSS system in which there is a Graphical User Interface (GUI) to interact between all users involved, and there is also a DSS model for weighting and ranking. There is a database that plays a role in storing various data used in the GDSSsystem.

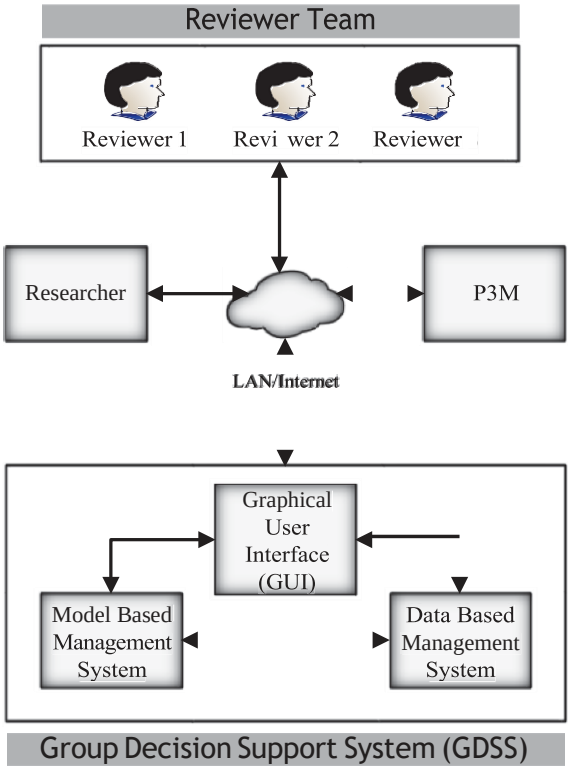

FIGURE 1. System Architecture Model of GDSS.

SMART Method

The SMART (Simple Multi-Attribute Rating Technique) method is a multi-criteria decision-making method, which is based on the theory that each alternative consists of several criteria that have values [2][3]. Each criterion has a weight that describes how important the criteria are. compared with other criteria [4][9][10][11]. The following are the calculation steps using the SMART method [12].

1. Step 1: Determine the number of criteria
2. Step 2: The system by default will provide a scale of 0-100 based on the priority that has been inputted and then normalized. The formula used in this process is:

$$Normalization = \frac{w_j}{\sum w_j} \quad (1)$$

Description:
Wj : weight of a criteria
∑wj : total weight of all criteria

3. Step 3: Provide a criteria value for each alternative
4. Step 4: Calculate the utility value for each criteria with the formula

$$\mu_i(a_i) = 100 \frac{(C_{outi} - C_{min})}{(C_{max} - C_{min})} \% \quad (2)$$

Description:

μi (ai) : the utility value of the criteria i
C_{max} : maximum criteria value
C_{min} : minimum criteria value
C_{outi} : the value of criteria i

5. Step 5: Calculate the final value of each alternative

$$\mu_i(a)_i = \sum_{j=1}^{m} w_j u_i(a)_i \quad (3)$$

Description:
$\mu(a_i)$: alternative total value
w_j : the result of the normalization of criteria weights
$u_i(a_i)$: utility value result

Aggregation Method

After determining the weight for each criterion by a reviewer assigned by P3M, the results of the weighting that have been carried out independently by each reviewer as a decision-maker (DM) will then be carried out an aggregation process to determine the ranking in the form of a list of research proposals that are eligible to be funded based on the weight values obtained. The greater the weight value, the more feasible the research proposal is recommended to be funded.

The method used to perform this aggregation is the Borda method. The Borda method was discovered by Jean-Charles de Borda in the 18th century [13]. The principle of the Borda method is to do alternative voting by assigning a weight value to each alternative ranking. The alternative with the highest rank is given the highest value, and so on in descending order; it is given a lower value in the form of 0 or 1 [14].

RESULTS AND DISCUSSION

Step of The Independent Reviewer Assessment

Determining the Number of Criteria

The criteria used in this study are divided into three parts: the track record of researchers, research substance, and research outputs, as shown in Table 1, along with the weights of each criterion. The criteria for research substance get greater weight because it is the main element in a study.

TABLE 1. Determining of Criteria Weight.

Criteria	Description	Preference Weight
C1	Track record of researchers	30%
C2	Research substance	40%
C3	Research outputs	30%
Total		100%

Table 2 is the track record criteria for submitting research proposals that will reference the assessment carried out by reviewers. This reference weight is the maximum weight that each reviewer can give. Furthermore, Table 3 is the criteria considered related to the substance of the study. Ten criteria are used as a reference in providing an assessment of the research output.

TABLE 2. Researcher Track Record Criteria.

Criteria	Description	Preference Weight
C11	Quantity and quality of publications in scientific journals	30
C12	Quality and quantity of publications in scientific proceedings	30
C13	Quality and quantity of books with ISBN	20
C14	Quality and quantity of acquired status of intellectual property (KI)	20
	Total	100

TABLE 3. Research Substance Criteria.

Criteria	Description	Preference Weight
C21	Relevance of research proposals to areas of focus, themes, and research topics	10
C22	Relevance of research proposals to university strategic plans (renstra)	15
C23	Quality and relevance of research objectives, problems, state of the art, methods, and novelty	15
C24	The relationship of the research proposal to the research results obtained previously and future plans (roadmap)	10
C25	Appropriateness of research assignments and division of tasks	5
C26	Suitability of research schedule	10
C27	The suitability of the research budget plan (RAB)	10
C28	TKT target fairness target	10
C29	Current primary source bibliography reference	10
C210	Funding support and participation of research collaboration partners	5
	Total	100

Furthermore, Table 4 is the criteria considered related to the planned research output target to be produced.

TABLE 4. Research Outcome Criteria

Criteria	Description	Preference Weight
C31	Publication in reputable international journals	20
C32	Publication in international journals	10
C33	Publication in accredited national journals	15
C34	Publication in national journals	5

TABLE 4. Research Outcome Criteria (continued).

Criteria	Description	Preference Weight
C35	Publication in international conference proceedings	15
C36	Publication in the proceedings of the national conference	5
C37	Books (monographs, reference books, textbooks, electronic books, book chapters)	10
C38	Copyright	5
C39	Patents, Simple patents, Protection of plant varieties (PVT), Integrated circuit layout design, Policy papers, Industrial products	10
C310	Appropriate Technology (TTG)	5
	Total	100

Criteria Normalization

By using formula (1), then normalization is carried out to obtain a priority scale from the predetermined criteria, as in the following calculation:

$$Normalization = \frac{w_j}{\sum w_j}$$

1) Criteria 1:
   Normalization: 30/(30+40+30) : 30/100: 0,3
2) Criteria 2:
   Normalization: 40/(30+40+30) : 40/100: 0,4
3) Criteria 3:
   Normalization: 30/(30+40+30) : 30/100: 0,3

Table 5 is the result of normalization of the criteria weights that have been defined previously.

TABLE 5. Normalization Weight of Each Criteria.

Criteria	Description	Preference Weight	Normalization
1	Track record of researchers	30%	0,3
2	Research substance	40%	0,4
3	Research outputs	30%	0,3
	Total	100%	1

Assessing Criteria for Each Alternative

In this model, each alternative will be assessed by the reviewers, in this case by 3 reviewers. Table 6, Table 7, and Table 8 provide examples of the distribution of scores assigned by a reviewer to each alternative.

TABLE 6. Assessment by Reviewer 1 for Criteria C1-Track Record Researchers.

Alternative /Crtieria	Criteia C1-Researcher Track Record				∑ C1
	C11	C12	C13	C14	
A1	25	25	10	15	75
A2	25	25	15	15	80
A3	20	20	15	15	70
A4	25	20	10	10	65
A5	20	20	10	15	65

TABLE 7. Assessment by Reviewer 1 for Criteria C2-Research Substance.

Alternative/ Crtieria	Criteria C2-Research Substance										∑ C2
	C21	C22	C23	C24	C25	C26	C27	C28	C29	C210	
A1	7	12	10	6	3	6	9	8	8	1	70
A2	8	10	12	7	4	7	8	8	7	2	73
A3	6	14	10	8	2	8	8	7	8	3	74
A4	8	12	10	7	3	8	6	9	8	2	73
A5	7	10	12	9	4	7	7	6	9	4	75

TABLE 8. Assessment by Reviewer 1 for Criteria C3 Research Outputs.

Alternative/ Crtieria	Criteria C3-Research Outputs										∑ C2
	C31	C32	C33	C34	C35	C36	C37	C38	C39	C310	
A1	15	8	12	3	12	3	8	3	8	3	75
A2	15	8	14	4	14	4	7	3	8	3	81
A3	10	7	12	2	12	4	6	4	6	4	67
A4	15	9	10	4	14	4	8	3	7	3	77
A5	10	6	14	3	10	4	8	4	6	4	69

Calculating the Utility Value of Each Criteria

In determining the utility value, this is done by using formula (2), for example the utility value obtained by Alternative 1 for criteria C1, C2, and C3 as a result of reviewer 1's assessment can be described as follows:

$$\mu_i(a_i) = 100\,\frac{(C_{outi} - C_{min})}{(C_{max} - C_{min})}\,\%$$

$$\mu C1(A1) = \frac{75-65}{80-65} = 0{,}67$$

$$\mu C2(A1) = \frac{70-70}{75-70} = 0{,}00$$

$$\mu C3(A1) = \frac{75-67}{81-67} = 0{,}37$$

Determining Final Value

For the final value calculation is done using formula (3) as an example for Table 9 obtained by the following calculation:

$$\mu_i(a)_i = \sum_{j=1}^{m} w_j u_i(a)_i$$

μ(A1) = (0,3*0,67) + (0,4 * 0,00) + (0,3 * 0,57)
= 0,37
μ(A2) = (0,3*1,00) + (0,4 * 0,60) + (0,3 * 1,00)
= 0,84
μ(A3) = (0,3*0,33) + (0,4 * 0,80) + (0,3 * 0,00)
= 0,42
μ(A4) = (0,3*0,00) + (0,4 * 0,60) + (0,3 * 0,71)
= 0,45
μ(A5) = (0,3*0,00) + (0,4 * 1,00) + (0,3 * 0,14)
= 0,44

Table 9, Table 10, and Table 11 are the distribution of the values of the decision makers, which in this case were carried out by 3 reviewers.

TABLE 9. Rating By Reviewer 1.

Criteria Weight	30	40	30	Utility Value			Final score
Normalization	0,3	0,4	0,3				
Alternative/Criteria	∑ C1	∑ C2	∑ C3	C1	C2	C3	
A1	75	70	75	0,67	0,00	0,57	0,37
A2	80	73	81	1,00	0,60	1,00	0,84
A3	70	74	67	0,33	0,80	0,00	0,42
A4	65	73	77	0,00	0,60	0,71	0,45
A5	65	75	69	0,00	1,00	0,14	0,44
Max ()	80	75	81				
Min ()	65	70	67				

TABLE 10. Rating By Reviewer 2.

Criteria Weight	30	40	30	Utility Value			Final score
Normalization	0,3	0,4	0,3				
Alternative/Criteria	∑ C1	∑ C2	∑ C3	C1	C2	C3	
A1	70	74	75	1,00	0,50	1,00	0,80
A2	70	75	72	1,00	1,00	0,63	0,89
A3	67	74	67	0,00	0,50	0,20	0,20
A4	70	73	73	1,00	0,00	0,53	0,53
A5	70	74	69	1,00	0,50	0,58	0,58
Max ()	70	75	75				
Min ()	67	73	67				

TABLE 11. Rating By Reviewer 3.

Criteria Weight	30	40	30	Utility Value			Final score
Normalization	0,3	0,4	0,3				
Alternative/Criteria	∑ C1	∑ C2	∑ C3	C1	C2	C3	
A1	65	74	73	0,00	1,00	1,00	0,70
A2	80	66	72	1,00	0,00	0,75	0,53
A3	70	74	69	0,33	1,00	0,00	0,50
A4	65	72	70	0,00	0,75	0,25	0,38
A5	70	74	69	0,33	1,00	0,00	0,50
Max ()	80	74	73				
Min ()	65	66	69				

So from the results of calculations using the SMART method, results such as Table 12 can be obtained.

TABEL 12. Final Result of SMART Method Ranking.

Ranking	DM 1		DM 2		DM 3	
	Criteria	Final Score	Criteria	Final Score	Criteria	Final Score
1	A2	0,84	A2	0,89	A1	0,70
2	A4	0,45	A1	0,80	A2	0,53
3	A5	0,44	A5	0,58	A3	0,50
4	A3	0,42	A4	0,53	A5	0,50
5	A1	0,37	A3	0,20	A4	0,38

Step of Aggregation

After each reviewer assessed a Decision Maker (DM), which three people opened, the aggregation stage was carried out to determine the final ranking of the GDSS process. The method used in this research is Borda, with the following calculation steps:

1. Collect Ranking Results

   Table 13 is the result of the final ranking of the decision makers in giving their individual preferences.

TABEL 13. Ranking By DM

Alternative	DM – 1	DM – 2	DM – 3
A1	5	2	1
A2	1	1	2
A3	4	5	3
A4	2	4	5
A5	3	3	4

2. Giving Borda Points

   With the number of alternative data samples as many as 5 pieces, then in giving this borda point the first rank will be given the largest weight, namely 4, and the last rank 0 (zero).

3. Calculating Borda Count

   Table 14 represents the borda count value, which is obtained by assigning a value of 0 to 4 as described in the previous step.

TABEL 14. Borda Count Score

Alternative	DM – 1	DM – 2	DM – 3	∑ Borda Count
A1	0	3	4	7
A2	4	4	3	10
A3	1	0	2	3
A4	3	1	0	4
A5	2	2	1	5

4. Final Ranking

   Table 15 is the final ranking in modelling using Borda. From the results of the borda calculation, it is obtained that Alternative A2 is highly recommended in the decision-making process. This is indicated by the largest value obtained, which is a value of 10.

TABEL 15. Final Ranking of Borda Count

No.	Alternative	Borda Score	Ranking
1	A2	10	1
2	A1	7	2
3	A5	5	3
4	A4	4	4
5	A3	3	5

CONCLUSION

Based on the results and discussions that have been described, some conclusions can be drawn as follows.

1. This GDSS model can be used to improve the quality, efficiency, effectiveness, objectivity, and accuracy of the assessment process conducted by research reviewers at P3M Sriwijaya State Polytechnic.
2. The SMART model can be used as an alternative in ranking the weights that have been given by the reviewers independently and then using the Borda method; aggregation can be done to produce the best-ranking order in determining the research proposals recommended for funding.

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The group decision support system model of research proposal assessment using researcher track record and research output

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The Group Decision Support System Model of Research Proposal Assessment Using Researcher Track Record and Research Output

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Abstract. The Center of Research and Community Service (P3M) Sriwijaya State Polytechnic is one of the implementer elements in college, which coordinates, monitor, and assess research activity and implementation conducted by research centres or research groups from various majors and study programs. Nowadays, P3M Polsri has mostly conducted research schemes funded internally by the college. The research proposal assessment was conducted by looking at the substance of the proposal itself, without further consideration on the research output produced and the track record of the researchers' profiles. This research makes Group Decision Support System (GDSS) model assist the research proposal reviewers in increasing their assessment quality. The model used in this research was Smart (Simple Multi-Attribute Rating Technique) to conduct ranking individually from the decision-makers, in this case, are the research proposal reviewers. Further, the aggregation process was conducted on the recommendation result from the decision-makers to obtain the final value recommendation in the GDSS process. The examination shows that the model developed is quite reliable in assisting the research proposal reviewer team in giving an objective assessment.

INTRODUCTION

One of the pillars of the tri dharma of higher education as an activity carried out by lecturers is research and carrying out the teaching process and community service. This research activity can give birth to new solutions to various problems faced by the wider community. Research also needs to be directed to produce innovative products and respond quickly to community needs. By the research master plan (RIP) established by the Center for Research and Community Service (P3M) of the Sriwijaya State Polytechnic, which stipulates eight research focuses, namely energy technology and management, food technology and management, information and communication technology, advanced material technology and management, water technology and management, social humanities-arts-culture-education, transportation technology and management, and disaster management technology and management [1]. With the existence of this RIP, it will become a research roadmap that will be carried out on an institutional scale from each research activity within the Sriwijaya State Polytechnic (Polsri).

In carrying out research activities, each lecturer must go through the selection stages, both administrative selection and substance selection. This selection was carried out by reviewers appointed by P3M Polsri through a decree signed by the Director of the Sriwijaya State Polytechnic. This selection stage aims to ensure that the research proposal meets the standards and is eligible for funding. At this selection stage, there are obstacles in determining the weight and assessment of proposals carried out by reviewers, which tend to be subjective and less measurable. In addition, the assessment of research proposals has only focused on the substance of the research without considering the aspects of the researcher's track record and research outputs.

This research is important to present an alternative assessment of research proposals by taking into account the aspects of the researcher's profile and the outputs generated from the research. It aims to improve the quality of research and the productivity of research activities carried out.

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Research related to decision support systems using the SMART method was carried out by Fitriani [4], who researched monitoring and evaluation applications using the SMART method to conduct an objective assessment of students' activity of students living in Trunojoyo University dormitories. This study uses four criteria in its application to produce recommendations for monitored students. Oktavianti's research [5] uses the SMART method to provide employee promotion recommendations. This study also uses four criteria for the weighting process: work experience, potential academic test, performance value, and supervisor's assessment. Sihombing's research [6] uses the SMART method to determine outstanding employees. This study uses 13 criteria used as the basis for making judgments to determine high achieving employees. Mahdiana's research [8] combined the SMART and AHP methods to determine the selection of the best lecturers, using 12 criteria.

METHOD

The model developed in this study is a group decision support system (GDSS) to assist P3M at the Sriwijaya State Polytechnic. The initial stage is the administrative selection carried out by the P3M administrative staff and ensuring that the administrative requirements have been met. After the administrative evaluation stage is sufficient, the evaluation stage of the research proposal is carried out.

System Architecture

Figure. 1 is a system architecture model developed in this study. The system consists of a group of decision-makers consisting of reviewers as decision-makers (DM). There is also an entity in the form of a researcher who proposes a research proposal in the system. Through the LAN/internet network, the proposal will then be entered into the system and managed by P3M, who also acts as a system administrator. Then it will be processed by the GDSS system in which there is a Graphical User Interface (GUI) to interact between all users involved, and there is also a DSS model for weighting and ranking. There is a database that plays a role in storing various data used in the GDSSsystem.

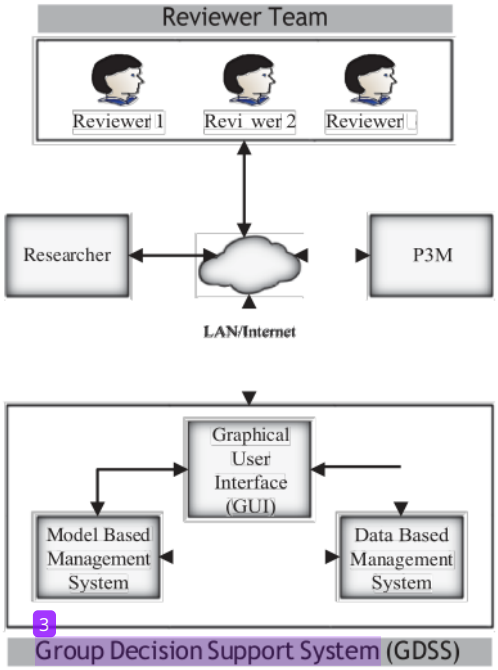

FIGURE 1. System Architecture Model of GDSS.

SMART Method

The SMART (Simple Multi-Attribute Rating Technique) method is a multi-criteria decision-making method, which is based on the theory that each alternative consists of several criteria that have values [2][3]. Each criterion has a weight that describes how important the criteria are. compared with other criteria [4][9][10][11]. The followingare the calculation steps using the SMART method [12].

1. Step 1: Determine the number of criteria
2. Step 2: The system by default will provide a scale of 0-100 based on the priority that has been inputted and then normalized. The formula used in this process is:

$$Normalization = \frac{w_j}{\sum w_j} \quad (1)$$

Description:
Wj : weight of a criteria
∑wj : total weight of all criteria

3. Step 3: Provide a criteria value for each alternative
4. Step 4: Calculate the utility value for each criteria with the formula

$$\mu_i(a_i) = 100 \frac{(C_{outi} - C_{min})}{(C_{max} - C_{min})} \% \quad (2)$$

Description:

μi (ai) : the utility value of the criteria i
C_{max} : maximum criteria value
C_{min} : minimum criteria value
C_{outi} : the value of criteria i

5. Step 5: Calculate the final value of each alternative

$$\mu_i(a)_i = \sum_{j=1}^{m} w_j u_i(a)_i \quad (3)$$

Description:
$\mu(a_i)$: alternative total value
w_j : the result of the normalization of criteria weights
$u_i(a_i)$: utility value result

Aggregation Method

After determining the weight for each criterion by a reviewer assigned by P3M, the results of the weighting that have been carried out independently by each reviewer as a decision-maker (DM) will then be carried out an aggregation process to determine the ranking in the form of a list of research proposals that are eligible to be funded based on the weight values obtained. The greater the weight value, the more feasible the research proposal is recommended to be funded.

The method used to perform this aggregation is the Borda method. The Borda method was discovered by Jean-Charles de Borda in the 18th century [13]. The principle of the Borda method is to do alternative voting by assigning a weight value to each alternative ranking. The alternative with the highest rank is given the highest value, and so on in descending order; it is given a lower value in the form of 0 or 1 [14].

RESULTS AND DISCUSSION

Step of The Independent Reviewer Assessment

Determining the Number of Criteria

The criteria used in this study are divided into three parts: the track record of researchers, research substance, and research outputs, as shown in Table 1, along with the weights of each criterion. The criteria for research substance get greater weight because it is the main element in a study.

TABLE 1. Determining of Criteria Weight.

Criteria	Description	Preference Weight
C1	Track record of researchers	30%
C2	Research substance	40%
C3	Research outputs	30%
Total		100%

Table 2 is the track record criteria for submitting research proposals that will reference the assessment carried out by reviewers. This reference weight is the maximum weight that each reviewer can give. Furthermore, Table 3 is the criteria considered related to the substance of the study. Ten criteria are used as a reference in providing an assessment of the research output.

TABLE 2. Researcher Track Record Criteria.

Criteria	Description	Preference Weight
C11	Quantity and quality of publications in scientific journals	30
C12	Quality and quantity of publications in scientific proceedings	30
C13	Quality and quantity of books with ISBN	20
C14	Quality and quantity of acquired status of intellectual property (KI)	20
	Total	100

TABLE 3. Research Substance Criteria.

Criteria	Description	Preference Weight
C21	Relevance of research proposals to areas of focus, themes, and research topics	10
C22	Relevance of research proposals to university strategic plans (renstra)	15
C23	Quality and relevance of research objectives, problems, state of the art, methods, and novelty	15
C24	The relationship of the research proposal to the research results obtained previously and future plans (roadmap)	10
C25	Appropriateness of research assignments and division of tasks	5
C26	Suitability of research schedule	10
C27	The suitability of the research budget plan (RAB)	10
C28	TKT target fairness target	10
C29	Current primary source bibliography reference	10
C210	Funding support and participation of research collaboration partners	5
	Total	100

Furthermore, Table 4 is the criteria considered related to the planned research output target to be produced.

TABLE 4. Research Outcome Criteria

Criteria	Description	Preference Weight
C31	Publication in reputable international journals	20
C32	Publication in international journals	10
C33	Publication in accredited national journals	15
C34	Publication in national journals	5

TABLE 4. Research Outcome Criteria (continued).

Criteria	Description	Preference Weight
C35	Publication in international conference proceedings	15
C36	Publication in the proceedings of the national conference	5
C37	Books (monographs, reference books, textbooks, electronic books, book chapters)	10
C38	Copyright	5
C39	Patents, Simple patents, Protection of plant varieties (PVT), Integrated circuit layout design, Policy papers, Industrial products	10
C310	Appropriate Technology (TTG)	5
	Total	100

Criteria Normalization

By using formula (1), then normalization is carried out to obtain a priority scale from the predetermined criteria, as in the following calculation:

$$Normalization = \frac{w_j}{\sum w_j}$$

1) Criteria 1:
   Normalization: 30/(30+40+30) : 30/100: 0,3
2) Criteria 2:
   Normalization: 40/(30+40+30) : 40/100: 0,4
3) Criteria 3:
   Normalization: 30/(30+40+30) : 30/100: 0,3

Table 5 is the result of normalization of the criteria weights that have been defined previously.

TABLE 5. Normalization Weight of Each Criteria.

Criteria	Description	Preference Weight	Normalization
1	Track record of researchers	30%	0,3
2	Research substance	40%	0,4
3	Research outputs	30%	0,3
	Total	100%	1

Assessing Criteria for Each Alternative

In this model, each alternative will be assessed by the reviewers, in this case by 3 reviewers. Table 6, Table 7, and Table 8 provide examples of the distribution of scores assigned by a reviewer to each alternative.

TABLE 6. Assessment by Reviewer 1 for Criteria C1-Track Record Researchers.

Alternative /Crtieria	Criteia C1-Researcher Track Record				∑ C1
	C11	C12	C13	C14	
A1	25	25	10	15	75
A2	25	25	15	15	80
A3	20	20	15	15	70
A4	25	20	10	10	65
A5	20	20	10	15	65

TABLE 7. Assessment by Reviewer 1 for Criteria C2-Research Substance.

Alternative/ Crtieria	Criteria C2-Research Substance										∑ C2
	C21	C22	C23	C24	C25	C26	C27	C28	C29	C210	
A1	7	12	10	6	3	6	9	8	8	1	70
A2	8	10	12	7	4	7	8	8	7	2	73
A3	6	14	10	8	2	8	8	7	8	3	74
A4	8	12	10	7	3	8	6	9	8	2	73
A5	7	10	12	9	4	7	7	6	9	4	75

TABLE 8. Assessment by Reviewer 1 for Criteria C3 Research Outputs.

Alternative/ Crtieria	Criteria C3-Research Outputs										∑ C2
	C31	C32	C33	C34	C35	C36	C37	C38	C39	C310	
A1	15	8	12	3	12	3	8	3	8	3	75
A2	15	8	14	4	14	4	7	3	8	3	81
A3	10	7	12	2	12	4	6	4	6	4	67
A4	15	9	10	4	14	4	8	3	7	3	77
A5	10	6	14	3	10	4	8	4	6	4	69

Calculating the Utility Value of Each Criteria

In determining the utility value, this is done by using formula (2), for example the utility value obtained by Alternative 1 for criteria C1, C2, and C3 as a result of reviewer 1's assessment can be described as follows:

$$\mu_i(a_i) = 100\,\frac{(C_{outi} - C_{min})}{(C_{max} - C_{min})}\,\%$$

$$\mu C1(A1) = \frac{75-65}{80-65} = 0{,}67$$

$$\mu C2(A1) = \frac{70-70}{75-70} = 0{,}00$$

$$\mu C3(A1) = \frac{75-67}{81-67} = 0{,}37$$

Determining Final Value

For the final value calculation is done using formula (3) as an example for Table 9 obtained by the following calculation:

$$\mu_i(a)_i = \sum_{j=1}^{m} w_j u_i(a)_i$$

μ(A1) = (0,3*0,67) + (0,4 * 0,00) + (0,3 * 0,57)
= 0,37
μ(A2) = (0,3*1,00) + (0,4 * 0,60) + (0,3 * 1,00)
= 0,84
μ(A3) = (0,3*0,33) + (0,4 * 0,80) + (0,3 * 0,00)
= 0,42
μ(A4) = (0,3*0,00) + (0,4 * 0,60) + (0,3 * 0,71)
= 0,45
μ(A5) = (0,3*0,00) + (0,4 * 1,00) + (0,3 * 0,14)
= 0,44

Table 9, Table 10, and Table 11 are the distribution of the values of the decision makers, which in this case were carried out by 3 reviewers.

TABLE 9. Rating By Reviewer 1.

Criteria Weight	30	40	30	Utility Value			Final score
Normalization	0,3	0,4	0,3				
Alternative/Criteria	∑ C1	∑ C2	∑ C3	C1	C2	C3	
A1	75	70	75	0,67	0,00	0,57	0,37
A2	80	73	81	1,00	0,60	1,00	0,84
A3	70	74	67	0,33	0,80	0,00	0,42
A4	65	73	77	0,00	0,60	0,71	0,45
A5	65	75	69	0,00	1,00	0,14	0,44
Max ()	80	75	81				
Min ()	65	70	67				

TABLE 10. Rating By Reviewer 2.

Criteria Weight	30	40	30	Utility Value			Final score
Normalization	0,3	0,4	0,3				
Alternative/Criteria	∑ C1	∑ C2	∑ C3	C1	C2	C3	
A1	70	74	75	1,00	0,50	1,00	0,80
A2	70	75	72	1,00	1,00	0,63	0,89
A3	67	74	67	0,00	0,50	0,20	0,20
A4	70	73	73	1,00	0,00	0,53	0,53
A5	70	74	69	1,00	0,50	0,58	0,58
Max ()	70	75	75				
Min ()	67	73	67				

TABLE 11. Rating By Reviewer 3.

Criteria Weight	30	40	30	Utility Value			Final score
Normalization	0,3	0,4	0,3				
Alternative/Criteria	∑ C1	∑ C2	∑ C3	C1	C2	C3	
A1	65	74	73	0,00	1,00	1,00	0,70
A2	80	66	72	1,00	0,00	0,75	0,53
A3	70	74	69	0,33	1,00	0,00	0,50
A4	65	72	70	0,00	0,75	0,25	0,38
A5	70	74	69	0,33	1,00	0,00	0,50
Max ()	80	74	73				
Min ()	65	66	69				

So from the results of calculations using the SMART method, results such as Table 12 can be obtained.

TABEL 12. Final Result of SMART Method Ranking.

Ranking	DM 1		DM 2		DM 3	
	Criteria	Final Score	Criteria	Final Score	Criteria	Final Score
1	A2	0,84	A2	0,89	A1	0,70
2	A4	0,45	A1	0,80	A2	0,53
3	A5	0,44	A5	0,58	A3	0,50
4	A3	0,42	A4	0,53	A5	0,50
5	A1	0,37	A3	0,20	A4	0,38

Step of Aggregation

After each reviewer assessed a Decision Maker (DM), which three people opened, the aggregation stage was carried out to determine the final ranking of the GDSS process. The method used in this research is Borda, with the following calculation steps:

1. Collect Ranking Results
   Table 13 is the result of the final ranking of the decision makers in giving their individual preferences.

TABEL 13. Ranking By DM

Alternative	DM – 1	DM – 2	DM – 3
A1	5	2	1
A2	1	1	2
A3	4	5	3
A4	2	4	5
A5	3	3	4

2. Giving Borda Points
   With the number of alternative data samples as many as 5 pieces, then in giving this borda point the first rank will be given the largest weight, namely 4, and the last rank 0 (zero).

3. Calculating Borda Count
   Table 14 represents the borda count value, which is obtained by assigning a value of 0 to 4 as described in the previous step.

TABEL 14. Borda Count Score

Alternative	DM – 1	DM – 2	DM – 3	∑ Borda Count
A1	0	3	4	7
A2	4	4	3	10
A3	1	0	2	3
A4	3	1	0	4
A5	2	2	1	5

4. Final Ranking
   Table 15 is the final ranking in modelling using Borda. From the results of the borda calculation, it is obtained that Alternative A2 is highly recommended in the decision-making process. This is indicated by the largest value obtained, which is a value of 10.

TABEL 15. Final Ranking of Borda Count

No.	Alternative	Borda Score	Ranking
1	A2	10	1
2	A1	7	2
3	A5	5	3
4	A4	4	4
5	A3	3	5

CONCLUSION

Based on the results and discussions that have been described, some conclusions can be drawn as follows.

1. This GDSS model can be used to improve the quality, efficiency, effectiveness, objectivity, and accuracy of the assessment process conducted by research reviewers at P3M Sriwijaya State Polytechnic.
2. The SMART model can be used as an alternative in ranking the weights that have been given by the reviewers independently and then using the Borda method; aggregation can be done to produce the best-ranking order in determining the research proposals recommended for funding.

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Title	The Group Decision Support System Model of Research Proposal Assessment Using Researcher Track Record and Research Output
Original file	1685-3099-1-SM.DOCX 09-07-2021
Supp. files	1685-1627-1-SP.DOCX 27-04-2021
Submitter	Mrs. Yevi Dwitayanti
Date submitted	July 9, 2021 - 10:19 PM
Track	Information System
Director	Tri Soeprobowati (Director)
Author comments	Please follow my submission.
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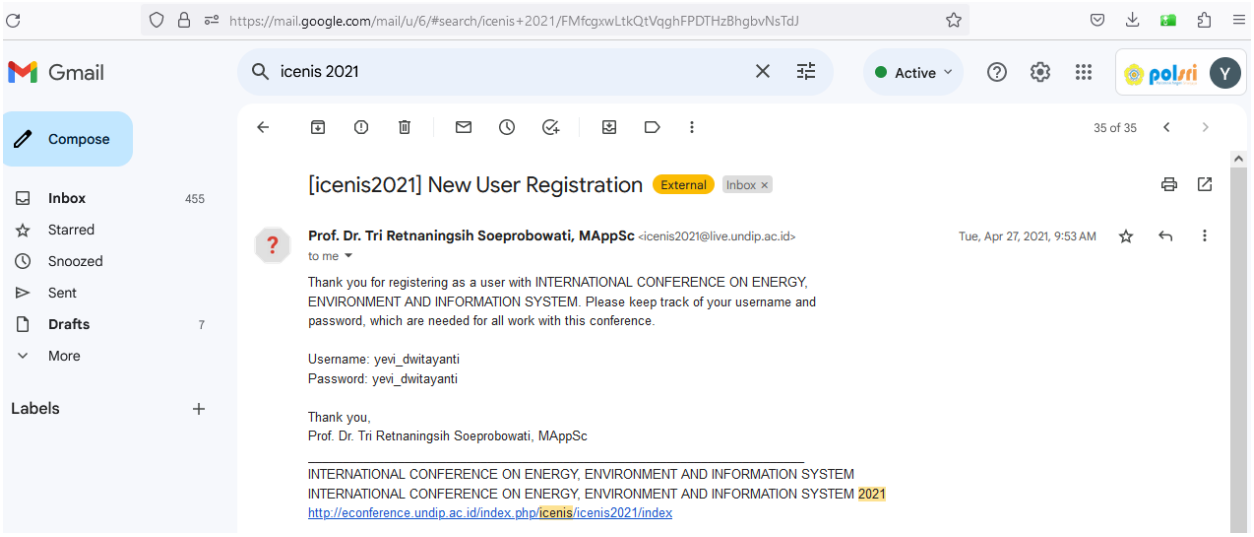
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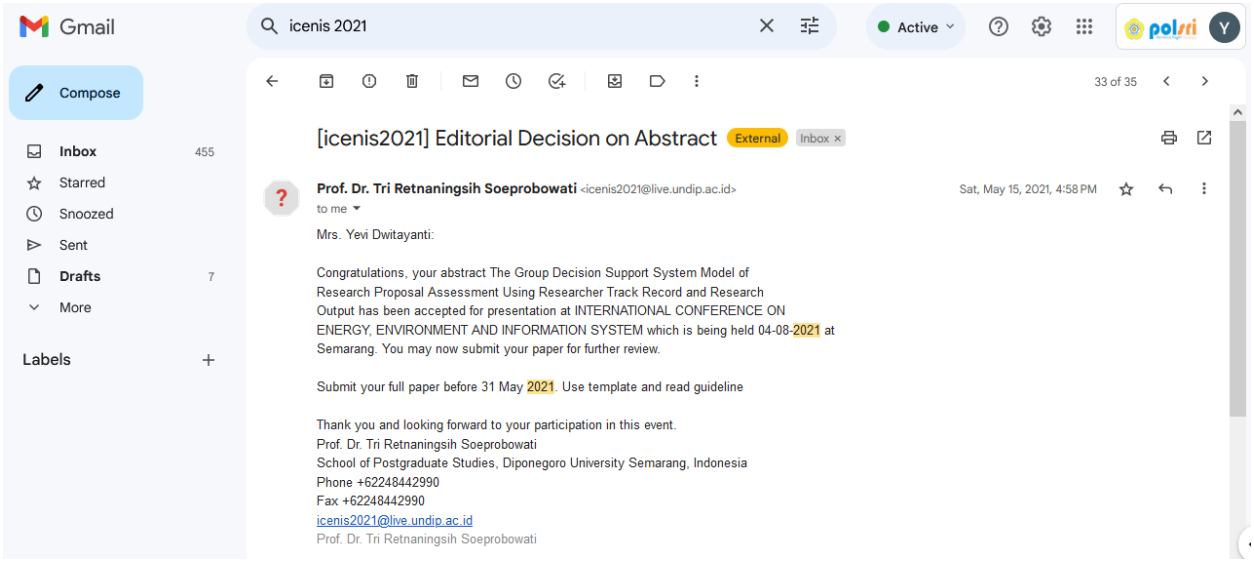
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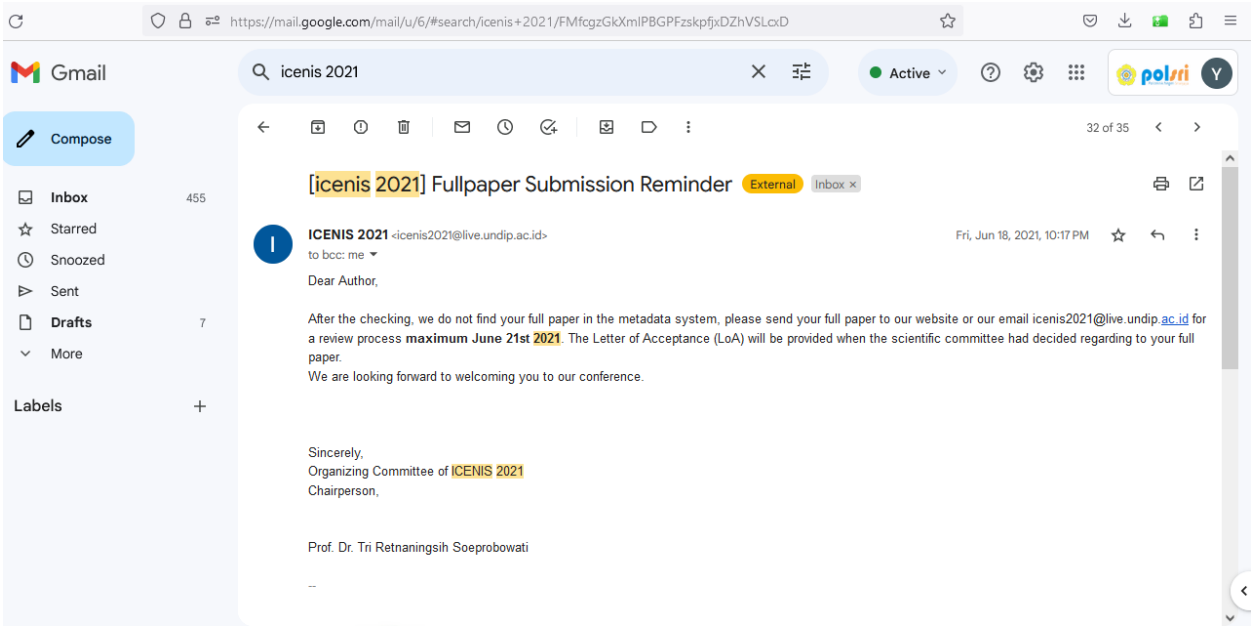
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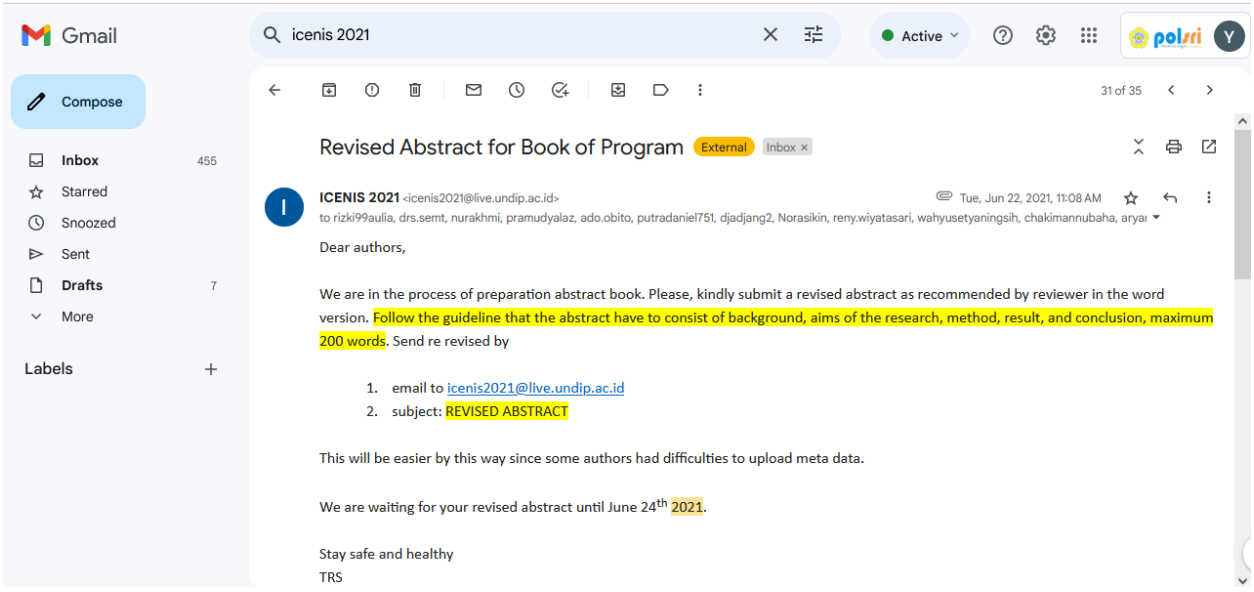
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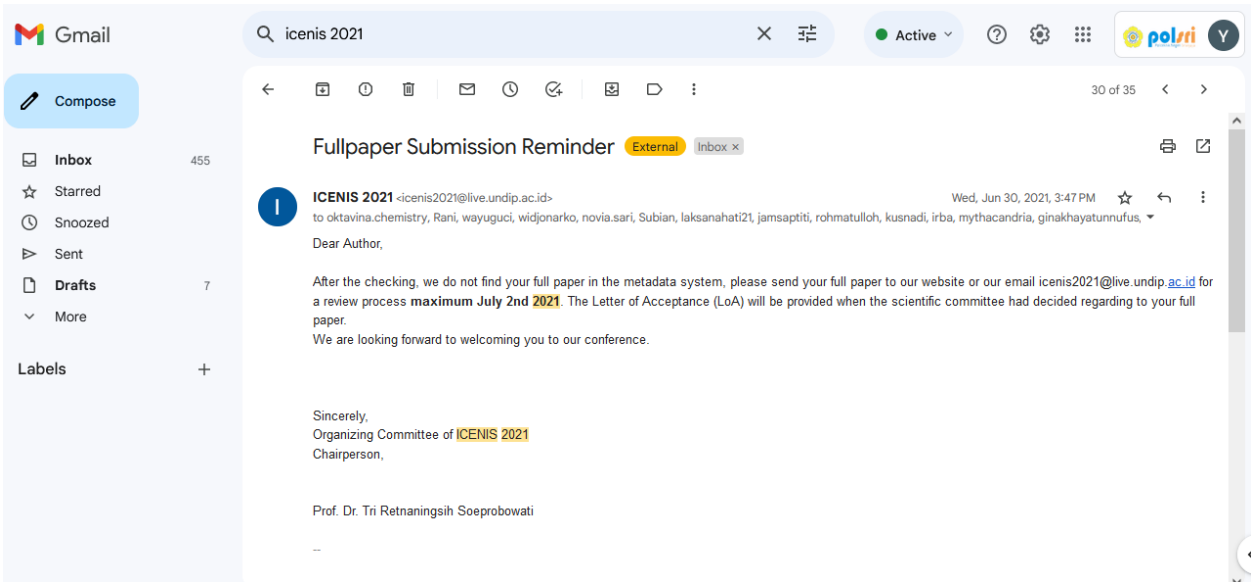
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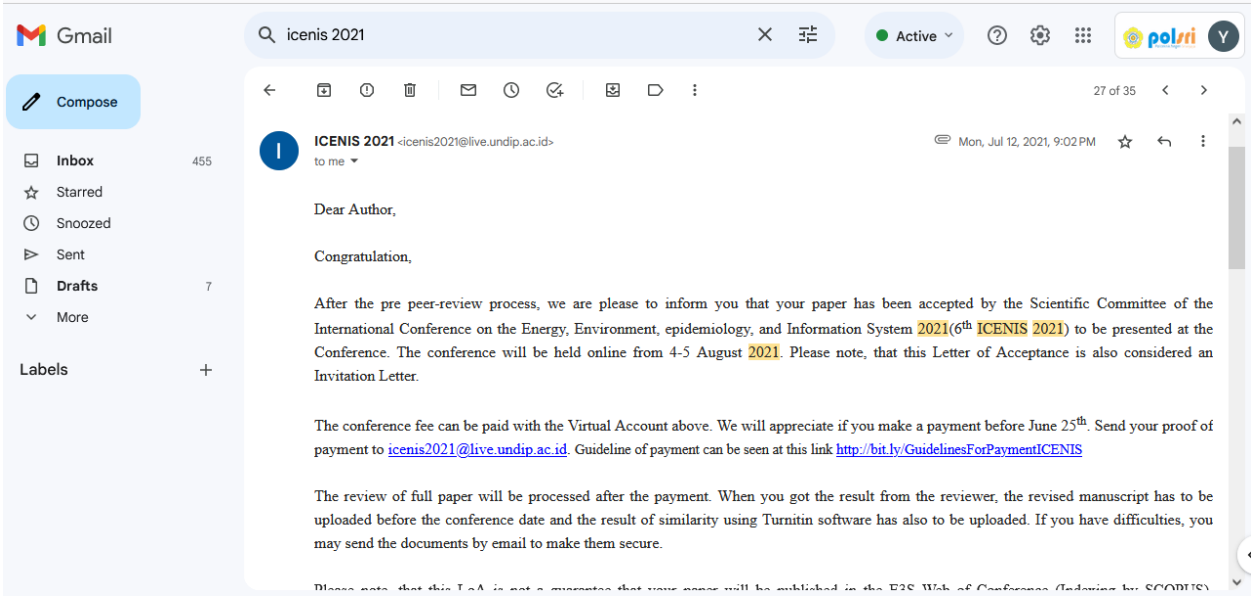
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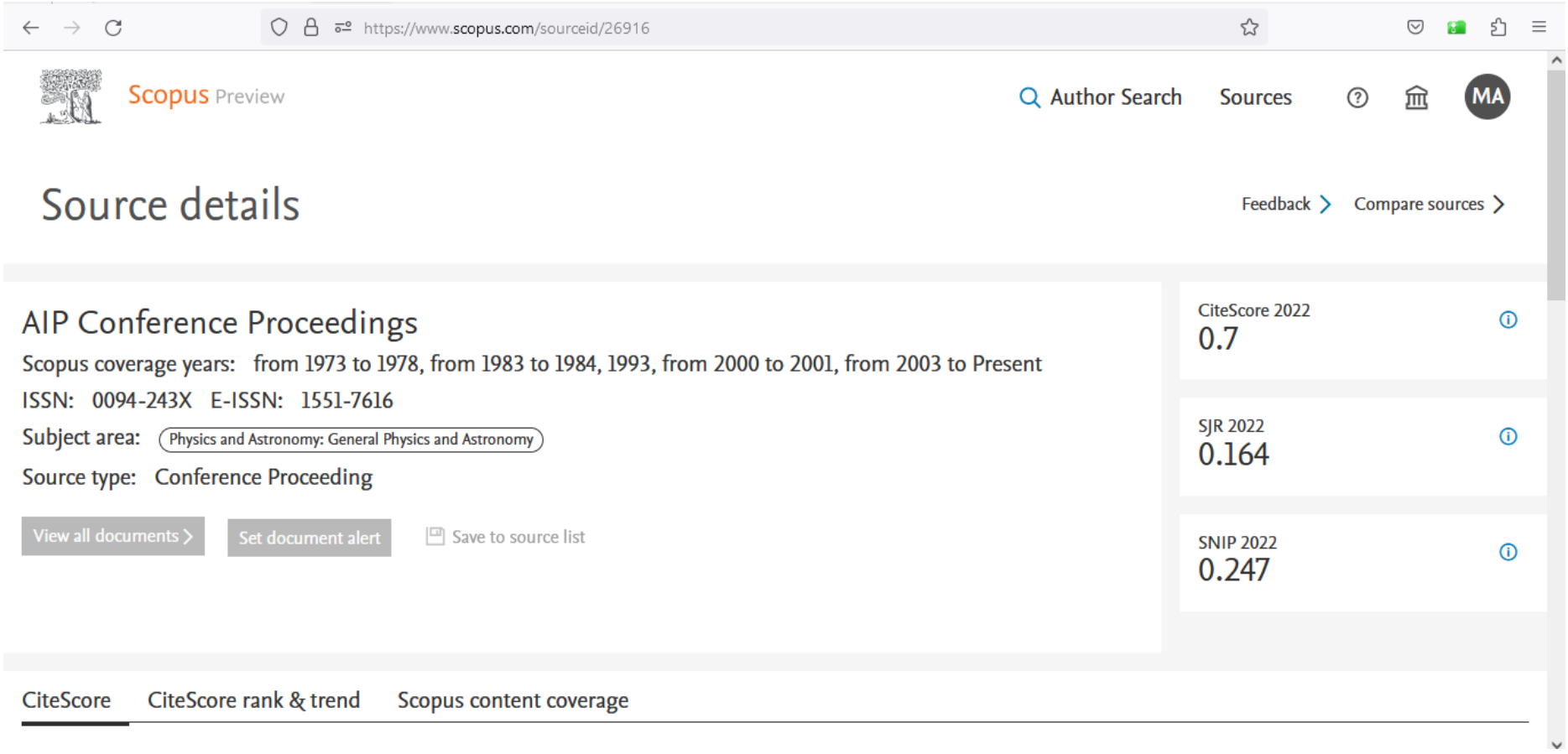
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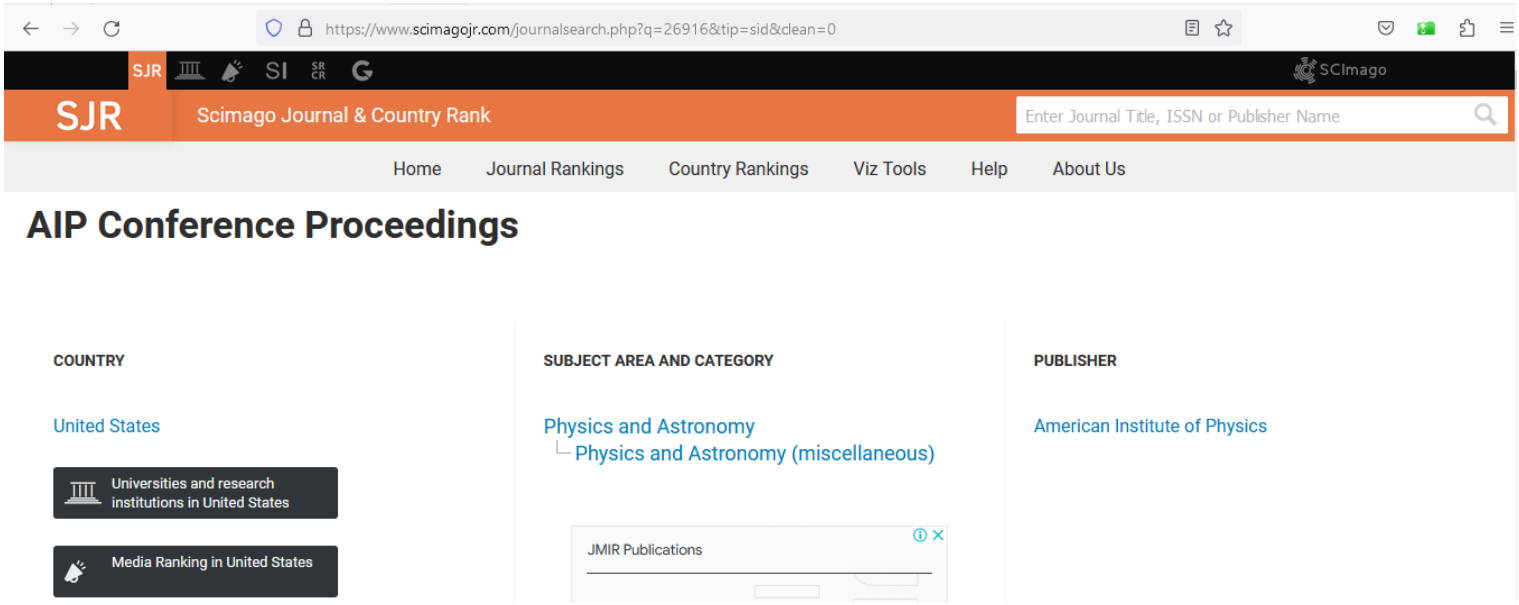
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