SOFTWARE QUALITY MODEL ISO/IEC 25010 PRIORITIZATION SMART GOVERNMENT APPLICATION

Winny Purbaratri*
Perbanas Institute
*Corresponding Author: winny.purbaratri@perbanas.id

Nani Krisnawaty
Perbanas Institute
nani.krisnawaty@perbanas.id

Abstract *– The priority of software quality requirements can vary depending on the characteristics and objectives of the project being worked on. The use of ISO/IEC 25010 can help software development teams understand and identify the most crucial quality requirements to ensure project success. The Smart Government application is software designed to support and improve government efficiency and effectiveness in providing public services and managing resources intelligently. Software quality in the context of Smart Government applications is an important aspect in achieving this goal. Quality aspects of the software above, the Smart Government application can be an effective tool in driving digital transformation of government and providing better services to society as a whole. Implementation of good software quality also helps create public trust in Smart Government applications. In this study, the Analytical Hierachy Process method will be used to determine the weighting criteria for the ISO/IEC 25010 standard assessment and Simple Additive Weighting for determine the priority ranking of the Banten province population service application. The results of this study can provide decision support where if the one who gets the best value, then it can be used as an example for cities or districts that get a low quality software score.*

Keywords: Software Quality, ISO/IEC 25010, Smart Government, AHP, SAW, MCDM

I. INTRODUCTION

The impact of software developers in providing quality software products is shown by the prioritization of software quality criteria (Senthilkumar & Arunkumar, 2016). The selection of search-based software engineering quality indicators was motivated by the absence of existing indicators for quality evaluation, despite the considerable number of published works in the field of SBSE (Wang et al., 2016). In contrast to normative papers, which typically provide a set of primary attributes for evaluating the quality of application programs, these characteristics do not align completely with the intended aims and fail to include quality control measures and compliance testing programs tailored to client requirements. One of the contributing factors to the present circumstances is the inherent challenge in assessing the quality of a system only based on quantitative metrics that include both technological components and human operators (Tikhanychev, 2020). In Scrum-based software development, recent studies use the AGIT model to assess compliance levels. These studies also include information system audit criteria based on the COBIT model (Mahnic & Natasa, 2015).

In order to ensure the sustained use of e-Government software for enhancing organizational performance over an extended duration, it is essential to maintain software maintenance practices. The E-Government Software Assessment Model has the capability to provide recommendations for maintenance

(Atimi & Pradasari, 2020). The concept of quality is gaining recognition as a promising strategy for fostering the development of services within the realm of e-Government. Ensuring a satisfactory Quality of Services is vital to meet the demands of both individuals and businesses, as well as to promote the use of Information and Communication Technology (ICT) in our society (Corradini et al., 2007). The idea of quality encompasses several factors, including perspectives such as quality of service, user experience, content, and usability. The quality and stability of a website are of utmost importance due to its potential for immediate global reach (Jati & Dominic, 2009).

The objective of this research was to determine the weight values assigned to the criteria inside the ISO/IEC 25010 software quality testing model. These weight values serve as a benchmark for assessing software quality based on the ISO/IEC 25010 model. In order to determine the relative importance of the criteria, the Analytical Hierarchy Process (AHP) might be used. The Analytic Hierarchy Process (AHP) is a methodological approach within the field of Multi-Criteria Decision-Making (MCDM) that enables decision makers to mathematically and psychologically model intricate problems (Saaty, 2000). The term "hierarchical decision making" refers to a strategy whereby many choice criteria are organized into a structured hierarchy. The assessment is conducted to determine the relative significance of these factors. The present study involves a comparative analysis of alternative options for each criteria, with a particular focus on expert assessments as the primary source of information. The determination of an overall rating scale for the options is thereafter conducted. The ranking system also incorporates factual and subjective considerations to determine a ratio scale that quantifies intangible elements in a comparative manner (Sultan et al., 2012).

In the relevant literature, many proprietary MCDMA approaches have been developed, proposed, and successfully applied to software quality assessment (Basciani et al., 2023)(Belinda et al., 2021)(Ardil, 2020). The use of methods, such as GQM, AHP, and Fuzzy Logic to measure software quality can also increase the accuracy of quality measurements (Mulyawan et al., 2021). For research criteria based on ISO/IEC 25010 Model. Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, dan Portability. And for the method used is the Analytical Hierarchy Process for weighting criteria and Simple Additive Weighting for priority ranking.

II. METHODS

A. ISO/IEC 25010

The ISO/IEC 25010 standard is used for the purpose of classifying and evaluating systems and software quality requirements, as well as identifying any associated difficulties. (Alves et al., 2014). This study aims to conduct an analysis on the quality of the e-learning system, using the ISO/IEC 25010 standard. ISO/IEC 25010 specifically emphasizes the aspects of Software Product Quality. (Ratnaduhitaa et al., 2023). The evaluation of the quality of use is facilitated by the use of the International Organization for Standardization (ISO). The ISO/IEC 25010 Quality in Use Model is a globally recognized standard approach used for assessing the quality of user experience. This model considers the user's viewpoint and encompasses factors such as effectiveness, efficiency, and user satisfaction in relation to satisfying their requirements. (Afiah et al., 2019) The evaluation characteristics and sub characteristics were identified from the ISO/IEC 25010 quality model. The multidimensional structure of the quality model is based on characteristics such as functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability, and associated sub characteristics.(Ardil, 2020)

Here are the eight main characteristics along with their sub-characteristics:(França & Soares, 2015)

Functional Suitability:

Completeness: The software's functionality covers all specified requirements and features.

Correctness: The software provides the intended results and behavior.

Appropriateness: The software's features and functions meet user needs.

Interoperability: The software can interact effectively with other systems.

Performance Efficiency:

Time Behavior: The software responds quickly enough for user interactions.

Resource Utilization: The software uses appropriate resources efficiently, such as memory and processing power.

Capacity: The software can handle a certain amount of work within specified limits.

Compatibility:

Coexistence: The software can work well with other software in a shared environment.

Interoperability: The software can interact seamlessly with other systems, using specified interfaces.

Replaceability: The software can replace another software in a given environment.

Usability:

Understandability: Users can easily understand the software's features and functions.

Learnability: Users can quickly learn how to use the software.

Operability: The software is easy to operate and control.

Attractiveness: The software has an appealing and user-friendly interface.

Reliability:

Maturity: The software is reliable, with few failures or defects over time.

Fault Tolerance: The software remains operational even in the presence of faults or errors.

Recoverability: The software can recover quickly after a failure, without losing data.

Security:

Confidentiality: The software ensures that sensitive information is kept private and secure.

Integrity: The software maintains data accuracy and prevents unauthorized modifications.

Availability: The software is available and accessible when needed.

Non-Repudiation: The software provides evidence of actions to prevent denial of performed actions.

Maintainability:

Modularity: The software's components are well-organized and can be easily replaced or modified.

Reusability: Software components can be reused in different contexts.

Analyzability: The software's code is easy to analyze and understand.

Modifiability: The software can be easily modified to accommodate changes or updates.

Portability:

Adaptability: The software can be adapted to different environments without significant changes.

Installability: The software can be installed in a specific environment.

Replaceability: The software can replace another software in a specific environment.

Figure 1 Product quality model defined in ISO/IEC 25010 comprises the eight quality characteristics

B. Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) is a fundamental methodology for facilitating the decision-making process. The design of this system is to effectively handle both logical and intuitive aspects in order to determine the optimal choice from a set of options, which are assessed based on many criteria. During this procedure, the individual responsible for making decisions engages in the evaluation of pairwise comparisons, which are then used to establish comprehensive priorities for the purpose of rating the available choices. The Analytic Hierarchy Process (AHP) accommodates the presence of inconsistency in judgements while also offering a mechanism to enhance consistency (Saaty & Vargas, 2012).

In order to effectively address issues using the Analytic Hierarchy Process (AHP), it is important to grasp the fundamental principles.

1. One approach to comprehending complex systems involves the process of creating hierarchies. By deconstructing these systems into constituent pieces, organizing them in a hierarchical manner, and then integrating or synthesizing them, a deeper understanding may be achieved.
2. Evaluation of criteria and alternatives: The assessment of criteria and alternatives is conducted via the use of pairwise comparisons. According to Saaty (1991), a scale ranging from 1 to 9 is considered the most suitable for expressing ideas on many matters. The assessment and characterization of a qualitative judgment derived from the Saaty comparison scale may be quantified via the use of an analysis table, shown in Table 1:

Table 1. The fundamental scale (Saaty & Vargas, 2012):

Intensity Of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmatio

3. Synthesis of Priority

In order to evaluate each criteria and option, it is important to conduct a pairwise comparison. The relative comparison values of all alternative criteria may be modified based on established judgements in order to generate weights and priority. The determination of weights and priority is achieved by the manipulation of matrices or the solution of mathematical equations.

4. Logical Consistency

Consistency has two meanings. First, similar objects can be grouped according to uniformity and relevance. Second, regarding the level of relationship between objects based on certain criteria. Calculation of logical consistency is done by following the steps as follows:

a. Perform matrix multiplication by multiplying each element of the matrix with its associated priority value.

b. Calculate the sum of the products obtained from each line.

c. The summation of each line is divided by the corresponding priority and then aggregated.

d. The quotient of c divided by the total number of elements yields the maximum value of π.

e. The formula for calculating the Consistency Index (CI) is given by (πmax-n)/(n-1).

f. The consistency ratio (CR) may be calculated by dividing the consistency index (CI) by the random index of consistency (RI). If the value of the consistency ratio is less than or equal to 0.1, it is possible to provide a valid justification for the conclusions obtained from the data calculations.

Table 2. Random Index Value

n	1	2	3	4	5	6	7	8
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41
n	9	10	11	12	13	14	15	
RI	1.45	1.49	1.51	1.48	1.56	1.57	1.59	

C. Simple Additive Weighting

The use of the Simple Additive Weighting (SAW) approach necessitates the normalization of the decision matrix (X) in order to provide a standardized scale that enables the comparison of various ratings. The SAW (Simple Additive Weighting) technique acknowledges the presence of two distinct features, namely the criterion for benefits and the criteria for costs. The fundamental distinction between these two criteria is in the process of selecting criteria during decision-making (Pribadi et al., 2018).

The solution phase for the Simple Additive Weight (SAW) method is as follows: (Susandi & Anita, 2019)

1) Establish the evaluative factors, denoted as Ci, which will serve as the basis for decision-making.

2) Assess the appropriateness rating of each choice based on each criteria.

3) Construct a decision matrix using the specified criteria (Ci), followed by the normalization of the matrix using an equation altered to account for the attribute type (benefit attribute or cost attribute), resulting in the acquisition of a normalized matrix denoted as R.

4) The ultimate outcome is derived by the process of ranking, wherein the normalized matrix R is multiplied by the weight vector. The resulting values are then evaluated, and the alternative (Ai) with the highest value is chosen as the optimal solution.

$$rij = \frac{xij}{\max(xij)} \text{ j is benefit atribute} \quad (1)$$

$$rij = \frac{\min(xij)}{xij} \text{ j is cost atribute} \quad (2)$$

a) The variable "rij" represents the score for the normalized performance rating.

b) The variable xij represents the attribute value of each criterion.

c) The variable Max xij represents the maximum value for each criterion.

d) The variable min xij represents the minimum value of each criterion.

e) The concept of benefit is contingent upon the notion that the highest value is most advantageous.

f) The cost is optimized when the least value is preferred.

g) The variable rij represents the performance of a twig, where i ranges from 1 to m and j ranges from 1 to m. The alternative preference value (vi) may be defined as:

$$v_i = \sum_j^n = 1^{wjrij} \quad (3)$$

h) The variable v_i represents the ranking for the given choice.

i) The variable w_j represents a specific value that is used as a criterion for evaluation. Weight may be represented by the normalized performance rating score, denoted as r_ij.

j) A high V value indicates a preference for option A.

III. RESULTS AND DISCUSSION

This study has provided an overview and evaluation of the ISO/IEC 25010 criteria. The quality assessment of e-government software may be conducted by the use of several methodologies such as MCDM, AHP, SAW, and other similar approaches. This study makes a significant contribution by including the ISO/IEC 25010 standard for assigning weights. In order to facilitate further measurements using diverse Multiple Criteria Decision Making (MCDM) methodologies.

A. Model Prioritization Smart Government Application using AHP and SAW method

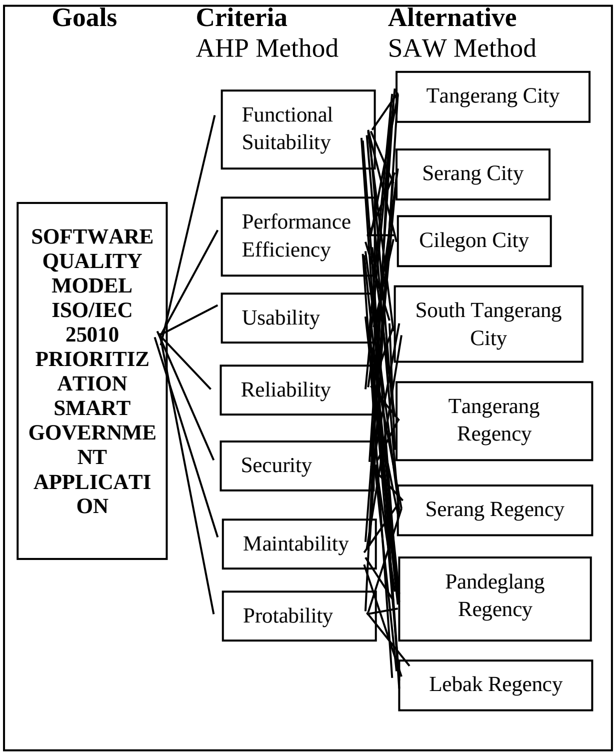

Figure 2. Product quality model defined in ISO/IEC 25010 comprises the eight quality characteristics

B. Research Steps

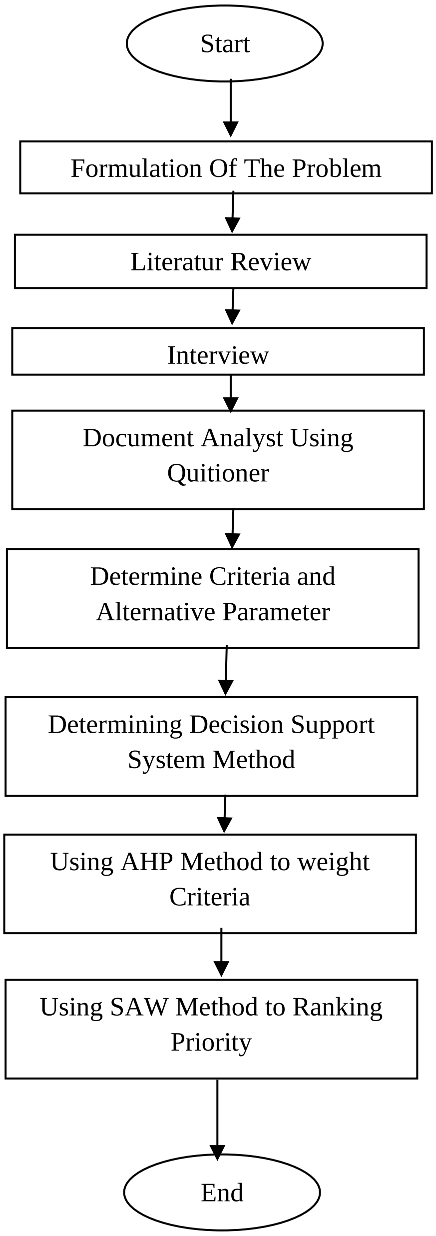

Figure 3. Research Steps

C. Weighting Process With AHP

In this study the expert will be given a questionnaire to determine the weight of the criteria to be used by the AHP method.

Table 3. Experts Value

Criteria	C01	C02	C03	C04	C05	C06	C07	C08
C01	1,000	2,000	2,000	1,000	2,000	1,000	2,000	2,000
C02	0,500	1,000	0,333	0,333	1,000	1,000	0,333	1,000
C03	0,500	3,000	1,000	0,333	1,000	1,000	0,333	3,000
C04	1,000	3,000	3,000	1,000	1,000	1,000	3,000	2,000
C05	0,500	1,000	1,000	0,333	1,000	1,000	0,333	1,000
C06	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
C07	0,500	3,000	3,000	0,333	3,000	1,000	1,000	3,000
C08	0,500	1,000	0,333	0,500	1,000	1,000	0,333	1,000
Total	**5,500**	**15,00**	**11,67**	**5,500**	**11,00**	**8,000**	**8,333**	**14,00**

1. Next, a normalization matrix is generated by dividing each pairwise comparison result by the sum of the outcomes of the criterion. Subsequently, the value is included into the right-hand side of the equation, and subsequently divided by the total number of criteria in order to determine the priority weight.

$$Initial\ Element\ Value = \frac{\text{The Value of each initial matrix element}}{\text{Number of initial columns}} \quad (4.1)$$

Example calculation of matrix

Normalization First line:

Addition of Research Column:

a. Functional Suitability:

1,000+0,500+0,500+1,000+0,500+1,000 +

0,500+0,500= 5,500

b. Performance Efficiency:

2,000 +1,000+3,000+3,000+1,000+1,000 + 3,000 + 1,000 = 15,5

c. Compatibility:

2,000 + 0,333+ 1,000+3,000+1,000+1,000+ 3,000+ 0,333 = 11,67

d. Usability

1,000 + 0,333+ 0,333+1,000+0,333+1,000 + 0,333 +0,500 = 5,500

e. Realiability

2,000 +1,000+1,000+1,000+1,000+1,000 + 3,000+1,000 = 11,00

f. Security

1,000 + 1,000 + 1,000 + 1,000+1,000+ 1,000 +1,000+1,000 = 8,000

g. Maintability

2,000 +0,333+0,333+3,000+0,333+1,000 +

1,000 + 0,333 = 8,333

h. Portability

2,000 +1,000+3,000+2,000+1,000+1,000 + 3,000+ 1,000 = 14,00

i. (Functional Suitability / Functional Suitability) / SUM = 1.0000 / 5,500 = 0,182

Then each line is divided by the Total Value per Criteria.

Table 4. Normalization (Eigen Value)

Criteria	C01	C02	C03	C04	C05	C06	C07	C08
C01	0,182	0,133	0,171	0,182	0,182	0,125	0,240	0,143
C02	0,091	0,067	0,029	0,061	0,091	0,125	0,040	0,071
C03	0,091	0,200	0,086	0,061	0,091	0,125	0,040	0,214
C04	0,182	0,200	0,257	0,182	0,091	0,125	0,360	0,143
C05	0,091	0,067	0,086	0,182	0,091	0,125	0,040	0,071
C06	0,182	0,067	0,086	0,182	0,091	0,125	0,120	0,071
C07	0,091	0,200	0,257	0,061	0,273	0,125	0,120	0,214
C08	0,091	0,067	0,029	0,091	0,091	0,125	0,040	0,071
Total	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**

If the value has been normalized the priority weight is searched by adding the first row and the next row.

$$Priority\ Weight = \frac{Number\ of\ Rows}{Number\ of\ Criteria} \quad (4.2)$$

Table 5. Criteria Weight Calculation AHP

Criteria	Sum	Priority Weight	%
C01	1,358	0,170	16,976 %
C02	0,574	0,072	7,176 %
C03	0,907	0,113	11,343 %
C04	1,540	0,192	19,244 %
C05	0,752	0,094	9,406%
C06	0,923	0,115	11,542 %
C07	1,341	0,168	16,758 %
C08	0,604	0,076	7,555 %
Total	**8,000**	**1,000**	**100%**

Example of calculating Priority Weight

Research Priority Weight:

0,182+0,133+0,171+0,182+0,182+0,125+0,240 + 0,302 +0,179 = 1,358

The next step is to calculate lambda max. To calculate lambda max, that is by 2 steps: the first step is the value of the importance of each criterion multiplied by the weight of each criterion then summed up then divided by each weight. The second step is to add the value in the first step divided by the number of criteria.

$$\lambda = \begin{bmatrix} \Sigma\ baris\ K1 \\ \vdots \\ \Sigma\ baris\ Kn \end{bmatrix} x \begin{bmatrix} BP1 \\ \vdots \\ BPn \end{bmatrix} = \begin{bmatrix} \lambda max\ K1 \\ \vdots \\ \lambda max\ Kn \end{bmatrix} \quad (4.3)$$

Information:

BP = Priority Weight   K = Column

The example of calculating lambda max uses data from the previous step.

Looking for Lamda Max with a formula.

$$\lambda = \frac{Number\ of\ elements\ in\ the\ matrix}{m} \quad (4.4)$$

λ max = (((5,500*0,170)+(15,000*0,072)+(11,667*0,113)+(5,500*0,192)+(11,000*0,094)+ (8,000*0,115) + (8,333*0,168)+(14,000*0,076)) = 8,8041

Then the Lambda value is 8,8041

The final step is to calculate the consistency index value (CI) used to calculate the consistency ratio value that will determine whether the pairwise comparison matrix to be obtained from the results of the questionnaire has a consistent or not. The purpose of the consistency test is to determine the consistency of the answers that have been filled in by the respondents which will affect the stability of the results. By being declared consistent, the data can be used and processed to the next stage.

$$CI = \frac{\lambda max - n}{(n-1)} \quad (4.5)$$

Information:

n = Number of criteria

CI = (8,8041– 8)/7 = 0,1149

Next looking for the ratio consistency value (CR), this CR value is obtained with the formula CR = CI / RI. The Random Index (RI) value, obtained from the L.Saaty table.

The random index value will be used to calculate ratio consistency (CR), this CR value will determine whether the paired comparison matrix obtained from the questionnaire results has a consistent or not. The index random value can be seen from the Random Index Table II-2.

Consistency ratio (CR) will be valid or consistent if the value of CR < 0.1 or worth < 10%, and vice versa CR will be invalid or inconsistent if the value is greater ≥ 0.1, with the formulation of the consistency ratio value (CR):

$$CR = \frac{CI}{CR} \quad (4.6)$$

CR = 0.1149/ 1.41 = 0,0815

In the two tables above the consistency ratio (CR) obtained a value of 0. This means that the ratio is considered consistent (CR <0.1) so that the assessment given by the respondents in the questionnaire is considered feasible.

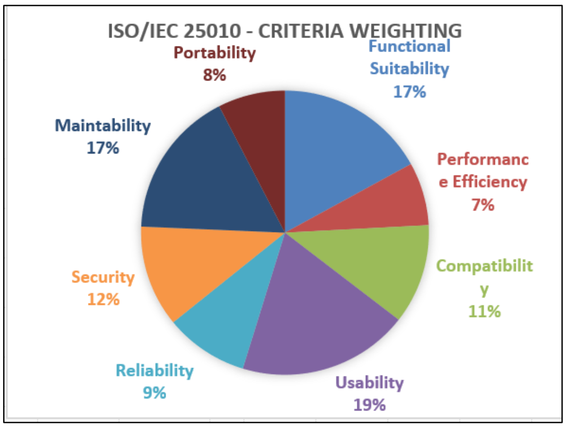

Figure 4. Result Criteria Weighting AHP Method

After getting the weight of the criteria, this research continues to rank the Population Service Applications in Banten Province using the Simple Additive Weighting (SAW) method.

D. Alternative Assessment ISO/IEC 25010 with SAW

Table 6. Criteria

Criteria Code	Criteria Name	Criteria Weight	Type
C1	Functional Suitability	17	Benefit
C2	Performance Efficiency	7	Benefit
C3	Compatibility	11	Cost
C4	Usability	19	Benefit
C5	Reliability	9	Benefit
C6	Security	12	Cost
C7	Maintability	17	Benefit
C8	Portability	8	Benefit
	Total	**100**	

Table 7. Alternative

Alternative Code	Alternative Name
A1	Tangerang City
A2	South Tangerang City
A3	Cilegon City
A4	Serang City
A5	Tangerang Regency
A6	Pandeglang Regency
A7	Lebak Regency
A8	Serang Regency

Table 8. Weight Value

Weight	Score
Very Good	5
Good	4
Good Enough	3
Not Good	2
Very Bad	1

Tabel 9. Alternative Value

Alternative	Criteria							
	C01	C02	C03	C04	C05	C06	C07	C08
	Benefit	Benefit	Cost	Benefit	Benefit	Cost	Benefit	Benefit
Tangerang City	5	68	10	4	55	3	4	4
South Tangerang City	5	70	17	4	46	3	4	4
Cilegon City	2	1	33	1	41	1	1	1
Serang City	3	32	9	3	66	3	3	3
Tangerang Regency	3	63	24	3	65	3	3	3
Pandeglan g Regency	3	50	51	3	78	3	3	3
Lebak Regency	4	91	14	4	68	3	4	4
Serang Regency	3	37	14	3	72	3	3	3
Total	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

The subsequent step involves the determination of the value assigned to the decision makers preference, denoted as W = (5, 4, 3, 2, 1), and the subsequent computation of the normalization matrix using the prescribed formula.

Based on Table 9. is converted into X decision matrix with data:

$$X=\begin{Bmatrix} 5 & 68 & 10 & 4 & 55 & 3 & 4 & 4 \\ 5 & 70 & 17 & 4 & 46 & 3 & 4 & 4 \\ 2 & 1 & 33 & 1 & 41 & 1 & 1 & 1 \\ 3 & 32 & 9 & 3 & 66 & 3 & 3 & 3 \\ 3 & 63 & 24 & 3 & 65 & 3 & 3 & 3 \\ 3 & 50 & 51 & 3 & 78 & 3 & 3 & 3 \\ 4 & 91 & 14 & 4 & 68 & 3 & 4 & 4 \\ 3 & 37 & 14 & 3 & 72 & 3 & 3 & 3 \end{Bmatrix}$$

The computation of the aforementioned equation is shown below:

$$rij = \frac{xij}{\max(xij)} \text{j is benefit atribute} \qquad (1)$$

$$rij = \frac{\min(xij)}{xij} \text{j is cost atribute} \qquad (2)$$

A1:

$r_{11} = \frac{5}{\max\{5;5;2;3;3;3;4;3\}} = \frac{5}{5} = 1$

$r_{12} = \frac{5}{\max\{5;5;2;3;3;3;4;3\}} = \frac{5}{5} = 1$

$r_{13} = \frac{2}{\max\{5;5;2;3;3;3;4;3\}} = \frac{2}{5} = 0{,}4$

$r_{14} = \frac{3}{\max\{5;5;2;3;3;3;4;3\}} = \frac{3}{5} = 0{,}6$

$r_{15} = \frac{3}{\max\{5;5;2;3;3;3;4;3\}} = \frac{3}{5} = 0{,}6$

$r_{16} = \frac{3}{\max\{5;5;2;3;3;3;4;3\}} = \frac{3}{5} = 0{,}6$

$r_{17} = \frac{4}{\max\{5;5;2;3;3;3;4;3\}} = \frac{4}{5} = 0{,}8$

$r_{18} = \frac{3}{\max\{5;5;2;3;3;3;4;3\}} = \frac{3}{5} = 0{,}6$

A2:

$r_{21} = \frac{68}{\max\{68;70;1;32;63;50;91;37\}} = \frac{68}{91} = 0{,}75$

$r_{22} = \frac{70}{\max\{68;70;1;32;63;50;91;37\}} = \frac{70}{91} = 0{,}769$

$r_{23} = \frac{1}{\max\{68;70;1;32;63;50;91;37\}} = \frac{1}{91} = 0{,}011$

$r_{24} = \frac{32}{\max\{68;70;1;32;63;50;91;37\}} = \frac{32}{91} = 0{,}352$

$r_{25} = \frac{63}{\max\{68;70;1;32;63;50;91;37\}} = \frac{63}{91} = 0{,}69$

$r_{26} = \frac{50}{\max\{68;70;1;32;63;50;91;37\}} = \frac{50}{91} = 0{,}55$

$r_{27} = \frac{91}{\max\{68;70;1;32;63;50;91;37\}} = \frac{91}{91} = 1$

$r_{28} = \frac{37}{\max\{68;70;1;32;63;50;91;37\}} = \frac{37}{91} = 0{,}41$

A3:

$r_{31} = \frac{\min\{10;17;33;9;24;51;14;14\}}{10} = \frac{9}{10} = 0{,}9$

$r_{32} = \frac{\min\{10;17;33;9;24;51;14;14\}}{17} = \frac{9}{17} = 0{,}53$

$r_{33} = \frac{\min\{10;17;33;9;24;51;14;14\}}{33} = \frac{9}{33} = 0{,}53$

$r_{34} = \frac{\min\{10;17;33;9;24;51;14;14\}}{9} = \frac{9}{9} = 0{,}27$

$r_{35} = \frac{\min\{10;17;33;9;24;51;14;14\}}{24} = \frac{9}{24} = 0{,}375$

$r_{36} = \frac{\min\{10;17;33;9;24;51;14;14\}}{51} = \frac{9}{51} = 0{,}176$

$r_{37} = \frac{\min\{10;17;33;9;24;51;14;14\}}{14} = \frac{9}{14} = 0{,}643$

$r_{38} = \frac{\min\{10;17;33;9;24;51;14;14\}}{14} = \frac{9}{14} = 0{,}643$

A4:

$r_{41} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$

$r_{42} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$

$r_{43} = \frac{1}{\max\{4;4;1;3;3;3;4;3\}} = \frac{1}{4} = 0{,}25$

$r_{44} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$

$r_{45} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$

$r_{46} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$

$r_{47} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$

$r_{48} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$

A5:

$r_{51} = \frac{55}{\max\{55;46;41;66;65;78;68;72\}} = \frac{55}{78} = 0{,}7$

$r_{52} = \frac{46}{\max\{55;46;41;66;65;78;68;72\}} = \frac{46}{78} = 0{,}59$

$r_{53} = \frac{41}{\max\{55;46;41;66;65;78;68;72\}} = \frac{41}{78} = 0{,}53$

$r_{54} = \frac{66}{\max\{55;46;41;66;65;78;68;72\}} = \frac{66}{78} = 0{,}85$

$r_{55} = \frac{65}{\max\{55;46;41;66;65;78;68;72\}} = \frac{65}{78} = 0{,}83$

$r_{56} = \frac{78}{\max\{55;46;41;66;65;78;68;72\}} = \frac{78}{78} = 1$

$$r_{57} = \frac{68}{\max\{55;46;41;66;65;78;68;72\}} = \frac{68}{78} = 0{,}87$$

$$r_{58} = \frac{72}{\max\{55;46;41;66;65;78;68;72\}} = \frac{72}{78} = 0{,}75$$

A6:

$$r_{61} = \frac{\min\{3;3;1;3;3;3;3;3\}}{3} = \frac{1}{3} = 0{,}333$$

$$r_{62} = \frac{\min\{3;3;1;3;3;3;3;3\}}{3} = \frac{1}{3} = 0{,}333$$

$$r_{63} = \frac{\min\{3;3;1;3;3;3;3;3\}}{1} = \frac{1}{1} = 1$$

$$r_{64} = \frac{\min\{3;3;1;3;3;3;3;3\}}{3} = \frac{1}{3} = 0{,}333$$

$$r_{65} = \frac{\min\{3;3;1;3;3;3;3;3\}}{3} = \frac{1}{3} = 0{,}333$$

$$r_{66} = \frac{\min\{3;3;1;3;3;3;3;3\}}{3} = \frac{1}{3} = 0{,}333$$

$$r_{67} = \frac{\min\{3;3;1;3;3;3;3;3\}}{3} = \frac{1}{3} = 0{,}333$$

$$r_{68} = \frac{\min\{3;3;1;3;3;3;3;3\}}{3} = \frac{1}{3} = 0{,}333$$

A7:

$$r_{71} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$$

$$r_{72} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$$

$$r_{73} = \frac{1}{\max\{4;4;1;3;3;3;4;3\}} = \frac{1}{4} = 0{,}25$$

$$r_{74} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$$

$$r_{75} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$$

$$r_{76} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$$

$$r_{77} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$$

$$r_{78} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 1$$

A8:

$$r_{81} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$$

$$r_{82} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$$

$$r_{83} = \frac{1}{\max\{4;4;1;3;3;3;4;3\}} = \frac{1}{4} = 0{,}25$$

$$r_{84} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$$

$$r_{85} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$$

$$r_{86} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 0{,}75$$

$$r_{87} = \frac{4}{\max\{4;4;1;3;3;3;4;3\}} = \frac{4}{4} = 1$$

$$r_{88} = \frac{3}{\max\{4;4;1;3;3;3;4;3\}} = \frac{3}{4} = 1$$

The normalized matrix was generated by the aforementioned technique.

$$rij = \begin{Bmatrix} 1 & 0{,}75 & 0{,}9\ 4 & 1 & 0{,}7 & 0{,}33 & 1 & 1 \\ 1 & 0{,}769 & 0{,}53 & 1 & 0{,}59 & 0{,}33 & 1 & 1 \\ 0{,}4 & 0{,}011 & 0{,}53 & 0{,}25 & 0{,}53 & 1 & 0{,}25 & 0{,}25 \\ 0{,}6 & 0{,}352 & 0{,}27 & 0{,}75 & 0{,}85 & 0{,}33 & 0{,}75 & 0{,}75 \\ 0{,}6 & 0{,}69 & 0{,}375 & 0{,}75 & 0{,}83 & 0{,}33 & 0{,}75 & 0{,}75 \\ 0{,}6 & 0{,}55 & 0{,}176 & 0{,}75 & 1 & 0{,}33 & 0{,}75 & 0{,}75 \\ 0{,}8 & 1 & 0{,}643 & 1 & 0{,}87 & 0{,}33 & 1 & 1 \\ 0{,}6 & 0{,}41 & 0{,}643 & 0{,}75 & 0{,}92 & 0{,}33 & 1 & 1 \end{Bmatrix}$$

E. Ranking process using AHP and SAW

$$v_i = \sum_j^n = 1^{wjrij} \qquad (3)$$

$v_1 =$ {(17x1)+(7x0,75)+(11x0,9)+(19x1)+(9x0,7) +(12x0,33)+(17x1)+(8x1)}= **86,41**
$v_2 =$ {(17x1)+(7x0,769)+(11x0,53)+(19x1)+ (9x0,59) +(12x0,33)+(17x1)+(8x1)}= **81,483**
$v_3 =$ {(17x0,4)+(7x0,011)+(11x0,53)+(19x0,25)+ (9x0,53) +(12x1)+(17x0,25)+(8x0,25)}= **37,977**
$v_4 =$ {(17x0,6)+(7x0,352)+(11x0,27)+(19x0,75)+ (9x0,85) +(12x0,33)+(17x0,75)+(8x0,75)}= **60,24**
$v_5 =$ {(17x0,6)+(7x0,69)+(11x0,375)+(19x0,75)+

(9x0,83) +(12x0,33)+(17x0,75)+(8x0,75)}= **63,585**
v_6 = {(17x0,6)+(7x0,55)+(11x0,176)+(19x0,75)+(9x1) +(12x0,33)+(17x0,75)+(8x0,75)}= **61,9463**
v_7 = {(17x0,8)+(7x1)+(11x0,643)+(19x1)+(9x0,87) +(12x0,33)+(17x1)+(8x1)}= **83,463**
v_8 = {(17x0,6)+(7x0,41)+(11x0,643)+(19x0,75)+(9x0,92) +(12x0,33)+(17x1)+(8x1)}= **71,563**

Table 10. Result Software Quality ISO/IEC 25010 Prioritization for Smart Government for Disdukcapil Application Banten Province

Disdukcapil Application	Score
Tangerang City	86,410
South Tangerang City	81,483
Cilegon City	37,977
Serang City	60,240
Tangerang Regency	63,585
Pandeglang Regency	61,946
Lebak Regency	83,463
Serang Regency	71,563

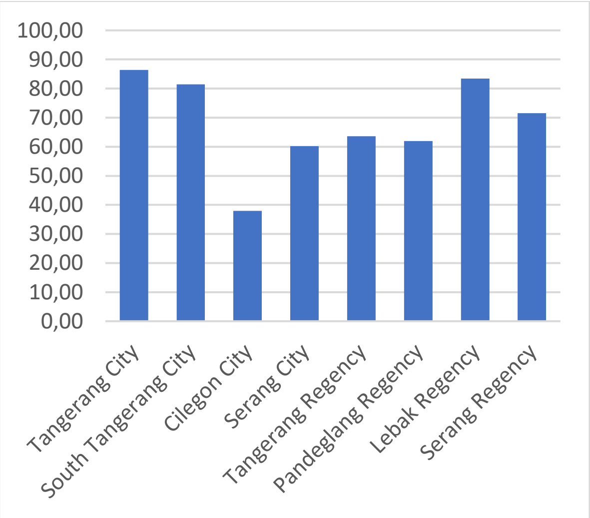

Figure 5. Result of Software Quality ISO/IEC 25010 for Disdukcapil Application Prioritazion

IV. CONCLUSION

The survey findings indicate that the City of Tangerang has achieved the highest score in software quality. Cilegon city is considered to have the lowest ranking. This study has the potential to provide valuable insights for stakeholders involved in the advancement of smart governance in the province of Banten. In order to get a superior software score, the disdukcapil system might be used as a pilot initiative in the district or city that attains the lowest score. This study may also serve as a foundation for evaluating the apps used in Smart Government initiatives at the municipal and regional levels of various provinces.

REFERENCES

Afiah, H., Darwiyanto, E., & Dwi Jatmiko, D. S. (2019). Evaluasi Kualitas Website Bandung Smart City Menggunakan ISO/IEC 25010 Quality-in-Use Model. *E-Proceeding of Engineering*, *6*(2), 8830–8837. https://smartcity.bandung.go.id

Alves, T. L., Silva, P., & Dias, M. S. (2014). Applying ISO/IEC 25010 Standard to prioritize and solve quality issues of automatic ETL processes. *Proceedings - 30th International Conference on Software Maintenance and Evolution, ICSME 2014*, *351*, 573–576. https://doi.org/10.1109/ICSME.2014.98

Ardil, C. (2020). *Software Product Quality Evaluation Model with Multiple Criteria Decision Making Analysis*. *14*(12), 486–502.

Atimi, R. L., & Pradasari, N. I. (2020). Model Penilaian Perangkat Lunak E-Government untuk Rekomendasi Pemeliharaan (Studi Kasus: BKPSDM Ketapang). *Jurnal Edukasi Dan Penelitian Informatika (JEPIN)*, *6*(2), 137. https://doi.org/10.26418/jp.v6i2.37986

Basciani, F., Di Pompeo, D., Di Rocco, J., & Pierantonio, A. (2023). A customizable approach to assess software quality through Multi-Criteria Decision Making. *Proceedings - IEEE 20th International Conference on Software Architecture Companion, ICSA-C 2023*, 264–271. https://doi.org/10.1109/ICSA-

C57050.2023.00063

Belinda, B. I., Emmanuel, A. A., Solomon, N., & Kayode, A. B. (2021). Evaluating Software Quality Attributes using Analytic Hierarchy Process (AHP). *International Journal of Advanced Computer Science and Applications*, *12*(3), 165–173. https://doi.org/10.14569/IJACSA.2021.0120321

Corradini, F., Marcantoni, F., Polzonetti, A., & Re, B. (2007). A formal model for quality of service measurement in e-Government. *Proceedings of the International Conference on Information Technology Interfaces, ITI*, 747–752. https://doi.org/10.1109/ITI.2007.4283865

França, J. M. S., & Soares, M. S. (2015). SOAQM: Quality model for SOA applications based on ISO 25010. *ICEIS 2015 - 17th International Conference on Enterprise Information Systems, Proceedings*, *2*, 60–70. https://doi.org/10.5220/0005369100600070

Jati, H., & Dominic, D. D. (2009). Quality evaluation of e-government website using web diagnostic tools: Asian case. *Proceedings - 2009 International Conference on Information Management and Engineering, ICIME 2009*, 85–89. https://doi.org/10.1109/ICIME.2009.147

Mahnic, V., & Natasa, Z. (2015). *Using COBIT indicators for measuring scrum- based software development Using C OBI T Indicators for Measuring Scrum-based Software Development*. *7*(JANUARY 2008), 1605–1617.

Mulyawan, M. D., Kumara, I. N. S., Bagus, Ida Swamardika, A., & Saputra, K. O. (2021). Kualitas Sistem Informasi Berdasarkan ISO / IEC 25010. *Jurnal Ilmiah Teknologi Elektro*, *20*(1), 15–28.

Pribadi, D., Saputra, R. A., Hudin, J. M., & Gunawan. (2018). *Sistem Pendukung Keputusan*.

Ratnaduhitaa, N., Sudiantob, Y., & Kusumawatic, A. (2023). *ISO/IEC 25010 : Analisis Kualitas Sistem E-learning sebagai Media Pembelajaran Online*. *05*, 8–20.

Saaty, T. L., & Vargas, L. G. (2012). Models, Methods, Concepts & Applications of the Analytic Hierarchy Process. In *Springer* (Vol. 17).

Senthilkumar, R., & Arunkumar, T. (2016). A survey on prioritization of software quality attributes. *Indian Journal of Science and Technology*, *9*(44). https://doi.org/10.17485/ijst/2016/v9i44/86988

Sultan, A., Alarfaj, K. A., & Alkutbi, G. A. (2012). Analytic hierarchy process for the success of e-government. *Business Strategy Series*, *13*(6), 295–306. https://doi.org/10.1108/17515631211286146

Susandi, D., & Anita, H. L. (2019). Rancang Bangun Sistem Pendukung Keputusan Pemilihan Supplier Menggunakan Metode Simple Additive Weight. *JSiI (Jurnal Sistem Informasi)*, *6*(2), 5. https://doi.org/10.30656/jsii.v6i2.1585

Tikhanychev, O. V. (2020). On improving indicators for assessing the decision support systems' software quality. *IOP Conference Series: Materials Science and Engineering*, *919*(5). https://doi.org/10.1088/1757-899X/919/5/052009

View of Higher Education Selection using Simple Additive Weighting.pdf. (n.d.).

Wang, S., Ali, S., Yue, T., Li, Y., & Liaaen, M. (2016). A practical guide to select quality indicators for assessing pareto-based search algorithms in search-based software engineering. *Proceedings - International Conference on Software Engineering*, *14-22-May-*, 631–642. https://doi.org/10.1145/2884781.2884880