Enhancing OSS E-Government Testing via CEG Method

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Abstract

The rapid growth of e-government systems has created new opportunities to improve public service delivery, transparency, and efficiency. One prominent initiative in this area is Indonesia's Online Single Submission (OSS) system, which centralizes licensing and regulatory processes into a digital platform. However, as usage expands, the OSS system faces recurring issues such as functional errors, incomplete test coverage, and inconsistent results that affect user trust and service reliability. To address these challenges, this study applies the Cause-Effect Graphing (CEG) method as a structured testing approach. By translating functional requirements into graphical models, the method enables systematic test case generation that covers both common and complex scenarios. The results show that CEG-based testing achieved higher test coverage (~90%), improved error detection, and reduced redundancy compared to traditional methods. These outcomes demonstrate the potential of CEG to enhance OSS quality and reliability while strengthening confidence in e-government services.

Keywords: *OSS system, Cause-Effect Graphing, e-government testing*

Abstrak

Pertumbuhan pesat sistem e-government telah membuka peluang baru untuk meningkatkan layanan publik, transparansi, dan efisiensi. Salah satu inisiatif yang menonjol adalah sistem Online Single Submission (OSS) di Indonesia, yang berfungsi sebagai platform digital terpusat untuk perizinan dan regulasi. Namun, seiring meningkatnya penggunaan, sistem OSS masih menghadapi berbagai masalah, seperti kesalahan fungsional, cakupan pengujian yang tidak menyeluruh, serta inkonsistensi hasil yang dapat memengaruhi kepercayaan pengguna dan keandalan layanan. Untuk mengatasi tantangan tersebut, penelitian ini menerapkan metode Cause-Effect Graphing (CEG) sebagai pendekatan pengujian yang terstruktur. Dengan menerjemahkan kebutuhan fungsional ke dalam model grafis, metode ini memungkinkan pembuatan kasus uji secara sistematis yang mencakup baik skenario umum maupun kompleks. Hasil penelitian menunjukkan bahwa pengujian berbasis CEG mencapai cakupan uji lebih tinggi (~90%), peningkatan deteksi kesalahan, serta pengurangan redundansi dibandingkan metode tradisional. Temuan ini menegaskan potensi CEG dalam meningkatkan kualitas dan keandalan OSS, sekaligus memperkuat kepercayaan pada layanan e-government.

Kata kunci: Sistem OSS, Cause-Effect Graphing, pengujian e-government

1. INTRODUCTION

The development of e-government systems has become a critical step in modernizing public services, improving transparency, and increasing efficiency in administrative processes. One prominent example is the Online Single Submission (OSS) system, which aims to streamline business licensing and regulatory processes through a centralized digital platform [1], [2]. As more users rely on the OSS system for various transactions, the need for its reliability, accuracy, and overall quality becomes increasingly important. A robust software testing approach is essential to ensure that the OSS system meets the expectations of users and fulfills its intended public service functions effectively. Despite its potential, the OSS system often faces issues related to functionality errors, data inconsistencies, and system failures, especially under high-load or complex submission scenarios. These problems can hinder user satisfaction and compromise the credibility of digital governance initiatives. Traditional testing methods may not be sufficient to capture all critical functional relationships or edge-case conditions within such a complex system. Therefore, a more structured and comprehensive approach to testing is needed—one that not only detects defects early but also improves the system's robustness and reliability.

This study aims to enhance the testing process of the OSS e-government system by applying the Cause-Effect Graphing (CEG) method. CEG is a well-known black-box testing technique that helps in identifying logical relationships between input conditions and system outcomes [3]-[6]. By transforming functional requirements into graphical representations, this method enables testers to design more effective test cases that cover a wide range of conditions. When applied to a system like OSS, CEG can help ensure that critical paths and logical dependencies are thoroughly validated. In this research, we apply the CEG method to the testing process of the OSS system, starting with requirement analysis, followed by the construction of cause-effect graphs, and finally generating test cases to evaluate different functionalities. The testing is conducted in a controlled environment using simulated data to ensure repeatability and reliability of results. The outcomes are then analyzed to assess improvements in test coverage, defect detection, and overall system reliability compared to previous manual or less-structured approaches.

The contribution of this study lies in demonstrating how the CEG method can be effectively applied in a real-world government system testing scenario. By enhancing the testing process, this research provides a practical framework for improving the quality assurance of OSS and similar e-government platforms. Ultimately, this work supports the broader goal of building more reliable, user-friendly, and efficient digital services for public administration.

2. METHOD

Figure 1 shows the conceptual framework for the testing mechanism of the OSS e-government system using the Cause-Effect Graphing (CEG) method. The framework illustrates the process of testing the OSS (Online Single Submission) e-government system using the Cause-Effect Graphing (CEG) method [7], [8]. It begins with gathering the functional requirements of the OSS system, which is the foundational step for understanding the core functionalities and expectations of the system. Once the requirements are clear, the next step is to identify the causes (input conditions) and effects (output outcomes) of the system's operations. This identification is crucial for constructing a cause-effect graph, which visually represents the logical relationships between different system inputs and their corresponding outputs. The graph allows testers to systematically analyze how each input affects the system's behavior and identify potential errors or inconsistencies.

From the cause-effect graph, a decision table is generated, which organizes and condenses the information into a structured format that highlights all possible input combinations and their resulting outputs. This decision table is then used to derive specific test cases, which are executed on the OSS system to assess its performance under various conditions [9]-[11]. By testing the system using these well-defined cases, the framework ensures that critical functionalities are rigorously validated. Finally, the results of these tests are analyzed to evaluate the system's accuracy, reliability, and overall quality, helping to pinpoint areas of improvement and ensure that the OSS system meets the necessary standards for effective e-government operations [12]-[15].

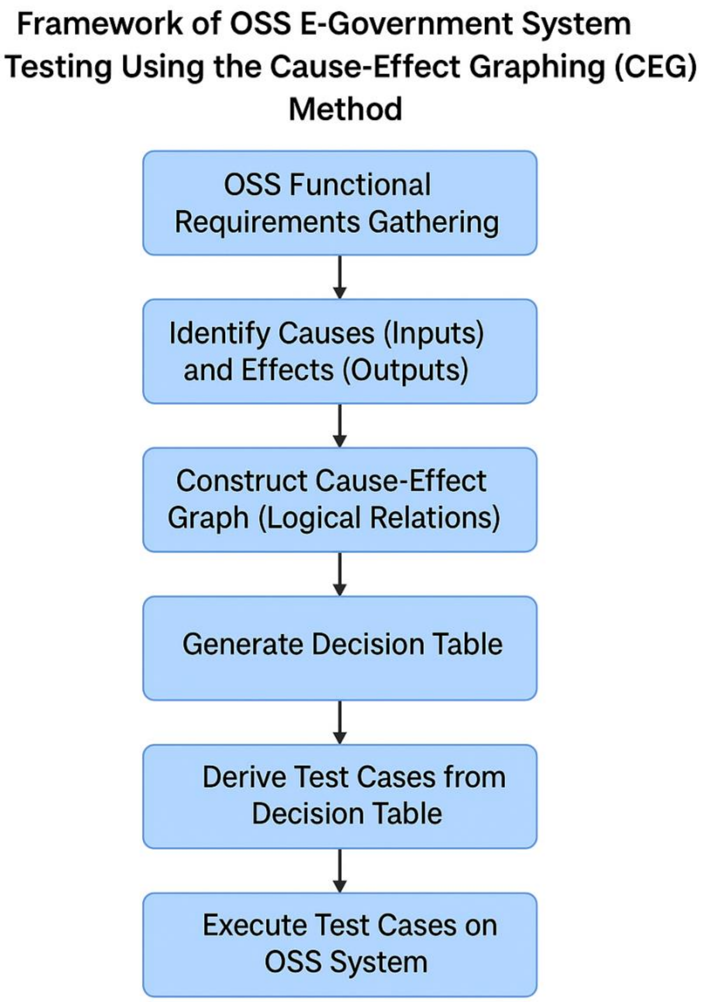

Figure 1 – Conceptuam Framework

3. RESULT AND DISCUSSION

The implementation of the Cause-Effect Graphing (CEG) method in the testing of the OSS e-government system produced measurable improvements when compared to traditional testing approaches. Test cases generated through CEG provided more comprehensive coverage of functional requirements, particularly in capturing complex conditions that are often overlooked in manual testing. This was evident during simulations, where combinations of user inputs—such as incomplete documents paired with expired identification—were successfully tested, whereas such scenarios had previously been missed. The method ensured that both expected and edge-case scenarios were consistently validated.

Table 1 summarizes the comparison between traditional testing and CEG-based testing. The results demonstrate that CEG achieved approximately 90% test coverage, significantly higher than the 65% coverage of traditional testing. Likewise, the error detection rate was notably improved, with CEG uncovering hidden logic defects that manual test design failed to identify. Furthermore, redundancy in test cases was substantially reduced because decision tables provided a clear, non-overlapping structure for deriving unique cases.

Table 1 - Comparison of Testing Outcomes

Aspect	Traditional Testing	CEG-Based Testing	Description
Test Coverage	~65%	~90%	Traditional methods often miss combined or edge scenarios, while CEG ensures broader coverage through systematic mapping.
Error Detection Rate	Medium	High	Manual testing detects obvious errors, but CEG captures hidden logic issues, such as interactions between ID and business category.
Redundancy of Test Cases	High	Low	Traditional testing often repeats similar scenarios; CEG ensures each case is unique and purposeful.
Complex Condition Handling	Limited	Strong	CEG systematically covers multi-condition scenarios that manual testing tends to skip.
Reliability of Results	Moderate	High	Traditional outcomes vary by tester; CEG ensures structured, repeatable, and consistent results.

The improved outcomes can be attributed to the logical rigor of the CEG method. By transforming functional requirements into cause-effect graphs, testers could visualize relationships between inputs and outputs more effectively. This reduced human error in test case design and enhanced the reliability of the results. For example, when testing licensing processes involving multiple dependencies (e.g., applicant type, business sector, and document validity), the CEG method ensured that every possible logical combination was evaluated. Another critical finding was the enhancement in system reliability and user alignment. Test executions demonstrated that the OSS platform responded more consistently across various scenarios when validated using CEG-based test cases. This consistency aligns better with user expectations, particularly in handling complex transactional processes where reliability is paramount. The method not only improved the system's technical robustness but also contributed to strengthening public trust in e-government services, as errors that could affect service delivery were minimized.

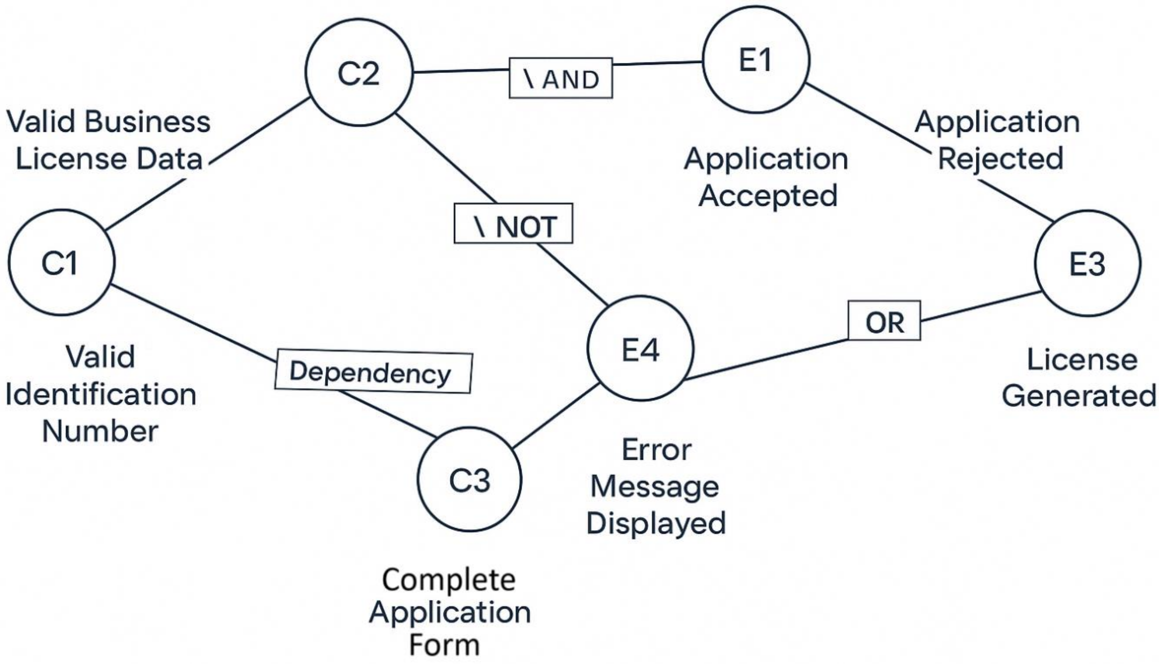

Figure 2 - The Cause-Effect Graph (CEG)

Figure 2 illustrates how different input conditions, or causes, within the OSS e-government system influence specific outcomes, or effects, during the licensing process. Each node represents either a cause (such as valid license data, identification number, or system stability) or an effect (such as application acceptance, rejection, or error messages). The connections between these nodes are logical relationships that define how the system responds under various conditions. For example, the combination of valid business license data and a valid identification number directly leads toward the possibility of an accepted application.

What makes this model powerful is the way it captures both positive and negative scenarios. If the form is incomplete, or either the license data or the number is invalid, the system follows an alternate path, leading to application rejection. Similarly, when system connectivity is unstable, the outcome is not tied to the application's correctness but to system reliability, resulting in an error message instead. This mapping of conditions to outcomes helps visualize not just the expected "happy path" but also the edge cases and failure points that need attention during testing. Finally, the graph emphasizes sequential and dependent relationships. An accepted application does not immediately result in a license being generated; it also requires confirmation of payment. By structuring the system logic in this way, the Cause-Effect Graph ensures that test cases derived from it cover all possible combinations of input and output. This enhances reliability and reduces the chance of missing hidden defects. In practice, such a structured approach provides testers and developers with a clear roadmap for validating the OSS system, ensuring it performs as expected in real-world usage.

4. CONCLUSION

This study demonstrates that the application of the Cause-Effect Graphing (CEG) method provides significant improvements in the testing of the OSS e-government system compared to traditional approaches. By systematically mapping input conditions to their corresponding outcomes, CEG ensures broader test coverage, reduces redundancy, and enhances the detection of hidden logic errors. The method not only strengthens the technical robustness of the OSS platform but also aligns its performance more closely with user expectations, particularly in complex and high-stakes transactional processes. Beyond its technical advantages, this approach also contributes to reinforcing public trust in digital governance, as it ensures more consistent, reliable, and error-resilient services. Ultimately, the findings highlight the importance of integrating structured testing methodologies like CEG into e-government systems to support the development of efficient, reliable, and user-centered public service platforms.

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