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A decision support system for *Ogoh-Ogoh* assessment based on SMART and SAW methods in the context of Balinese cultural preservation

I Ketut Widhi Adnyana [1]*, Tria Hikmah Fratiwi [2]

[1] *Information System Study Program, Institut Teknologi dan Bisnis STIKOM Bali, Indonesia*
[2] *Digital Business Study Program, Institut Teknologi dan Bisnis STIKOM Bali, Indonesia*

*****Corresponding Author: *widhi_adnyana@stikom-bali.ac.id*

Abstract: Bali's cultural richness includes the *Ogoh-Ogoh* tradition, which has recently evolved from a ritualistic practice into a competitive event evaluated through multidimensional criteria. However, the current manual evaluation process faces significant challenges, including subjective bias, inconsistent scoring standards, and inefficient data processing, which often reduce public trust in competition results. This study proposes a web-based Decision Support System (DSS) integrating the Simple Multi-Attribute Rating Technique (SMART) and Simple Additive Weighting (SAW) methods to enhance objectivity and transparency in *Ogoh-Ogoh* assessment. The system was implemented and tested using a dataset of 45 *Ogoh-Ogoh* alternatives. The comparative analysis demonstrates a strong consistency between the two methods, evidenced by a Spearman's Rank Correlation coefficient of 0.81. Furthermore, performance testing revealed that the system achieved an 85% ranking accuracy compared to expert manual evaluations and significantly improved operational efficiency by reducing processing time by 40% (from 2.5 hours to 1.5 hours). These findings confirm that the proposed DSS not only minimizes subjectivity but also serves as a valid tool for the digitalization and preservation of cultural heritage assets.

Keywords: cultural preservation, decision support system, multi-criteria evaluation, *ogoh-ogoh*, SAW, SMART.

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Introduction

One of the Hindu religious celebrations is *Nyepi* Day, which marks the Hindu New Year in the Saka calendar. To welcome this new year, the Hindu community in Bali collectively creates *Ogoh-Ogoh*. The *Ogoh-Ogoh* tradition is one of Bali's cultural heritages. The process of making *Ogoh-Ogoh* not only reflects the spiritual and philosophical values of the Balinese Hindu community but also serves as a platform for creativity, innovation, and social collaboration among local communities *(banjar).* In recent years, *Ogoh-Ogoh* has evolved from a purely ritualistic practice into a cultural competition, where the best creations are selected based on the materials used and the symbolic meaning of the *Ogoh-Ogoh* itself. However, challenges often arise, particularly in calculating and determining the best *Ogoh-Ogoh*. The evaluation is usually based on various criteria, such as aesthetics, creativity, thematic relevance, community participation, and elements of local wisdom. Nevertheless, the process is still largely manual, lacking structured and well-documented assessment standards [1], [2], [3].

However, the transition to a competitive format introduces significant evaluation challenges. While Decision Support Systems (DSS) have been widely implemented to assist data-driven decision-making in business, education, and industrial sectors, their application within the domain of cultural preservation remains significantly underexplored. This creates a notable research gap regarding how technology can be utilized to quantify qualitative cultural aesthetics efficiently. Most existing studies focus on technical or managerial decision-making, leaving the specific complexities of traditional arts assessment—such as *Ogoh-Ogoh* competitions—largely untouched by modern MCDM implementations [4], [5], [6].

The urgency of this research stems from critical issues observed in the current conventional assessment methods. The evaluation process, typically conducted by a panel of judges using paper-based scoring, is hindered by several fundamental problems. First, the assessment suffers from subjectivity, where evaluations rely heavily on individual judges' perceptions without standardized scoring rubrics, leading to inconsistency in scoring standards across different judges. Second, the manual tabulation process is inherently inefficient and prone to calculation errors, which consumes significant time during the competition. Third, and most critically, there is a lack of transparency in how final scores are derived. Consequently, participants are often unable to verify results, which may lead to negative perceptions and reduced public trust in the competition outcomes. Therefore, a systematic and technology-based approach is needed to mitigate these issues and support objective, transparent, and fair decision-making [7], [8], [9].

To address these challenges, this study proposes a web-based Decision Support System (DSS) integrating the Simple Multi-Attribute Rating Technique (SMART) and Simple Additive Weighting (SAW) methods. Although other MCDM methods such as the Analytic Hierarchy Process (AHP) or TOPSIS are commonly used, SMART and SAW were specifically chosen for this study due to their simplicity and ease of implementation for non-technical users, such as customary committees. Unlike AHP, which requires complex and time-consuming pairwise comparisons, SMART allows for direct scoring based on criteria weights determined through stakeholder consensus, while SAW normalizes scores to simplify the final ranking process [10].

The primary objective of this research is to design a valid DSS model for *Ogoh-Ogoh* evaluation by comparing the consistency and accuracy of these two methods. The criteria integrated into the system include aesthetics, creativity, thematic relevance, community participation, and environmental sustainability. Beyond serving as an objective assessment tool, this system contributes to the digital transformation of local culture. By digitizing the evaluation process, the system creates a historical database of *Ogoh-Ogoh* creations, thereby promoting cultural preservation through technology [11], [12], [13], [14], [15].

Methodology

The research methodology describes the systematic stages carried out in this study to ensure the validity and reliability of the proposed system. The research stages are illustrated in Figure 1.

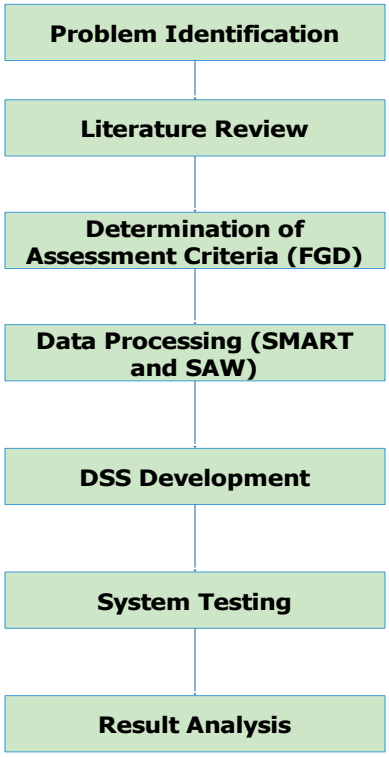


Figure 1. Research methodology

The stages of the research methodology can be explained as follows:

1. Problem Identification
   The research begins by identifying critical issues in the current *Ogoh-Ogoh* evaluation process in Bali. Observations revealed that the manual and subjective assessment approach led to inconsistencies, lack of transparency, and a high risk of calculation errors. These issues formed the basis for the urgency of developing a technology-based Decision Support System.
2. Literature Review
   This study utilized two primary data sources. First, a literature review was conducted to understand the theoretical frameworks of DSS, SMART, and SAW methods. Second, empirical data was collected from 45 *Ogoh-Ogoh* alternatives to serve as the test dataset for the system simulation.
3. Determination of Assessment Criteria (FGD)
   To ensure the validity of the assessment standards, the criteria and their respective weights were determined through a Focus Group Discussion (FGD) mechanism. This discussion involved relevant stakeholders, including traditional leaders (*Bendesa*), competition committees, and local art experts. The consensus resulted in five main criteria: aesthetics, creativity, thematic relevance, community participation, and environmental sustainability.
4. Data Processing (SMART and SAW)
   The data processing stage involves two mathematical approaches. Weighting (SMART) Weights for each criterion were normalized based on the priorities set during the FGD to produce proportional values and Ranking (SAW) The SAW method was applied to calculate the final score. Assessor evaluations were normalized and aggregated to produce a final ranking for each of the 45 *Ogoh-Ogoh* alternatives
5. DSS Development
   The system was developed as a web-based application to ensure accessibility for field judges. The technical environment for development included. Programming Language PHP with the CodeIgniter framework was used for the back-end logic Database MySQL was utilized to store alternative data, criteria weights, and assessment history User Interface The front-end was built using Bootstrap to ensure mobile responsiveness, allowing judges to input scores via smartphones or tablets directly at the competition site
6. System Testing
   System testing was conducted using two approaches Black-box Testing: To validate that all functional features (input, edit, delete, and calculation logic) worked according to the requirements without errors and Comparative Testing: To measure efficiency and accuracy. The system's ranking results were compared against manual calculations to verify the Spearman's Rank Correlation, and the processing time was measured to quantify efficiency gains.
7. Result Analysis
   The final stage involved analyzing the consistency between SMART and SAW methods and evaluating the system's impact on transparency and objectivity based on the testing results.

Results and Discussions

This section presents the experimental results of the *Ogoh-Ogoh* assessment using the proposed DSS. The analysis focuses on three key aspects: the comparison of ranking outputs between SMART and SAW, the statistical consistency test using Spearman's Rank Correlation, and the system efficiency testing.

Results

Ranking Calculation Analysis

The assessment involved 45 *Ogoh-Ogoh* alternatives evaluated against five weighted criteria. The calculation process for both methods was automated within the system. Table 1 presents the final ranking comparison between the SAW and SMART methods for the top and bottom alternatives.

Table 1. Assessment calculation of *ogoh-ogoh*

Alternative	K1	K2	K3	K4	K5	Final Score	SAW Score	SMART Score	Rank
A25	3	5	4	5	3	4.1	0.75	4	1
A11	4	4	4	5	3	4.05	0.75	4	2
A24	4	5	4	5	5	4	0.76	4.6	3
A17	5	1	5	5	1	4	0.84	3.4	3
A1	4	5	3	5	5	3.8	0.72	4.4	5
A23	2	4	5	3	1	3.75	0.76	3	6
A20	5	3	4	3	3	3.6	0.67	3.6	7
A8	5	3	5	1	2	3.55	0.66	3.2	8
A35	3	5	3	4	4	3.55	0.65	3.8	8
A45	3	5	3	3	3	3.5	0.63	3.4	10
A5	2	5	4	1	1	3.4	0.68	2.6	11
A13	2	4	5	2	2	3.4	0.62	3	11
A41	1	4	4	3	1	3.35	0.68	2.6	14
A37	3	4	4	1	1	3.35	0.68	2.6	14
A26	1	5	4	4	4	3.35	0.61	3.6	14
A21	1	3	5	3	1	3.3	0.68	2.6	16
A3	4	3	5	2	4	3.25	0.61	3.6	17
A33	2	5	4	2	4	3.15	0.57	3.4	18
A31	2	3	1	5	1	3.1	0.64	2.4	19
A27	4	4	3	2	4	3.1	0.57	3.4	19
A7	3	4	4	1	3	3.05	0.55	3	21
A36	3	4	3	2	3	3.05	0.55	3	21
A15	1	5	5	2	5	3	0.56	3.6	23
A12	1	4	2	4	2	3	0.54	2.6	23
A22	5	2	3	1	2	2.9	0.54	2.6	25
A4	2	4	5	1	4	2.9	0.53	3.2	25
A6	3	3	2	4	4	2.85	0.53	3.2	28
A29	1	4	5	1	3	2.85	0.51	2.8	28
A9	4	1	4	2	2	2.85	0.54	2.6	28
A14	4	2	2	4	4	2.8	0.53	3.2	30
A19	3	1	3	3	1	2.8	0.60	2.2	30
A43	1	4	1	5	4	2.7	0.49	3	32
A42	2	3	5	1	4	2.65	0.49	3	33
A39	2	1	4	5	5	2.6	0.52	3.4	34
A16	2	1	4	4	4	2.55	0.49	3	35
A2	2	3	3	3	5	2.5	0.48	3.2	36
A10	1	2	5	2	4	2.4	0.45	2.8	37
A44	3	1	1	4	3	2.3	0.43	2.4	38
A32	1	3	1	2	2	2.15	0.38	1.8	39
A40	3	1	1	3	3	2.1	0.39	2.2	40
A38	1	2	2	3	4	2	0.37	2.4	41
A30	1	1	2	4	4	1.95	0.37	2.4	42

A18	1	1	1	4	3	1.9	0.35	2	43
A34	2	3	1	1	4	1.85	0.33	2.2	44
A28	1	1	1	1	3	1.3	0.23	1.4	45

The comparison reveals that while the top-ranked alternatives are generally consistent, minor discrepancies exist due to the calculation nature of each method. SAW uses normalization relative to the maximum value in the dataset, making it stable for competitive ranking. In contrast, SMART uses utility functions based on criterion ranges, making it more sensitive to specific weight values.

Statistical Validation (Spearman's Rank Correlation)

To quantitatively validate the consistency between SMART and SAW, a Spearman's Rank Correlation test was conducted. This analysis determines whether the two methods produce linear ranking orders Table 2.

Table 2. Statistical summary table

Statistics	SAW Score	SMART Score
Mean	0.561	2.987
Standard Deviation	0.132	0.660

As visualized in Figure 2, the data distribution shows a linear trend. The statistical calculation yielded a Spearman correlation coefficient ρ of 0.81. A coefficient value closer to 1.0 indicates a very strong positive correlation. This statistically proves that the DSS provides reliable and consistent decision outcomes regardless of the method used, although SAW offers slightly better stability for this specific dataset

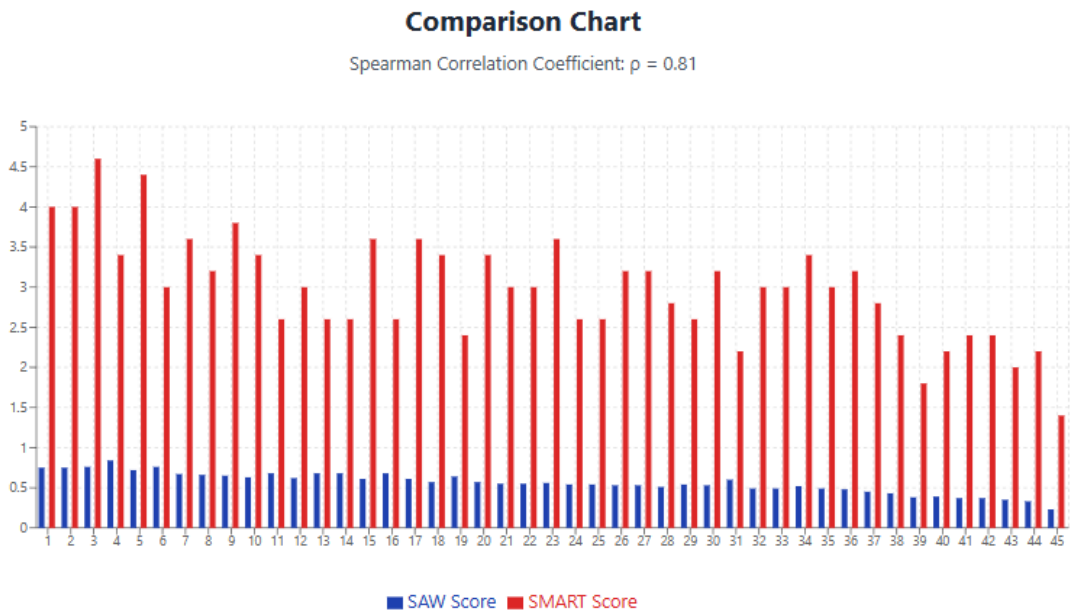


Figure 2. Comparison of SAW and SMART

System Implementation

The DSS was successfully developed as a web-based platform. The implementation covers the entire assessment lifecycle, from alternative registration to final reporting. The key interfaces are presented below:

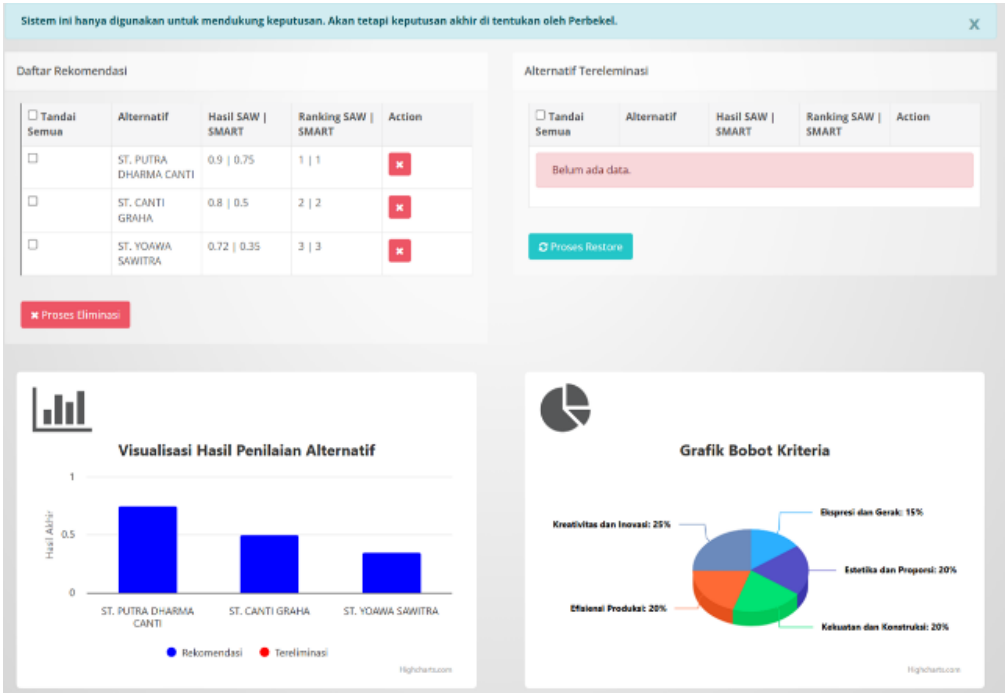
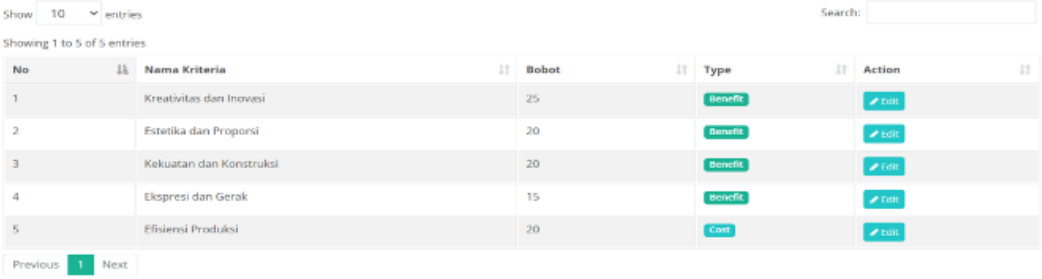


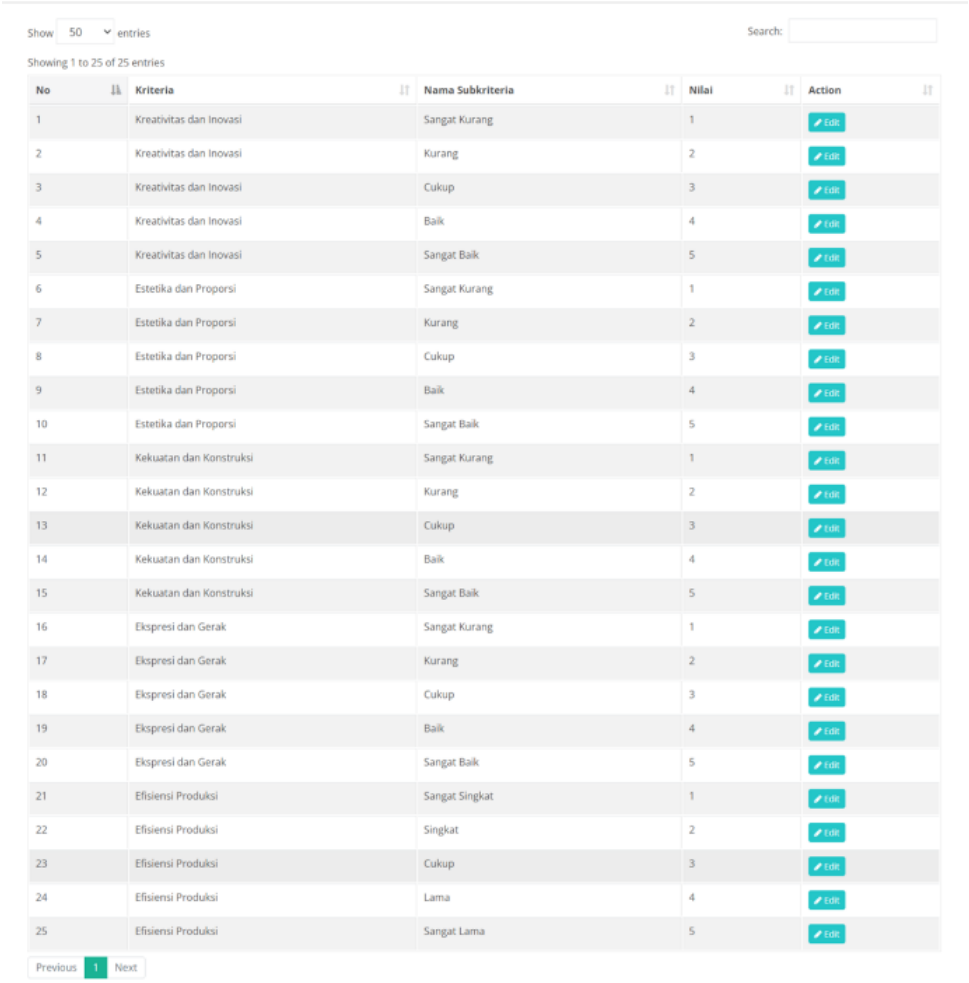
Figure 3. Assessment system dashboard

Figure 3 shows the system dashboard, where this section displays the alternative data and the calculation results using both the SMART and SAW methods.

Figure 4. Alternative data

Figure 4 shows the display of alternative data for evaluation, presenting each dataset that has been collected.





Show 50 entries Search:

Showing 1 to 25 of 25 entries

No	Kriteria	Nama Subkriteria	Nilai	Action
1	Kreativitas dan Inovasi	Sangat Kurang	1	Edit
2	Kreativitas dan Inovasi	Kurang	2	Edit
3	Kreativitas dan Inovasi	Cukup	3	Edit
4	Kreativitas dan Inovasi	Baik	4	Edit
5	Kreativitas dan Inovasi	Sangat Baik	5	Edit
6	Estetika dan Proporsi	Sangat Kurang	1	Edit
7	Estetika dan Proporsi	Kurang	2	Edit
8	Estetika dan Proporsi	Cukup	3	Edit
9	Estetika dan Proporsi	Baik	4	Edit
10	Estetika dan Proporsi	Sangat Baik	5	Edit
11	Kekuatan dan Konstruksi	Sangat Kurang	1	Edit
12	Kekuatan dan Konstruksi	Kurang	2	Edit
13	Kekuatan dan Konstruksi	Cukup	3	Edit
14	Kekuatan dan Konstruksi	Baik	4	Edit
15	Kekuatan dan Konstruksi	Sangat Baik	5	Edit
16	Ekspresi dan Gerak	Sangat Kurang	1	Edit
17	Ekspresi dan Gerak	Kurang	2	Edit
18	Ekspresi dan Gerak	Cukup	3	Edit
19	Ekspresi dan Gerak	Baik	4	Edit
20	Ekspresi dan Gerak	Sangat Baik	5	Edit
21	Efisiensi Produksi	Sangat Singkat	1	Edit
22	Efisiensi Produksi	Singkat	2	Edit
23	Efisiensi Produksi	Cukup	3	Edit
24	Efisiensi Produksi	Lama	4	Edit
25	Efisiensi Produksi	Sangat Lama	5	Edit

Previous 1 Next

Figure 5. Criteria and sub-criteria

Figure 5 shows the display of criteria and sub-criteria within the system

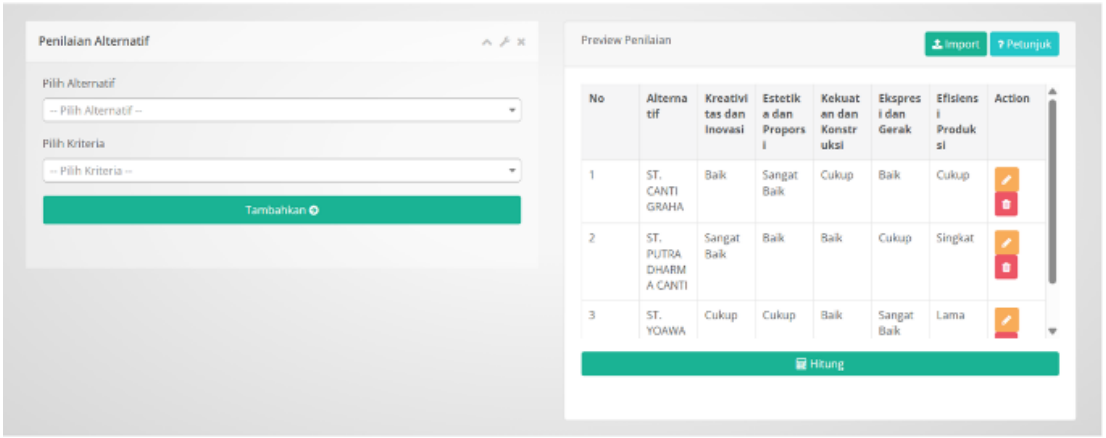


Figure 6. Assessment page

Figure 6 shows the assessment results page. Judges can view the evaluation results directly on this system interface, preventing redundancy or loss of documents. Decision-making for the evaluation can be conducted quickly, with calculations performed transparently.

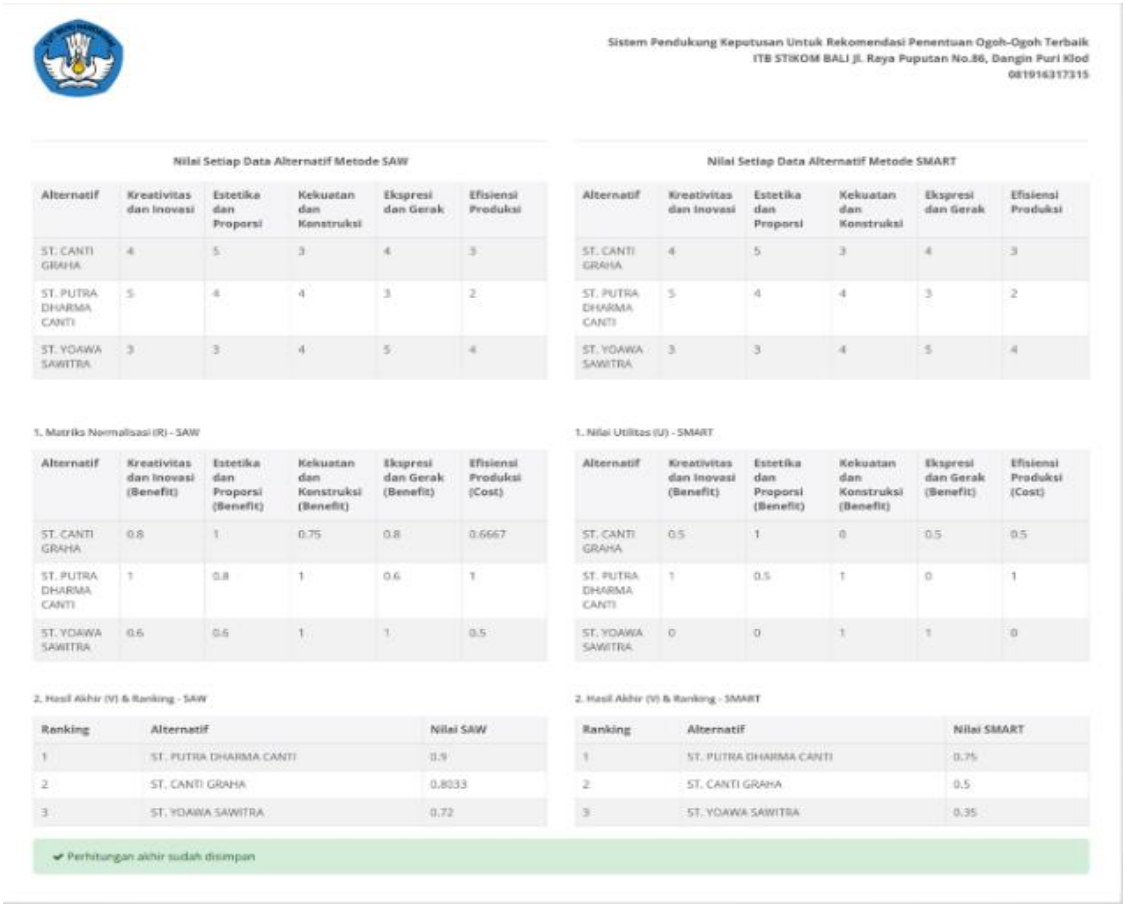


Figure 7. Calculation results and ranking

Figure 7 shows the display of the calculation results. On this page, the system performs computerized calculations, allowing the evaluation results to be obtained more quickly

System Testing and Efficiency

System testing was conducted to measure operational efficiency and accuracy compared to the previous manual method. The testing involved the competition committee and judges. The results are summarized as follows:

1. Accuracy: The system achieved an 85% ranking accuracy when cross-validated with expert manual decisions from the previous year's records.
2. Efficiency: The automated calculation significantly reduced the administrative workload. As illustrated in Figure 8, the scoring process for 45 alternatives, which previously took 150 minutes (2.5 hours) using manual tabulation, was completed in only 90 minutes (1.5 hours) using the DSS. This represents a 40% reduction in processing time, proving the system's effectiveness in real-world scenarios. Can be seen in the visualization of Figure 8.

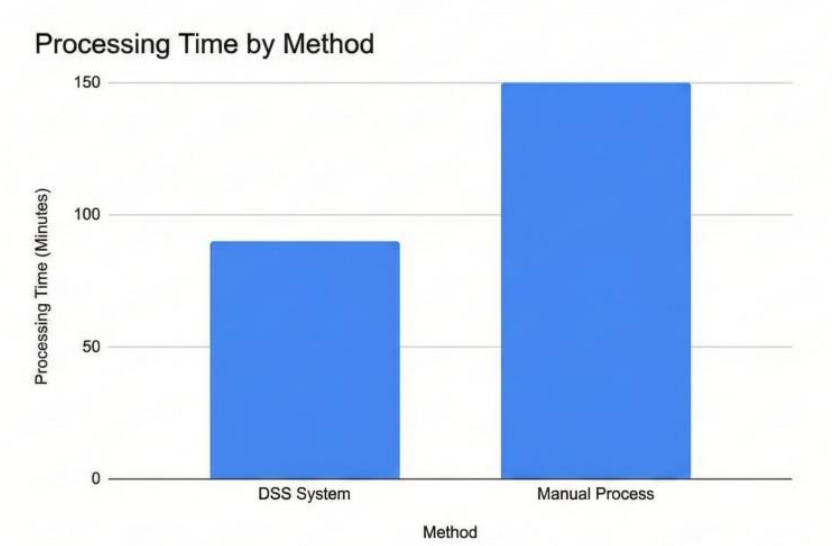


Figure 8. Comparison of processing time (Manual vs. DSS)

Discussions

The development of this DSS addresses the critical need for objectivity in cultural competitions. The integration of SMART and SAW methods successfully mitigates the issues of subjectivity and calculation errors found in manual processes.

1. Methodological Implications The comparative analysis confirms that both methods are valid for this domain. However, the SAW method is recommended as the default setting for *Ogoh-Ogoh* competitions due to its normalization technique (Benefit/Cost attributes), which is more robust in handling dynamic scores from diverse judges. SMART remains a valuable alternative when the committee requires flexibility in adjusting specific criteria weights to emphasize certain artistic themes.
2. Impact on Cultural Preservation Beyond technical efficiency, this research contributes significantly to cultural preservation. The "Preservation" aspect is quantified through the digitalization of 45 *Ogoh-Ogoh* artifacts into a structured database. In the manual system, assessment sheets were often lost or discarded. With this DSS, 100% of the assessment data is archived, creating a historical record of artistic trends, materials used, and community participation levels. This digital archive supports the long-term sustainability of the *Ogoh-Ogoh* tradition by providing future generations with referenced data on artistic evolution.
3. Operational Transparency The web-based nature of the system ensures transparency. Participants can view the criteria and final scores, reducing suspicion of bias. The 40% efficiency gain allows the committee to focus more on event management rather than administrative tabulation, making this model highly replicable for other cultural festivals in Bali.

Conclusion

This study successfully developed a web-based Decision Support System (DSS) for *Ogoh-Ogoh* assessment by integrating the SMART and SAW methods. The comparative analysis confirms that both methods produce objective and consistent rankings, statistically evidenced by a Spearman's Rank Correlation coefficient of 0.81. While SMART offers flexibility in criteria weighting according to evaluator preferences, SAW ensures greater stability through its normalization process.

The implementation of this system significantly enhances the effectiveness of cultural competitions. Testing results demonstrated an 85% ranking accuracy compared to expert manual evaluations and a 40% increase in efficiency, reducing the processing time from 2.5 hours to 1.5 hours per session. By minimizing subjective bias and automating calculations, the system fosters greater transparency and public trust. Furthermore, this study contributes to the preservation of Balinese culture by digitizing the assessment data of 45 *Ogoh-Ogoh* artifacts, creating a valuable historical database for future reference. Future research can expand this model by integrating

other MCDM methods or developing mobile-based applications to further broaden its accessibility in various cultural contexts

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