

## E-GOVERNMENT MATURITY ANALYSIS USING THE LAYNE AND LEE, HILLER AND BELANGER, AND SPBE MODELS

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**Abstract**—This research aims to analyze the level of e-government maturity in Kupang City using the Layne and Lee and Hiller and Belanger models and combine them with the SPBE model to provide a more comprehensive approach. The method used to develop an audit model involves a literature study to understand the e-government maturity model, identification of specific objectives for analysis of the Kupang City Population and Civil Registration Service (DUKCAPIL) website, determination of scope based on the SPBE model, determination of design audit criteria and benchmarks, collection and data synthesis from the Kupang City DUKCAPIL e-Government site, as well as analysis of audit findings, and using the GT Metrix tool for performance analysis and evaluation of the Kupang City DUKCAPIL website. The research results show that the lowest rating is F out of six, which indicates poor service performance. The Layne and Lee Model assessment gives a score of 18, indicating the technology's lack of integration and complexity. Hiller and Belanger's Model assessment gives a value of 13, indicating an immature level. These findings highlight significant gaps between the models evaluated. Recommendations based on research are to increase citizen participation by improving the Kupang City DUKCAPIL website based on a maturity model and the need for regular audits and ongoing evaluations to improve public services in Kupang City in e-government maturity. In conclusion, this research provides a new contribution to the field of e-government by highlighting the need for audits using several e-government maturity models to improve public services in Kupang City.

**Keywords:** e-government, Hiller and Belanger's model, Layne and Lee's model, maturity model, SPBE.

**Intisari**—Penelitian ini bertujuan untuk menganalisis tingkat kematangan e-Government di Kota Kupang dengan menggunakan model Layne dan Lee serta Hiller dan Belanger, serta memadukannya dengan model SPBE untuk memberikan pendekatan yang lebih komprehensif. Metode yang digunakan pengembangan model audit dengan melibatkan studi literatur untuk memahami model kematangan e-Government, identifikasi tujuan khusus analisis website Dinas Kependudukan dan Pencatatan Sipil Kota Kupang (DUKCAPIL), penentuan ruang lingkup berdasarkan model SPBE, penetapan kriteria dan tolok ukur audit desain, pengumpulan dan sintesis data dari situs e-Government DUKCAPIL Kota Kupang, serta analisis temuan audit, serta menggunakan alat bantu GT Metrix. untuk analisis kinerja dan evaluasi terhadap website DUKCAPIL Kota Kupang. Hasil penelitian menunjukkan peringkat terendah yaitu F dari enam peringkat, hal tersebut menunjukkan kinerja layanan yang buruk. Penilaian Model Layne dan Lee memberikan nilai 18, menandakan ketidakintegrasian dan kerumitan teknologi. Penilaian Hiller and Belanger's Model memberikan nilai 13, menunjukkan tingkat yang belum matang. Temuan ini menyoroti kesenjangan signifikan antara model-model yang di evaluasi. Rekomendasi berdasarkan penelitian adalah untuk meningkatkan partisipasi warga melalui peningkatan website DUKCAPIL Kota Kupang berdasarkan model kematangan dan perlunya audit serta evaluasi berkelanjutan secara berkala guna meningkatkan layanan publik di Kota Kupang dalam konteks kematangan e-pemerintahan. Kesimpulannya, penelitian ini memberikan kontribusi baru dalam bidang e-Government dengan menyoroti perlunya audit menggunakan beberapa model kematangan e-Government untuk meningkatkan layanan publik di Kota Kupang.

**Kata Kunci:** e-pemerintahan, Hiller and Belanger's model, Layne and Lee's Model, model kematangan, SPBE.

### INTRODUCTION

E-government is an electronic government service for interaction between citizens and the government to fulfill the democratic goals of digital

government through independent public services for citizens [1], [2]. Appropriate e-government can support and achieve Sustainable Development Goals (SDGs) [3]. The drastic development of e-government has increased citizens' hopes for a

better life in developing and developed countries through the innovation of more competent government by opening government websites to publish information and citizen participation in more efficient and effective decision-making processes [4].

Increasing the security and effectiveness of information systems, including e-government, requires evaluation schemes with verification simulations and audit mechanisms [5] and strategic planning [6]. Evaluation of community involvement in local government websites provides an overview of services and citizen participation; this provides the basis for recommendations for models that can be applied to increase community involvement, especially in encouraging participation in local democracy for local governments [7]. The e-government maturity model is used to review information systems and describe the transformation of e-government to prepare e-government strategies theoretically and practically [8].

The e-government maturity model, such as Layne and Lee, was developed based on observations of e-government initiatives in America, strengthening public representation of integrated systems through electronic portals. In contrast, the Hiller and Belanger model shows the evolution of online services from providing essential information to active support in the political process, including voting [9]. SPBE is an Indonesian Government Maturity Model for assessing electronic-based public service indices in the Indonesian government environment [10].

The e-government maturity model in Indonesia has not explicitly identified the public values that must be met in each maturity stage [11], including governance and e-government security, which still need to be improved [12]. Therefore, the contribution of technology to government is also considered a need still to improve public services [13]. In the 2020 Indonesian Information and Communication Technology Development Index, East Nusa Tenggara (NTT) Province occupies the second lowest position with a percentage of 4.49% [14]. Indicators for the use of information technology in Kupang City face fundamental obstacles related to organization, so competent human resources accompanied by infrastructure and budget are required to realize the appropriate use of information technology [15].

Several previous studies have highlighted various frameworks or models for analyzing the maturity level of e-government services [16]. discusses the advantages of multiple maturity model approaches in flexible and adaptive software development [17] emphasizes the importance of maturity models for measuring IT service quality

[18] as well as [19] provides insight into the core factors responsible for e-service development - government in Pakistan and the City of Surabaya [20], [21] used a maturity model to assess the maturity of IT governance in public information services and public complaints [22] analyzed the use of e-reports in the Special Region of Yogyakarta with the Layne and Lee framework [23] examined the level of e-government maturity in the northeastern states of India. At the same time, [10] evaluated the e-government maturity of sub-district services in Indonesia by highlighting the improvements needed based on the SPBE index. These studies contribute to the understanding and applying e-government maturity models to achieve digital transformation and better service quality.

Based on the previous description, various e-Government maturity models include Layne and Lee, Hiller and Belanger, and SPBE. However, research has yet to explicitly combine these three models in analyzing the level of e-government maturity in Kupang City. Therefore, this research aims to analyze the level of e-government maturity in Kupang City using the Layne and Lee and Hiller and Belanger models to confirm previous SPBE model evaluation reports with a more comprehensive approach. The results of this research provide a new and significant contribution to the field of e-government. By combining different maturity models and confirming the SPBE evaluation report, this research can provide useful insights and recommendations for the Kupang City government in improving the quality of public services.

## MATERIALS AND METHODS

In developing research stages related to the analysis of e-government maturity in Kupang City, this research refers to the concept of the traceability audit model [16]. The steps of the proposed method are the primary basis for mapping systematic and directed stages based on the theoretical perspective of evaluating architectural analysis methods. The research stages adopted in this research can be seen in Figure 1.

Explanation of Figure 1 regarding the research stages of the Kupang City e-government maturity model audit, as follows:

### 1) Literature Study

The research began with a literature study to understand the e-government and e-government maturity models, such as Layne and Lee's Model and Hiller and Belanger's Model. It helps establish a theoretical foundation for building an audit framework for analyzing and evaluating e-government.

### 2) Target Limitation



Identify the specific objectives of the analysis or audit of the Kupang City Population and Civil Registration Service (DUKCAPIL) website in the context of e-government.

- 3) **Scope Limitations**  
 The SPBE model is used to regulate the scope of the audit, determining the aspects that will be evaluated based on the results of the NTT Provincial Government's audit of the Kupang City DUKCAPIL website.
- 4) **Design Audit Criteria and Benchmarks**  
 Based on Layne and Lee's Model and Hiller and Belanger's Model, audit criteria and benchmarks are established. Research focuses on system integration, data security, user interactivity, and service efficiency in this model.
- 5) **Data Collection and Synthesis**  
 They are collecting data from the e-government website of the Kupang City population and civil registration service. This data includes features, security, and efficiency, which are then synthesized for evaluation.
- 6) **Audit Discussion**  
 Analyze audit findings from website evaluations. This discussion includes identifying weaknesses and strengths, as well as recommendations for improvements to improve the performance and security of the website.

factors have been considered in most models, namely: presence at the web level, interaction between government and society, transactions, and integration [25]. The e-government maturity model used as an audit framework can be seen in Table 1.

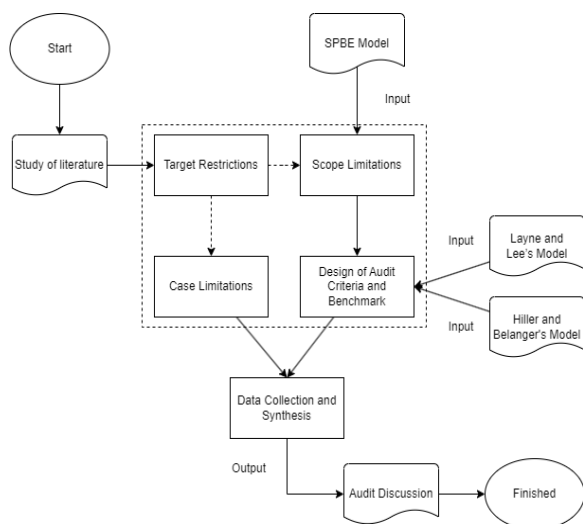
**Table 1. Kupang City E-Government Maturity Model Audit Framework**

Model	Step 1	Step 2	Step 3	Step 4	Step 5
Layne and Lee's	Catalog	Transaction	Vertical Integration	Horizontal Integration	
Hiller and Belanger's	Information	Bilateral Communication	Transaction	Integration	Cooperation

The second stage is target limitation by identifying specific audit objectives related to the Kupang City DUKCAPIL website in the context of e-government. The Kupang City DUKCAPIL website was determined as the audit target in this research because there is previous research which is the basis and comparison for e-government services, especially the Kupang City DUKCAPIL website regarding the use of the Kupang City website as online public relations which includes population administration services [26] and quality. Online population administration services in Kupang City [27] can help evaluate the maturity level of e-government in Kupang City based on the model adopted in this research.

The third stage identifies a scope limitation involving the SPBE model, as it serves as the foundation for benchmarking and specifies the parameters and aspects to be evaluated on the DUKCAPIL website within the context of Kupang City's e-government maturity. The Kupang City SPBE model itself is used because there is a publication in 2022 regarding the SPBE index in NTT Province, and Kupang City is ranked eighth with an index of 2.05 with a sufficient predicate [28], the Kupang City SPBE index guarantees neutrality and impartiality in conducting audits so that with the two e-government maturity models used in this research, it can confirm the level of e-government maturity of Kupang City.

The fourth stage of audit criteria and benchmarks design refers to Layne and Lee's Model and Hiller and Belanger's Model. Researchers set relevant and comprehensive evaluation standards to assess the performance and maturity of the Kupang City population and civil registration service website in e-government. The criteria for assessing the maturity level of Kupang City e-government can be seen in Table 2 and Table 3.



**Figure 1. Stages of Kupang City E-Government Maturity Analysis Research**

**RESULTS AND DISCUSSION**

In the first stage, researchers mapped a conceptual structure based on literature studies, insights, and understanding necessary for incorporating information technology in audit practice [24]. The model used to conduct audits in this research is Layne and Lee's Model and Hiller and Belanger's Model; it is determined that four



**Table 2. Layne and Lee's Model Criteria**

Stages	Assessment Criteria
Catalog	1 Online
	2 Views
	3 Forms can be downloaded
Transaction	4 Online services and forms
	5 Working database supports online transactions
Integration Vertical	6 Local systems are connected to higher level systems
	7 Similar system functions
Integration Horizontal	8 Integrated systems in various systems
	9 One citizen transaction portal

Measurements use a ranking scale of 1 to 5, namely: (1) very bad, (2) bad, (3) fair, (4) good, (5) very good. The ranking value is divided into four stages of the Layne and Lee's Model assessment criteria to determine the status or position of the audit target's e-Government maturity level. 4 stages of criteria based on ranking values are as follows:

- 1-15 is not fully integrated, and the technology is straightforward
- 16-25 less integrated and straightforward technology
- 26-35 are relatively completely integrated, and the technology is rather complex
- 36-45 complete integrated and complex technologies

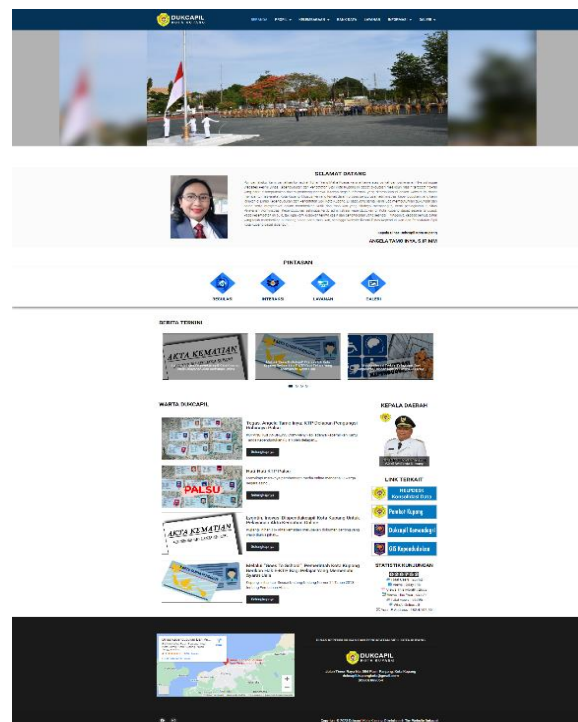
**Table 3. Hiller and Belanger's Model Criteria**

Stages	Assessment Criteria
Information	1 Ease of obtaining information
	2 Accuracy and clarity of information
Communication two-way direction	3 Communicate directly
	4 Speed of response/communication response
Transaction	5 Can make transaction
	6 Smooth transaction process
Integrations	7 Integrated with database and other applications
	8 Provide political information
Participation political	9 Encourage political participation
	1 Facilities and features available
	0 for political participation

Measurements use a ranking scale of 1 to 5, namely: (1) very bad, (2) bad, (3) fair, (4) good, (5) very good. The ranking value is divided into five stages of Hiller and Belanger's Model assessment criteria to determine the status or position of the audit target's e-Government maturity level. 5 stages of criteria based on ranking values are as follows:

- Points 1-10 represent Stage 1 (Immature Information)
- Points 11-20 indicate Stage 2 (Immature Two-way Communication)
- Points 21-30 signify Stage 3 (Moderate Maturity in Transactions)
- Points 31-35 denote Stage 4 (Moderate Maturity in Integration)
- Points 36-50 signify Stage 5 (Mature Political Participation)

The fifth data collection stage is based on the Kupang City DUKCAPIL website at the following URL: "https://dukcapil.kupangkota.go.id/" Data collection includes all features available on the website for evaluation of the audit that will be carried out. The collected data is then synthesized and analyzed to provide insight and a comprehensive understanding of the level of e-government maturity based on the site. The synthesis process allows for a more in-depth evaluation of each aspect and maps the findings according to established criteria and benchmarks. The data collected for the audit can be seen in Figure 2.



**Figure 2. Main page of the Kupang City DUKCAPIL website**

In Figure 2, this main page is where the overall aspect of the website is presented to concentrated users, used as audit data to evaluate the ease of navigation, clarity of information, and suitability of design to user needs to understand the extent to which this website can provide a satisfactory experience to its users.

response to requests are essential in ensuring the quality of public services produced by the website.

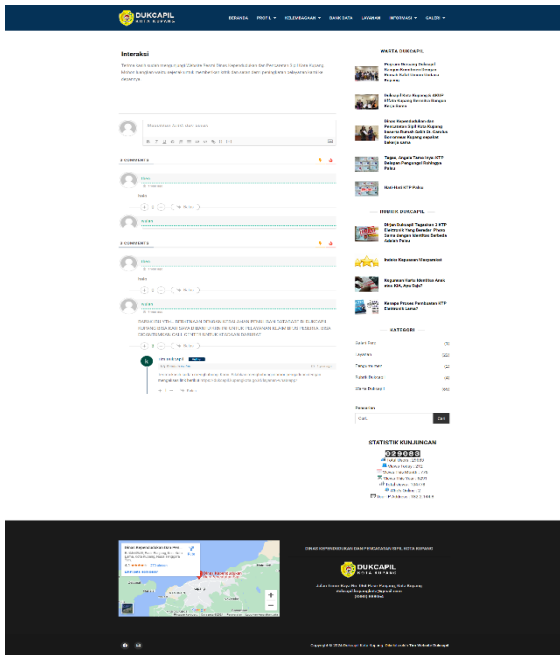


Figure 3. Pages and Interaction Features of the Kupang City DUKCAPIL Website

Figure 3 is used as audit data because it can provide an overview of how this website facilitates two-way communication between users and the department through the public services provided.

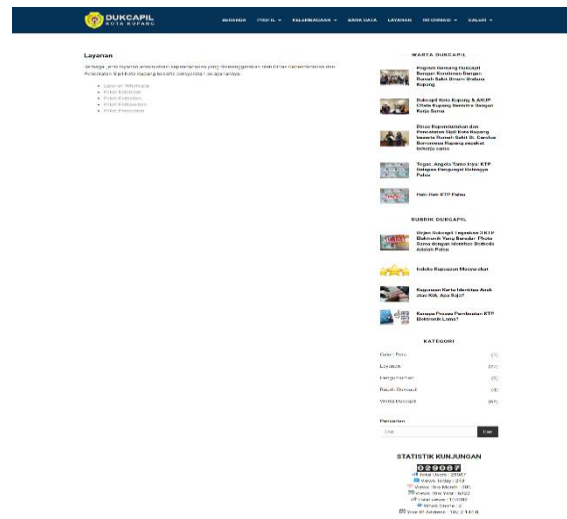


Figure 5. Kupang City DUKCAPIL Website Services Page

Figure 5 is used as audit data to evaluate the overall service process and integration of Kupang City DUKCAPIL e-government administration services, including clarity of instructions, easy-to-understand layout, and data security during the registration or application process.

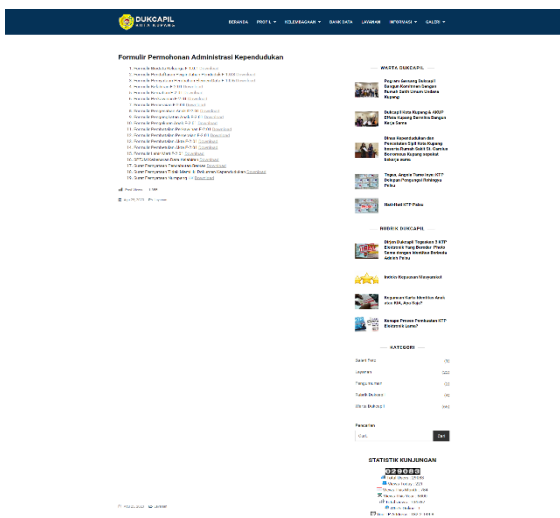


Figure 4. Population Administration Form Page of the Kupang City DUKCAPIL Website

Figure 4 is used to help determine how efficient and effective the population administration application process is for users. Disclosure of required information, data security, and system

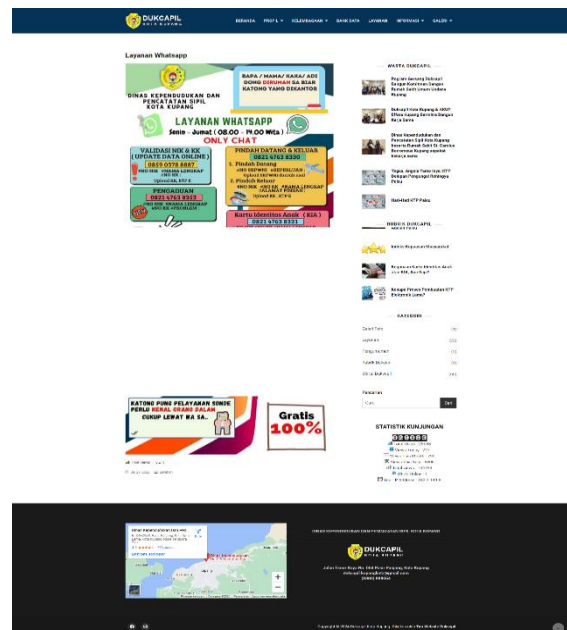


Figure 6. Kupang City DUKCAPIL Communication Services Page



Figure 6 is used as audit data to evaluate the ease of access to contact information, inquiry forms, and communication mechanisms with related agencies. The communication services page on the Kupang City DUKCAPIL website can provide an overview of the availability and quality of responses to questions or input from users.

The discussion is the sixth stage of audit and discussion. Evaluation of the level of e-government maturity in Kupang City is carried out using two models, namely Layne and Lee's Model and Hiller and Belanger's Model. The GT Metrix tool assists in assessing and mapping the security, efficiency, and features of the Kupang City Dukcapil website. The use of GT Metrix on the Kupang City DUKCAPIL website can be seen in Figure 7.



Figure 7. GT Metrix Report on DUKCAPIL Website Performance in Kupang City

In Figure 7, the Kupang City DUKCAPIL website is in the lowest ranking, namely F out of 6 rankings (A to F), which states that the performance and structure of the website provide poor service to users.

The findings in Figure 7 are the basis for researchers to carry out assessments using the two models in research as instruments by each stage and criteria in Table 2 and Table 3 above. The audit results using the Layne and Lee Model show a value of 18, which places the maturity level of the Kupang City Dukcapil e-Government in the Less Integrated and Simple Technology category [29]. Meanwhile, evaluation using the Hiller and Belanger Model scored 13, placing the maturity of Kupang City's E-Government at stage 1, indicating an immature maturity level [30]. The assessment can be seen in table 4 and 5.

Table 2. Assessment With Layne and Lee's Model

Stages	Criteria	Assessment
Catalog	Online	4
	Views	4
	Forms can be downloaded	4
Transaction	Online services and forms	1
	Working database supports online transactions	1
Integration Vertical	Local systems are connected to higher level systems	1
	Similar system functions	1

Stages	Criteria	Assessment
Integration Horizontal	Integrated systems in various systems	1
	One citizen transaction portal	1
Amount		18

Table 3. Assessment With Hiller and Belanger's Model

Stages	Criteria	Assessment
Information	Ease of obtaining information	2
	Accuracy and clarity of information	3
Communication two-way direction	Communicate directly	1
	Speed of response/communication response	1
Transaction	Can make transaction	1
	Smooth transaction process	1
Integrations	Integrated with database and other applications	1
	Provide political information	1
Participation political	Encourage political participation	1
	Facilities and features available for political participation	1
Amount		13

Compared to the Kupang City e-government maturity index, which received a score of 2.5 with a sufficient rating using the SPBE Model [28], The findings of this evaluation provide a fascinating picture, showing that there is a large gap between the assessment using the SPBE model and the other two e-government maturity models. The results of this research are the basis for recommending a more appropriate e-government maturity model for the government at the East Nusa Tenggara Province and Kupang City level, and ongoing evaluation can contribute to improving information systems, including e-government in Kupang City [5].

The low level of maturity in e-government in Kupang City and NTT Province illustrates the main challenge in developing adequate information technology [14]. Several fundamental obstacles related to organizations, such as inadequate human resources, inadequate infrastructure, and limited budgets, have also been identified as obstacles to the appropriate use of information technology [15]. Therefore, improving governance and using information technology is essential for better public services.

The findings of this study are also consistent with several previous studies that emphasize the importance of evaluation and measurement in the context of E-Government services [17], [18]. Continuous monitoring and assessment of website access's usability and performance are essential to improving the quality of information technology services. In the context of e-government, maturity models have also been used previously to strengthen e-government democratic services in other countries [19], [21], [31].



## CONCLUSION

This research reveals a significant gap in previous research regarding the level of maturity of E-Government in Kupang City using the SPBE model, which was previously given the title quite mature. Evaluation using the Layne and Lee Model shows poorly integrated technology with a value of 18, while the Hiller and Belanger Model reveals immature Two-way Communication with a value of 13. The conclusion highlights the need for greater technological integration and complexity. This research provides vital insights for the Kupang City government to improve the quality and accessibility of public services through optimizing e-government. Research limitations include evaluating the Kupang City DUKCAPIL website using the Layne and Lee and Hiller and Belanger models and confirming the results of previous research using the SPBE model. Suggestions include increasing community participation, improving the website, and conducting regular information system audits.

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