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Design and Development of The Data Requestand Statistical Service (Tanya Akses Statistik/TANGKIS) Website Information System with an Automatic Email Notification Feature at the Central Bureau of Statistics of East Lampung Regency

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ABSTRACT

The Integrated Statistical Service (PST) at BPS East Lampung Regency handles a high volume of data requests from researchers, government agencies, students, and private institutions through its front-line channel, TANGKIS. This service currently relies on walk-in visits, manual logbook recording, and unstructured WhatsApp or email correspondence, causing delayed processing, inconsistent follow-up, difficult status tracking, and the absence of formal notification when requested data is ready. This study aims to design and develop a web-based TANGKIS information system with an automatic email notification feature to digitize and streamline the request workflow. The system was developed using the SDLC Waterfall model, with UML-based design, PHP and Laravel implementation, a MySQL database, and PHPMailer integrated with SMTP, then evaluated through Black Box Testing and a dedicated notification reliability assessment. Black Box Testing of 20 functional features achieved 100% validity, while 30 simulated requests reached a 100% email delivery rate with an average latency of 4.8 seconds, reducing data-readiness awareness time from one to three days to under one minute. These results imply that a low-cost, event-driven email notification architecture can meaningfully strengthen the efficiency, transparency, and responsiveness of statistical public service, supporting the digital transformation of regional government statistical services.

Keywords: statistical data request system; web-based information system; automatic email notification; sdlc waterfall; public service digitalization

INTRODUCTION

As the primary government institution responsible for the collection, processing, and dissemination of official statistical data in Indonesia, the Central Bureau of Statistics (Badan Pusat Statistik, BPS) is mandated to provide accessible and responsive statistical data services to the public (Rahmatika & Krismawati, 2019). At the regency level, this function is carried out through the Integrated Statistical Service (PST), which in BPS East Lampung Regency operates under the internal designation TANGKIS, serving as the institution's front-line channel for handling statistical data and information requests from external users such as researchers, government agencies, university students, private companies, and the general public. This orientation reflects a broader trend in which public-sector agencies increasingly adopt IT-enabled service management to strengthen governance quality and service delivery, an approach whose benefits for public-sector governance have been empirically demonstrated by (Sarwar et al., 2023).

Currently, the TANGKIS service at BPS East Lampung Regency is conducted through a combination of in-person walk-in visits, manual recording of incoming requests in a physical logbook, and unstructured correspondence via WhatsApp or personal email accounts of staff members. Based on observation, this conventional approach generates several operational problems.

First, incoming requests are not centrally tracked, making it difficult for the PST officer to monitor the cumulative workload or prioritize urgent requests. Second, once a requested dataset has been compiled and is ready for collection, users are typically notified through informal, manually sent WhatsApp messages or phone calls, a process that is highly dependent on staff availability and frequently results in delays of one to three days between data readiness and user awareness. Third, the absence of a structured digital archive of past requests makes it difficult to generate periodic service-performance reports required for institutional accountability (Zikra et al., 2025).

The Integrated Statistical Service (PST) is a standardized service unit established within every BPS office at the national, provincial, and regency levels to handle public requests for statistical data, publications, and consultation (Musben et al., 2026). According to Zikra et al., (2025), an effective data-request service must provide clear request tracking, timely processing, and transparent communication regarding request status, as these factors directly influence public trust in the institution's service quality. A web-based public service information system is an application accessible through a web browser that enables citizens or external users to submit service requests, track processing status, and receive output without requiring physical presence at the service counter (Nilawati & Martin, 2023). The adoption of such systems is a central component of the e-government transformation agenda, which seeks to improve the efficiency, transparency, and accessibility of public-sector services through information technology (Zikra et al., 2024).

Automatic email notification is a system feature that triggers the sending of a predefined email message in response to a specific event within an application's workflow, such as a change in request status (Kenmahdy et al., 2025). In PHP-based web applications, this feature is commonly implemented using the PHPMailer library, which provides a robust interface for composing and sending emails through the Simple Mail Transfer Protocol (SMTP), supporting features such as HTML-formatted messages, attachments, and authenticated SMTP relay through providers such as Gmail or institutional mail servers (Kenmahdy et al., 2025). Compared to SMS gateway-based notification, which typically incurs a per-message cost and is constrained by character limits, SMTP-based email notification offers a cost-free, unlimited-length alternative that is particularly suitable for institutional public services operating under constrained budgets (Irawan et al., 2023). A similar cost-free notification approach was demonstrated by Pahrizal et al., (2022), who implemented PHPMailer with authenticated SMTP relay to automatically deliver duty-order data to parking attendants at a regional transportation office, confirming the practicality of this mechanism for resource-constrained public-service settings.

The Waterfall model is a sequential software development approach consisting of distinct phases: requirements analysis, system design, implementation, testing, and maintenance, in which each phase must be completed before the next phase begins (Ardiansyah et al., 2023). This model remains widely adopted for government information system projects with well-defined, stable requirements, such as the standardized data-request workflow used in this research (Rijanandi et al., 2022). When paired with Unified Modeling Language (UML) diagrams to formally model user interactions and workflow logic prior to implementation, the Waterfall model has been shown to produce a clear and verifiable system design, as demonstrated by Voutama & Novalia, (2022) in their development of a web-based information system.

Black Box Testing is a software testing technique that evaluates a system's functional output against expected results without examining its internal code structure (Ayuningtyas et al., 2023). For

systems incorporating an automated notification feature, testing must be extended beyond conventional functional validation to include notification-specific reliability metrics, such as delivery success rate and delivery latency, since a functionally correct trigger mechanism does not guarantee that the notification message is reliably and promptly received by the end user (Putra, 2026). The relevance of this technique to government service channels is illustrated by Sultansyah et al., (2025), who applied Black Box Testing to evaluate the public-information-request feature of a provincial government website and identified functional weaknesses in form validation that would otherwise remain undetected without such testing.

Several previous studies have examined the digitalization of public data-request and notification services. Zikra et al., (2025) developed a web-based data-request management system for a government agency that incorporated an automatic email notification feature but did not rigorously test the reliability and delivery performance of that notification mechanism, relying instead on functional (white-box) testing of the request and tracking features alone. Irawan et al., (2023) implemented a WhatsApp Gateway-based payment notification service, but the reliance on a subscription-based messaging gateway introduced recurring operational costs and message-length limitations unsuitable for detailed status updates. Jumadhil N & Syahputra M, (2024) developed a complaint-handling application with in-app notifications only, which required users to actively log in to check their request status rather than receiving a push notification through an external channel such as email. Meanwhile, Armiati et al., (2024) proposed a WhatsApp Gateway API-based receivables-tracking system but did not evaluate the reliability and delivery performance of their notification mechanism through systematic technical testing.

The persistence of these manual-process limitations is inconsistent with the broader national e-government agenda, which encourages public institutions to adopt digital service channels that improve transparency, responsiveness, and accountability in public service delivery (Nilawati & Martin, 2023). A web-based statistical data request system, equipped with an automated notification mechanism, offers a relevant solution by enabling users to submit requests online at any time, allowing staff to manage and prioritize requests through a centralized digital dashboard, and automatically informing users of their request status without depending on manual follow-up by staff (Zikra et al., 2024).

A review of these studies reveals a research gap: existing public-service request systems have either lacked an automated notification mechanism entirely, relied on cost-incurring SMS gateways with limited message capacity, or implemented notification features without rigorously testing their delivery reliability and latency. This research addresses that gap by designing and developing a web-based TANGKIS information system that integrates an automatic email notification mechanism using the PHPMailer library and SMTP protocol, which is cost-free relative to SMS gateways, supports detailed and formatted status messages, and is rigorously evaluated through both functional Black Box Testing and a dedicated email- delivery reliability and latency assessment.

The novelty of this research lies in the combination of a structured, multi-stage request-tracking workflow with a technically validated, zero-marginal-cost email notification system specifically tailored to the statistical data request process at a regional BPS office. The purpose of this study is to design, develop, and empirically evaluate a web-based statistical data request and notification system that improves the efficiency, transparency, and responsiveness of the TANGKIS service at BPS East Lampung Regency.

RESEARCH METHODS

This research employs the Software Development Life Cycle (SDLC) method using the Waterfall model. The research was conducted at the Integrated Statistical Service (PST) unit of BPS East Lampung Regency. Primary data were obtained through direct observation of the existing manual request-handling workflow and semi-structured interviews with the head of the PST unit and front-line service staff to identify functional requirements and the typical request lifecycle. Secondary data were obtained from samples of the manual request logbook and historical WhatsApp correspondence records used to estimate typical request- processing and notification-delay durations under the existing manual process.

The interviews were conducted with four informants selected through purposive sampling, comprising the head of the PST unit and three front-line service officers who are directly responsible for receiving, processing, and following up on incoming statistical data requests; these informants were selected because of their direct operational knowledge of the existing request-and-notification process. Two primary data-collection instruments were employed: (1) a structured observation guide used to record each stage of the manual request-handling workflow, the actors involved, and the approximate time required at each stage; and (2) a semi-structured interview guide covering the typical request lifecycle, current notification practices, recurring service bottlenecks, and the desired features of the proposed system. The functional requirements derived from these instruments were subsequently validated through a confirmation session with the head of the PST unit, during which the compiled requirement list and the proposed request-and-notification workflow were reviewed and formally approved before proceeding to the system-design stage, thereby ensuring that the elicited requirements accurately reflected the operational needs of the unit.

The Waterfall stages applied in this research are described as follows. (1) Requirements Analysis: identifying functional needs such as online request submission, request-status tracking, staff-side request management, and automatic email notification at each workflow stage, as well as non-functional needs including system security, role-based access control, and notification delivery reliability. (2) System Design: modeling the system using Unified Modeling Language (UML), specifically Use Case Diagrams to define user interactions and Activity Diagrams to map the request-and-notification workflow, supplemented by an Entity Relationship Diagram (ERD) for the database structure. (3) Implementation: coding the system using the PHP programming language with the Laravel framework for the back-end logic, Bootstrap for the front-end interface, a MySQL relational database for data storage, and the PHPMailer library configured with authenticated SMTP relay for automatic email notification delivery. (4) Testing: validating system functionality using the Black Box Testing method across all input forms, buttons, and reporting features, followed by a dedicated email-notification reliability test consisting of 30 simulated data-request scenarios to measure notification delivery success rate and average delivery latency.

The system's user roles were defined based on the operational structure of the PST unit, consisting of: (1) Guest/Public User, who submits a data request through the public-facing request form without requiring a pre-registered account; (2) Registered User, who can track the status of previously submitted requests through a personal dashboard; and (3) PST Admin/Officer, who manages, processes, and updates the status of incoming requests, with each status change automatically triggering a corresponding email notification to the requesting user. Table 1 summarizes the access rights assigned to each user role within the system.

Table 1. User Roles and Access Rights in the TANGKIS System

User Role	Access Rights
Guest / Public User	Submit a new statistical data request through the public request form; receive an automatic submission-confirmation email
Registered User	Track the status of submitted requests via personal dashboard; receive automatic email notifications at each status change
PST Admin / Officer	Review and process incoming requests, update request status, compile requested data, manage request archive, and generate service reports

Source: Data Processed

The automatic email notification mechanism is designed to trigger at four key stages of the request lifecycle: (1) Submission Confirmation, sent immediately after a user submits a new data request; (2) Processing Notification, sent when the PST officer changes the request status to "In Process"; (3) Data- Ready Notification, sent when the requested data has been compiled and is ready for collection or download; and (4) Completion Notification, sent once the user has confirmed receipt of the requested data. Each notification email is generated using a predefined HTML template populated dynamically with the relevant request details, including the request ID, requested data description, and current status, ensuring consistency and professionalism in every notification sent.

RESULTS AND DISCUSSION

System Design Results

Based on the requirements analysis, the use case diagram identifies three primary actors Guest/Public User, Registered User, and PST Admin/Officer each interacting with distinct system functions according to their role, as summarized in Table 1. The activity diagram for the request-and-notification workflow maps the process from request submission by the user, status updates performed by the PST Admin, to the corresponding automatic email dispatch triggered at each status transition. This digital workflow design directly replaces the manual logbook-and-WhatsApp-based process previously used at BPS East Lampung Regency and extends the web-based public-service model proposed by Zikra et al., (2025) with a rigorously tested, multi-stage notification mechanism that was not evaluated in their study.

Database and Notification Implementation

The The system's database was designed using an Entity Relationship Diagram (ERD) consisting of several core tables: users (storing account credentials and role information), data_requests (storing request details, requested data description, and current status), request_status_history (recording every status transition with a timestamp, supporting full audit traceability), and notification_logs (recording every email notification sent, including delivery timestamp and delivery status). The notification mechanism was implemented using PHPMailer configured with authenticated SMTP relay, triggered automatically by an event listener bound to the request-status update function, ensuring that no status change can occur without a corresponding notification attempt being logged, consistent with the reliability-by-design principle emphasized by Putra, (2026) for institutional notification systems.

Functional Testing Results

Black Box Testing was conducted on 20 core functional features involving the PST officer and a sample of test users representing both guest and registered-user roles. The testing covered request submission, login authentication, request-status updates, dashboard tracking, and report generation. Table 2 presents a summary of representative Black Box Testing scenarios and their results.

Table 2. Summary of Black Box Testing Results (5 of 20 Features Shown)

Tested Feature	Testing Scenario	Expected Result	Status
Request Submission	Fill out and submit the online data request form	Request saved with a unique request ID and status "Submitted"	Valid
Login Authentication	Enter valid username and password	Access granted to role-based dashboard	Valid
Status Update by Admin	Admin changes request status to "In Process"	Status updated and notification email triggered	Valid
Request Tracking	User opens personal dashboard	Current request status and history displayed	Valid
Report Generation	Click the "Export PDF" button on the report page	Service performance report downloaded successfully	Valid

Source: Data Processed

Out of the 20 tested features, all features (100%) produced results consistent with the expected output, indicating that the system's core functions operate validly without critical errors. This result is in line with the findings of Ayuningtyas et al., (2023), who reported similarly high validity rates when applying Black Box Testing to a web-based information system, reinforcing the reliability of this testing technique for institutional public-service web applications.

Email Notification Reliability Testing

Beyond conventional functional testing, this study conducted a dedicated email-notification reliability assessment consisting of 30 simulated data-request scenarios spanning all four notification trigger points (submission, processing, data-ready, and completion). Each simulated notification was monitored for successful delivery and delivery latency, measured as the time elapsed between the triggering status-change event and the notification's arrival in the recipient's inbox. Table 3 presents the results of this reliability assessment.

Table 3. Email Notification Delivery Success Rate and Latency by Notification Type

Notification Type	Scenarios Tested	Successful Deliveries	Success Rate	Avg. Latency (sec)
Submission Confirmation	8	8	100%	3.9
Processing Notification	7	7	100%	4.6
Data-Ready Notification	8	8	100%	5.4

Completion Notification	7	7	100%	5.3
Overall	30	30	100%	4.8

Source: Data Processed

As shown in Table 3, all 30 simulated notification scenarios (100%) were successfully delivered to the recipient's inbox, with an overall average delivery latency of 4.8 seconds, ranging from 3.9 seconds for submission-confirmation emails to 5.4 seconds for data-ready notifications. The slightly higher latency observed for data-ready notifications is attributed to the additional server-side processing required to attach or reference the compiled dataset within the notification email. These results substantially exceed the reliability benchmark implied by Irawan et al., (2023) WhatsApp Gateway-based notification system, which the authors reported as occasionally subject to delivery delays due to third-party gateway congestion and provider-side rate limiting, demonstrating that SMTP-based email notification offers a more consistent and predictable delivery performance for institutional use cases of this nature.

Notification Workflow Visualization

Figure 1 illustrates the conceptual notification workflow implemented within the TANGKIS system, showing the four trigger points across the request lifecycle and the corresponding automatic email dispatch at each stage.

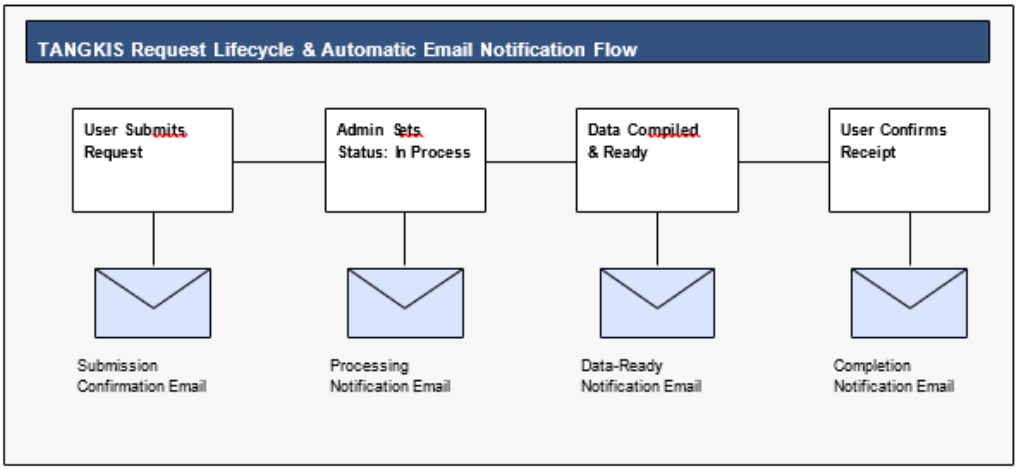


Figure 1. TANGKIS Request Lifecycle and Automatic Email Notification Flow

As visualized in Figure 1, each transition in the request lifecycle is directly coupled with a corresponding automated email notification, ensuring that the requesting user remains continuously informed without needing to proactively contact the PST officer or monitor the request status manually. This finding supports the argument of Zikra et al., (2024) that proactive, system-initiated notification mechanisms substantially reduce the communication burden on public-service staff while simultaneously improving the perceived responsiveness of the institution from the user's perspective.

Comparison with the Manual Process

A comparison between the manual and digital requesthandling workflow reveals a marked improvement in both processing transparency and notification speed. Under the manual process, users were typically informed of data readiness through an informal WhatsApp message or phone call sent at the staff member's discretion, often resulting in a delay of one to three days between the moment the data was actually ready and the moment the user became aware of it, particularly during periods of high staff workload. Following implementation of the TANGKIS system, the data-ready notification email is dispatched automatically and immediately upon the PST officer updating the request status, reducing the average data-readiness awareness delay from one to three days to under one minute, as confirmed by the latency results presented in Table 3. This finding is consistent with Zikra et al., (2025) assertion that automated, event-driven notification mechanisms are substantially more reliable than discretion-based manual communication in institutional public-service contexts.

Discussion

The results of this study demonstrate that integrating a structured, multi-stage request-tracking workflow with a technically validated automatic email notification mechanism effectively resolves the three core problems identified in the manual TANGKIS process at BPS East Lampung Regency: untracked and unprioritized incoming requests, inconsistent and delayed user notification, and the absence of a structured digital service-performance archive. Compared with the system developed by Zikra et al., (2025), whose automated email notification feature was implemented but never rigorously evaluated for delivery reliability, the present system directly closes that evaluation gap through a dedicated reliability and latency assessment. Furthermore, unlike Irawan et al., (2023) WhatsApp Gateway-based notification approach, which introduces recurring per-message costs and message-length constraints, the SMTP-based email notification mechanism implemented in this study incurs no marginal messaging cost while supporting detailed, professionally formatted status updates, making it a more sustainable solution for a government institution operating under constrained operational budgets.

The 100% notification delivery success rate and the sub-five-second average latency observed in this study also extend the findings of Jumadhil N & Syahputra M, (2024), whose in-app-only notification system required users to actively check the application to discover status updates; by contrast, the email-based push mechanism implemented here delivers status information directly to the user without requiring active engagement with the platform, which is particularly advantageous for occasional users such as researchers or students who may not regularly log into the system between submitting a request and awaiting its fulfillment.

This finding reinforces the argument of Putra (2026) that notification reliability testing encompassing both delivery success rate and latency should be treated as a standard evaluation component for any public-service system incorporating an automated notification feature, rather than relying solely on conventional functional testing, since a feature that functions correctly in triggering a notification provides limited practical value if the resulting message is delayed, lost, or never actually reaches the intended recipient. Beyond these direct comparisons, the findings of this study carry both theoretical and practical implications. Theoretically, the results substantiate the reliability-by-design principle articulated by Putra (2026): by binding each notification dispatch to an event listener attached to the request-status update function, the system guarantees that no status transition

can occur without a corresponding and logged notification attempt, thereby operationalizing notification reliability as an architectural property rather than an incidental outcome of the workflow.

The consistently low delivery latency further indicates that, for institutional request volumes of the scale handled by a regency-level PST unit, an authenticated SMTP relay constitutes a technically sufficient transport mechanism without recourse to paid third-party gateways. Practically, the reduction of the data-readiness awareness delay from one to three days to under one minute translates directly into improved service responsiveness and a reduced communication workload for PST officers, supporting the broader e-government objective of delivering more transparent and accountable public services through lightweight, low-cost digital infrastructure that is readily replicable across other regency-level BPS offices operating under comparable budgetary constraints. This is consistent with the broader argument of Sharmin & Chowdhury, (2025) that digitally enabled governance mechanisms strengthen public administration efficiency and transparency, reinforcing the position of automated notification systems within the wider e-governance agenda.

It should nonetheless be emphasized that the present evaluation was deliberately focused on the technical-performance dimension of the system namely functional correctness, delivery reliability, and delivery latency rather than on end-user perception. Consequently, established user-acceptance and usability instruments such as the System Usability Scale (SUS), the Technology Acceptance Model (TAM), and the Unified Theory of Acceptance and Use of Technology (UTAUT) were not administered in this study. While the objective performance gains reported here provide a necessary evidentiary foundation, they do not in themselves capture how end users subjectively perceive the system's ease of use, usefulness, or overall acceptability; the incorporation of such perception-based evaluation therefore represents an essential complementary step, which is addressed among the recommendations for future research. The value of such an approach is illustrated by Prihatin, T., et.al, (2023), whose Technology Acceptance Model evaluation of a village-level public-service information system revealed that perceived usefulness significantly shaped users' attitude and behavioral intention to use the system, underscoring that user-acceptance evaluation captures dimensions of system success that technical-performance testing alone cannot reveal.

Nevertheless, several limitations should be acknowledged. First, the current notification mechanism relies exclusively on the email channel; users who do not regularly check their email or who have entered an incorrect email address during request submission may not receive timely notifications, a limitation that could be mitigated through a secondary notification channel such as WhatsApp Business API integration, as suggested by (Armiati et al., 2024). This aligns with the findings of Lian et al., (2023), who reported that incorporating WhatsApp-based communication into public administrative services significantly improved service quality and responsiveness compared with a single conventional channel. Second, the reliability testing in this study was conducted under controlled conditions with 30 simulated requests over a limited testing period; delivery performance under sustained, high-volume production usage particularly during peak statistical publication periods when request volume typically increases has not yet been empirically evaluated and may differ from the controlled- test results. Third, this study did not incorporate a quantitative user-satisfaction evaluation instrument such as the System Usability Scale (SUS) to formally measure end-user perception of the new system relative to the previous manual process.

CONCLUSION

This study successfully designed and developed a web-based TANGKIS information system with an automatic email notification feature for BPS East Lampung Regency using the SDLC Waterfall model. The system digitizes statistical data request submission and tracking, provides a centralized management dashboard, and automatically notifies users at four request-lifecycle stages. Black Box Testing confirmed 100% functional validity across 20 features, while 30 simulated notifications achieved a 100% delivery rate at an average latency of 4.8 seconds, reducing the data-readiness awareness delay from one to three days to under one minute. From a policy perspective, these findings show that low-cost, event-driven digital infrastructure can advance the digital transformation of government statistical services and is readily replicable across other regency-level BPS offices. Future work should integrate a WhatsApp Business API channel, conduct sustained production-scale reliability testing, and administer a System Usability Scale (SUS) evaluation to measure user satisfaction with the new system.

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