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DEVELOPMENT OF INTEGRATED DIGITAL HR SYSTEM USING WATERFALL FOR LEAVE AND REPORT MANAGEMENT

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Abstract— *Digitalization in human resource management (HRM) is crucial for modern companies. Several previous studies have discussed HRM, but only a few have focused explicitly on developing leave applications and daily reports, especially regarding comprehensive data recapitulation. Until now, no research has explicitly designed an integrated HRM model incorporating these essential features. In response to this gap, this study presents the design and development of a digital HR management system named "CUTI DULU" to manage leave requests and daily reports. The system was developed Using the Waterfall SDLC model on the Laravel framework to streamline development. It incorporates role-based access control (RBAC) for user permissions and employs JSON Web Tokens (JWT) for secure authentication; data transmission and storage are protected by industry-standard encryption protocols. User Acceptance Testing (UAT) by IT experts and employees verified that the system met functional requirements. Results showed that average leave request processing time fell from four days to about five hours, and administrative errors (e.g. duplicate entries or miscalculations) decreased by 80.95%. Survey responses indicated high satisfaction: 94% of IT experts and 92% of end users reported that the system met their needs. By automating leave and reporting workflows, the proposed system significantly improves administrative efficiency, data transparency, and HR process accuracy. While these results are promising, the current study is limited to a single organizational context, and its broader applicability remains to be validated. Future work should investigate its adaptability across diverse institutional settings to confirm its scalability and generalizability*.

Keywords: *entity relationship diagram, human resource management, SDLC, UAT, waterfall.*

Intisari— *Digitalisasi dalam manajemen sumber daya manusia menjadi aspek krusial bagi perusahaan modern. Beberapa penelitian sebelumnya telah membahas topik manajemen SDM, namun hanya sedikit yang secara eksplisit menyoroti pengembangan aplikasi cuti dan pelaporan harian, khususnya dalam hal rekapitulasi data yang komprehensif. Hingga saat ini, belum ada penelitian yang secara khusus merancang model manajemen SDM terintegrasi yang mencakup fitur-fitur esensial tersebut. Menanggapi kesenjangan ini, penelitian ini menyajikan perancangan dan pengembangan sistem manajemen SDM digital bernama "CUTI DULU" yang ditujukan untuk mengelola permohonan cuti dan laporan harian. Sistem ini dikembangkan menggunakan model Waterfall dalam kerangka SDLC berbasis Laravel untuk mempermudah proses pengembangan. Sistem ini juga mengimplementasikan kontrol akses berbasis peran RBAC untuk pengaturan izin pengguna dan menggunakan JWT sebagai metode autentikasi yang aman; sementara itu, transmisi dan penyimpanan data dilindungi oleh protokol enkripsi standar industri. Pengujian Penerimaan Pengguna UAT yang dilakukan oleh pakar TI dan karyawan menunjukkan bahwa sistem telah memenuhi kebutuhan fungsional. Hasil evaluasi menunjukkan bahwa rata-rata waktu pemrosesan permohonan cuti menurun dari empat hari menjadi sekitar lima jam, dan kesalahan administratif (seperti entri ganda atau kesalahan perhitungan) berkurang sebesar 80,95%. Hasil survei juga menunjukkan tingkat kepuasan yang tinggi: 94% pakar TI dan 92% pengguna akhir menyatakan bahwa sistem memenuhi kebutuhan mereka. Dengan mengotomatisasi alur kerja cuti dan pelaporan, sistem yang diusulkan secara signifikan meningkatkan*

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efisiensi administratif, transparansi data, dan akurasi proses SDM. Meski hasil awal menunjukkan potensi, penelitian ini terbatas pada satu organisasi, sehingga perlu pengujian lebih lanjut di berbagai institusi untuk menilai skalabilitas dan generalisasinya.

***Kata Kunci**: diagram hubungan entitas, manajemen sumber daya manusia, sdlc, uat, waterfall.*

INTRODUCTION

According to Indonesia's Central Bureau of Statistics, the number of medium- and large scale manufacturing companies reached 32,193 in 2023. This expansion intensifies competition in the sector, prompting firms to pursue innovations that boost efficiency and performance. In this context, digital transformation has become a strategic priority: experts note that adopting digital technologies helps businesses stay competitive in a rapidly evolving market [1]. Indeed, digital transformation is credited with improving operations, streamlining processes, and lowering costs, which are crucial advantages for companies like ABC Company [2][3].

In particular, the digitization of Human Resource Management (HRM) processes can significantly enhance productivity and reduce administrative burdens. Modern HR platforms enable the integration of functions such as attendance tracking, leave management, performance evaluation, and payroll into a single system, creating seamless data flow across HR operations and even enabling predictive analytics [4]. As one study observes, digitizing HR processes reduces complexity and bureaucracy while improving administrative quality and flexibility [5].

Despite these general advances, ABC Company has not yet realized such benefits in practice. Currently, the processes for managing leave requests and daily work reports remain largely manual and disconnected. Employees submit paper leave forms and separately record daily activities, with these records handled independently by different staff. This paper-based approach is slow and error-prone; for instance, manual leave processes often result in lost paperwork and wasted administrative effort [6]. Because leave approvals are not automatically linked to work logs, managers must manually reconcile multiple records, Previous attempts to integrate leave and reporting systems at ABC Company have failed for several reasons: the absence of a unified digital platform, reliance on legacy paper processes, lack of investment in customized software, and organizational resistance to change. Earlier solutions treated leave management and daily reporting as separate issues, overlooking the need for real-time, cross-functional data integration. As a result, these fragmented efforts did not achieve the operational cohesion required for seamless HR workflows, undermining transparency and hindering timely decision-making. [7].

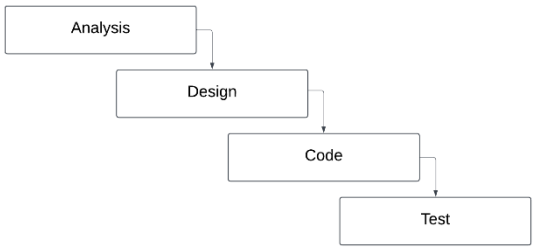
To date, numerous studies have proposed digital application models to improve HRM efficiency, especially in attendance, leave management, and daily reporting. These studies highlight how digital platforms can automate the collection of attendance and performance data, improve data accuracy, and support more effective payroll and workforce evaluation processes [8]. For example, integrated dashboards and mobile access can facilitate real-time reporting, while web-based systems can streamline leave approval workflows and reduce administrative burdens. Collectively, these works underscore the growing reliance on data-driven HR practices and enhance organizational accountability [8].

Building on these insights, this study proposes an integrated digital solution for managing leave and daily reporting at ABC Company. Developed using a structured SDLC Waterfall methodology [9]. the system automates workflows such as leave submission, approval, and tracking, and provides an online platform for inputting and reviewing daily performance records. By centralizing these functions in a single application, the system is expected to enhance administrative efficiency, improve data accuracy, and support greater transparency. Division heads will benefit from real-time access to employee activity and leave data, enabling more timely, data-driven decisions and strengthening organizational accountability. Ultimately, this study addresses the lack of an integrated digital framework for leave and daily reporting within the company, thereby aligning operational practices with the broader goals of efficiency and transparency.

MATERIALS AND METHODS

The software development in this research followed the Software Development Life Cycle (SDLC) using the Waterfall model, a linear and sequential approach where each phase must be completed before the subsequent phase begins Figure 1. This model was selected to ensure that the

outputs of each phase serve as structured inputs for the next, enabling systematic planning, execution, and evaluation across all development stages [10].



Source: (Research Results, 2025)
Figure 1. Illustration of the Waterfall Model

1. Analysis

The analysis phase involved identifying both functional and non-functional requirements through structured interviews with three key stakeholders in the organization: the division head, the human resources team, and the IT department. The insights gained were documented and formalized in the Software Requirements Specification (SRS), which served as the foundation for designing workflows and system features. This phase also incorporated the identification of essential security needs, including the use of secure password hashing, access control mechanisms, and data encryption strategies to ensure confidentiality, integrity, and availability in subsequent development phases.

2. Design

The system design stage uses a unified modelling language (UML). UML diagrams used include use cases and activities. In addition, database design is also carried out at this stage. The outcome of this phase is a set of structured blueprints used for implementation.

3. Code

The implementation phase translated the system designs into executable code using several programming languages and frameworks. The system was developed using PHP as the primary server-side language, leveraging the Laravel framework to facilitate structured development and enhance maintainability. Laravel built in features, such as Eloquent ORM, streamlined database interactions, while middleware components were used to manage authentication and access control [11]. Additional technologies included HTML for structuring web content and JavaScript for improving client-side interactivity [12][13]. Security features were systematically implemented: bcrypt was employed to hash user passwords securely JWT (JSON Web Token) was used to manage user sessions and authenticate requests; RBAC ensured that access rights aligned with organizational roles; and input validation routines, combined with a WAF layer, safeguarded the system against external threats.

4. Test

At this stage, the system was evaluated through User Acceptance Testing (UAT), which involved two groups of participants: IT experts and end users. This testing aimed to assess the extent to which the system meets the required functionality, usability, and security standards before deployment in a real operational environment. These results validate the success of the preceding SDLC steps, with minimal revisions needed before the operational stage.

RESULTS AND DISCUSSION

Analysis of system requirements

The analysis identified specific system requirements based on the roles of users: Employees, Division Heads, and Admins. Employees require an intuitive interface to submit leave requests, including information such as the type of leave, start and end dates, and the rationale. Additionally, they need functionality to submit daily work activity reports. Division Heads must be able to approve or reject leave requests and monitor employee performance via daily reports. The Admin role includes full access to manage users, divisions, schedules, leave data, and perform CRUD operations. These requirements serve as the foundation for the system's design and functionality.

System design

The system architecture was designed to align with user roles and access restrictions. Admins have full system access, including managing employee data, divisions, daily reports, and leave schedules. Division Heads can view and manage data related to employees in their divisions, including performance evaluations and leave monitoring. Employees can log in, access dashboards, submit daily reports, and request leave.

The Use Case Diagram Figure 2 illustrates the interactions between the three user roles and the system, emphasizing the submission of leave requests and reporting of daily activities. Meanwhile, the Activity Diagrams Figures 3 and 4 detail the workflows for Employees, Division Heads, and Admins. These diagrams reflect the logical flow

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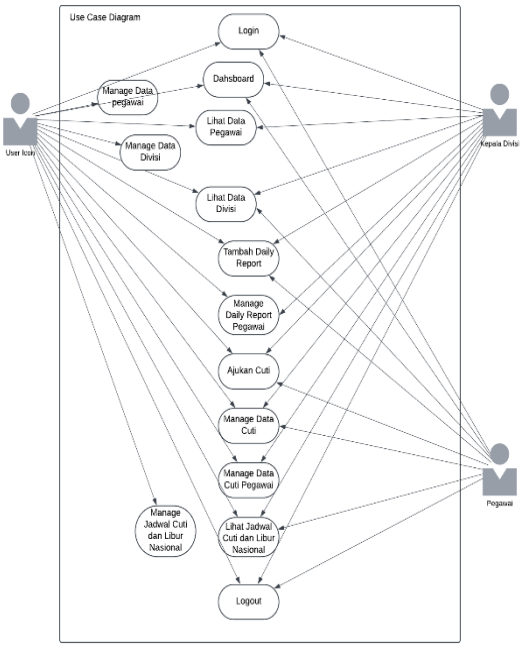
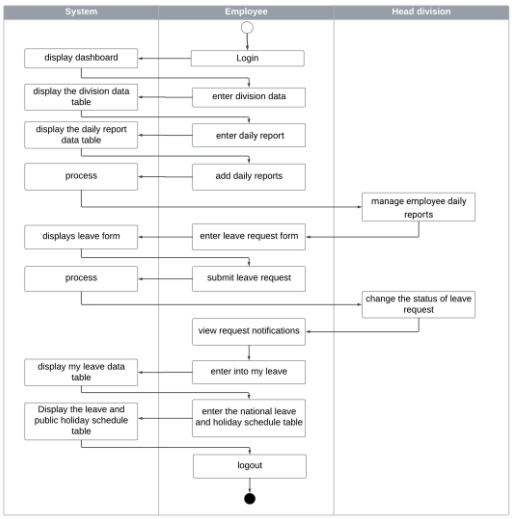
of actions from login to data management and leave approval processes. [14].



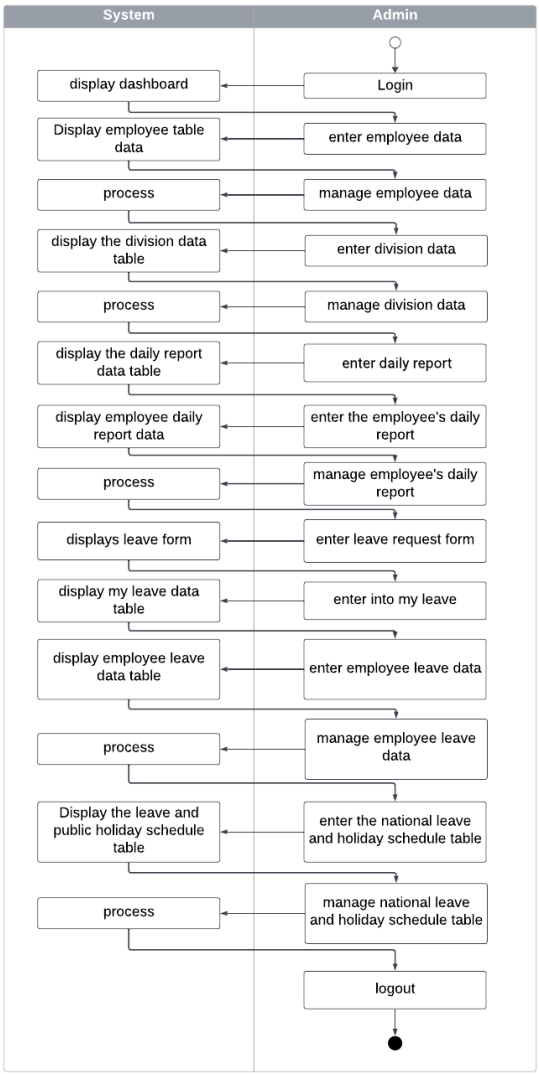
Source: (Research Results, 2025)
Figure 2. Use Case Diagram

An Activity Diagram is a UML diagram that describes the flow of activities in a system [15]. Figure 3 illustrates activities related to leave requests and daily reports involving two users, namely Employees and division heads.



Source: (Research Results, 2025)
Figure 3. Activity Diagram of Leave Request and Daily Report

This diagram shows the flow of leave requests and daily reports, which starts when the Employee logs in. After logging in, Employees can view division data, fill out daily reports, and add new reports. The leave request is then sent for processing and review by the division heads, who are responsible for changing the status of the leave request to approved or rejected. Employees can monitor the status of their leave requests through notifications displayed on the system and view personal leave data and schedules for leave and public holidays.



Source: (Research Results, 2025)
Figure 4. Admin Activity Diagram

The Admin user has the authority for full access to the system to manage all existing data. As the highest authority in the system, the Admin is responsible for managing Employee data, division data, daily reports, leave and public holiday schedules. Admin tasks include adding, changing, and deleting Employee and division data and ensuring information related to leave schedules and

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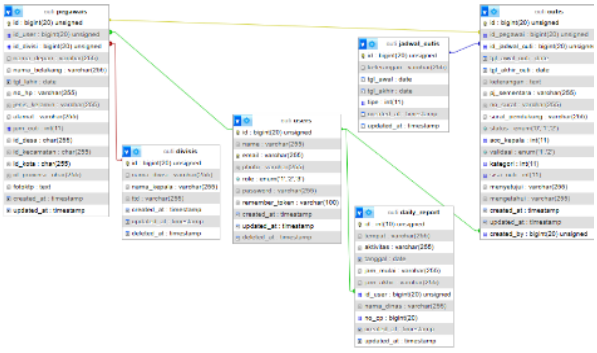
public holidays is constantly updated. Admin can also submit leave requests and record daily reports because Admin is also an Employee at ABC company. However, the Admin cannot change the status of Employee leave requests, which can only be accessed by the division heads.

ERD is a conceptual data model that describes the relationships between entities in a system database [16]. Several master tables, such as users, divisions, and schedule_leaves, interact and form child tables, such as Employees, leave, and daily_report.

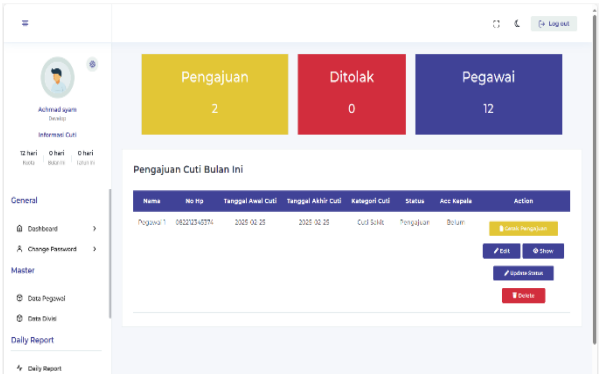


Source: (Research Results, 2025)
Figure 5. Entity Relationship Diagram

Each table in the database schema has a specific function in supporting system operations, such as Users to store user data, Employees to record employee information, Divisions to manage organizational units, Daily_Report to record daily activities, and Cutis and Schedule_Cutis which play a role in managing leave requests and scheduling. Data security is implemented through bcrypt hashing encryption for passwords and AES-256 for sensitive information, as well as the implementation of Role-Based Access Control (RBAC) to set access rights according to roles in the organization. Session authentication using JSON Web Token (JWT) ensures that only authorized users can access each request. At the same time, additional protection through Web Application Firewall (WAF) prevents cyber-attacks such as SQL Injection, Cross-Site Scripting (XSS), and Cross-Site Request Forgery (CSRF). Strict input validation is also implemented to reduce the risk of data manipulation. With this approach, the system is designed to ensure data integrity, access security, and transparency in information management.

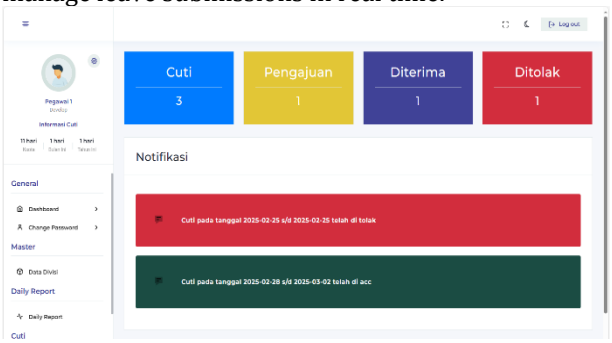
Result of Coding

Following system design, the system was implemented and tested with a role-based interface. Figures 6, 7, and 8 provide screenshots of dashboards for Division Heads, Employees, and Admin. Each dashboard layout reflects role-specific access.



Source: (Research Results, 2025)
Figure 6. Division heads Dashboard Page

Figure 6 illustrates the admin dashboard interface of the leave application system. The interface displays three primary information cards showing the number of leave requests 2, rejected requests 0, and the total number of employees 12. Below the summary cards is a table listing current leave requests for the month, including employee name, phone number, leave start and end dates, leave category, and status. Action buttons such as “Print,” “Edit,” “Update Status,” and “Delete” are provided for administrative control. This feature enables administrators to efficiently monitor and manage leave submissions in real time.



Source: (Research Results, 2025)
Figure 7. Employee Dashboard Page

Figure 7 illustrates the employee dashboard view. The upper section displays four summary cards containing total used leave 3, active requests 1, approved requests 1, and rejected requests 1. Below these cards, a notification section provides real-time system feedback to the user. For instance, a red alert indicates that a leave request for February 25, 2025, was rejected, while a green alert shows that a leave request for February 28 to March 2, 2025, was approved. This notification mechanism ensures immediate and transparent communication between the system and employees regarding the status of their applications.

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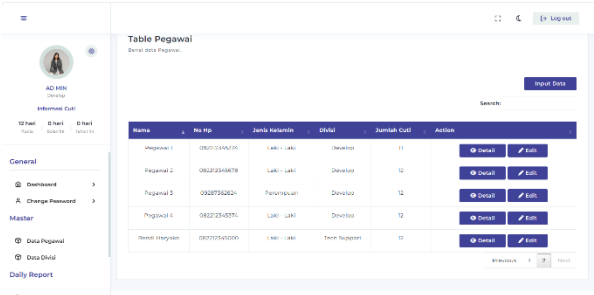

Source: (Research Results, 2025)

Figure 8. Employee Data Admin Page

Figure 8 illustrates the employee data management interface accessible by administrators. The table lists employee records including name, phone number, gender, division, and total leave taken. Each record is accompanied by action buttons such as “View” and “Edit” to facilitate data maintenance. A search feature and pagination function are also available, allowing the admin to navigate and manage large data sets effectively. This menu supports the administrative function of maintaining accurate and up-to-date employee data within the system.

System testing

System evaluation was conducted through expert review involving four IT specialists from the company's IT division and user acceptance testing (UAT) with 20 end users from five divisions within the organization: Resources, Finance, Operations, Marketing, and PR divisions using a structured questionnaire based on five evaluation dimensions rated on a Likert scale from 1 (very unsatisfactory) to 4 (very satisfactory).

1. Testing by IT Expert:

IT Expert evaluation results are presented in Table 1, highlighting average scores across five key dimensions:

a. Ease of Use: This aspect assessed whether the system could be operated intuitively without additional training. According to expert evaluation, the average score of 3.75 indicates that the system has achieved a high level of usability.
b. Interface Design: The evaluation focused on layout, navigation flow, and overall user experience. The system received an average score of 3.5, reflecting compliance with established usability standards and accessibility for users with varying levels of digital literacy.
c. Feature Completeness: This dimension evaluated the adequacy of system features in fulfilling operational requirements, including additional functionalities such as automated reminders or submission histories. The average score of 3.5 indicates that the available features are aligned with user expectations.
d. Clarity of Information: This aspect measures the information's accuracy, structure, and readability. With an average score of 3.5, the system can deliver well-structured and easily understood information across user levels.
e. Security Testing: The evaluation examined the system's resistance to common security threats, such as SQL injection and Cross-Site Scripting (XSS), as well as its data protection mechanisms. The system scored an average of 3.75, suggesting it provides sufficient security and data integrity.

Table 1. UAT IT Expert

Evaluation aspect	IT expert 1	IT expert 2	IT expert 3	IT expert 4	Average	Std. Dev
Ease of Use	4	3	4	4	3.75	0.50
Interface Design	3	4	4	3	3.5	0.58
Feature Comprehensiveness	3	3	4	4	3.5	0.58
Clarity of Information	4	3	4	3	3.5	0.58
Security Testing	4	4	3	4	3.75	0.50

Source: (Research Results, 2025)

2. Testing by end users

After IT expert testing, further testing was conducted with 20 end users from five divisions. This evaluation used the exact five dimensions and the Likert scale in the expert assessment:

a. Benefits to the: Evaluated primarily by staff from the Human Resources and Finance divisions, this aspect assessed whether the system improves administrative efficiency. An average score of 3.7 indicates that the system significantly simplifies internal processes and enhances data transparency.
b. Speed of Access: Evaluated by employees across all divisions, this dimension measured the system's responsiveness during regular use. With an average score of 3.6, the system provided sufficient performance speed to support uninterrupted user operations.
c. Data Accuracy: This aspect was assessed by staff responsible for data entry and report generation, particularly in the Operations and HR divisions. The high average score of 3.8

confirms the system's reliable accuracy in processing and displaying user data.

d. Information Accuracy: Respondents from the HR, Finance, and General Affairs divisions evaluated this aspect as part of their role in policy formulation and decision-making. An average score of 3.7 demonstrates that the system provides timely and accurate information for strategic use.
e. System Stability: Tested by users from all five divisions under various usage conditions, this evaluation emphasized performance consistency during high-access periods. With an average score of 3.6, the system proved stable and dependable for continuous operation.

Table 2. UAT Users

Evaluation aspect	Average Score	Std. Dev
Benefits to the Company	3.7	0.47
Speed of Access	3.6	0.50
Data Accuracy	3.8	0.40
Accuracy of Information	3.7	0.47
System Stability	3.6	0.50

Source: (Research Results, 2025)

Overall, these results show that IT experts have validated the system with a score of 94%, while end-users provided a 92% approval rating. The system implementation can proceed to the operational stage without significant revisions, although minor improvements to certain aspects can still be made to enhance the overall user experience. The standard deviation values across both expert and user evaluations remain consistently below 0.6, indicating a high level of agreement among respondents. This low variability suggests that perceptions of the system's usability, interface design, and performance are stable and consistent across evaluators. Particularly, the system's security and data accuracy aspects received not only high average scores but also low standard deviation, reinforcing confidence in its reliability.

A total of 10 end-users were invited to participate in the UAT, all of whom completed the evaluation process, resulting in a 100% completion rate. Feedback was collected through open-ended responses and short interviews. As a result, several refinements were made to the system: the dashboard interface was simplified for better navigation, tooltips were added to guide users on the employee data form, and validation error messages were clarified. These improvements were integrated prior to deployment to ensure better usability and to align the system more closely with user expectations.

RESULTS AND DISCUSSION

The effectiveness effectiveness of the CUTI DULU leave management system hinges not only on technical infrastructure such as network stability, server reliability, and robust software but also on its alignment with broader digital transformation strategies in Human Resource Management (HRM) [17]. As digitalization becomes a critical enabler in HR processes, especially in large-scale organizations such as manufacturing firms, systems like CUTI DULU must be evaluated through both practical and theoretical lenses. According to digital transformation in HRM is driven by evolving workplace expectations, organizational restructuring, and the imperative for real time data integration, particularly in the context of Industry 4.0. In this regard, CUTI DULU is designed with three primary user roles admin, employees, and division heads thereby enabling a streamlined, role-specific workflow that supports operational clarity and accountability.

The Unlike earlier manual procedures that depended on physical documents and lacked predictability in approval timelines, CUTI DULU replaces uncertainty with procedural automation and transparent approval paths. While previous studies, such as [16], have proposed digital leave systems, many require substantial customization to match diverse organizational structures. In contrast, CUTI DULU offers a modular and adaptable framework suitable for integration into the dynamic workflow of large enterprises, such as those found in the manufacturing sector where coordination across multiple departments is crucial. The system's design reflects best practices in digital HRM implementation, as noted by [18], often benefit from models like UTAUT to explain system adoption across varying technological maturities.

Table 3. time comparison

Old System	Other Systems	CUTI System	DULU
4 day	1 day	5 hours	

Source: (Research Results, 2025)

Empirical findings show a significant reduction in leave processing time from four days using traditional methods to approximately five hours with the system. However, beyond presenting numerical improvements, this result is reflective of a broader shift enabled by digital HRM systems: reallocation of human resource efforts from manual, administrative functions to more strategic roles. Literature on e HRM emphasizes that automation frees HR staff to engage in high value activities such as workforce planning, competency management,

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and organizational development [17]. Similarly, the sharp reduction in error rates from 63 to just 2 incidents over comparable timeframes illustrates how automation mitigates risks associated with manual data entry and approvals. These outcomes are not merely technical enhancements; they represent increased process integrity and employee trust in HR services, which are key dimensions in digital workplace readiness [17].

Table 4. comparison of errors in the system

Old System	CUTI DULU System
23 error	2 error

Source: (Research Results, 2025)

Despite these operational strengths, several limitations remain. The system's current scope is largely confined to vertical interactions (i.e., between employees and their direct supervisors), and it does not yet support horizontal workflows or hierarchical escalation, which are often essential in larger, matrixed organizations. Furthermore, reliance on stable internet connectivity introduces vulnerability in environments with limited digital infrastructure. This challenge is particularly acute in manufacturing operations with remote or industrial settings, where intermittent connectivity may hinder access. Future development should include offline access modules, automated backup mechanisms, and synchronization protocols to maintain system resilience under unstable conditions.

From a system maintenance perspective, the manual error reporting mechanism where users must contact a super administrator may become inefficient during peak operational loads. Incorporating real time error logging dashboards, automated alerts, and self healing functionalities would enhance system robustness. While the concept of integrating CUTI DULU with ERP or HRM platforms is currently aspirational, it is consistent with trends in enterprise digitalization. Integrating leave systems with broader enterprise resource planning (ERP) suites could facilitate real-time data synchronization across HR, finance, and operations, thus reducing data silos. However, given that integration is not yet realized in this implementation, future research should explore its technical feasibility and organizational readiness.

CONCLUSION

This research has developed and implemented a digital leave management and daily reporting system based on the Waterfall development model. The system demonstrates tangible improvements in administrative processes, notably in reducing leave application processing time from an average of four days to five hours and decreasing administrative errors by 80.95%. User Acceptance Testing (UAT), conducted with both IT professionals and general users, indicates high acceptance and functionality, with satisfaction scores averaging above 3.5 out of 4 in key evaluation criteria. The current implementation has not been tested across multiple organizational contexts, which limits the ability to generalize its adaptability. Although the system design suggests potential for broader applicability, future research should include cross-organizational pilot studies to empirically validate its adaptability across varying operational structures. Moreover, given the system's role in processing sensitive human resource data, ethical considerations and data protection implications warrant deeper examination. Aspects such as user consent, data encryption standards, and compliance with data privacy regulations.

CUTI DULU represents a significant advancement in digital HR process modernization, offering a scalable solution with the potential for broader institutional adoption. Nonetheless, further development is required to address limitations in inter-division functionality, network resilience, and data protection, thereby enhancing its robustness and trustworthiness in diverse organizational settings.

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