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A Framework for E-Government Service Management Implementation in Indonesia: An Actor-Network Theory (ANT) Perspective

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Abstract. The Electronic Government Service Management System (EGSMS) is mandated by the Indonesian government; however, its implementation remains limited, particularly at the local government level. This study aims to examine the implementation of EGSMS in Madura, Indonesia, using Actor-Network Theory (ANT) as the theoretical lens to understand interactions among human actors, technological artefacts, institutional arrangements, and regulatory instruments. The research was conducted in the Departments of Communication and Informatics in Pamekasan and Sampang, Madura, Indonesia, during 2023 and 2024. Based on two local government case studies, this study develops an ANT-based framework for EGSMS implementation, which was subsequently reviewed by two experts to strengthen its relevance, validity, and practical applicability. The findings reveal actor-network dynamics, implementation challenges, enabling factors, and best practices in local EGSMS adoption. The novelty of this research lies in applying ANT to construct a context-sensitive EGSMS implementation framework grounded in empirical evidence. This framework is significant because it can serve as a practical guide for implementing and improving EGSMS in other local government contexts in Indonesia.

Keywords: E-Government implementation, Service Management System, Local Government, Framework Development, Actor-Network Theory (ANT)

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1. INTRODUCTION

The introduction provides the background of E-Government implementation in Indonesia, including its regulatory basis, current challenges, research gaps, novelty, objectives, and contributions. E-Government implementation in Indonesia is mandated through Presidential Regulation No. 95/2018 concerning the Electronic-Based Government System. Its implementation across government institutions is monitored and evaluated annually based on the Minister of State Apparatus Empowerment Regulations No. 59/2020, No. 6/2023, and No. 3/2024. Within this context, the Electronic Government Service Management System (EGSMS) plays an important role as a benchmark for assessing and improving E-Government services. EGSMS supports the management of faults, errors, complaints, and requests related to hardware, software, and digital infrastructure. However, its adoption in Indonesia remains limited, mostly within ministerial institutions. In Madura, including Bangkalan, Sampang, Pamekasan, and Sumenep, local governments have not fully implemented EGSMS. Although public service malls and call centres have been introduced, these solutions still lack an integrated complaint-handling management system and historical database. As a result, several issues remain, including slow response times, unclear responsibility, and the absence of standard procedures for complaint handling.

Previous studies have discussed E-Government and service management from various perspectives, including AI-supported public services [1], technological capabilities and service quality [2], e-GovQual development and validation [3], technology adoption factors [4], policy implementation challenges [5], value-centred E-Government frameworks [6], comparative e-democracy [7], perceived service quality challenges [8], public service quality assessment using the analytical hierarchy process [9], cybercrime mitigation [10], cloud computing and agile development [11], AI and IoT integration [12], LLM-based assistants using RAG architecture [13], citizen adoption factors [14], sustainable E-Government development [15], security models [16], national vocabulary development for digital transformation [17], public sector website integration [18], citizen participation [19], democratic E-Government in the Industrial Revolution 4.0 era [20], blockchain-based E-Government [21], government-as-a-service using cloud infrastructure [22], user-centricity and public values [23], blockchain security [24], smart city initiatives [25], E-Government Development Index analysis [26], AI chatbot

adoption [27], and AI-supported E-Government services [28]. Meanwhile, studies using Actor-Network Theory (ANT) have explored contextualist analysis [29], practical implementation challenges [30], E-Government case studies [31], modernisation and socio-technical transformation [28], e-participation frameworks [29], technology transfer between patent office's [32], ANT-based E-Government publication analysis [33], social media and public demonstrations [34], Freedom of Information frameworks [35], LAN House sustainability [36], and E-Government design in developing countries [37].

Based on these studies, the existing literature has made important contributions to E-Government development, service quality evaluation, technology adoption, digital transformation, and emerging technology implementation. However, most studies focus mainly on technical performance, system functionality, and service efficiency. Non-technical factors, such as institutional arrangements, social relations, political context, cultural dynamics, governance accountability, and citizen participation, are often insufficiently addressed. In addition, emerging technologies such as AI, IoT, blockchain, cloud computing, and LLMs are frequently viewed as direct solutions for improving public services, while issues such as algorithmic bias, data privacy, ethical risks, institutional readiness, and socio-political implications receive less attention. Although ANT offers a useful socio-technical lens for analysing relationships between human and non-human actors, its application in E-Government research remains limited, particularly in the context of service management systems.

Therefore, several research gaps can be identified. Previous studies have examined E-Government and service management systems using various approaches, but limited research has specifically addressed EGSMS implementation in Indonesia. Research focusing on local government contexts, particularly in Madura, is also still scarce. In addition, the use of ANT to analyse EGSMS implementation remains limited, and there is still a lack of comprehensive, context-sensitive frameworks for implementing EGSMS in local government institutions.

The novelty of this study lies in the development of an ANT-based framework for EGSMS implementation, grounded in two case studies in Madura, Indonesia. This study aims to examine the implementation of EGSMS in the Departments of Communication

and Informatics in Pamekasan and Sampang, Madura, during 2023–2024. By applying ANT as the theoretical lens, this research analyses the interaction between human actors, technological artefacts, institutional structures, regulations, and service management practices. The study contributes by proposing a practical EGSMS implementation framework that can serve as a best-practice reference for local governments in Madura and other similar regional contexts.

2. METHODS

We intend to investigate the evolution and execution of the EGSMS within the communication and informatics departments of Pamekasan and Sampang, Madura, Indonesia. Pamekasan and Sampang are municipalities located on Madura Island, Indonesia. The Pamekasan case study was developed in 2023, creating EGSMS 1.0, whereas Sampang is progressing with EGSMS 2.0 in 2024. The Institute of Research and Development at Universitas Trunodjoyo Madura financed both research initiatives. This research employed qualitative methods, with data and answers unstructured, unique to each case study, and subjective, based on the interviewee's point of view, experience, and background. It is also an interpretive study, as the case analysis integrates all the data and answers into a single synthesis.

We applied Actor-Network Theory (ANT) as a theoretical lens for this research [29], [30], [31], [38], [39], [40]. It is an approach for analysing case studies from the perspective of the sociology of science and technology, proposed by Bruno Latour, Michel Callon, and John Law. The ANT aims to understand the hidden, complex relationships between technological, scientific, organisational, and social phenomena. We would also like to identify the actor(s), actant(s), networks, actor-network(s), and translations, and explore and understand the richness, similarities, and differences between the two case studies. ANT has been implemented in many fields, such as information systems, organisational studies, environmental studies, and science studies. In this theory, an actor (or actant) encompasses anything that interacts with humans and non-humans, such as machines, texts, laws, animals, and software, that can act within a network. For example, a laptop can be an actor. Additionally, an actor-network is a dynamic relationship between actors. Moreover, translation is a process in which all actors align their interests with one another within their networks. It is about building and maintaining power to create

alliances and stabilise networks. Moreover, we utilised interpretive and contextualist approaches in this research.

Therefore, ANT was chosen for analysing EGSMS implementation as it is a famous approach in the sociology of science and technology. ANT has also been applied across various subjects, has attracted numerous critiques, and has undergone significant improvement. Furthermore, ANT is suitable for case studies and is particularly helpful in interpretative and qualitative research, enabling us to describe and understand the contexts of both case studies. ANT will be used to help analyse the interactions and use of technology by the various stakeholders.

Our research process, as shown in Figure 1, was meticulous and comprehensive. We initiated our search across multiple reputable, recent databases for references, including journals, conference proceedings, books, and other materials pertinent to E-Government and Service Management [32] ; Moreover, we conducted a literature review of the references. In this stage, we analyse and conclude from the literature.

Also, we conducted observations at the office of the Department of Communication and Informatics in Pamekasan in 2023. We met the staff of e-Government and Smart City initiatives at the command centre and had a discussion for 2 hours. Therefore, we could see directly one of the important e-Government and smart city infrastructures and could see the office, staff, and their interaction.

Furthermore, we discussed and interviewed a staff of e-Government and Smart City initiatives at the Department of Communication and Informatics in Pamekasan for two hours. We recorded the interview materials by note as the interview was set as a meeting. The interviewers were three researchers from Universitas Trunodjoyo Madura. We also communicated with the staff through WhatsApp five times. We asked about e-Government implementation in Pamekasan, especially the service management system there. Furthermore, we developed EGSMS 1.0 using PHP and MySQL, with support from a student programmer, a documenter, and a tester. After that, we provided the technical documents and code to the staff.

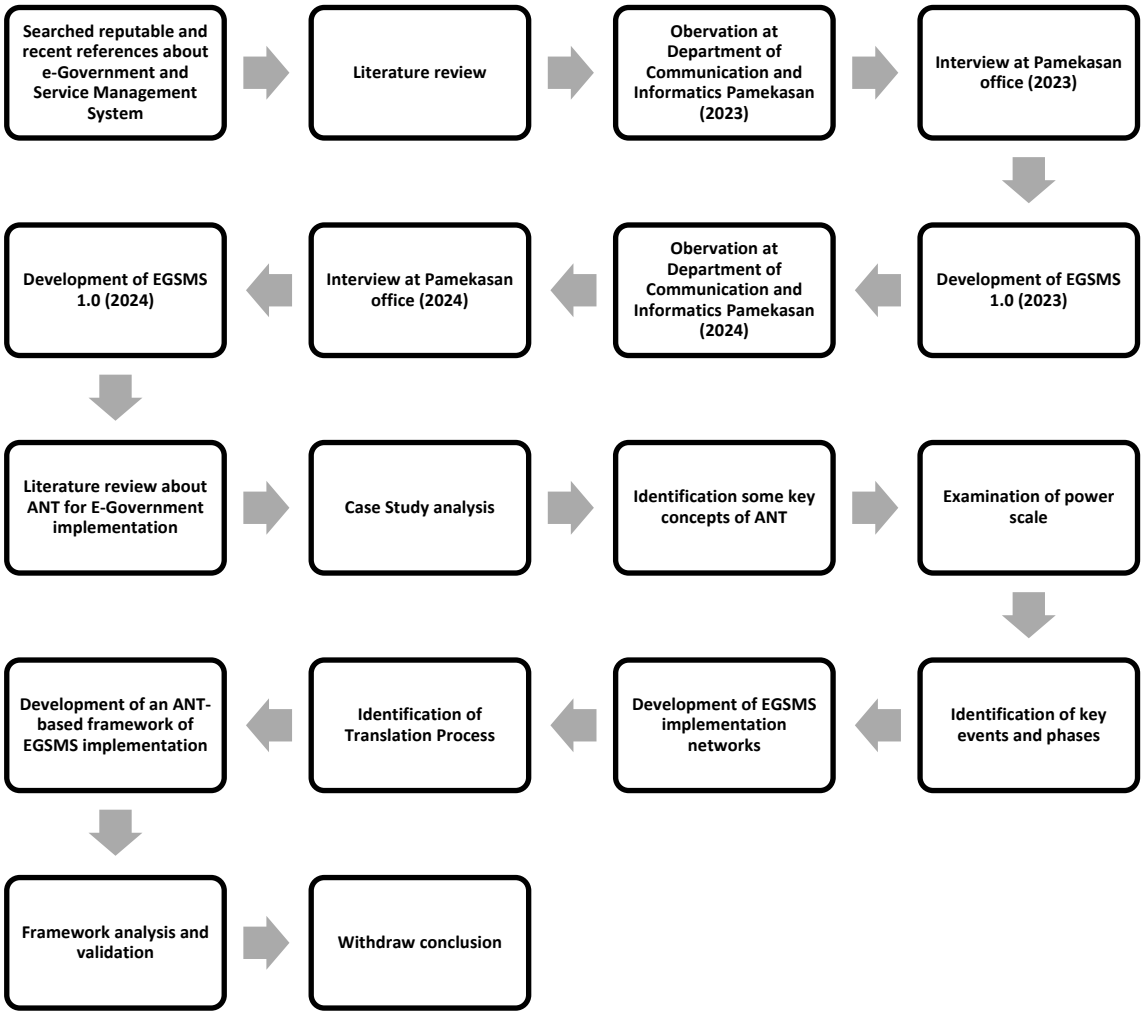

Figure 1. Research stages

In 2024, we conducted research on EGSMS development with a case study in Sampang. We conducted three observations at the Department of Communication and Informatics office in Sampang. The first observation lasted 2 hours and was conducted by the lead researcher. Then, our students, as research assistants, conducted the second and third observations.

Moreover, we had interviews with the Head of Communication and Informatics, the Head of the Sub-Department of Application and Informatics, and the staff of the Sub-Department of Application and Informatics in Sampang's office. The lead researcher met the Head of Communication and Informatics once at the beginning of the research. The interview was held for two hours in a meeting. The interview result was recorded in a meeting note. Additionally, our research team met and interviewed the Head of the

Sub-Department of Application and Informatics, and the staff of the Sub-Department of Application and Informatics twice in their office. The interviews were also held for two hours and 1 hour. The interview results were recorded in notes.

We prepared the semi-structured interview guide before the interview sessions, as shown in Table 1. The guide contains eight interview points, such as Introduction, interviewee's background, implementation background, EGSMS implementation, effectiveness of EGSMS, challenges and barriers, Infrastructures and supports, user satisfaction, and recommendations. Additionally, we developed EGSMS 2.0 and gave the technical documents and codes to the staff. During the development process, we were supported by three students as our research team: a programmer, a documenter, and a tester.

Table 1. Semi-structured interview guide

No	Interview points
1	Introduction: • Thank you very much for participating in this research, especially the interview session • The objective of this research is to examine the implementation of EGSMS in Pamekasan or Sampang • The researcher will keep the responses confidential and use them only for this research • The interview will take a maximum of 60 minutes.
2	Interviewee's Background: • Could you please explain your role in the Department of Communication and Informatics? • How long have you been involved with the E-Government system or EGSMS implementation in this Department?
3	EGSMS Implementation • Is there any EGSMS in this department? • What are the features of EGSMS in this department? • Who are the users of EGSMS in this department? • What kinds of services are handled by the EGSMS? • Which features have you used?

	• Is the EGSMS integrated with other systems? • How accessible is the EGSMS for the public or users outside of this department?
4	Effectiveness of EGSMS • How effective is the EGSMS in this department? • Has it enhanced the E-Government service?
5	Challenges and Barriers • What are the challenges of EGSMS implementation? • How to solve the challenges?
6	Infrastructures and supports • How is the infrastructure to support EGSMS implementation? • How is the institutional budget to support EGSMS implementation • How is the policy support for the EGSMS implementation?
7	User Satisfaction • How is the user satisfaction with the EGSMS? • What are the most common complaints from the user with the EGSMS?
8	Recommendations • What are the recommendations to improve the EGSMS? • What are the features or changes suggested for better EGSMS?

Moreover, we manually transcribed the interview results from two case studies: one from Pamekasan and three from Sampang. Manual transcriptions were conducted to ensure the researcher fully understood the context and implicit meaning of the data and the answers. After that, we asked the research assistant to check the transcripts and sent them to the interviewees to re-check the results.

Then, we coded the interview results from both case studies into themes and grouped them based on similarities and closeness. The coding process is an important step in qualitative data analysis and is time-consuming. The coding process was conducted manually in MS Word using the interview transcripts and meeting notes. The coding process in MS Word has some advantages, such as ease of use and the ability to trace code and sources. However, it offers limited visualisation and requires multiple applications. Additionally, we coded the interviewee's answers into a few key sentences

that clearly convey the main message. Therefore, we had lists of codes, which we synthesised into themes. We identified three main themes: actors, features, and success factors. Also, we coded some sub-themes in each main theme. We confirmed the interpretation results by discussing with the interviewees. The codes and themes were presented to the interviewees, and they were asked for their opinion on the results. In Sampang, the Head of Department was very busy; therefore, we just confirmed the interpretation with the Head of the Sub-Department of Application and Informatics and the staff of the Sub-Department of Application and Informatics. Then they provided feedback and comments to improve the reliability and validity of the interpretation.

Furthermore, we conducted a literature review of ANT in the e-Government domain from various reputable, recent journals and conference papers, written by top academics in ANT and e-Government research. Additionally, we analysed the concepts and selected the applicable concepts based on the case studies. Moreover, we examined the case studies from the perspective of the ANT, using key concepts such as actor(s), actant(s), network, actor-network(s), and power scales [26] [39] [40] [33]. Additionally, we compared the two cases and identified lessons learned.

We examined the power scale of the actors and actants in the two case studies and classified them into three levels: High, medium, and low. After that, we identified key events and phases of the two case studies. Then, we figured out the EGSMS implementation networks within global and local networks. Each network has some elements. Additionally, we identified the translation process that consists of actors, obstacles, objectives, and Obligatory Passage Point (OPP) [36]; Furthermore, we developed an ANT-based framework of EGSMS implementation that consists of some elements and sub-elements [39] .

The framework was derived from two case studies and ANT analysis by identifying similarities among the actors, features, and success factors in two cases. Additionally, it is also derived from the previous ANT analysis in two case studies, such as the identification of key concepts, such as actors, actants, and actor-networks, power scales actors and actants, key events and phases, global and local networks, and the translation process. We synthesised those into a framework as shown in Figure 10.

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Moreover, we analysed and validated the framework with two experts from Universitas Trunodjoyo Madura. The experts are active lecturers and researchers with experience in system development. The validators are also the external assessor of the E-Government of the Ministry of State Apparatus Empowerment. The validation criteria are usability, functional completeness, clarity, consistency, scalability, reliability, and integration capability. The validation instruments used to validate the framework are observation checklists, interview validation forms, and expert judgment sheets. We did not use a scoring scheme because this is qualitative research. There are some revisions after validation, such as features and users. There is an additional feature, such as a microservice and a super admin user. The validation process was also used as a structured framework-assessment procedure, as shown in Table 2. There are six dimensions that validate the framework as follows: effectiveness, efficiency, accessibility, security and privacy, interoperability, as well as user satisfaction.

Table 2. Assessment Dimensions

Number	Assessment Dimensions
1	Effectiveness
2	Efficiency
3	Accessibility
4	Security and Privacy
5	Interoperability
6	User Satisfaction

Moreover, the validator follows some assessment procedures as presented in Table 3 that consist of defining the scope, review and analysis, recommendations, and conclusions.

Table 3. Assessment Procedures

Stages	Assessment Procedures
1	Defining the Scope
2	Review and analysis
3	Recommendations
4	Conclusions

Finally, we concluded the research by summarising the findings. Additionally, as part of ethical approval, we have obtained official institutional permission from the staff of the e-Government and Smart City initiatives at the Department of Communication and Informatics in Pamekasan and from the Head of Communication and Informatics in Sampang to conduct research and collect data there.

3. RESULTS AND DISCUSSION

This section will present the research results and discussion, analysis, as well as the proposed framework as the main contribution of the research.

3.1. Actor-Network Theory (ANT) Perspective

This sub-section will capture the actors, actants, actor-networks, power scales, key events and phases, local and global networks, and the translation process of both case studies.

Table 4 shows actor(s), actant(s), and actor networks in both cases. There are some actors in the Pamekasan case, such as researchers at Universitas Trunodjoyo Madura, researchers at Universitas Islam Madura, as well as an e-Government and Smart City staff member. Furthermore, the actant in this case is the application of EGSMS 1.0, developed by researchers at Universitas Trunodjoyo Madura. Moreover, there are some actor-networks in the Pamekasan case, such as the Network of Staff at the Department of Communication and Informatics of Pamekasan, Madura, Indonesia, the Network of researchers of Universitas Trunodjoyo Madura, the Network of researchers of Universitas Islam Madura, the Department of Communication and Informatics of Pamekasan, Universitas Trunodjoyo Madura, Universitas Islam Madura, and DevOps for SDLC standard.

Moreover, the Sampang case involves several key actors, including researchers at Universitas Trunodjoyo Madura, a researcher at Universitas Lambung Mangkurat, the Head of the Department of Communication and Informatics, the Head of the Sub-Department of Application and Informatics, and Staff Members of the Sub-Department of Application and Informatics. Also, this case has two actants: Applications of EGSMS 2.0 and LANTIK SPG. Researchers of Universitas Trunodjoyo Madura developed the EGSMS

2.0, and LANTIK SPG was built by the Department of Communication and Informatics of Sampang. LANTIK SPG is an application that supports service management in Sampang. It primarily handles complaint data related to the Network, domain, and hosting. Still, there are no features for handling complaints about software or applications. Additionally, there are several actor networks, as follows: the Network of staff from the Department of Communication and Informatics; the Network of researchers from Universitas Lambung Mangkurat and Universitas Trunodjoyo Madura; and the DevOps and FCC networks for SDLC standards. Therefore, there are more actors and actants in Sampang than in Pamekasan. However, the actor-networks in Sampang are the same number as in Sampang. It shows that staff in Sampang are more engaged than in Pamekasan.

Table 4. Identification of some key concepts of ANT in the Pamekasan and Sampang

Concept	Pamekasan Case	Sampang Case
Actor(s)	Researchers of Universitas Trunodjoyo Madura, A researcher of Universitas Islam Madura, a Staff of e-Government and Smart City	Researchers of Universitas Trunodjoyo Madura, A researcher of Universitas Lambung Mangkurat, The Head of the Department of Communication and Informatics, the Head of the Sub-Department of Application and Informatics, Staff of the Sub-Department of Application and Informatics
Actant(s)	Application of EGSMS 1.0	Application of EGSMS 2.0, Application of LANTIK SPG
Actor-networks	Network of Staff at Department of Communication and Informatics of Pamekasan, Madura, Indonesia, Network of Researchers of Universitas Trunodjoyo Madura, Network of researchers of Universitas Islam Madura, Department of Communication	Network of staff of the Department of Communication and Informatics in Sampang, Network of Researchers of Universitas Trunodjoyo Madura, Network of researchers of Universitas Lambung Mangkurat, Department of Communication and Informatics of Sampang, Universitas Trunodjoyo

	and Informatics of Pamekasan, Universitas Trunodjoyo Madura, Universitas Islam Madura, DevOps for SDLC standard	Madura, Universitas Lambung Mangkurat DevOps, and FCC for SDLC standard

Table 5 presents the power scale of the actor(s) and actant(s) in both cases. In Pamekasan, the staff of e-government and Smart City have medium power. She did not have the power to decide the implementation of EGSMS. She had the power to approve the cooperation between the researcher from Universitas Trunodjoyo Madura and the Department of Communication and Informatics to develop EGSMS in Pamekasan and coordinate with the programmers and other young staff there. Furthermore, the Sampang case involves three key actors, including the head of the communication and informatics department, who holds significant power. He has the authority to decide on research cooperation between researchers of Universitas Trunodjoyo Madura and the Department of Communication and Informatics of Sampang. He also has the authority to issue commands to the head of the sub-department of Application and Informatics and the staff to provide data for the EGSMS project. Additionally, the head of the sub-department of Application and Informatics has medium power. He can command the sub-department of Application and Informatics staff to support its EGSMS project.

Table 5. Power scale of the actor(s) and actant(s) in the Pamekasan and Sampang cases

Case study	Actor(s) or Actant(s)	Power
Pamekasan	a Staff of e-Government and Smart City	Medium
Sampang	The Head of the Department	High
	Head of Sub-Department of Application and Informatics	Medium
	Staff of the Sub-Department of Application and Informatics	Low

Additionally, the sub-department of Application and Informatics staff has low power. They provide data, procedure files, and other files for the EGSMS project. Actor(s), Actant(s), Actor-Network, and Power Scale of ANT analysis influenced the success. If the actor(s) or actant(s) have a high-power scale, and the actor-networks have a stronger network, this would influence and increase the opportunity for successful EGSMS

implementation. Moreover, according to [26], The key events and phases were identified in this research, as presented in Figure 2. The key events and phases are the implementation of EGSMS 1.0 from June to December 2023 and EGSMS 2.0 from June to December 2024. The research duration in both case studies is the same.

Figure 2. Key events and phases in the case studies

Furthermore, the networks of EGSMS were identified as shown in Figure 3 based on [33]. The networks consist of local and global networks, which interact with each other through EGSMS implementation as an Obligatory Point of Passage (OPP). The local actors include citizens, researchers, the Department of Communication and Informatics, as well as local governments. Additionally, the global actors are provincial governments and the central government.

Moreover, in the local networks, the citizen can send a message through EGSMS to send complaints about the government services. The researchers conducted research, analysed the system requirements, and designed the EGSMS. The development team built the EGSMS, ensured the system worked well, and deployed it. The Department of Communication and Informatics supported the data, system design, validation, and testing of the EGSMS. Other local governments communicated with the Pamekasan and Sampang governments through various channels, including mobile phones, WhatsApp, email, and letters. In the global networks, the province and central government also communicated with the Pamekasan and Sampang governments through various channels. The actors in global and local networks are identified through interviews, observations, and data collection in both case studies. Those actors are multi-stakeholders in the research and EGSMS implementation. The actors in local and global networks might exhibit dynamics driven by changes over time, within the system and its environment.

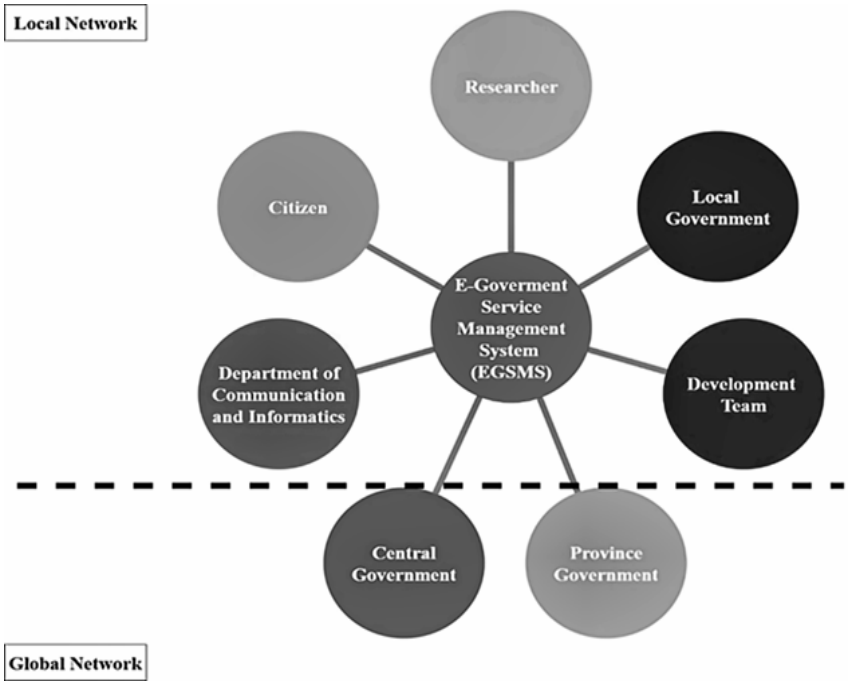

Figure 3. Networks of the EGSMS implementation

Figure 4 presents the translation process, which contains EGSMS as the Obligatory Passage Point (OPP), as described in [36]. There are several key stakeholders, including the head and staff of the IT Department, the Development team, and the users. Furthermore, the objectives of each actor are as follows: the head and staff of the IT department aim to utilise EGSMS to handle and resolve complaints, the development team aims to develop EGSMS, and users have the objective of using EGSMS to report problems with public services. Moreover, a lack of service management is the obstacle. The translation process is also dynamically driven over time, with changes in systems, actors, aims, and environments. The actors in the translation process interact directly with the EGSMS implementation.

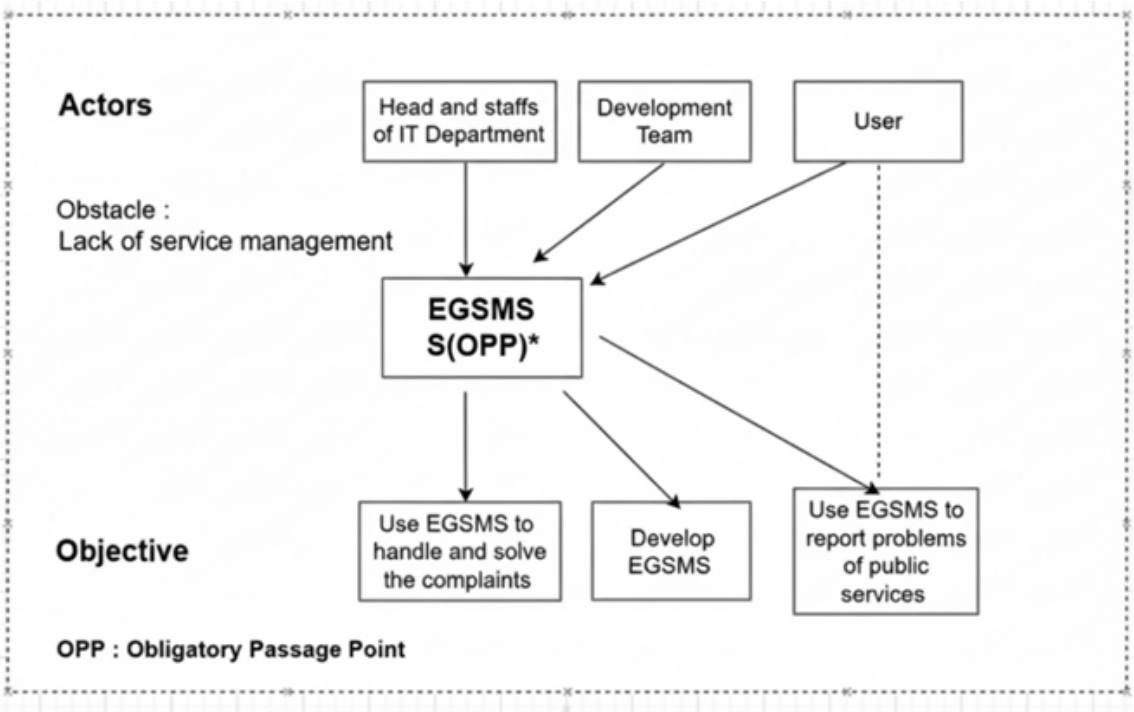

Figure 4. Translation Process

Furthermore, the detailed results of the validation process using Observation, Interviews, and Experts' judgements are shown in Table 6. Each validation method yields different results. However, all validation results indicated that the elements and sub-elements of the proposed framework are valid and reliable. The validation results of observation explain that the elements of actors and success factors are suitable for the real condition. Furthermore, the sub-elements of actors, such as the Head and staff of the IT Department, as well as Super admin, admin, operator, and officer, are suitable for real conditions. Moreover, the sub-elements of Power of the user, Commitment of the user, Infrastructure, Support system, and Networking between the development team and the user are suitable for real conditions. Additionally, the validation results of the Interviews are that all elements and their sub-elements are suitable for the user requirements. Also, the validation results of the expert judgments show that the microservice is an important sub-element of the feature element, the framework covers technological and non-technological elements, and the EGSMS framework is applicable to other contexts and local areas.

Table 6. Validation results

Observation	Interviews	Expert Judgments
• The elements of actors and success factors are suitable for the real condition • The sub-elements of actors, such as the Head and staff of the IT Department, as well as Super admin, admin, operator and officer, are suitable for the real condition • The sub-elements of Power of the user, Commitment of the user, Infrastructures, Support system, and Networking between the development team and user are suitable for the real condition	• All elements are suitable for user requirements • All sub-elements are suitable for user requirements	• Microservice is an important sub-element of the feature element • The framework covers technological and non-technological elements • The EGSMS framework is applicable to other contexts and local areas.

3.2. Discussion

The results achieve the research objective of examining and understanding the implementation of the EGSMS, as presented in Table 4, which outlines the actors, actants, and actor-networks, as well as the power scale of the actors and actants in both case studies. Furthermore, it also achieves the second objective of the research by developing a framework for implementing an EGSMS, as shown in Figure 5, based on case studies in Madura, Indonesia. Moreover, this research has some limitations, including its reliance on two case studies from the Department of Communication and Informatics, specifically in Pamekasan and Sampang, Madura, Indonesia. Furthermore, the research was only conducted for 6 months in 2023 and 6 months in 2024.

There are some similarities in best practices between EGSMS in Pamekasan and Sampang, Madura, Indonesia. The similarities include that the case study is located on Madura Island, Indonesia, and shares the same culture as the Maduranese, making it an exact case study for the Department of Communication and Informatics. The research team consists of a research team leader, a research team member, a junior or student

programmer, and two of the students ' teams. Additionally, the SDLC method is a DevOps approach, in which the research team precisely conducts user requirements analysis, system design, and implementation.

Furthermore, the two case studies are different as presented in Table 4. Also, Pamekasan and Sampang are different cities in Madura, with distinct socio-cultural environments, IT budgets, technologies and infrastructures, and human resources. EGSMS implementation was stronger in Sampang, as the lead researcher contacted and met the Head of Communication and Informatics in the office. The department head supported the EGSMS implementation. Therefore, it is also supported by the Head and staff of the Sub-Department of Application and Informatics at Sampang's office. The data collection, discussion, and interview were easily held in Sampang. However, the EGSMS implementation in Pamekasan is not as strong as the research team had discussed, interviewed, and communicated with the middle management staff with limited authority. Also, the Department of Communication and Informatics in Pamekasan and Sampang has a different organisational structure, number, capacity and roles of staff, service areas and challenges, as well as vision and mission.

Moreover, Table 5 shows that the Head of the Department of Communication and Informatics has strong power, as he has the authority to decide and make policy, and is responsible for EGSMS. Furthermore, the staff of the e-Government and Smart City in Pamekasan and the Head of the Sub-Department of Application and Informatics in Sampang have medium power, as they are responsible for EGSMS implementation. However, they have only partial authority to decide and make policy. In addition, the staff of the Sub-Department of Application and Informatics in Sampang have limited authority, as they only support and provide data for EGSMS at the direction of their superior positions, such as the Head of the Sub-Department of Application and Informatics and the Head of the Department of Communication and Informatics.

The research found that some lessons learned can be learned from both case studies. It is crucial to remember that e-government best practices are constantly evolving. Therefore, it is essential and urgent to stay current with the latest industry advancements and trends. Speaking with specialists and government representatives nationwide is necessary for the most current and pertinent information on EGSMSs in

Indonesia. This continuous learning and adaptation is the key to success in the dynamic field of e-government. In Indonesia, the role of the leader is crucial in implementing a system. One of the key success factors in implementing the system in government institutions in Indonesia is the vision, commitment, and actions of the leader.

Additionally, the system's implementation needs to be regularly evaluated to ensure it is executed correctly. After that, the system needs to be updated to reflect the latest technology and global changes. Successful system implementation depends on both technological factors, such as the sophisticated technology used, and non-technological factors, including leadership, culture, and organisation. Developing an application or system is not enough; further action is required to implement the system. Moreover, ANT helps understand the dynamic implementation of EGSMS by identifying actors, actants, networks, actor-networks, key events and phases, power scales, translation processes, and obligatory passage points (OPPs).

Furthermore, Table 7 synthesises these research findings by systematically comparing them with existing studies [29], [39], [34], [36], [30], [41] across multiple ANT dimensions on key concepts, power scales of actors and actants, Key events and phases, Networks, translation processes, and frameworks. The comparisons highlight how the research aligns with previous studies and show that those ANT dimensions have been used in prior reputable research. Therefore, those ANT dimensions are valid as an instrument analysis in this research. Table 4 presents the actor(s), actant(s), and actor-network in this research compared with the table in [41] . Moreover, Table 5, which compares the Power scale of actors and actants in the Pamekasan and Sampang cases with the table in [30] , is also provided. Additionally, Key events and phases in the case studies, as highlighted in Figure 2, are compared with those in [29]. Also, the Networks of the EGSMS implementation compared with the Figure in [34]. Furthermore, Figure 4, which compares the Translation process with the Figure in [36]. Figure 5, as the framework of EGSMS Implementation, also compares with the Figure in [39].

Additionally, based on lessons learned from 2 years of research, we propose a framework for EGSMS implementation, as shown in Figure 5. It comprises actors, features, and success factors. The first category consists of actors, which include the head and staff of the IT department, the development team, and users. The development team contains a research

manager, project manager, programmer, tester, documentator, and data collector. Moreover, the users are super admin, admin, operator, and officer.

Table 7. Comparison of these research findings with other research

Discussion points	This research	Another research
Key concepts	Table 4	The number of actors and interviewees, as shown in Table 1 in this research, is fewer than [41]
Power scale of the actors and actants	Table 5	The power scale of the actors and actants, as presented in Table 2 of this research, is classified by the level of authority for decision-making in two local government institutions in Indonesia over two years. [30] classified the power based on bureaucracy and technology power base in the central government stakeholders in Srilanka for five years.
Key events and phases	Figure 2	This research captures key events and phases as captured in Figure 2 in two local government institutions in Indonesia for two years. [29] identified key events and phases in India for ten years.
Networks	Figure 3	[34] presented actors of government, traditional media, and military police in global networks, as well as protesters, free fare movements, and independent media in local networks. Furthermore, this research identifies actors: the Department of Communication and Informatics, citizens, researchers, local government, and the development team for local networks, as well as the central and province governments, as a global network, as shown in Figure 3.
Translation Process	Figure 4	[34] Presented the translation process on social media and the trajectory of the '20 Cents Movement' in Brazil. Moreover, Figure 4 presents the translation process for EGSMS implementation. The actors and OPP in both cases are different.

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Discussion points	This research	Another research
Framework	Figure 5	[39] Presented the E-Participation framework for public policy in Malaysia that contains multiple applications. Moreover, Figure 5 presents a framework for EGSMS implementation in two local governments in Indonesia.

Furthermore, the second category encompasses new complaints, requests, notifications via email and WhatsApp, reports, and microservices. The new complaints feature could be about applications, hardware, and infrastructure. Moreover, the new requests contain add, change, and remove applications, hardware, and software. The third category comprises success factors, including the user's power, commitment, infrastructure, support system, the development team's capacity, and networking between the development team and the user. The greater the power and commitment of the user, the greater the opportunity to successfully implement the project. The better the support system and the development team's capacity, the greater the chance of success. Additionally, the closer the collaboration between the development team and the user, the better the chances of a successful project.

The three main elements, such as actors, features, and success factors, are derived from both case studies. The actors and their sub-elements exist in both Pamekasan and Sampang. We have discussed and interviewed with the Head and staff of the IT Department in both case studies. The development team and its sub-elements are our research team. Moreover, the user and its sub-elements are proposed by the research and development team, based on discussions and interviews with staff from the Communication and Informatics Departments in both cases.

The features and their sub-elements mostly exist in both cases, except for the microservices developed in Sampang at the request of the Head of Communication and Informatics there. All the features are developed by the development team based on discussions and interviews with the staff in both departments. Additionally, the success factors and their sub-elements are derived from data collection, discussion, and interviews during the development process for both case studies.

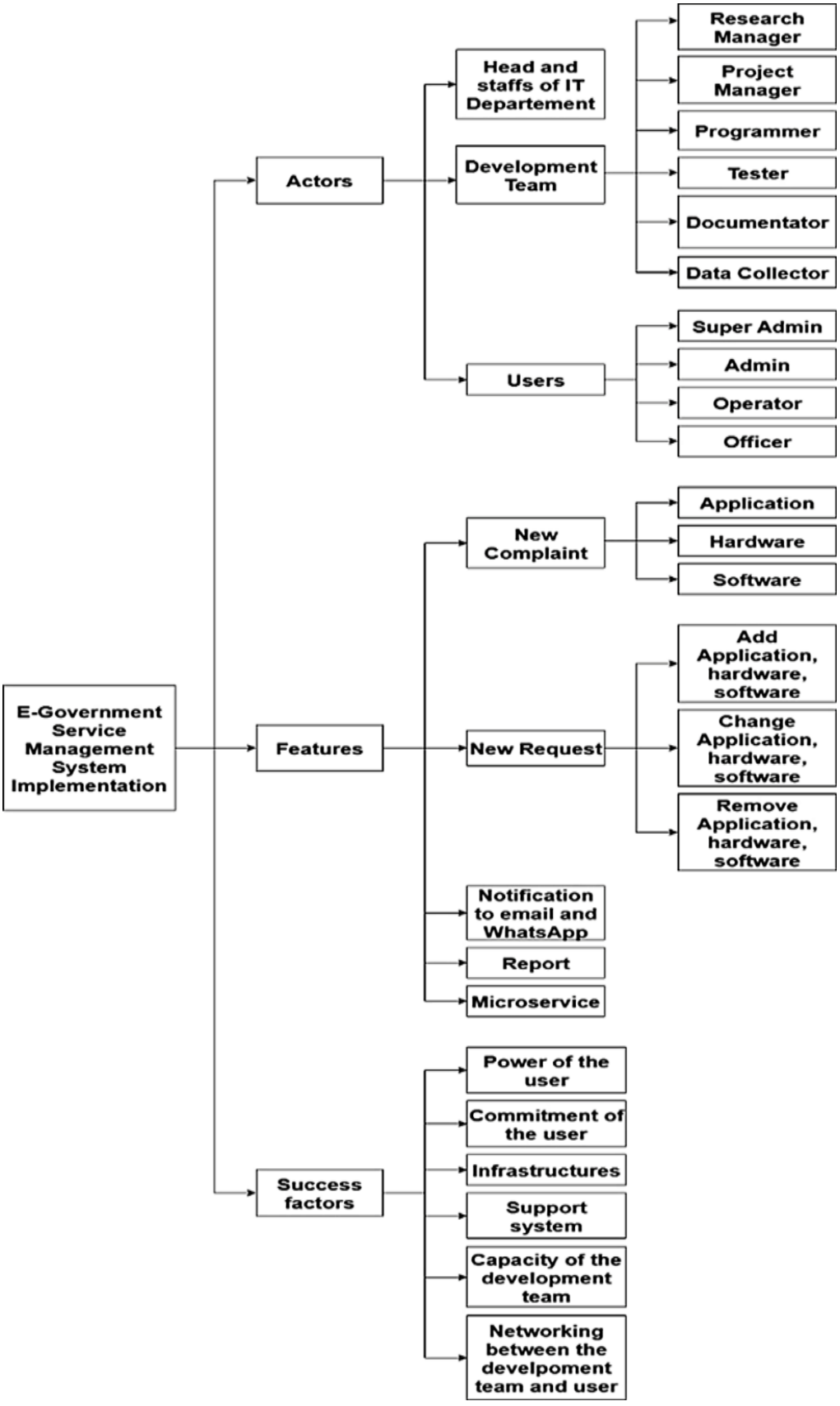

Figure 5. An ANT-based Framework of EGSMS Implementation

Furthermore, Table 8 presents the mapping of case evidence and ANT findings with framework components. The actor's components are based on case evidence that is outlined in Table 4, especially in actors as the ANT findings. Moreover, the feature components are based on case evidence, such as interview results and user requirements system as well as ANT findings, as presented in Table 4 of Actants. Additionally, the success factors components are based on case evidence found in observation and interview results, as well as ANT findings, as shown in Table 5, Figures 3 and 4. Therefore, it can be concluded that the case evidence and ANT findings serve as the basis for the components of the developed framework. These components are derived from data in tables 4 and 5, observation and interview results, as well as system requirements. It shows that empirical evidence and ANT analysis findings support the development of framework components.

Table 8. Mapping of Case Evidence, ANT findings, and Framework components

Case evidence	ANT Findings	Framework Components
Table 4	Table 4: Actors	Actors
Interview results and the system requirements	Table 4: Actants	Features
Observation and Interview results	Table 5, Figure 3, and Figure 4	Success Factors

The framework has been validated by two validators with experience in system development, as well as by the assessor of the e-Government Management System. The validation process used some criteria, such as usability, functional completeness, clarity, consistency, scalability, reliability, and integration capability. The validation criteria and results are presented in Table 9.

Table 9. Validation Criteria and Results

Validation Criteria	Results
Usability	The framework is easy to use and could be used in different local areas
Functional completeness	The function is relatively complete, as captured in the feature components

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Validation Criteria	Results
Clarity	The roles are clearly defined in the actors' components
Consistency	It has consistent and no overlap roles as presented in the actors' components
Scalability	The system could handle the growth of users
Reliability	The framework was designed to be reliable and could respond quickly and correctly
Integration capability	The framework accommodates the integration capability as developed in the Sampang system

This research investigated the implementation of the EGSMS in Madura, Indonesia, and developed a conceptual framework for its implementation. However, additional in-depth research across other local governments in Indonesia is needed to further develop the framework. The proposed model is based on case studies of Pamekasan and Sampang, Madura, Indonesia, in 2023 and 2024. Therefore, implementing EGSMS across contexts may involve different actors, features, and success factors. Also, the implementation of EGSMS could be combined with AI in the future. Furthermore, ANT can help analyse the case study and e-government research in Indonesia.

Additionally, the research findings have substantial and significant implications for the research field, enhancing the body of knowledge on e-governments implementation, service management, and Actor-Network Theory (ANT), with practical ramifications for both theory and practice. Service Management is also one of the important areas in E-Government implementation theory. This application of the well-known ANT approach to the EGSMS in two local areas in Indonesia could advance the E-Government theory, as there is still limited research on it. The two different case studies, with their richness, support the E-Government research methodology in terms of the contextualist approach. Moreover, E-Government implementation theory should consider technology and non-technological factors. A proposed framework and lessons learned from the two case studies could improve the E-Government implementation theory and could be adopted in different contexts.

Moreover, there are practical implementation aspects: for policymakers and

communities, it serves as a pragmatic reference for efficiently implementing the EGSMS across diverse localities in Indonesia and other countries. One lesson learned from both cases is that the department head's vision, competency, and commitment are among the success factors for EGSMS implementation in Madura, Indonesia. Also, the implementation of a service management system in other contexts could apply the framework and its elements. Therefore, the role of leaders is essential to the successful implementation of the EGSMS. Furthermore, organisational culture, as a support system, is also important for the successful implementation of EGSMS.

Furthermore, the research complements the recent ANT-based E-Government research, as presented in Table 10, as follows: [42] proposed a model of data sovereignty in Indonesia based on Actor-network analysis, [43] examined the power over the e-government implementation and global-local network actors at districts in East Java in 2018 and Lampung in 2019, [44] examined a digital government platform using ANT, [45] analysed the actors, power relations, networks, and policies using ANT for the Estonian e-Government solution, [46] developed a framework based on ANT for capturing e-participation in schools, [47] captured e-government implementation using ANT to point out the process of interaction and change, as well as [48] examined a strategy for e-government implementation using ANT. Therefore, ANT has been used in various E-Government research worldwide.

Table 10. Comparison with the recent ANT-based E-Government research

Title	Published year	Citation	Results
A Framework of Service Management System for E-Government in Indonesia: An Actor-Network Theory (ANT) Perspective	On progress		A framework for EGSMS in Madura, Indonesia.
An actor-network model for developing data sovereignty: evidence from Indonesia	2023	[42]	The research proposed a model of data sovereignty in Indonesia based on the actor-network

Title	Published year	Citation	Results
Actor-Network Theory (ANT) for Indonesia e-Government implementation	2020	[43]	The research examined the power over the e-government implementation and global-local network actors at districts in East Java in 2018 and Lampung in 2019
Actor Network Theory as A Framework to Build Business Collaboration Network Applied to Digital Government	2018	[44]	The research examined a digital government platform using ANT
Actor Network Analysis on the Estonian e-Government Development	2017	[45]	The research analyzed the actors, power relations, networks, and policies using ANT for the Estonian e-Government solution
Digital Citizen Participation within Schools in the United Kingdom and Indonesia: An Actor–Network Theory (ANT) Perspective	2016	[46]	A framework for examining e-participation based on ANT in schools
E-government in the making: an actor network perspective	2015	[47]	The research captured e-government implementation using ANT to point out the process of interaction and change.
Strategizing E-Government Development Using an	2015	[48]	The research examined a strategy for e-government implementation using ANT

Title	Published year	Citation	Results
Actor-Network Theory Perspective			

4. CONCLUSION

The core validated contribution in this research is the ANT-based framework of EGSMS implementation. Based on our research, there are some ANT key insights, such as ANT helps to understand how EGSMS is implemented in Pamekasan and Sampang. This research identified key concepts of ANT in Pamekasan and Sampang, Madura, including Actors, Actants, and actor-networks. Furthermore, it also examined the power scale of the actor(s) and actant(s) in the Pamekasan and Sampang cases. Moreover, this study captured the key events and phases in the case studies, developed the Networks of the EGSMS implementation and the translation process. Additionally, these research findings have substantial and significant impacts and implications for the research field, enhancing the body of knowledge on e-governments, service management, and Actor-Network Theory (ANT), with practical ramifications for both theory and practice. Moreover, there are practical implementation aspects: for policymakers and communities, it serves as a pragmatic reference for efficiently implementing the EGSMS in regions with varying local conditions across Indonesia and other countries. Additionally, the significant limitations of the two current case contexts are that the call centre and public service mall do not have complaint-handling management systems or history databases. Also, this research has some limitations, including its reliance on two case studies from the Department of Communication and Informatics, specifically in Pamekasan and Sampang, Madura, Indonesia. Furthermore, future research could implement the EGSMS framework in other contexts, provinces, and countries, and conduct in-depth analyses and cross-country comparisons. Also, the next research could integrate the EGSMS with Artificial Intelligence (AI) tools. The AI feature will help respond automatically to incoming complaints and resolve routine problems. Moreover, future research can validate and enhance the EGSMS model, paving the way for further advancements in this field.

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