

Purpose: Technical reference for understanding system design and development patterns Last Updated: 2025-10-17 (Updated with Multi-Currency Implementation)

Architecture Documentation Guidelines

Document Purpose

This document describes the CURRENT WORKING STATE of the application architecture. It serves as:

- Technical reference for understanding how the system currently works
- Onboarding guide for new developers
- Design pattern documentation for consistent development
- Schema and data flow documentation reflecting actual implementation

What TO Include

- **Current Technology Stack:** Technologies actually in use
- **Working Components:** Components that are implemented and functional
- **Actual Database Schema:** Tables, fields, and relationships as they exist
- **Implemented Data Flows:** How data actually moves through the system
- **Working API Endpoints:** Routes that are active and functional
- **Deployment Patterns:** How the system is actually deployed
- **Security Measures:** Security implementations that are active

What NOT to Include

- **Issues or Bugs:** These belong in [MEMORY.md](#) with technical debt entries
- **Limitations or Problems:** Document what IS working, not what isn't
- **Future Plans:** Enhancement ideas belong in [backlog.md](#)
- **Deprecated Features:** Remove outdated information rather than marking as deprecated
- **Wishlist Items:** Planned features that aren't implemented yet

Update Guidelines

- **Reflect Reality:** Always document the actual current state, not intended state
- **Schema Notes:** When database schema has unused fields, note them factually
- **Cross-Reference:** Link to other docs when appropriate, but don't duplicate content

For AI Coding Agents

- **Investigate Before Updating:** Use codebase search to verify current implementation
- **Move Issues to Memory:** If you discover problems, document them in [MEMORY.md](#)
- **Factual Documentation:** Describe what exists, not what should exist

Sarange ERP System Architecture

Project Overview

Sarange ERP is a comprehensive Enterprise Resource Planning system built with Laravel 12, designed for Indonesian businesses. It provides complete financial management, fixed asset management, procurement, sales, and reporting capabilities with role-based access control and multi-dimensional accounting.

Current System Status

Production Readiness: 95% Complete ☒

Last Comprehensive Testing: 2025-09-21

Testing Status: Complete end-to-end validation successful

Validated Functionality

- ☒ **Inventory Management:** Complete CRUD operations, multi-category support, validation
- ☒ **Purchase Workflow:** PO → GRPO → PI → PP complete workflow validated
- ☒ **Sales Workflow:** SO → DO → SI → SR complete workflow validated
- ☒ **Financial Integration:** Automatic document numbering, tax calculations, journal entries
- ☒ **User Interface:** Professional AdminLTE integration, responsive design, form validation
- ☒ **Data Management:** Business partner consolidation, field mapping resolution, data persistence

Critical Issues Resolved

- ☒ Field mapping issues (business_partner_id vs vendor_id/customer_id)
- ☒ DocumentClosureService import issues and missing models
- ☒ View template references (customers → business_partners)
- ☒ Form submission failures and validation errors

Technology Stack

- **Backend:** Laravel 12 (PHP 8.2+)
- **Frontend:** Blade templates with AdminLTE 3.14, jQuery, DataTables, SweetAlert2
- **Database:** MySQL with comprehensive schema (51 migrations)
- **Authentication:** Laravel Auth with Spatie Permission package
- **PDF Generation:** DomPDF for document printing
- **Excel Export:** Laravel Excel (Maatwebsite)
- **UI Framework:** AdminLTE 3 with Bootstrap 4
- **Timezone:** Asia/Singapore (configured)

Navigation Structure

The system uses a hierarchical sidebar navigation structure optimized for trading company operations:

Main Navigation Sections

1. **Dashboard** - System overview and key metrics
2. **MAIN** - Core business operations (ordered by business process flow):
 - **Inventory** - Item management, stock levels, valuation reports, low stock alerts
 - **Purchase** - Dashboard, purchase orders, goods receipts, purchase invoices, purchase payments
 - **Sales** - Dashboard, sales orders, delivery orders, sales invoices, sales receipts

- **Fixed Assets** - Asset categories, assets, depreciation, disposals, movements, import, data quality, bulk operations
 - **Business Partner** - Unified customer and supplier management with tabbed interface
 - **Accounting** - Journals, cash expenses, accounts, periods
 - **Master Data** - Projects, departments
3. **REPORTS** - Comprehensive reporting modules
 4. **ADMIN** - User management, roles and permissions

Navigation Features

- **Role-Based Access:** Menu items are conditionally displayed based on user permissions
- **Active State Management:** Current page highlighting and menu expansion
- **Responsive Design:** Collapsible sidebar with mobile-friendly navigation
- **Icon Integration:** FontAwesome icons for visual navigation cues
- **Breadcrumb Navigation:** Page-level breadcrumb trails for deep navigation

Core Components

1. Financial Management System

- **Chart of Accounts:** Hierarchical account structure with 5 types (asset, liability, net_assets, income, expense)
- **Journal Management:** Manual journal entries with automatic numbering (JNL-YYYYMM-#####) and multi-currency support
- **Period Management:** Financial period closing with validation
- **Posting Service:** Centralized accounting posting with balance validation and foreign currency handling
- **Account Statements:** Comprehensive financial statements for GL accounts and Business Partners with transaction tracking and running balances
- **Control Account System:** Enterprise-level control account architecture with automatic balance tracking, subsidiary ledger management, and reconciliation dashboard for financial control and compliance
- **Auto-Numbering System:** Centralized document numbering service with consistent PREFIX-YYYYMM-##### format across all document types

1.1. Multi-Currency Management System

- **Currency Master:** Support for multiple currencies with IDR as base currency, including USD, SGD, EUR, CNY, JPY, MYR, AUD, GBP, HKD
- **Exchange Rate Management:** Daily exchange rate entry with automatic inverse rate calculation and historical rate tracking
- **Foreign Currency Transactions:** All financial documents support foreign currency with automatic IDR conversion using exchange rates
- **Dual Currency Reporting:** Financial reports display both foreign currency amounts and IDR equivalents
- **FX Gain/Loss Tracking:** Automatic calculation and posting of realized and unrealized foreign exchange gains/losses
- **Currency Revaluation:** Periodic revaluation of foreign currency balances with journal entry generation

- **Multi-Currency Forms:** Purchase Orders, Sales Orders, and Journal Entries support currency selection with real-time exchange rate updates

2. Accounts Receivable (AR) Module

- **Sales Invoices:** Customer billing with line items, tax codes, and dimensions (SINV-YYYYMM-#####)
- **Sales Receipts:** Payment collection with automatic allocation to invoices (SR-YYYYMM-#####)
- **Sales Orders:** Customer order management with automatic numbering (SO-YYYYMM-#####)
- **AR Aging:** Customer payment tracking and aging analysis
- **AR Balances:** Customer account balance reporting

3. Accounts Payable (AP) Module

- **Purchase Invoices:** Vendor billing with line items and tax handling (PINV-YYYYMM-#####)
- **Purchase Payments:** Vendor payment processing with allocation (PP-YYYYMM-#####)
- **Purchase Orders:** Vendor order management with automatic numbering (PO-YYYYMM-#####)
- **Goods Receipt PO:** Purchase Order-based inventory receipt processing with automatic numbering (GR-YYYYMM-#####)
- **AP Aging:** Vendor payment tracking and aging analysis
- **AP Balances:** Vendor account balance reporting

4. Enhanced Inventory Management System

4.1. Dual-Type Inventory System

- **Item Types:** Support for both physical items and services with item_type field
- **Order Types:** Purchase and Sales orders support both item and service types
- **Inventory Impact:** Only 'item' type affects stock quantities, 'service' type bypasses inventory
- **Document Flow:**
 - Item PO → GRPO → Sales Invoice (with multi-GRPO combination)
 - Service PO → Purchase Invoice (direct, no GRPO needed)
- **Type Validation:** Prevents mixing item/service types within same order
- **Numbering:** Different prefixes for copied documents (GRPO vs GR)

4.2. Item Category Account Mapping System

- **Account Integration:** Each product category maps to 3 specific accounts:
 - **Inventory Account:** For inventory valuation (e.g., "Inventory - Stationery")
 - **COGS Account:** For cost of goods sold (e.g., "COGS - Stationery")
 - **Sales Account:** For revenue recognition (e.g., "Sales - Stationery")
- **Automatic Mapping:** Items inherit account mappings from their category
- **Service Categories:** Support for service-only categories without inventory accounts
- **CRUD Interface:** Complete Product Category management system with:
 - **ProductCategoryController:** Full CRUD operations with validation
 - **AdminLTE Views:** Index, create, show, edit views with proper form handling
 - **Account Selection:** Dropdown interfaces for selecting inventory, COGS, and sales accounts
 - **Hierarchical Support:** Parent-child category relationships
 - **Audit Integration:** Complete audit trail for category changes

- **Menu Integration:** Accessible via Master Data → Product Categories
- **Sample Categories:** Stationery, Electronics, Furniture, Vehicles, Services with proper account mappings

4.3. Multi-Warehouse Management

- **Warehouse Master Data:** Complete warehouse information with contact details and status
- **Per-Warehouse Stock Tracking:** Individual stock levels for each item-warehouse combination
- **Default Warehouse Assignment:** Items can have default warehouses for automatic assignment
- **Stock Transfers:** Inter-warehouse stock transfer capabilities with full audit trail
- **Warehouse-Specific Reorder Points:** Different reorder points per warehouse
- **Sample Warehouses:** Main Warehouse, Branch Warehouse, Storage Facility

4.4. Sales Price Level System

- **Three Price Levels:** Level 1 (default), Level 2, Level 3 with flexible pricing
- **Customer Assignment:** Customers can have default price levels
- **Item-Specific Pricing:** Individual items can have different prices for each level
- **Percentage-Based Calculations:** Support for percentage-based price calculations
- **Customer Overrides:** Customer-specific price overrides for individual items
- **Flexible Pricing:** Both fixed prices and percentage-based calculations supported

4.5. Comprehensive Audit Trail System

- **System-Wide Tracking:** Complete audit trail for all inventory-related changes
- **Change Tracking:** Old and new values captured for all modifications
- **User Attribution:** Full user tracking with IP address and user agent
- **Entity-Specific Logs:** Separate audit trails for items, transactions, warehouses
- **Action Types:** Created, Updated, Deleted, Approved, Rejected, Transferred, Adjusted
- **Search and Filtering:** Comprehensive audit log management with filtering capabilities

5. Fixed Asset Management

- **Asset Register:** Complete asset lifecycle management
- **Asset Categories:** Configurable categories with depreciation settings
- **Depreciation Management:** Automated depreciation calculation and posting
- **Asset Disposal:** Disposal process with gain/loss calculation and automatic numbering (DIS-YYYYMM-#####)
- **Asset Movement:** Transfer tracking between departments/projects
- **Data Quality:** Duplicate detection, completeness checks, consistency validation

5. Procurement Management

- **Purchase Orders:** Vendor order management with approval workflow (PO-YYYYMM-#####)
- **Goods Receipt PO:** Purchase Order-based inventory receipt processing (GR-YYYYMM-#####)
- **Vendor Management:** Vendor master data with performance tracking

5.1 Goods Receipt PO System Architecture

- **Vendor-First Workflow:** Users must select vendor before accessing Purchase Orders, ensuring data consistency
- **Dynamic PO Filtering:** AJAX-powered Purchase Order dropdown filtered by selected vendor and remaining quantities
- **Copy Remaining Lines:** Automated copying of Purchase Order lines with remaining quantities (pending_qty > 0)
- **Smart Quantity Calculation:** Automatic calculation of remaining quantities (PO qty - received qty) for accurate line population
- **Remaining Quantity Display:** Dedicated "Remaining Qty" column in GRPO lines table showing pending quantities from source PO
- **PO-Based Item Filtering:** Item selection modal filters items to show only those from selected PO with remaining quantities
- **Enhanced User Interface:** Simplified interface for warehouse users with financial columns removed (amount, VAT, WTax)
- **Intelligent Item Selection:** Modal displays items with "From PO" category and remaining quantities in stock column
- **Database Schema:** goods_receipt_po and goods_receipt_po_lines tables with proper foreign key relationships
- **Model Structure:** GoodsReceiptPO and GoodsReceiptPOLine models with comprehensive relationships
- **Controller Architecture:** GoodsReceiptPOController with AJAX endpoints for vendor-specific PO retrieval and line copying
- **Route Structure:** goods-receipt-pos.* routes with enhanced AJAX endpoints (/vendor-pos, /remaining-lines)
- **JavaScript Enhancement:** Dynamic form handling with vendor selection triggering PO filtering, copy functionality, and item filtering
- **User Interface:** Professional AdminLTE integration with enhanced form controls, remaining quantity tracking, and guided user experience

6. Sales Management

- **Sales Orders:** Customer order management (SO-YYYYMM-#####)
- **Delivery Orders:** Delivery management with inventory reservation and revenue recognition (DO-YYYYMM-#####)
- **Customer Management:** Customer master data with credit management

6.1. Warehouse Selection System

- **Comprehensive Warehouse Integration:** Warehouse selection functionality across all order types (Purchase Orders, Goods Receipt PO, Sales Orders, Delivery Orders) with required field validation
- **Single Warehouse Selection:** Each order type supports single warehouse selection (destination warehouse for POs, source warehouse for SOs, single warehouse for DOs)
- **GRPO Default Logic:** Goods Receipt PO defaults to the original Purchase Order's warehouse but allows manual changes for flexibility
- **Transit Warehouse Filtering:** Automatic filtering of transit warehouses from manual selection dropdowns since transit warehouses are only used for automatic ITO/ITI activities
- **Database Schema Integration:** warehouse_id foreign key fields added to all order tables with proper constraints and relationships

- **Model Relationships:** BelongsTo relationships between order models and Warehouse model with proper fillable field configuration
- **Controller Validation:** Comprehensive validation rules ensuring warehouse_id is required and exists in warehouses table
- **View Integration:** Professional warehouse selection dropdowns using Select2BS4 with active warehouse filtering and proper error handling
- **Service Layer Support:** Service methods updated to handle warehouse_id parameter passing and business logic integration
- **Transit Warehouse Logic:** Transit warehouses follow naming convention (e.g., WH001_TRANSIT for WH001) and are automatically used in ITO/ITI operations based on source warehouse

6.2. GR/GI Management System

- **Goods Receipt (GR):** Non-purchase receiving operations with automatic journal integration
- **Goods Issue (GI):** Non-sales issuing operations with FIFO/LIFO/Average cost valuation
- **Purpose Management:** Configurable GR/GI purposes (Customer Return, Donation, Sample, etc.)
- **Account Mapping:** Automatic account mapping based on item categories and purposes
- **Approval Workflow:** Draft → Pending Approval → Approved status progression
- **Journal Integration:** Automatic journal entry creation on document approval
- **Valuation Methods:** Multiple cost calculation methods (FIFO, LIFO, Average, Manual)
- **SweetAlert2 Integration:** Professional confirmation dialogs for critical operations

6.3. Delivery Order System

- **Delivery Lifecycle Management:** Complete delivery process from sales order to completion
- **Inventory Reservation:** Automatic stock allocation and reservation upon delivery order approval
- **Revenue Recognition:** Automated revenue recognition with COGS calculation upon delivery completion
- **Status Tracking:** Comprehensive status management (draft, picking, packed, ready, in_transit, delivered, completed)
- **Approval Workflows:** Multi-level approval process with proper authorization controls
- **Journal Entries Integration:** Automatic journal entries for inventory reservation and revenue recognition
- **Delivery Tracking:** Logistics cost tracking, performance metrics, and customer satisfaction monitoring
- **Print Functionality:** Professional delivery order documents with company branding

7. Control Account Management System

- **Control Accounts:** Summary accounts representing totals of subsidiary ledger groups (AR Control, AP Control, Inventory Control, Fixed Assets Control)
- **Subsidiary Ledger Management:** Individual subsidiary accounts linked to control accounts (Business Partners, Inventory Items, Fixed Assets)
- **Automatic Balance Tracking:** Real-time balance updates through PostingService integration
- **Reconciliation Dashboard:** Comprehensive reconciliation interface with variance detection and exception reporting
- **Multi-Dimensional Support:** Control account balances tracked by project and department dimensions
- **Exception Reporting:** Automatic identification of accounts with variances above tolerance levels
- **Audit Trail:** Complete transaction history and reconciliation tracking

8. Corrected Accounting Flow with Intermediate Accounts

- **Intermediate Accounts:** AR UnInvoice (1.1.2.04) and AP UnInvoice (2.1.1.03) for proper accrual accounting
- **GRPO Accounting:** Debit Inventory Account, Credit AP UnInvoice (goods received but not yet invoiced)
- **Purchase Invoice Accounting:** Debit AP UnInvoice, Credit Utang Dagang (liability transfer from intermediate to final)
- **Purchase Payment Accounting:** Debit Utang Dagang, Credit Cash (liability settlement)
- **Delivery Order Accounting:** Debit AR UnInvoice, Credit Revenue (goods delivered but not yet invoiced)
- **Sales Invoice Accounting:** Debit AR UnInvoice, Credit Piutang Dagang (receivable transfer from intermediate to final)
- **Sales Receipt Accounting:** Debit Cash, Credit Piutang Dagang (receivable settlement)
- **Automatic Journal Generation:** All transactions automatically create balanced journal entries
- **Account Mapping Logic:** Inventory accounts mapped by item categories, liability/receivable accounts by business partner type

9. Multi-Dimensional Accounting

- **Projects:** Project-based cost tracking
- **Departments:** Departmental cost allocation

10. Reporting & Analytics

- **Trial Balance:** Real-time financial position reporting
- **GL Detail:** Detailed general ledger with filtering
- **Cash Ledger:** Cash flow tracking and reporting
- **Asset Reports:** Comprehensive asset reporting suite
- **AR/AP Reports:** Customer and vendor analysis
- **Withholding Tax:** Tax reporting and compliance

10. Indonesian Tax Compliance System

- **Tax Transaction Management:** Comprehensive tracking of all tax transactions (PPN, PPh 21-26, PPh 4(2))
- **Tax Period Management:** Monthly/quarterly/annual tax period management with status tracking
- **Tax Report Generation:** Automatic SPT (Surat Pemberitahuan Tahunan) report generation
- **Tax Settings Configuration:** Configurable tax rates, company information, and reporting preferences
- **Compliance Monitoring:** Overdue tracking, audit trail, and compliance status monitoring
- **Integration:** Automatic tax calculation with purchase/sales systems

11. Advanced Trading Analytics System (Phase 4)

- **COGS Foundation:** Comprehensive Cost of Goods Sold tracking with multiple valuation methods (FIFO, LIFO, Weighted Average)
- **Cost Allocation:** Automatic cost allocation across products, customers, and suppliers with configurable methods
- **Margin Analysis:** Real-time profitability analysis with gross and net margin calculations
- **Supplier Analytics:** Performance tracking, cost optimization, risk assessment, and supplier ranking

- **Business Intelligence:** Advanced analytics with insights generation, recommendations engine, and KPI tracking
- **Unified Dashboard:** Integrated analytics platform combining all trading components for comprehensive decision making

12. User Management & Security

- **Role-Based Access Control:** Granular permission system
- **User Management:** Complete user lifecycle management
- **Permission Management:** Fine-grained access control
- **Session Management:** Secure authentication and session handling

13. Training & Documentation System

- **Comprehensive Training Materials:** Complete 3-day training workshop package with 9 comprehensive documents
- **Module-Based Training:** 7 specialized training modules covering all major system components
- **Story-Based Learning:** 35+ realistic business scenarios with hands-on exercises
- **Assessment Framework:** Multi-level evaluation system with certification levels (Basic, Intermediate, Advanced, Expert)
- **Indonesian Business Context:** All training materials tailored for Indonesian trading company operations
- **Implementation Guidelines:** Detailed delivery structure, success metrics, and post-training support

14. Business Partner Management System

- **Unified Partner Management:** Single interface for managing customers and suppliers with partner_type classification (customer, supplier)
- **Account Mapping:** Business partners can be assigned specific GL accounts with automatic default assignment (Customer→AR, Supplier→AP)
- **Journal History:** Comprehensive transaction history with running balance calculation, multi-source data consolidation, and pagination
- **Tabbed Interface:** Organized partner data across General Information, Contact Details, Addresses, Taxation & Terms (with Accounting section), Banking & Financial, Transactions, and Account Balance - Journal History sections
- **Flexible Data Storage:** BusinessPartnerDetail model enables custom field storage without schema changes
- **Multiple Contacts:** Support for multiple contact persons per partner with different contact types (primary, billing, shipping, technical, sales, support)
- **Multiple Addresses:** Support for multiple addresses per partner with different address types (billing, shipping, registered, warehouse, office)
- **Transaction Consolidation:** BusinessPartnerJournalService consolidates transactions from journal lines, sales/purchase invoices/receipts
- **Backward Compatibility:** Maintained compatibility with existing PurchaseOrder, SalesOrder, and DeliveryOrder models
- **Data Migration:** Comprehensive migration from separate customers and vendors tables to unified business_partners structure

- **Field Mapping Consistency:** All controllers, services, forms, and JavaScript use `business_partner_id` consistently across the entire ERP system
- **Form Submission Integrity:** All forms submit correctly with proper field validation and JavaScript handling

15. Master Data Management System

- **Projects Management:** Project-based cost tracking with comprehensive CRUD operations
- **Departments Management:** Departmental cost allocation and organizational structure management
- **SweetAlert2 Integration:** Consistent confirmation dialogs and success notifications across all Master Data features
- **JSON API Responses:** Proper AJAX handling with JSON success/error responses for seamless user experience
- **DataTable Integration:** Dynamic data loading with search, sorting, and pagination capabilities

16. Comprehensive Auto-Numbering System

- **Centralized Service:** `DocumentNumberingService` provides unified document numbering across all document types
- **Consistent Format:** All documents follow `PREFIX-YYYYMM-#####` format (e.g., `PO-202509-000001`)
- **Thread-Safe Operations:** Database transactions with proper locking prevent duplicate numbers
- **Month-Based Sequences:** Automatic sequence reset and tracking per month
- **Document Type Support:** 10 document types with standardized prefixes:
 - Purchase Orders: `PO-YYYYMM-#####`
 - Sales Orders: `SO-YYYYMM-#####`
 - Purchase Invoices: `PINV-YYYYMM-#####`
 - Sales Invoices: `SINV-YYYYMM-#####`
 - Purchase Payments: `PP-YYYYMM-#####`
 - Sales Receipts: `SR-YYYYMM-#####`
 - Asset Disposals: `DIS-YYYYMM-#####`
 - Goods Receipt PO: `GR-YYYYMM-#####`
 - Cash Expenses: `CEV-YYYYMM-#####`
 - Journals: `JNL-YYYYMM-#####`
- **Sequence Management:** `DocumentSequence` model tracks last sequence per document type and month
- **Error Handling:** Comprehensive exception handling and validation
- **Database Persistence:** Sequence tracking stored in `document_sequences` table with unique constraints

17. Document Closure System

- **Document Lifecycle Management:** Comprehensive tracking of document status (open/closed) throughout business workflows
- **Automatic Closure Logic:** Documents automatically close when subsequent documents fulfill their requirements
- **Closure Chain Management:** Purchase Orders closed by Goods Receipt PO, Goods Receipt PO closed by Purchase Invoices, Purchase Invoices closed by Purchase Payments, Sales Orders closed by Delivery Orders, Delivery Orders closed by Sales Invoices, Sales Invoices closed by Sales Receipts

- **Partial Closure Support:** Documents can be partially fulfilled by multiple subsequent documents with quantity/amount tracking
- **Manual Closure Override:** Permission-based manual closure and reversal capabilities for corrections and exceptions
- **Closure Tracking:** Complete audit trail of closure events including closing document type, ID, timestamp, and user attribution
- **ERP Parameters Configuration:** User-configurable business rules including overdue thresholds, auto-closure settings, and price difference handling
- **Open Items Reporting:** Comprehensive reporting system for monitoring outstanding documents with aging analysis and exception identification
- **Database Schema Enhancement:** Added `closure_status`, `closed_by_document_type`, `closed_by_document_id`, `closed_at`, and `closed_by_user_id` fields to all document tables
- **Service Layer Architecture:** `DocumentClosureService` for closure logic and `OpenItemsService` for reporting with comprehensive business rule validation
- **UI Integration:** Status indicators in `DataTables`, closure information in document views, and dedicated Open Items report interface
- **Performance Optimization:** Database indexes on `closure_status` and `closed_by` fields for efficient querying

18. Unified Design System

- **Consistent UI Patterns:** All create pages follow unified design standards with card-outline styling
- **Professional Visual Design:** Enhanced headers with relevant icons, proper color schemes, and visual hierarchy
- **Responsive Form Layouts:** 3-column responsive layouts with proper Bootstrap grid implementation
- **Enhanced User Experience:** Select2BS4 integration for improved dropdown functionality with search capabilities
- **Real-Time Calculations:** Automatic total calculations with Indonesian number formatting across all forms
- **Professional Table Design:** Card-outline table sections with striped styling and proper action buttons
- **Improved Navigation:** Consistent breadcrumb navigation and "Back" buttons across all pages
- **Form Validation:** Comprehensive error handling with proper field indicators and validation messages
- **Button Styling:** Consistent button design with FontAwesome icons and professional styling
- **Page Structure:** Standardized page layout with proper sections, headers, and footers
- **Accessibility:** Proper form labels, required field indicators, and semantic HTML structure

Database Schema

Core Tables (52 migrations total - consolidated from 51, plus Phase 3 tax compliance and Phase 4 advanced trading analytics)

Financial Tables

- **accounts:** Chart of accounts with hierarchical structure
- **journals:** Journal headers with automatic numbering and multi-currency support (`currency_id`, `exchange_rate`)
- **journal_lines:** Journal line items with dimensions and foreign currency amounts (`currency_id`, `exchange_rate`, `debit_foreign`, `credit_foreign`)

- **periods**: Financial periods with close/open status
- **account_statements**: Account statement headers with opening/closing balances
- **account_statement_lines**: Statement line items with transaction details and running balances
- **control_accounts**: Control account definitions linking GL accounts to control types (AR, AP, Inventory, Fixed Assets)
- **subsidiary_ledger_accounts**: Subsidiary ledger accounts linking individual entities to control accounts
- **control_account_balances**: Control account balances with multi-dimensional accounting support (projects/departments)

Multi-Currency Tables

- **currencies**: Currency master data with code, name, symbol, decimal places, and base currency flag
- **exchange_rates**: Exchange rate management with from/to currency pairs, effective dates, rate types (daily/manual/custom), and source tracking
- **currency_revaluations**: Currency revaluation headers for periodic FX adjustments
- **currency_revaluation_lines**: Individual account revaluation details with original and revalued amounts

AR/AP Tables

- **sales_invoices** / **sales_invoice_lines**: Customer billing
- **sales_receipts** / **sales_receipt_lines**: Customer payments
- **purchase_invoices** / **purchase_invoice_lines**: Vendor billing
- **purchase_payments** / **purchase_payment_lines**: Vendor payments
- **receipt_payment_allocations**: Payment allocation tracking

Asset Management Tables

- **asset_categories**: Asset classification with depreciation rules
- **assets**: Complete asset register with financial tracking
- **asset_depreciation_entries**: Depreciation transaction history
- **asset_depreciation_runs**: Depreciation batch processing
- **asset_disposals**: Asset disposal transactions
- **asset_movements**: Asset transfer tracking

Business Partner Tables

- **business_partners**: Unified customer and supplier master data with partner_type classification (customer, supplier) and account_id for GL account mapping
- **business_partner_contacts**: Multiple contact persons per partner with contact types
- **business_partner_addresses**: Multiple addresses per partner with address types
- **business_partner_details**: Flexible custom field storage for partner-specific data
- **tax_codes**: Tax configuration
- **bank_accounts** / **bank_transactions**: Banking integration

Order Management Tables

- **sales_orders / sales_order_lines**: Sales order processing with order_type (item/service), business_partner_id, warehouse_id (single source warehouse), and document closure fields (closure_status, closed_by_document_type, closed_by_document_id, closed_at, closed_by_user_id)
- **purchase_orders / purchase_order_lines**: Purchase order processing with order_type (item/service), business_partner_id, warehouse_id (single destination warehouse), and document closure fields (closure_status, closed_by_document_type, closed_by_document_id, closed_at, closed_by_user_id)
- **goods_receipt_po / goods_receipt_po_lines**: Purchase Order-based inventory receipt with source tracking (purchase_order_id), business_partner_id, warehouse_id (defaults to PO's warehouse but allows changes), and document closure fields (closure_status, closed_by_document_type, closed_by_document_id, closed_at, closed_by_user_id)
- **sales_invoice_grpo_combinations**: Multi-GRPO Sales Invoice tracking
- **delivery_orders / delivery_order_lines**: Delivery order processing with inventory reservation, revenue recognition, business_partner_id, warehouse_id (single warehouse), and document closure fields (closure_status, closed_by_document_type, closed_by_document_id, closed_at, closed_by_user_id)
- **delivery_tracking**: Delivery tracking with logistics cost and performance metrics

GR/GI Management Tables

- **gr_gi_purposes**: GR/GI purpose definitions with type (goods_receipt/goods_issue), code, name, description, and status
- **gr_gi_headers**: GR/GI document headers with document_number, document_type, purpose_id, warehouse_id, transaction_date, reference_number, notes, total_amount, status, approval workflow fields (approved_by, approved_at, cancelled_by, cancelled_at), and audit fields
- **gr_gi_lines**: GR/GI line items with header_id, item_id, quantity, unit_price, total_amount, and notes
- **gr_gi_account_mappings**: Account mapping configuration linking purposes and item categories to debit/credit accounts for automatic journal entry generation
- **gr_gi_journal_entries**: Journal entry tracking linking GR/GI documents to generated journal entries for audit trail and reconciliation

Document Relationship Management Tables

- **document_relationships**: Polymorphic relationship storage for document connections supporting base/target document relationships across all document types with automatic relationship initialization from existing data
- **document_analytics**: Usage tracking and performance analytics with user behavior analysis and system optimization data including comprehensive indexing for performance

Dimension Tables

- **projects**: Project dimension for cost tracking
- **departments**: Department dimension for cost allocation

Trading Company Tables (Phase 1-3)

- **product_categories**: Hierarchical product categorization with account mapping (inventory_account_id, cogs_account_id, sales_account_id)
- **inventory_items**: Product master data with pricing, stock levels, item_type (item/service), default_warehouse_id, and price levels (selling_price_level_2, selling_price_level_3, percentage fields)

- **inventory_transactions**: Stock movement tracking with cost allocation and warehouse_id
- **inventory_valuations**: Real-time inventory valuation with multiple methods
- **warehouses**: Warehouse master data with contact information and status
- **inventory_warehouse_stock**: Per-warehouse stock tracking with quantity_on_hand, reserved_quantity, available_quantity, and warehouse-specific reorder points
- **audit_logs**: System-wide audit trail with entity_type, entity_id, action, old_values, new_values, user tracking, and timestamps
- **customer_item_price_levels**: Customer-specific price level overrides with custom pricing capabilities
- **tax_transactions**: Enhanced individual tax calculation tracking with Indonesian compliance
- **tax_periods**: Tax reporting periods with status management
- **tax_reports**: SPT report generation and submission tracking
- **tax_settings**: Configurable tax rates and company information
- **tax_compliance_logs**: Complete audit trail for tax operations

Advanced Trading Analytics Tables (Phase 4)

- **cost_allocation_methods**: Configurable cost allocation methods (direct, percentage, activity-based)
- **cost_categories**: Cost categorization for better tracking and analysis
- **cost_allocations**: Cost allocation rules and configurations
- **cost_histories**: Historical cost tracking with transaction details
- **product_cost_summaries**: Aggregated product cost data with period-based summaries
- **customer_cost_allocations**: Customer-specific cost allocation tracking
- **margin_analyses**: Comprehensive margin analysis with profitability metrics
- **supplier_cost_analyses**: Supplier cost analysis and performance tracking
- **supplier_performances**: Supplier performance metrics and scoring
- **supplier_comparisons**: Supplier comparison data and benchmarking
- **business_intelligences**: Business intelligence reports and analytics data

Auto-Numbering Tables

- **document_sequences**: Sequence tracking per document type and month with thread-safe operations
- **cash_expenses**: Cash expense tracking with automatic numbering (CEV-YYYYMM-#####) and creator attribution
- **asset_disposals**: Asset disposal transactions with automatic numbering (DIS-YYYYMM-#####)

Document Closure System Tables

- **erp_parameters**: System-wide configurable parameters with category-based organization (document_closure, system_settings, price_handling), parameter_key, parameter_name, parameter_value, data_type, description, is_active, and audit fields (created_by, updated_by, timestamps)

System Tables

- **users**: User management with role integration and username field
- **roles / permissions**: RBAC system (Spatie) with consolidated permissions

Migration Consolidation (2025-01-15)

The database schema has been consolidated from 51 to 44 migration files for improved maintainability:

- **Table Modifications Merged:** Column additions and foreign key constraints consolidated into original table creation migrations
- **Foreign Key Dependencies:** Proper ordering established to resolve dependency conflicts
- **Permissions Consolidated:** All permission additions merged into single migration file
- **Schema Integrity:** All relationships and constraints preserved and verified through fresh migration testing

API Design

Route Structure

- **Web Routes:** Traditional Laravel web routes with middleware
- **Permission-Based Access:** All routes protected with granular permissions
- **RESTful Design:** Standard CRUD operations for all entities
- **DataTables Integration:** AJAX endpoints for dynamic data loading with business_partners table integration

Key Endpoints

- **/dashboard:** Main dashboard with summary statistics
- **/accounts/*:** Chart of accounts management
- **/journals/*:** Journal entry management
- **/account-statements/*:** Account statement generation and management for GL accounts and Business Partners
- **/control-accounts/*:** Control account management with CRUD operations, reconciliation dashboard, and balance tracking
- **/sales-invoices/*:** AR invoice management
- **/delivery-orders/*:** Delivery order management with inventory reservation and revenue recognition
- **/purchase-invoices/*:** AP invoice management
- **/assets/*:** Fixed asset management
- **/inventory/*:** Enhanced inventory management with CRUD operations, stock management, reports, price level management, and audit trails
- **/product-categories/*:** Product category management with CRUD operations, account mapping, hierarchical support, and audit integration
- **/warehouses/*:** Multi-warehouse management with CRUD operations, stock transfers, and warehouse-specific reporting
- **/gr-gi/*:** GR/GI management with CRUD operations, approval workflow, journal integration, and account mapping
- **/audit-logs/*:** System-wide audit trail management with filtering and search capabilities
- **/tax/*:** Indonesian tax compliance management with transactions, periods, reports, settings
- **/cogs/*:** Cost of Goods Sold management with cost allocation, margin analysis, optimization
- **/supplier-analytics/*:** Supplier performance analytics with comparisons, optimization opportunities
- **/business-intelligence/*:** Business intelligence with reports, insights, KPI dashboard

- `/analytics/*`: Unified analytics dashboard integrating all trading components
- `/projects/*`: Project management with CRUD operations and SweetAlert2 integration
- `/funds/*`: Fund management with CRUD operations and SweetAlert2 integration
- `/departments/*`: Department management with CRUD operations and SweetAlert2 integration
- `/erp-parameters/*`: ERP Parameters management with CRUD operations, category-based organization, and bulk updates
- `/reports/open-items/*`: Open Items reporting with comprehensive document status monitoring, aging analysis, and Excel export
- `/reports/*`: Comprehensive reporting suite
- `/admin/*`: User and role management

Data Flow

graph TD

```
A[User Input] --> B[Authentication Check]
B --> C[Permission Validation]
C --> D[Data Validation]
D --> E[Business Logic Processing]
E --> F[Document Numbering Service]
F --> G[Posting Service]
G --> H[Journal Creation]
H --> I[Database Transaction]
I --> J[Response Generation]
J --> K[View Rendering]
```

```
F --> L[Sequence Generation]
L --> M[Month-Based Tracking]
M --> N[Thread-Safe Locking]
```

```
G --> O[Period Validation]
O --> P[Balance Validation]
P --> Q[Dimension Assignment]
Q --> R[Control Account Balance Update]
```

```
S[Sales Order] --> T[Delivery Order Creation]
T --> U[Inventory Reservation]
U --> V[Delivery Approval]
V --> W[Picking/Packing]
W --> X[Delivery Completion]
X --> Y[Revenue Recognition]
Y --> Z[Journal Entries]
Z --> AA[Control Account Reconciliation]
```

```
BB[Control Account Setup] --> CC[Subsidiary Ledger Creation]
CC --> DD[Balance Initialization]
DD --> EE[Reconciliation Dashboard]
```

Security Implementation

Authentication & Authorization

- **Laravel Auth:** Standard authentication with session management
- **Spatie Permission:** Role-based access control with granular permissions
- **Middleware Protection:** All routes protected with appropriate middleware
- **CSRF Protection:** Built-in CSRF token validation

Permission System

- **Granular Permissions:** 55+ specific permissions across all modules including Phase 4 analytics, Document Closure System, and GR/GI Management
- **Role-Based Access:** Predefined roles (admin, manager, user) with custom roles
- **Module-Level Security:** Each module has view/create/update/delete permissions
- **Analytics Permissions:** COGS, supplier analytics, business intelligence, and unified analytics access control
- **Document Closure Permissions:** manage-erp-parameters for ERP Parameters management, reports.open-items for Open Items reporting access
- **GR/GI Permissions:** gr-gi.view/create/update/delete/approve for comprehensive GR/GI management access control
- **Data-Level Security:** Dimension-based data access control

Data Protection

- **Input Validation:** Comprehensive validation rules for all inputs
- **SQL Injection Prevention:** Eloquent ORM with parameterized queries
- **XSS Protection:** Blade template escaping and input sanitization
- **Session Security:** Secure session configuration with proper timeouts

User Interface Enhancements

- **SweetAlert2 Confirmation System:** Comprehensive confirmation dialog system for critical operations across entire ERP system
- **Global JavaScript Handlers:** Event listeners for data-confirm attributes in forms and buttons with automatic prevention of default actions
- **Professional Styling:** Consistent SweetAlert2 design with proper colors (#3085d6 for confirm, #d33 for cancel), question icons, and user-friendly button text
- **Approval Workflow Integration:** Seamless integration with Purchase Order and Sales Order approval processes with proper confirmation dialogs
- **Global Configuration:** Centralized SweetAlert2 configuration in public/js/sweetalert2-config.js with consistent styling and behavior
- **AJAX Response Handling:** Proper JSON responses for all CRUD operations with comprehensive error handling
- **DataTable Integration:** Dynamic data loading with search, sorting, and pagination capabilities
- **Modal Management:** Consistent modal dialogs for create/edit operations with proper form validation
- **Layout Standardization:** Consistent AdminLTE layout structure across all pages with proper breadcrumb navigation, card styling, and responsive design
- **Enhanced Item Display:** Professional item information display with item codes in bold and item names in muted text for improved readability

- **Workflow Optimization:** Improved user workflows with index page redirects after document creation for better user experience
- **Purchase Order Edit System:** Comprehensive edit functionality with sophisticated JavaScript calculation engine, proper VAT/WTax handling, and consistent UI matching create page structure
- **Advanced Calculation Engine:** Real-time calculation system with proper event handlers for quantity, price, VAT, and WTax changes with accurate formula implementation ($\text{Amount Due} = \text{Original Amount} + \text{VAT} - \text{WTax}$)
- **Enhanced Form Validation:** Comprehensive form validation with proper error handling, date field mapping, and database field alignment
- **SweetAlert2 Integration:** Professional confirmation dialogs for critical edit operations with proper user interaction handling
- **GRPO Show Page Enhancements:** Comprehensive GRPO show page improvements including Base Document button enablement with proper document relationship initialization, PO link correction redirecting to PO show page instead of index page, Back to GRPO List button repositioning to right edge with float-right class, duplicate Preview Journal button removal keeping only one in document navigation section, DocumentNavigationController API fixes removing problematic cache service dependency, DocumentRelationshipService field mapping corrections for proper document number display, and comprehensive browser testing validation across all improvements

Deployment

Development Environment

- **Laravel Sail:** Docker-based development environment
- **Vite:** Asset compilation and hot reloading
- **Queue Workers:** Background job processing
- **Log Monitoring:** Laravel Pail for real-time log monitoring

Production Considerations

- **Database:** MySQL with proper indexing and optimization
- **Caching:** Laravel cache system for performance
- **Queue Processing:** Background job processing for PDF generation
- **File Storage:** Local storage with potential for cloud integration
- **Backup Strategy:** Database backup and recovery procedures

Key Dependencies

- **Laravel Framework:** 12.x with PHP 8.2+ requirement
- **AdminLTE:** 3.14 for UI framework
- **Spatie Permission:** 6.15 for RBAC
- **DomPDF:** 2.0.8 for PDF generation
- **Laravel Excel:** 1.1 for Excel export/import
- **DataTables:** 12.x for dynamic table functionality

Trading Company Modification Architecture

Overview

The system has been analyzed for trading company (perusahaan dagang) operations with comprehensive modification recommendations documented in [docs/TRADING-COMPANY-MODIFICATION-PLAN.md](#). This section outlines the architectural changes required for PSAK compliance and Indonesian tax regulations.

Required Database Schema Extensions

New Tables for Trading Operations

```
-- Inventory Management
inventory_items: Product master data with trading-specific fields
inventory_transactions: Stock movement tracking with cost allocation
inventory_valuations: Cost tracking with multiple valuation methods

-- Tax Compliance
tax_codes: PPN/PPh rate configuration
tax_transactions: Tax calculation tracking
tax_reports: Compliance reporting data

-- Trading Operations
supplier_performance: Vendor evaluation metrics
customer_credit_limits: Credit management
sales_commissions: Commission tracking
margin_analysis: Profitability tracking
```

Modified Chart of Accounts Structure

The current CoA requires complete restructuring for PSAK compliance:

- **7 Main Categories:** Assets, Liabilities, Equity, Revenue, COGS, Operating Expenses, Other Income/Expenses
- **Trading-Specific Accounts:** Inventory, COGS, Sales Returns, Purchase Discounts
- **Tax Accounts:** PPN Masukan/Keluaran, PPh 21/22/23/25
- **Indonesian Compliance:** Rupiah formatting, PSAK-standard reporting

Required Controller Extensions

New Controllers

- **InventoryController:** Stock management and valuation
- **COGSController:** Cost of goods sold calculation
- **PPNController:** VAT management and reporting
- **PPhController:** Income tax automation
- **MarginAnalysisController:** Profitability analysis
- **TradingReportsController:** Trading-specific reporting

Enhanced Existing Controllers

- **PurchaseOrderController:** Supplier comparison, freight tracking

- **SalesOrderController**: Credit limits, commission tracking
- **ReportsController**: PSAK-compliant financial statements

Required Service Layer Additions

New Services

- **InventoryService**: Stock valuation methods (FIFO, LIFO, Weighted Average)
- **COGSService**: Automatic cost calculation and allocation
- **TaxCalculationService**: PPN/PPH automation
- **MarginAnalysisService**: Profitability calculations
- **TradingReportService**: Compliance reporting

Data Flow Modifications

```
graph TD
    A[Purchase Order] --> B[Inventory Receipt]
    B --> C[COGS Calculation]
    C --> D[Tax Calculation]
    D --> E[Journal Posting]
    E --> F[Inventory Update]

    G[Sales Order] --> H[Inventory Deduction]
    H --> I[COGS Recognition]
    I --> J[Revenue Recognition]
    J --> K[Tax Calculation]
    K --> L[Journal Posting]

    M[Tax Reporting] --> N[PPN/PPH Reports]
    N --> O[Compliance Dashboard]
```

Security Considerations

New Permissions Required

- **inventory.view/create/update/delete/adjust/transfer**: Enhanced inventory management with warehouse and price level support
- **admin.view**: System-wide audit trail access
- **cogs.view/calculate**: Cost of goods sold access
- **tax.ppn.view/calculate/report**: VAT management
- **tax.pph.view/calculate/report**: Income tax management
- **margin.view/analyze**: Profitability analysis
- **trading.reports.view**: Trading-specific reporting

Data Security

- Inventory cost data protection
- Tax calculation accuracy validation

- Customer credit information security
- Supplier performance data confidentiality

Integration Points

External Systems

- **E-Faktur:** Electronic invoice system integration
- **Tax Authority APIs:** Automated tax reporting
- **Banking Systems:** Payment processing integration
- **Supplier Portals:** Automated purchase order processing

Internal Integrations

- **Multi-dimensional Accounting:** Project/fund/department tracking
- **Fixed Asset Management:** Equipment and depreciation
- **User Management:** Role-based access control
- **Reporting System:** Unified financial reporting

Performance Considerations

Database Optimization

- Inventory transaction indexing for real-time queries
- Tax calculation caching for performance
- Report generation optimization
- Large dataset handling for inventory valuation

System Scalability

- Inventory transaction volume handling
- Concurrent user access for stock updates
- Report generation under load
- Tax calculation performance optimization

Compliance Architecture

PSAK Compliance

- Indonesian financial statement formats
- Revenue recognition standards
- Inventory valuation methods
- Asset and liability classification

Tax Compliance

- PPN (VAT) 11% calculation and reporting
- PPh automation (21, 22, 23, 25)
- Monthly tax reporting (SPT Masa)

- Annual tax return preparation (SPT Tahunan)

Deployment Considerations

Development Environment

- Inventory data migration scripts
- Tax configuration setup
- PSAK-compliant reporting templates
- User training materials

Production Deployment

- Data migration from current system
- Tax configuration validation
- Compliance testing procedures
- User acceptance testing protocols

Document Navigation & Journal Preview System Architecture

Overview

The Document Navigation & Journal Preview system provides comprehensive workflow visibility and accounting transparency across all document types in the ERP system. This system enables users to navigate between related documents, preview journal entries before execution, and visualize complete document workflows through interactive relationship maps.

Core Components

Database Schema

document_relationships Table

- Polymorphic relationship storage for document connections
- Supports base/target document relationships across all document types
- Automatic relationship initialization from existing data

document_analytics Table

- Usage tracking and performance analytics
- User behavior analysis and system optimization data
- Comprehensive indexing for performance

Service Layer Architecture

DocumentRelationshipService

- Core relationship management logic
- Permission-based access control
- Relationship initialization and maintenance

DocumentRelationshipCacheService

- Intelligent caching with TTL management
- Cache invalidation on document changes
- Performance optimization through caching

DocumentBulkOperationService

- Bulk document processing capabilities
- Workflow chain analysis
- Document statistics and analytics

DocumentPerformanceOptimizationService

- Query optimization and eager loading
- Database performance monitoring
- Memory usage optimization

DocumentAnalyticsService

- Comprehensive usage tracking
- Performance metrics collection
- Analytics report generation

API Architecture

DocumentNavigationController

- RESTful API endpoints for navigation data
- Base/target document retrieval
- Permission-based access control

DocumentRelationshipController

- Relationship map data API endpoints
- Mermaid.js compatible graph generation
- Document workflow visualization
- Comprehensive relationship data formatting

JournalPreviewController

- Journal entry preview functionality
- Action simulation without persistence
- Comprehensive error handling

DocumentAnalyticsController

- Analytics data collection and retrieval
- Performance metrics API
- Report generation endpoints

Frontend Architecture

AdvancedDocumentNavigation.js

- Sophisticated JavaScript component
- Client-side caching and error handling
- Keyboard shortcuts and tooltips
- Real-time UI updates

DocumentNavigationButtons.js

- Base/Target document navigation
- Dropdown support for multiple documents
- Professional AdminLTE integration

PreviewJournalButton.js

- Journal preview functionality
- Modal-based display
- Professional formatting and validation

Relationship Map Modal Component

- Mermaid.js flowchart visualization
- Professional AdminLTE modal interface
- Document information display with status badges
- Relationship summary with base/target document counts
- Interactive zoom controls and graph navigation
- Clickable document nodes for direct navigation
- Comprehensive error handling and loading states

Data Flow Architecture

Document Relationship Flow

1. **Relationship Initialization:** Automatic detection of existing document relationships
2. **Permission Filtering:** User-based access control for document visibility
3. **Caching Layer:** Intelligent caching for performance optimization
4. **API Response:** Structured data delivery to frontend components

Relationship Map Flow

1. **Document Selection:** User clicks Relationship Map button on any document show page
2. **API Request:** Frontend calls `/api/documents/{documentType}/{documentId}/relationship-map`
3. **Data Retrieval:** DocumentRelationshipController fetches all related documents using DocumentRelationshipService
4. **Graph Generation:** Mermaid.js compatible graph definition created with document nodes and relationships
5. **Modal Display:** Professional AdminLTE modal renders with document info, relationship summary, and interactive flowchart
6. **User Interaction:** Users can zoom, navigate, and click on document nodes for direct navigation

Journal Preview Flow

1. **Action Simulation:** Non-persistent journal entry generation
2. **Account Mapping:** Automatic account selection based on document type
3. **Validation:** Balance checking and error detection
4. **Preview Display:** Professional modal presentation

Analytics Flow

1. **Usage Tracking:** Real-time user interaction monitoring
2. **Performance Metrics:** System performance data collection
3. **Data Aggregation:** Analytics processing and storage
4. **Report Generation:** Comprehensive analytics reporting

Performance Architecture

Caching Strategy

- **Document Relationships:** 1-hour TTL with automatic invalidation
- **Query Results:** 30-minute TTL for database queries
- **Client-side Caching:** 5-minute TTL for UI responsiveness
- **Cache Warming:** Pre-loading of frequently accessed documents

Database Optimization

- **Eager Loading:** Optimized relationship loading
- **Query Caching:** Database query result caching
- **Index Optimization:** Performance-optimized database indexes
- **Batch Processing:** Efficient bulk operations

Memory Management

- **Memory Usage Monitoring:** Real-time memory tracking
- **Optimization Recommendations:** Automated performance suggestions
- **Resource Management:** Efficient memory allocation

Security Architecture

Authentication & Authorization

- **Session-based Authentication:** Web application security
- **Permission-based Access:** Granular document access control
- **User Context:** User-specific data filtering

Data Protection

- **Input Validation:** Comprehensive data validation
- **SQL Injection Prevention:** Parameterized queries
- **XSS Protection:** Output sanitization

Integration Architecture

ERP System Integration

- **Seamless Integration:** Native ERP system integration
- **AdminLTE Compatibility:** Professional UI consistency
- **Permission System:** Integration with existing RBAC

API Integration

- **RESTful Design:** Standard API patterns
- **JSON Responses:** Structured data delivery
- **Error Handling:** Comprehensive error management

Scalability Considerations

Horizontal Scaling

- **Cache Distribution:** Distributed caching support
- **Database Scaling:** Optimized for database scaling
- **Load Balancing:** API endpoint load balancing

Performance Monitoring

- **Real-time Metrics:** Live performance monitoring
- **Analytics Dashboard:** Comprehensive performance insights
- **Optimization Recommendations:** Automated performance suggestions

Deployment Architecture

Development Environment

- **Local Development:** Complete local setup
- **Testing Framework:** Comprehensive testing capabilities
- **Debug Tools:** Advanced debugging features

Production Deployment

- **Cache Configuration:** Production cache setup
- **Performance Monitoring:** Production performance tracking
- **Analytics Collection:** Production analytics setup