
Integrated ERP System – Detailed End-to-End Architecture & Functional Design

A Unified Platform for Cost Accuracy, Operational Control & Real-Time Decision Making

1. ERP Strategic Purpose

Modern construction and project-driven organizations rely on multiple disconnected systems: HR attendance sheets, material ledgers, WhatsApp communication, manual project updates, etc.

This causes **delays, errors, inflated costs, and poor forecasting**.

This ERP replaces fragmentation with:

- ✓ **Real-time data flow**
 - ✓ **Automated calculations**
 - ✓ **Instant visibility of labor, material, equipment & project performance**
 - ✓ **AI-driven forecasting & variance alerts**
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2. Current Pain Points (Deep Breakdown)

2.1 Fragmented Information

- HR attendance stored separately
- Material consumption recorded manually
- Project delays reported late
- Cost overruns discovered after weeks/months

2.2 Decision Making Delays

- Management receives outdated reports
- No predictive warnings
- No centralized timeline or progress tracking

2.3 Lack of Cost Control

- BOQ vs Actual mismatch discovered too late
- Subcontractor claims difficult to verify
- No integrated cost-per-phase breakdown

2.4 Manual Communication Bottlenecks

- Site engineers contact departments through phone/WhatsApp
- Overtime approvals delayed
- Shortages not reported in a structured format

3. ERP Vision & Core Objectives (Detailed)

3.1 Vision

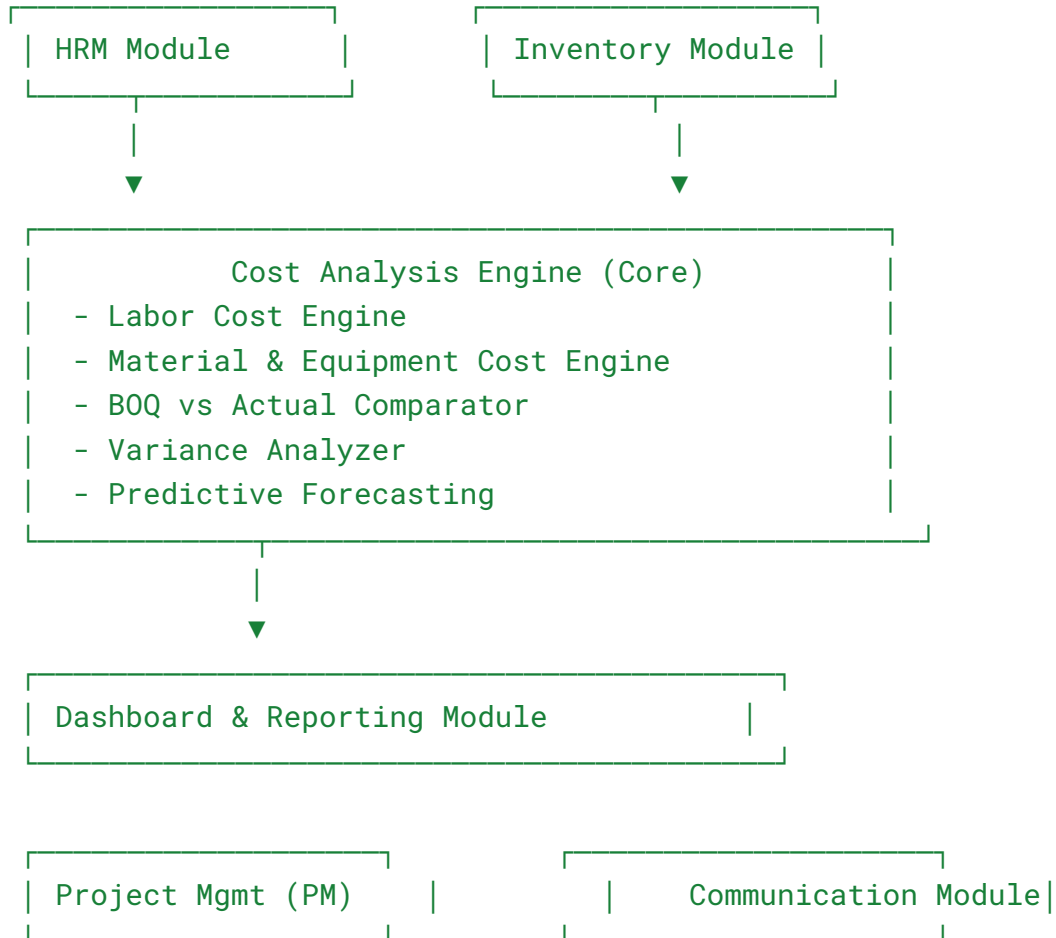
To build an **intelligent, integrated ERP platform** where all operational data flows into a **central Cost Analysis Engine**, enabling:

- Real-time cost visibility
- Data-driven decision making
- Full project lifecycle control
- Predictive analytics

3.2 Objectives

- Automate labor, material, equipment, and project tracking
 - Reduce cost leakage
 - Improve accuracy across departments
 - Enhance internal communication
 - Enable centralized dashboards for executives
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4. High-Level ERP Architecture (Detailed Component View)



5. Detailed Module Breakdown

5.1 HRM Module → Cost Engine

Data Captured

- Daily attendance (biometric / mobile punch / manual)
- Skill level (Helper, Mason, Steel Fixer, Carpenter, Welder, Electrician)
- Assigned crew & shift
- Overtime hours based on rules
- Idle hours
- Productivity KPIs

Processing

- Auto-calculation of:
 - Labor hourly cost
 - Overtime premiums
 - Cost per activity (e.g., concreting, blockwork)
 - Utilization %
 - Cost leakage detection (low productivity, overdeployment)

Data Sent to Cost Engine

- Daily labor cost
 - Workforce utilization charts
 - Labor productivity benchmarks
 - Wage-based cost predictions
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5.2 Inventory Module → Cost Engine

Data Captured

- Material issue & return logs
- Consumption mapped to activities
- Actual quantity vs BOQ quantity
- Equipment usage hours (fuel, maintenance, depreciation)
- Waste & scrap logs
- Supplier price variations

Processing

- Material cost per task
- Equipment operating cost per hour/day
- Waste percentage
- Overconsumption detection

Data Sent to Cost Engine

- Material cost curves
- Equipment cost distribution
- Waste impact on cost
- Supplier cost trends

5.3 Project Management (PM) Module → Cost Engine

Data Captured

- Gantt chart schedules
- Activities & milestones
- Subcontractor contracts & progress claims
- Delays (internal, external, rework, approvals)
- BOQ vs Actual progress
- Site work % completion

Processing

- Phase-wise cost tracking
- Delay cost impact computed
- Subcontractor cost verification
- Progress vs cost correlation

Data Sent to Cost Engine

- Earned value metrics
 - Budget vs Actual vs Forecast comparison
 - Subcontractor financial summaries
 - Delay impact cost
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5.4 Internal Communication Module

Handles

- Real-time alerts:
 - Material shortages
 - Overruns
 - Rework notifications
 - Overtime approval
 - Equipment breakdown
- Structured communication with logs
- Task assignments and closing

Outputs

- Smarter decision-making
- Faster approvals
- Fewer project delays

5.5 Reporting Engine (Deep Detail)

Generates

- Cost variance analysis (CVA)
- Earned value management (EVM) charts
- Project financial dashboards
- Material consumption analysis
- Weekly labor productivity reports

- Forecasting curves (S-Curves, CPI, SPI)
- Executive summary snapshots

Features

- Drill-down data
 - Export to Excel / PDF
 - Role-based access
 - KPI scoring for each site
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6. Cost Analysis Engine (Core Logic)

This is the **heart** of the ERP system.

Step-by-step Workflow

1. Data Extraction

Pulls data from HRM, Inventory, PM, Communication.

2. Data Cleaning

- Removes duplicates
- Fixes missing values
- Converts units (m², m³, kg, hours etc.)
- Standardizes activity codes

3. Transformation

- Maps costs to BOQ items

- Aggregates per activity/phase/site
- Converts raw data into measurable KPIs

4. Cost Computation

- Labor cost
- Material cost
- Equipment cost
- Overheads
- Subcontractor cost
- Delay cost
- Waste cost

5. Output Generation

- Dashboards
- KPI trackers
- Alerts
- Forecast models

7. System Benefits (Managerial + Financial)

Operational Benefits

- Instant visibility across all sites

- Auto-generated daily reports
- Faster approvals & communication
- Lower manual errors

Financial Benefits

- Cost savings through early detection
- Improved forecasting
- Stronger budget control
- Enhanced profitability

Strategic Benefits

- Reliable decision-making
- Higher productivity
- Data-driven project planning
- Strong compliance & audit readiness