RESEARCH ARTICLE

Development of a Web-Based Integrated Payroll Information System: A case study of multi-branch distribution operations at CV Katansa

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Abstract

Geographically dispersed enterprise operations often face severe administrative bottlenecks when relying on decentralized, spreadsheet-based payroll management. CV Katansa, a building materials distribution enterprise with operational headquarters, marketing offices, and regional warehouses located separately across Tegal, Brebes, and Banyumas, experienced recurring payroll delays, data redundancy, and a lack of individualized salary slips due to manual spreadsheet workflows transmitted via email. To address these operational constraints, this study developed an integrated web-based employee payroll information system using the classical Waterfall software engineering life cycle, comprising systematic requirements analysis, Unified Modeling Language (UML) architectural design, relational database modeling using Entity-Relationship Diagrams (ERD) and Logical Record Structures (LRS), PHP and MySQL implementation, and rigorous black-box validation. The resulting system centralizes multi-role data access for super administrators, finance administrators, and marketing supervisors, automating salary calculations that integrate base compensation, position allowances, and sales performance incentives. Black-box functional testing across authentication, user management, employee records, job positions, sales incentives, and payroll transaction processing modules confirmed 100% test case validity with zero logic defects. Real-time digital payslip generation and automated financial reporting reduced the monthly payroll cycle time while eliminating cross-branch calculation discrepancies. In conclusion, the web-based payroll platform eliminates operational delays, ensures transactional accuracy, and enhances organizational transparency in multi-branch distributor environments.

Keywords: Payroll information system; Waterfall model; Web-based application; Black-box testing; Enterprise systems

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1 Introduction

In modern commercial operations, enterprise productivity and financial integrity depend heavily on the speed, accuracy, and reliability of administrative workflows [1]. Small and medium-sized distribution enterprises (SMEs) frequently operate across geographically separated branches, requiring seamless data synchronization between field marketing divisions, logistics warehouses, and central financial management [2], [3]. However, many developing commercial organizations continue to execute core administrative functions—particularly employee compensation and payroll accounting—through decentralized desktop spreadsheets and asynchronous email transmissions [4], [5]. Such disconnected operational mechanisms introduce severe vulnerabilities, including duplicated data entry, delayed salary disbursements, human calculation errors, and inadequate financial transparency [6], [7].

CV Katansa is a commercial building materials distributor specializing in asbestos distribution across the Tegal, Brebes, and Pemalang regencies in Central Java, Indonesia. Due to rapid commercial expansion, the enterprise distributed its operational facilities across three separate physical locations: the commercial marketing and field sales branch in Kertayasa (Tegal Regency), the central administrative and financial headquarters in Kandang Gampang (Purbalingga Regency), and the central logistics distribution warehouse in Sokaraja (Banyumas Regency). Under the legacy operational workflow, the marketing supervisor in Tegal manually recorded sales achievements, field attendance, and monthly

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compensation using Microsoft Excel spreadsheets. At each month's end, this spreadsheet file was transmitted via email to the central finance administration in Purbalingga for audit, verification, and bank transfer authorization.

This decentralized legacy procedure introduced three critical operational failures. First, physical separation and reliance on asynchronous email communications caused frequent payroll computation delays, requiring days of reconciliation before salary funds could be disbursed. Second, unstructured file storage led to data redundancy, version divergence, and the accumulation of unindexed spreadsheet files prone to accidental alteration or corruption [8], [9]. Third, the enterprise lacked an automated mechanism to generate individualized pay slips; consequently, field sales personnel and operational staff received net bank transfers without transparent documentation regarding base salary, transportation allowances, communication subsidies, or performance-based sales unit incentives [5].

Previous investigations into enterprise payroll automation highlight the effectiveness of centralized web-based information architectures in eliminating inter-departmental latency [3], [4], [6]. Moenir and Yuliyanto [4] demonstrated that transitioning from spreadsheet-based recording to a structured web application accelerated payroll reporting cycles at manufacturing firms. Similarly, Widarma and Rahayu [3] established that database-driven payroll architectures significantly reduce arithmetic errors in gross and net pay calculations. Furthermore, the classic Waterfall software engineering life cycle provides a disciplined, structured framework for developing transaction-oriented business information systems where operational requirements are well-defined and stable [10], [11], [12].

To resolve the administrative bottlenecks at CV Katansa, this research designed and implemented a centralized, web-based Employee Payroll Information System. Utilizing the Waterfall software development methodology, the system models multi-role access control, unifies employee master data, automates multi-component salary and sales incentive calculations, and provides instant digital payslips and audit-ready management reports. This paper documents the end-to-end engineering life cycle of the system, including requirements engineering, Unified Modeling Language (UML) architectural modeling, relational database design, prototype implementation, and exhaustive black-box validation.

2 Methods

The development of the web-based employee payroll information system followed a structured software engineering framework based on the classic Waterfall model [12], [13]. The sequential stages comprising this research methodology are depicted systematically in the operational life cycle: Requirements Analysis, System Design, Coding/Implementation, Testing, and Maintenance.

2.1 Research Design and Software Development Life Cycle

The Waterfall life cycle was selected due to its sequential, milestone-driven approach, which ensures thorough verification at each phase before advancing to subsequent implementation stages [10], [11]. The five core stages applied in this investigation were:

1. **Requirements Analysis:** Eliciting operational, functional, and data requirements through field observations and stakeholder interviews to define complete system boundaries and user privileges [14].
2. **System Design:** Translating functional requirements into formal structural blueprints, including use case diagrams, activity workflows, sequence diagrams, class diagrams, Entity-Relationship Diagrams (ERD), Logical Record Structures (LRS), and interface wireframes [2].
3. **Coding and Implementation:** Constructing the relational database schema in MySQL/MariaDB and developing the web application using PHP, HTML5, Cascading Style Sheets (CSS), and JavaScript within the Apache web server environment [15].
4. **Testing:** Conducting comprehensive black-box functional testing across all user roles, navigation paths, form submissions, data validations, and mathematical computation routines [16].
5. **Maintenance and Deployment:** Deploying the system within the enterprise's local intranet/cloud environment, establishing data backup routines, and evaluating operational readiness.

2.2 Data Collection and Requirements Elicitation

Data collection was conducted through three empirical methodologies:

- **Direct Field Observation:** Systematic on-site examination was conducted at CV Katansa's marketing branch office in Kertayasa, Kramat, Tegal. The workflow of monthly sales tallying, manual incentive calculation, and inter-office email correspondence was documented to identify operational bottlenecks.
- **Structured Interviews:** In-depth interviews were conducted with key enterprise stakeholders, including the operational supervisor (Mr. A3 Syaiful Atiq, S.T.) and financial administrative personnel. These interviews established

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specific business rules regarding job position allowances, incentive tiers per asbestos product unit sold, and required management report structures.
- **Literature Review:** Theoretical and empirical studies on enterprise payroll automation, database normalization, and web application architecture were surveyed to guide system design [4], [5], [8].

2.3 System and Database Architectural Modeling

System analysis and design employed the Unified Modeling Language (UML) to represent actor interactions, dynamic behaviors, and object structures [2], [14]. Database architecture was established via Entity-Relationship Diagrams (ERD), mapped to Logical Record Structures (LRS) based on relational cardinality principles:

- One-to-One ($1:1$) relationships embed the foreign key in either entity or combine tables.
- One-to-Many ($1:M$) relationships propagate the primary key of the "One" entity as a foreign key into the "Many" entity [8].
- Many-to-Many ($M:N$) relationships resolve into intermediate composite junction tables containing foreign keys from both parent entities.

Data dictionaries and file specifications were defined for five core relational entities: `user`, `karyawan` (employee), `jabatan` (job position), `insentif` (sales incentive), and `gaji` (payroll transaction).

2.4 Mathematical Formulation of Payroll Components

The payroll system computes total employee take-home compensation through a deterministic linear formulation combining base salary, job-specific allowances, and volume-based sales incentives. For employee i in billing period t:

$$T_i = B_j + M_j + P_j \tag{1}$$

$$I_i = Q_i \times V_i \tag{2}$$

$$G_i = T_i + I_i \tag{3}$$

where T_i represents the fixed position-based compensation comprising base salary B_j, motorcycle vehicle allowance M_j, and communication allowance P_j for job position j. The performance-based sales incentive I_i is determined by the total quantity of product units sold Q_i multiplied by the per-unit incentive rate V_i. The gross total payroll disbursement G_i represents the sum of fixed compensation and variable sales incentives.

2.5 Verification and Testing Strategy

Functional validation was performed using black-box testing methodology [16], [17]. Black-box testing evaluates the software against specified functional requirements without examining internal source code logic. Boundary value analysis and equivalence partitioning were applied across authentication, data input forms, mathematical computation routines, and PDF export functions to verify that valid inputs yield expected outputs and invalid inputs trigger proper validation warnings.

3 Results and Discussion

3.1 User Role and Functional Requirement Analysis

System requirements analysis identified three distinct user actors with strictly partitioned access rights:

1. **Super Administrator:** Possesses full unrestricted privileges, including system configuration, user account creation and role modification, master data management (employees, job positions, incentives), payroll computation, and access to all financial reports.
2. **Finance Administrator (Administrasi Keuangan):** Responsible for operational payroll processing. Privileges include user registration, login, employee record management (CRUD), job position allowance configuration, incentive calculation, monthly payroll transaction recording, payslip printing, and monthly payroll report generation.
3. **Marketing Supervisor:** Operates at the branch office level. Privileges include authentication, viewing employee lists, configuring job position and incentive parameters, initiating monthly payroll calculations, and generating payslips for field personnel.

The use case models illustrating interactions for both operational user roles are presented side-by-side in Fig. 1.

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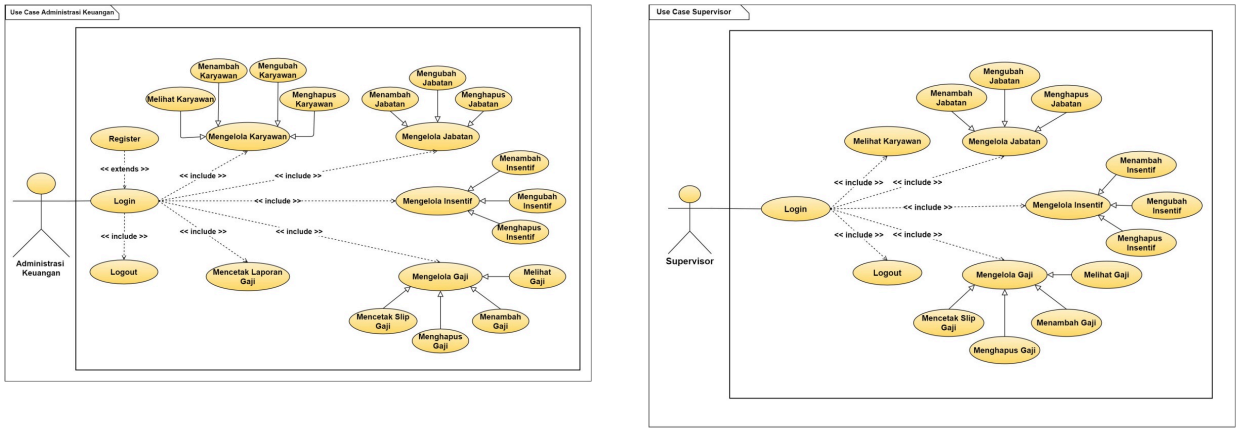

(a) Finance Administrator

(b) Marketing Supervisor

Fig. 1: Use case diagrams for key enterprise user roles: (a) Finance Administrator and (b) Marketing Supervisor.

3.2 Architectural and Relational Database Modeling

The structural relationship between business entities was modeled through an Entity-Relationship Diagram (ERD), which was subsequently transformed into the Logical Record Structure (LRS) illustrated in Fig. 2 and Fig. 3.

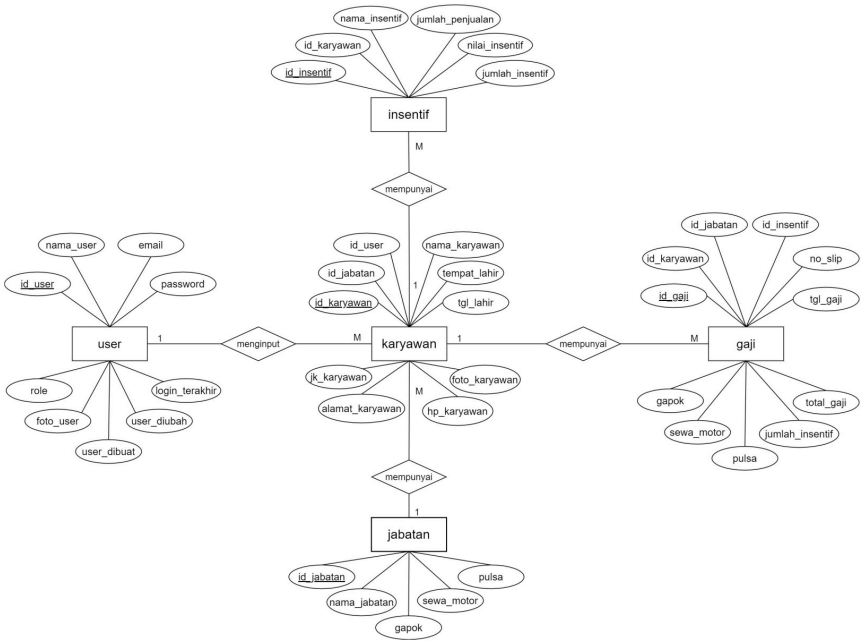

Fig. 2: Entity-Relationship Diagram (ERD) defining system entities and relational multiplicities.

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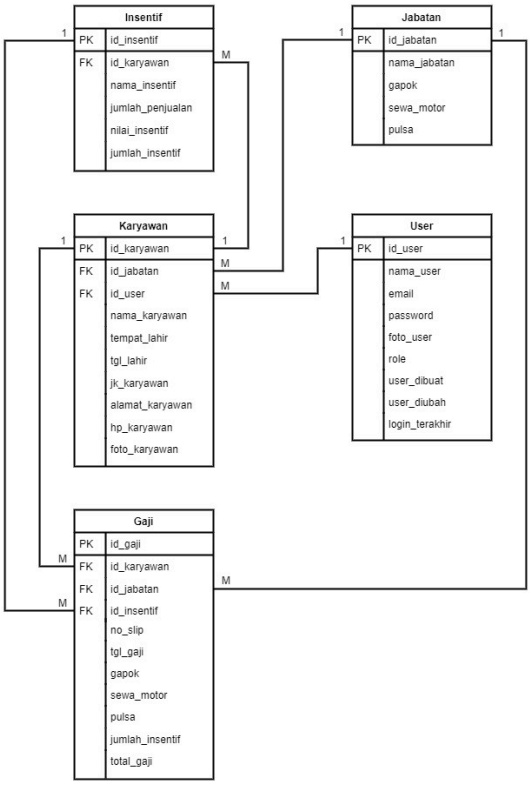

Fig. 3: Logical Record Structure (LRS) defining relational table links and key dependencies.

The relational database schema is structured into five core tables:

- `user`: Stores system credentials, user names, email contacts, and privilege levels.
- `karyawan`: Contains demographic and contact details for all active staff members.
- `jabatan`: Defines organizational roles, base salary scales, and operational allowances.
- `insentif`: Records periodic unit sales targets, actual volumes achieved, and incentive rates.
- `gaji`: Records finalized transactional payroll disbursements with unique voucher identifiers.

The physical specifications for key relational tables are detailed in Table 1, Table 2, and Table 3.

Table 1: Data dictionary specification for the employee table (`karyawan`).

Field Name	Data Type	Length	Constraint	Description
`id_karyawan`	INT	11	Primary Key	Unique employee identification number
`nik`	VARCHAR	20	Unique	National / company employee identity number
`nama`	VARCHAR	50	Not Null	Full name of employee
`tempat_lahir`	VARCHAR	30	Not Null	Birthplace location
`tgl_lahir`	DATE	-	Not Null	Date of birth
`jenis_kelamin`	VARCHAR	15	Not Null	Gender classification
`alamat`	TEXT	-	Not Null	Residential address
`no_telp`	VARCHAR	15	Not Null	Contact telephone number

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Table 2: Data dictionary specification for the position table (`jabatan`).

Field Name	Data Type	Length	Constraint	Description
`id_jabatan`	INT	11	Primary Key	Unique position identifier
`nama_jabatan`	VARCHAR	30	Not Null	Designation title (e.g., Supervisor, Sales)
`gaji_pokok`	INT	11	Not Null	Base monthly salary amount in IDR
`sewa_motor`	INT	11	Not Null	Motorcycle vehicle operational allowance
`pulsa`	INT	11	Not Null	Mobile cellular communication allowance

Table 3: Data dictionary specification for the payroll transaction table (`gaji`).

Field Name	Data Type	Length	Constraint	Description
`id_gaji`	INT	11	Primary Key	Unique transaction identifier
`id_karyawan`	INT	11	Foreign Key	Reference to `karyawan` table
`id_jabatan`	INT	11	Foreign Key	Reference to `jabatan` table
`no_slip`	VARCHAR	20	Unique	Standardized payslip serial code (e.g., SLP2007001)
`id_insentif`	INT	11	Foreign Key	Reference to `insentif` table
`tgl_gaji`	DATE	-	Not Null	Transaction settlement timestamp

The object-oriented software structure coordinating controller actions, data models, and database access is modeled via the Class Diagram shown in Fig. 4.

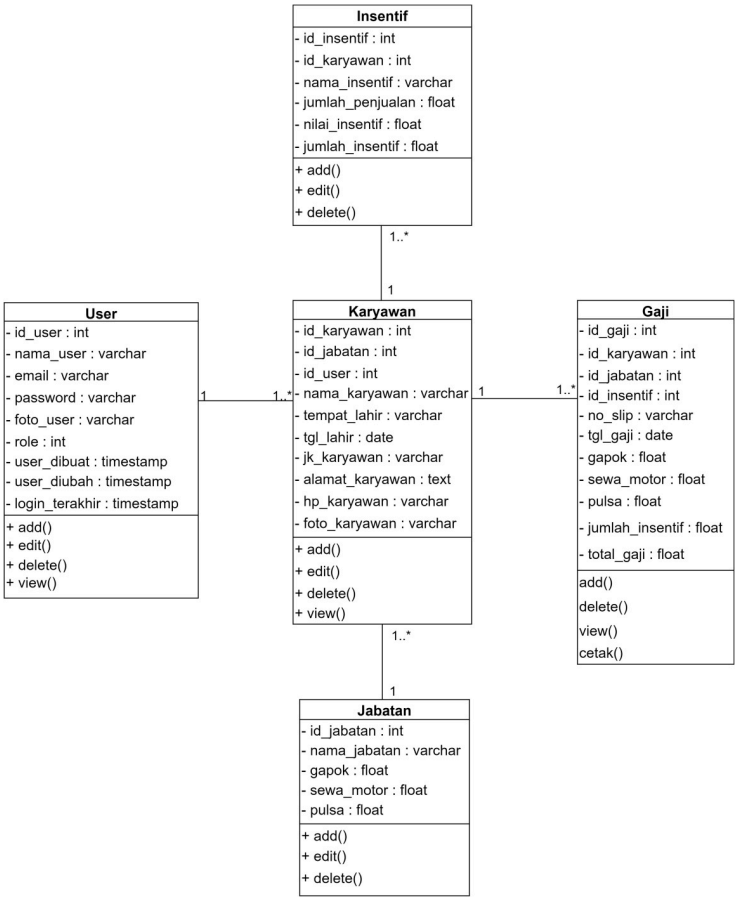

Fig. 4: Class Diagram representing system entity classes, attributes, and methods.

3.3 System Implementation and User Interface

The web application was implemented using standard multi-tier web technologies. The interface design emphasizes operational clarity, rapid navigation, and input validation to minimize human data-entry mistakes.

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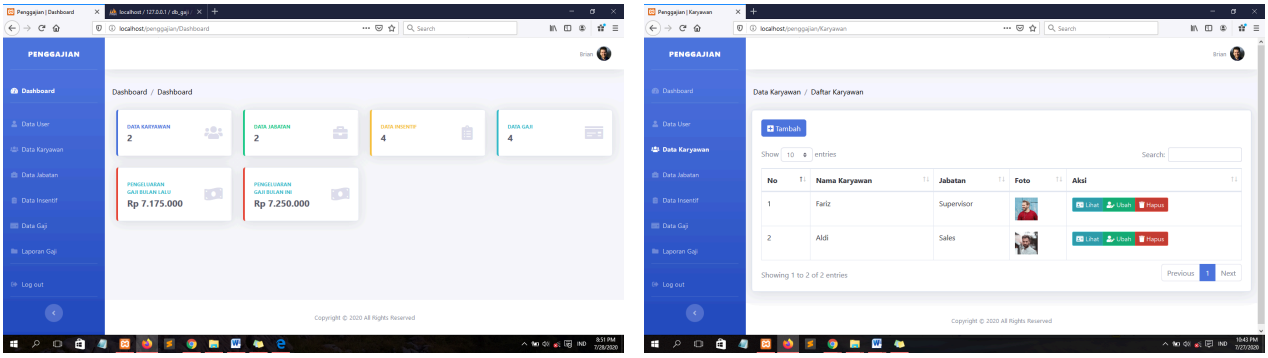
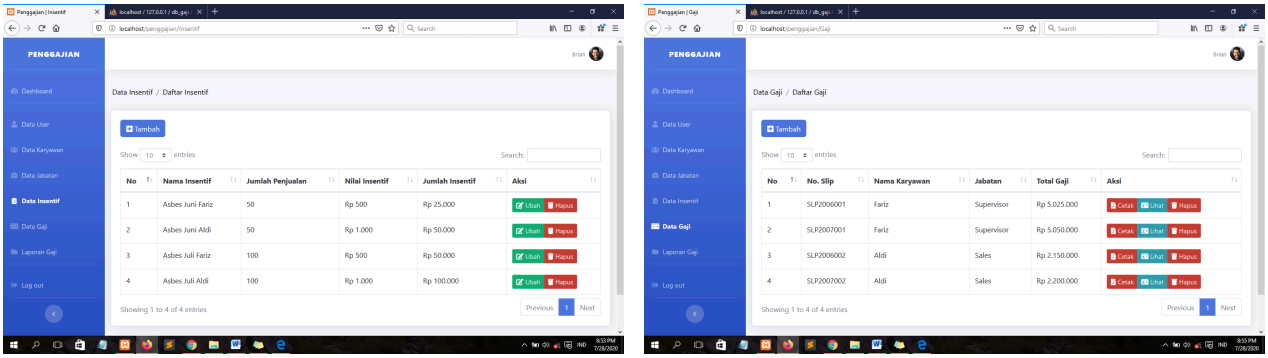


(a) Executive Dashboard Interface **(b)** Employee Master Data Management

Fig. 5: Administrative interfaces: (a) executive dashboard and (b) employee master data management.

As depicted in Fig. 5(a), the central dashboard provides administrative users with summary metric cards and immediate access to master data entities. The employee management interface (Fig. 5(b)) enables finance personnel to create, update, and search employee profiles. Each employee is mapped to organizational job roles that dynamically link to base salary structures.

The sales incentive management module (Fig. 6(a)) enables marketing supervisors to record monthly product sales quantities achieved by sales representatives and specify per-unit incentive amounts. The system automatically computes total incentive earnings according to Equation 2. The payroll processing module (Fig. 6(b)) aggregates base salary, position allowances, and sales incentives into a unified transaction. Each transaction generates a standardized alphanumeric slip code (e.g., `SLP2007001`).



(a) Sales Incentive Configuration **(b)** Payroll Transaction Processing

Fig. 6: Transaction processing interfaces: (a) sales incentive configuration and (b) payroll transaction processing.

Upon transaction completion, the system produces official digitized payslips (Fig. 7(a)) and cumulative monthly payroll reports (Fig. 7(b)) ready for auditing and executive approval.

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CV. KATANSA

Jl. Raya Klahang No. 100 Rt. 03 Rw. 01 Klahang, Sokaraja, Banyumas

Nomor Telp : (0281) 891305 | Email : cv.katansa@gmail.com

SLIP GAJI KARYAWAN

Nama : Fariz
Jabatan : Supervisor
No. Slip : SLP2007001
Tanggal : 31 Juli 2020

No	Keterangan	Jumlah
1	Gaji Pokok	Rp 5.000.000
2	Sewa Motor	Rp 0
3	Pulsa	Rp 0
4	Insentif	Rp 50.000
Total Diterima :		**Rp 5.050.000**

Penerima

Fariz

(a) Itemized Payslip Voucher



CV. KATANSA

Jl. Raya Klahang No. 100 Rt. 03 Rw. 01 Klahang, Sokaraja, Banyumas

Nomor Telp : (0281) 891305 | Email : cv.katansa@gmail.com

Laporan Gaji Karyawan

No	No. Slip	Nama Karyawan	Jabatan	Gaji Pokok	Pulsa	Sewa Motor	Insentif	Total Gaji
1	SLP2006001	Fariz	Supervisor	Rp 5.000.000	Rp 0	Rp 0	Rp 25.000	Rp 5.025.000
2	SLP2007001	Fariz	Supervisor	Rp 5.000.000	Rp 0	Rp 0	Rp 50.000	Rp 5.050.000
3	SLP2006002	Aldi	Sales	Rp 1.750.000	Rp 250.000	Rp 100.000	Rp 50.000	Rp 2.150.000
4	SLP2007002	Aldi	Sales	Rp 1.750.000	Rp 250.000	Rp 100.000	Rp 100.000	Rp 2.200.000
Total Gaji yang Di Keluarkan								**Rp 14.425.000**

(b) Cumulative Monthly Payroll Summary Report

Fig. 7: Official system outputs: (a) employee itemized payslip voucher and (b) executive monthly payroll summary report.

3.4 Functional Verification and Black-Box Testing

To ensure robust operation and software reliability, black-box testing was conducted across all core modules. Test scenarios evaluated form field constraints, duplicate record prevention, required-field validations, calculation accuracy, and report rendering.

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Table 4: Black-box testing execution results across key functional modules.

No	Module & Scenario	Test Input / Action	Expected Output	Result
1	User Registration	Leave required fields empty and click submit	System rejects submission and displays validation warning	Valid
2	User Registration	Submit complete valid user data	System registers account and redirects to login interface	Valid
3	Authentication	Enter incorrect password	System blocks access and displays authentication error alert	Valid
4	Authentication	Enter valid credentials	System authenticates session and loads dashboard	Valid
5	Employee Management	Submit employee form with empty NIK and Name	System rejects entry with mandatory field notifications	Valid
6	Employee Management	Submit complete employee record	Record stored in database and table list refreshed	Valid
7	Job Position Setup	Enter position name and allowance values	Position record saved with correct currency formatting	Valid
8	Sales Incentive Setup	Input sales volume and unit rate for employee	Total incentive computed accurately and saved	Valid
9	Payroll Transaction	Process salary without selecting slip number	System rejects transaction with mandatory slip alert	Valid
10	Payroll Transaction	Select employee, position, and incentive, then save	Full salary computed, transaction saved, slip generated	Valid
11	Payslip Output	Click print payslip icon on transaction row	Pop-up window renders itemized PDF payslip	Valid
12	Payroll Summary Report	Filter by month/year and click export	Consolidated financial payroll summary report generated	Valid

As summarized in Table 4, all twelve major testing scenarios executed successfully in accordance with expected outcomes, verifying 100% functional validity without runtime crashes or mathematical anomalies.

3.5 Discussion and Empirical Significance

The implementation of the web-based payroll information system directly resolves the operational shortcomings identified during the field study at CV Katansa:

1. **Elimination of Cross-Branch Latency:** By replacing asynchronous email exchanges with a centralized web database, data recorded by the marketing supervisor in Tegal is instantly accessible to finance administrators in Purbalingga. This eliminates the multi-day latency previously required to reconcile spreadsheets.
2. **Data Integrity and Elimination of Redundancy:** Centralized relational storage in MySQL eliminates duplicate Excel files across local branch computers, ensuring a single source of truth for employee records, sales commissions, and historical payments [8], [14].
3. **Transparency and Employee Satisfaction:** The automated generation of itemized payslips (Fig. 7) provides employees with full visibility into their compensation breakdown, including base salary, vehicle allowance, mobile allowance, and sales unit commissions, resolving long-standing employee inquiries.
4. **Management Reporting Accuracy:** Automated calculation routines eliminate human arithmetic errors inherent in manual spreadsheet formulas, producing verified monthly payroll summaries (Fig. 7) for executive decision-making [3], [4].

4 Conclusion

This study successfully developed and validated a web-based employee payroll information system for CV Katansa using the Waterfall software engineering life cycle. The platform effectively bridges the geographical separation between the marketing branch in Tegal and the administrative headquarters in Purbalingga by establishing a centralized, multi-role web application. Key features including employee master data management, dynamic sales incentive calcu-

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lations, automated transaction processing, digitized payslip printing, and monthly payroll reporting were designed, implemented, and verified. Black-box testing demonstrated 100% functional validity across all test cases with zero logic errors. The system significantly accelerates monthly payroll processing cycles, eliminates data redundancy, and enhances financial transparency for both management and employees. Future research and system development should focus on integrating dynamic multi-tiered product commission structures, an automated mobile attendance recording module, and cloud-based automated database backup mechanisms.

CRediT authorship contribution statement

Y. P. Chaeriko: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization, Project Administration.

Declaration of competing interest

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics statement

This study did not involve human clinical trials or animal experimentation. Informed consent was obtained from the organizational stakeholders and management of CV Katansa for the observational data collection and workflow analysis conducted during this research.

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Data availability

The software source code and anonymized sample datasets generated during the current study are available from the corresponding author upon reasonable academic request.

Author Biographies

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Yunsi Pasmalisya Chaeriko received her Associate Degree (A.Md.Kom.) in Information Systems from Universitas Bina Sarana Informatika, Tegal, Indonesia, in 2020. Her academic and practical interests focus on web engineering, enterprise resource planning, transactional database architecture, and business information systems.

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