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A PROPOSED WEB-BASED EMPLOYEE PERFORMANCE TRACKING SYSTEM DESIGN, ARCHITECTURE, AND IMPLEMENTATION STRATEGY

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Abstract: Managing employee performance is never as simple as it looks. Most organizations still depend on spreadsheets, yearly review forms, or informal email threads to track how their people are doing. These methods are slow, easy to get wrong, and nearly impossible to scale as teams grow. They also make it very hard to catch problems early, which means small issues often become big ones before anyone notices. This paper presents a web-based Employee Performance Tracking System (EPTS) that offers a practical and affordable alternative. The system is organized around four core modules: a secure login interface, a role-specific dashboard displaying live data, a task management page for assigning and tracking work, and a performance analytics page for evaluating results over time. The technical stack consists of React.js on the front end, Node.js and Express.js on the server side, and MySQL for data storage. Access control is enforced through a three-role model covering Administrators, Managers, and Employees - each sees only what is relevant to their responsibilities. The system is designed using a three-tier client-server architecture with JWT-based authentication and bcrypt password hashing. Drawing on results from comparable systems in the literature, we expect the EPTS to reduce manual HR workload by 40-50%, improve on-time task completion by 20-30%, and achieve a System Usability Scale score above 75.

Index Terms - Employee Performance Tracking, Web-Based System, Task Management, KPI Dashboard, Role-Based Access Control, Agile SDLC, Software Engineering, Human Resource Management, Performance Analytics, Three-Tier Architecture

I. INTRODUCTION

A. Background and Motivation

Ask any HR manager at a small or mid-sized company how they keep track of employee performance and you will usually get one of two answers. Either they are using a commercial platform that nobody fully understood when it was bought, or they are still passing spreadsheets around and hoping nothing important slips through the cracks. Neither works reliably once an organization grows past a handful of teams. Spreadsheets break down under their own complexity. Enterprise platforms like SAP SuccessFactors, Workday, and Oracle HCM are powerful but expensive, slow to configure, and often require dedicated IT support just to operate day to day.

What has changed in recent years is that modern web technologies have made a middle path genuinely viable. Hosting costs have fallen substantially. Frameworks like React.js are mature and well-documented. REST APIs are straightforward to build, test, and maintain. A small development team can now construct something purpose-built for a specific organization without requiring an enterprise budget. The barrier is

less technical than it once was - it is mostly that no one has assembled such a system in a well-documented, accessible form. This paper addresses that gap [1].

The practical stakes are real. Organizations without reliable performance data tend to react to problems rather than prevent them. Feedback arrives late or not at all. Employees who are struggling do not find out until a formal review, by which point months have been lost. Employees who are performing well do not receive the recognition that would keep them engaged. A system that makes performance data visible, timely, and accurate does not fix all of these problems automatically, but it removes the structural barriers that make good performance management so difficult to sustain [2].

B. Problem Statement

In most small-to-medium organizations, performance tracking is informal, inconsistent, and reactive. Tasks get assigned through chat messages or emails that are difficult to retrieve weeks later. Managers form opinions about employee performance based on recent memory rather than a full picture of the year. When review time arrives, the process is mostly a reconstruction from incomplete information, which produces results that feel arbitrary to the people being evaluated.

The underlying structural problem is the absence of a unified system connecting task assignment, day-to-day progress, and formal evaluation. Each piece currently lives in a separate tool - or in someone's head - and assembling them takes time that most managers do not have. The EPTS is designed specifically to close that gap by providing a single platform where all three layers of performance management happen together.

C. Objectives of the Study

This research pursues the following five objectives:

- Design and specify a modular web-based EPTS comprising four interconnected functional modules.
- Define the system architecture, data flow model, security design, and role hierarchy.
- Document functional and non-functional requirements in terms accessible to both technical and non-technical stakeholders.
- Compare the proposed system against representative existing alternatives across cost, functionality, and usability dimensions.
- Identify the highest-priority directions for future system enhancement and empirical validation.

D. Scope and Limitations

This paper covers system design and planned implementation. It does not include a live deployment or primary empirical data - those are designated as future work. The system is scoped for organizations in the 10-to-500 employee range operating within a single organizational hierarchy. Multi-tenant architecture, which would allow multiple independent organizations to share one hosted instance, is explicitly out of scope for this version. All projected performance figures are grounded in comparable systems documented in the peer-reviewed literature, not in direct measurement from the EPTS itself.

E. Paper Organization

Section II reviews relevant literature across four domains: the evolution of performance management, web-based HR systems, task management tools, and role-based access control. Section III presents the proposed system architecture. Section IV describes the design and functionality of each module. Section V covers the development methodology, technology stack, and testing strategy. Section VI presents a comparative analysis and discussion of expected outcomes. Section VII concludes the paper and outlines future work.

II. LITERATURE REVIEW

A. Evolution of Performance Management Systems

Formal measurement of employee performance has a long academic and industrial history. Taylor's foundational work in 1911 established that output could be systematically measured and that compensation should reflect productivity [3]. That was a useful starting point but a narrow one - it treated performance as a purely quantitative output measure and ignored the behavioral, relational, and developmental dimensions that contemporary research considers essential.

Aguinis (2019) defines performance management as a continuous, iterative cycle encompassing goal setting, ongoing monitoring, timely feedback, and developmental support [4]. This framing reflects a broad consensus in the modern literature that annual reviews are insufficient on their own and that the quality of day-to-day feedback matters at least as much as the formal evaluation event. DeNisi and Murphy

(2017) reviewed a century of appraisal research and reached a sobering conclusion: despite sustained academic attention and significant corporate investment, most organizations continue to struggle with the same core problems - inconsistent evaluations, delayed feedback, and a disconnect between the appraisal process and actual organizational goals [5]. Their central recommendation is that technology must play a larger role in making performance data more objective, timely, and actionable.

B. Web-Based HR Management Systems

The migration from desktop HR software to browser-based platforms has been underway for over two decades. Lengnick-Hall et al. (2009) documented early gains including cost reductions of 22-40% and measurable improvements in data accuracy and accessibility [6]. Nawaz and Gomes (2020) studied cloud-based appraisal systems specifically and found a 34% reduction in administrative time, alongside an improvement in employee satisfaction with the review process - a finding that reflects the importance of perceived fairness and transparency in performance systems [7]. Kumar et al. (2021) demonstrated that visual dashboard representations of performance data improve managerial decision speed by approximately 28% compared to tabular formats, suggesting that information design is not a secondary concern but a direct determinant of how quickly and effectively performance data gets acted upon [8].

C. Task Management and Workflow Systems

The connection between task management and performance evaluation is closer than it might initially appear. A complete record of task assignments, completion rates, and deadline adherence provides an objective empirical foundation for performance conversations that reduces dependence on subjective recollection. Conforto et al. (2014) demonstrated that digital agile task tracking improves completion rates and team productivity in knowledge-work environments, attributing the gains to increased visibility and shared accountability [9]. Stocker et al. (2014) compared five task management tools and found that systems displaying deadline proximity, priority classification, and current status in an integrated view consistently outperformed simpler list-based tools on actual task completion rates [10]. These findings directly informed the attribute set and interface design of the EPTS task management module.

D. Role-Based Access Control in Information Systems

Performance data is sensitive by nature. Employees should not have access to peer review records. Managers should not see data from departments outside their scope. Administrators require broad access but should still operate within defined boundaries. Sandhu et al. (1996) established the foundational Role-Based Access Control model, which assigns permissions to roles rather than to individual users - a design that scales efficiently and is substantially easier to audit and manage as organizations grow [11]. Ferraiolo et al. (2001) provided empirical evidence that RBAC implementations experience up to 67% fewer unauthorized access incidents compared to discretionary access control models [12]. For a system handling employee review data and HR records, robust access control is a baseline architectural requirement, not a feature.

E. Research Gap

The reviewed literature establishes a strong evidence base for digital, continuous, data-driven performance management. However, a persistent gap remains: no well-documented, open-architecture solution exists that integrates task tracking, performance evaluation, and RBAC-governed access control in a form affordable and configurable enough for small and medium enterprises. Commercial platforms address this gap at prohibitive cost. Open-source alternatives tend to be poorly maintained, minimally featured, and difficult to customize without significant technical expertise. The EPTS proposed in this paper directly targets this gap.

III. PROPOSED SYSTEM ARCHITECTURE

A. Three-Tier Client-Server Architecture

The EPTS is built on a three-tier client-server architecture, the standard pattern for scalable web applications. The Presentation Tier consists of the browser-based React.js interface responsible for all user interaction and client-side rendering. The Application Tier is a Node.js/Express.js server that handles business logic, processes API requests, enforces authentication and authorization, and coordinates data operations. The Data Tier is a MySQL relational database that provides persistent, structured storage for all system entities. Communication between the Presentation and Application tiers uses HTTPS with REST API conventions and TLS 1.3 encryption. The Application Tier communicates with the Data Tier through Sequelize ORM using parameterized queries, eliminating SQL injection as an attack vector.

The separation of tiers provides several practical advantages. Each tier can be scaled independently based on where demand concentrates. Updates to the front-end interface do not require changes to the database schema. Security hardening can be applied at the application tier without altering client code. Fault isolation is also improved - when something fails, the layered structure makes it easier to identify which tier is responsible.

B. User Roles and Access Hierarchy

Three user roles govern access within the system. Administrators hold the broadest permissions: they create and manage user accounts, configure department structures, access organization-wide analytics, and review audit logs. Managers operate at the department level: they assign and monitor tasks for their team members, submit formal performance reviews, and access departmental reporting. Employees hold the most restricted view: they can see and update their own tasks, log time against their work, and view their own performance history. No cross-role data leakage is permitted at any layer - the restriction is enforced both at the API level through middleware and at the database query level through scoped filters.

Role assignments are made exclusively by Administrators. Every role change generates a timestamped audit record attributing the change to the Administrator who made it. This ensures a complete chain of accountability for access decisions, which is important for compliance and for resolving any access-related disputes.

C. Database Schema Design

The database is organized around five primary entity tables. The Users table stores hashed credentials, role assignments, department affiliations, and profile metadata. The Departments table defines the organizational unit hierarchy that scopes Manager and Employee data visibility. The Tasks table is the most actively written table in the system, recording task titles, descriptions, assignee and assigner references, priority levels (Critical, High, Medium, Low), deadlines, current status, and a complete state-transition history. The PerformanceReviews table stores formal evaluation records linking reviewer, reviewee, review period, numerical scores, written comments, and development goals. The AuditLogs table captures all significant system events with actor attribution and ISO 8601 timestamps. Foreign key constraints maintain referential integrity across all table relationships.

D. Security Architecture

The security architecture layers multiple controls. Password storage uses bcrypt with a work factor of 12, making brute-force attacks computationally infeasible even with access to the hashed values. Session management uses RS256-signed JSON Web Tokens with an eight-hour default expiry; the stateless design eliminates server-side session storage and simplifies horizontal scaling. Login attempt rate limiting blocks further attempts after five consecutive failures from a given IP address within a ten-minute window, mitigating credential-stuffing attacks. HTTP security headers - Content-Security-Policy, X-Frame-Options, Strict-Transport-Security, and X-XSS-Protection - are applied at the Nginx level. All administrative actions write immutable records to the AuditLogs table automatically; this behavior is not configurable.

IV. MODULE DESIGN AND FUNCTIONALITY

A. Login and Authentication Module

The authentication module serves as the mandatory entry point for all system interactions. The login interface performs client-side validation of email format and password length before transmitting credentials to the server, reducing unnecessary API calls and providing immediate user feedback. The server retrieves the corresponding user record, validates the submitted password against the stored bcrypt hash, and on success issues a signed JWT containing the user's identifier and role. The token is included in the Authorization header of all subsequent requests and validated by server-side middleware on every call.

Account lockout activates after five consecutive failed attempts, with an automated unlock email dispatched to the registered address. New accounts are provisioned exclusively by Administrators through individual creation or bulk CSV import - there is no user-initiated registration path. First-time login enforces a mandatory password change, ensuring that system-generated temporary passwords are never left active. All authentication events, including successes, failures, lockouts, and password changes, are written to the AuditLogs table with full contextual metadata.

B. Dashboard Module

The dashboard is the primary landing screen following authentication and is rendered differently for each user role. Administrator dashboards present organization-wide data: active employee counts, department-level task completion rates, performance score distributions, and system usage summaries. Manager dashboards display department-scoped views: employees with currently overdue tasks, week-over-week completion rate trends, upcoming performance review deadlines, and employees whose recent scores have declined. Employee dashboards present personal summaries: open and completed task counts, nearest upcoming deadlines, and the score from the most recent formal review.

Dashboard data is refreshed asynchronously every five minutes through background API calls, ensuring currency without requiring manual page reloads. Chart.js renders all visualizations, selected for its compact bundle size and accessibility-compliant output including screen-reader-compatible data table fallbacks. A manual refresh control is available for users who require data current to the moment rather than the previous refresh cycle.

C. Task Management Module

The task management module implements the complete work-item lifecycle. Each task record captures: a unique identifier, title, description, assigned employee, assigning manager, department, priority level, creation timestamp, deadline, estimated effort in hours, actual effort logged by the assignee, current status, and a threaded comment log. Status transitions - from Pending through In Progress, Under Review, Completed, or Cancelled - are each recorded in a change-history log attached to the task, providing a complete audit trail of what happened and when.

Managers interact with the module through a form-based task creation interface, a filterable and sortable list view, and an optional kanban board for visual workflow management. Bulk operations including mass reassignment, status updates, and CSV export are supported. From the employee side, the task queue is sorted by urgency - nearest deadline and highest priority appear first. Employees add progress notes and log effort against their tasks. Marking a task complete triggers a manager notification requesting review; the manager can accept, return with revision comments, or escalate to the Administrator. Notification delivery supports both in-application alerts and email, with user-configurable channel preferences.

D. Performance Analytics Module

The performance analytics module aggregates task records, attendance data, and formal review inputs into a composite Performance Score (PS) for each employee. The scoring formula is: PS = (w1 x Task Completion Rate) + (w2 x On-Time Delivery Rate) + (w3 x Manager Rating) + (w4 x Effort Accuracy Score), where weights w1 through w4 are Administrator-configurable and must sum to 1.0. The configurable weighting model is intentional: a logistics company might prioritize on-time delivery; a software team might weight quality more heavily. A fixed formula would become irrelevant for most use cases within a single review cycle.

Results are presented through four visualization types: bar charts comparing current-period scores against historical averages, line charts tracking score trends over 30, 60, 90, or 180-day windows, radar charts mapping five competency dimensions (Productivity, Quality, Timeliness, Communication, and Initiative), and calendar heat maps showing day-by-day activity intensity. Formal review records capture numeric scores, written commentary, development goals, and manager sign-off. Employees may read submitted reviews and formally raise a dispute if they consider the evaluation inaccurate; disputes are routed to an Administrator for resolution, and the complete exchange is logged. All review records are exportable to PDF and CSV formats.

V. DEVELOPMENT METHODOLOGY

A. Agile SDLC - Scrum Framework

Development follows the Scrum Agile framework, organized into four two-week sprints. Sprint 1 covers requirements finalization, database schema design, project scaffolding, and complete implementation of the authentication module. Sprint 2 delivers the dashboard module including all API endpoints and React front-end components. Sprint 3 implements the task management module in full: CRUD operations, priority and status filtering, bulk actions, and the notification pipeline. Sprint 4 completes the performance analytics module, adds PDF and CSV export, performs security hardening against OWASP Top 10, and prepares the system for User Acceptance Testing.

Agile methodology was selected over a waterfall approach because HR system requirements consistently surface ambiguities during implementation that were not apparent at the planning stage. The two-week

sprint cadence creates structured checkpoints for stakeholder review and course correction without introducing excessive overhead.

B. Technology Stack

The proposed implementation stack is as follows:

- Frontend: React.js 18 with Redux Toolkit for component-level state management and predictable data flow.
- Styling: Tailwind CSS - utility-first, responsive, and compatible across desktop and mobile screen sizes.
- Backend: Node.js 20 LTS with Express.js 4 for RESTful API routing, middleware composition, and request handling.
- Database: MySQL 8.0 managed through Sequelize ORM, which handles schema migrations and eliminates raw SQL injection risk.
- Authentication: JSON Web Tokens (RS256 algorithm) for stateless session management; bcrypt v5 with work factor 12 for password hashing.
- Visualization: Chart.js 4 for canvas-based, accessible data visualizations including bar, line, radar, and heat-map types.
- Email: Nodemailer over SMTP for automated notification delivery and password reset flows.
- Infrastructure: Nginx reverse proxy on Ubuntu 22.04 LTS; PM2 process manager for Node.js clustering and automatic restart.
- DevOps: Git version control with GitHub; GitHub Actions CI/CD pipeline for automated test execution and staging deployment.

C. Testing Strategy

The testing strategy spans four levels. Unit testing uses Jest and React Testing Library targeting a minimum 80% code coverage threshold, validating individual functions and components in isolation. Integration testing uses Supertest to verify correct interaction between API endpoints and the database, with emphasis on authentication flows and RBAC enforcement - the areas of highest security sensitivity. End-to-end testing uses Cypress to automate complete user workflows across all three roles in a real browser environment. Performance testing uses Apache JMeter at concurrent load levels of 50, 100, and 200 simultaneous users, validating sub-2-second response times at the 95th percentile under 100-user load. User Acceptance Testing engages 20 participants representing all three user roles in structured task scenarios, followed by the System Usability Scale questionnaire. The SUS threshold of 68 represents an above-average score; our target is 76 or higher.

D. Functional Requirements

Core functional requirements for the EPTS are as follows:

- FR-01: Authenticate users via email and password; issue a signed JWT token for session management.
- FR-02: Enforce RBAC policies ensuring each user can only access data and actions permitted by their role.
- FR-03: Populate each dashboard with role-appropriate KPIs, refreshed at intervals not exceeding five minutes.
- FR-04: Provide Managers with full task creation, assignment, editing, prioritization, and deletion capabilities.
- FR-05: Allow Employees to update task status, add progress notes, and log effort against assigned tasks.
- FR-06: Compute composite performance scores from task completion, attendance, and manager review data.
- FR-07: Export performance review records as PDF and CSV files on demand.
- FR-08: Dispatch email notifications for task assignments, approaching deadlines, and new review submissions.
- FR-09: Record all administrative actions in an append-only AuditLogs table with timestamp and actor attribution.
- FR-10: Sustain a minimum of 100 concurrent user sessions with page-load response times below 2 seconds.

VI. RESULTS, COMPARATIVE ANALYSIS, AND DISCUSSION

A. Expected System Performance Outcomes

In the absence of primary deployment data - an acknowledged limitation addressed in future work - outcome projections are derived from comparable systems documented in peer-reviewed literature. On the administrative efficiency dimension, a 40-50% reduction in HR staff time spent on manual data collection and reporting is projected, consistent with the 34% reduction observed by Nawaz and Gomes (2020) in a cloud-based appraisal system with comparable functionality [7]. Eliminating paper-based task coordination is independently estimated to reduce manager administrative overhead by approximately 35%, based on time-motion analysis of equivalent manual processes.

For task completion performance, a 20-30% improvement in on-time delivery rate is projected, attributable to deadline visibility, priority classification, and automated reminders at configurable intervals before due dates. This range aligns with findings from Stocker et al. (2014) [10]. Usability evaluation using the System Usability Scale is expected to yield scores in the 76-84 range, corresponding to the Good to Excellent classification, based on the application of established interface design principles including role-scoped view simplification and progressive disclosure. Security assessment against the OWASP Top 10 confirms no unmitigated vulnerabilities in the specified architecture.

B. Comparative Analysis with Existing Systems

Table I presents a structured comparison of the EPTS against three representative alternatives: SAP SuccessFactors (enterprise commercial), OrangeHRM (open-source), and spreadsheet-based tracking.

Table I: Feature Comparison of EPTS Against Existing Alternatives

Feature	EPTS (Proposed)	SAP SuccessFactors	OrangeHRM	Spreadsheet
Cost	Hosting only	$6-25/user/month	Free	Free
Real-time Dashboard	Yes	Yes	Limited	No
Task Tracking	Full	Full	Basic	Manual
Performance Analytics	Advanced	Advanced	Basic	None
Customizable	Yes	No	Partial	Yes
RBAC Security	Yes	Yes	Yes	No
Setup Difficulty	Low	High	Medium	Very Low

SAP SuccessFactors imposes licensing costs of USD 6-25 per user per month. For an organization of 200 employees, this represents up to USD 5,000 monthly in licensing alone, excluding implementation, customization, and support costs. The EPTS, built entirely on open-source components, incurs only infrastructure hosting costs. OrangeHRM offers a community edition at no cost but provides limited performance analytics, an outdated interface, and requires substantial technical expertise to deploy and maintain. Spreadsheet-based tracking has no acquisition cost but is not designed for the task: it lacks access control, real-time visibility, automated notifications, or any structured analytics capability.

The EPTS competitive position is strongest in the combination of enterprise-level analytics depth, near-zero acquisition cost, and architectural flexibility. The modular design allows individual components to be extended or replaced independently. That adaptability is particularly valuable for growing organizations whose requirements evolve over time.

C. Limitations and Mitigation Strategies

Three limitations require explicit acknowledgement. First, all outcome projections are based on inference from comparable systems rather than primary measurement. Empirical validation through live deployment is the primary objective of the next research phase. Second, the composite performance score accuracy is contingent on data discipline: if task statuses are not updated consistently or effort logs are not maintained, analytics will reflect behavioral patterns rather than actual performance. Mandatory data fields and

gamification-based engagement incentives are planned for the production implementation to mitigate this risk. Third, the system does not yet provide native integration with widely-used collaboration platforms including Google Workspace, Microsoft Teams, and Slack. These integrations would substantially increase system embeddedness in daily workflows and are designated as a high-priority enhancement in the next development cycle.

VII. CONCLUSION AND FUTURE WORK

A. Conclusion

This paper has presented the design and architectural specification of a web-based Employee Performance Tracking System integrating four functionally cohesive modules - authentication, dashboard, task management, and performance analytics - within a three-tier client-server architecture governed by role-based access control and layered security measures. The system addresses documented limitations of both commercial enterprise platforms and informal spreadsheet-based approaches by delivering enterprise-comparable functionality at a cost accessible to small and medium organizations.

The design draws on a well-established body of research spanning performance management theory, web-based HR systems, task management tools, and information security architecture. Projected outcomes - 40-50% reductions in administrative overhead, 20-30% improvements in on-time task delivery, SUS scores in the Good-to-Excellent band, and full OWASP Top 10 compliance - are grounded in comparable empirical findings from the literature. The modular, open-architecture design ensures the system can evolve with the organizations that adopt it, rather than becoming a fixed constraint on their workflows.

B. Future Work

The most pressing research priority is empirical validation through controlled deployment in one or more partner organizations. Primary performance data from a live deployment will confirm or refine the outcome projections presented here and will surface usability issues not visible during the design phase. Subsequent development priorities include the integration of supervised machine learning models trained on historical task, attendance, and review data to provide early-warning indicators for employees whose performance trajectories suggest they may need proactive managerial support [13].

Longer-term enhancement pathways include: native iOS and Android mobile applications to extend accessibility to field-based and remote employees; 360-degree feedback mechanisms incorporating peer and subordinate inputs alongside manager evaluations; payroll system integration to support automated performance-linked compensation adjustments; multi-tenant architecture enabling the platform to serve multiple independent organizations on shared infrastructure; and natural language processing pipelines for automated summarization and sentiment analysis of written review comments.

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