### **Role and Goal**

**Role:** You are an expert software engineer tasked with building a full-stack, enterprise-grade Project Management (PM) application.

**Goal:** Your objective is to create a clean, modern, and intuitive application that functions as a single source of truth for project teams. The application must support various project management methodologies (Waterfall, Agile, Hybrid) and seamlessly integrate project planning, execution, collaboration, and strategic oversight.

### **Core Modules and Functionality**

You are to build the application based on the following modules. Ensure that the modules are deeply integrated, allowing for real-time data synchronization and intelligent, cross-functional interactions.

#### **Module 1: Foundational Core - Project and Task Management**

This module forms the bedrock of the application.

1. **Project Structuring:**
   * **Create Project:** Allow users to create projects with fields for *Project Name*, *Project Manager*, *Start/End Dates*, *Budget*, and a rich-text *Project Charter/Scope Statement*.
   * **Work Breakdown Structure (WBS):** Implement a hierarchical structure to decompose projects into smaller deliverables and work packages.
   * **Project Templates:** Enable users to save any project's structure (phases, tasks, custom fields, dependencies) as a reusable template.
2. **Task Management:**
   * **Core Task Attributes:** Each task must include a *Task Title*, *Description* (rich text), *Assignee(s)*, *Due Date*, *Status* (customizable, e.g., To Do, In Progress, Done), and *Priority* (e.g., Low, Medium, High).
   * **Subtasks:** Support nested checklists within a parent task, where each subtask can have its own assignee and due date.
   * **Recurring Tasks:** Allow tasks to be set to repeat on a daily, weekly, monthly, or custom schedule.
   * **Custom Fields:** Enable users to add their own fields to tasks (supported types: text, number, date, dropdown lists) for enhanced filtering, sorting, and reporting.
3. **Advanced Scheduling:**
   * **Task Dependencies:** Implement all four dependency types (Finish-to-Start, Start-to-Start, Finish-to-Finish, Start-to-Finish). The schedule must automatically update all dependent tasks when a predecessor's date changes.
   * **Milestone Tracking:** Allow users to define milestones (significant events with no duration) that are visually distinct on timelines (e.g., represented as a diamond).
   * **Critical Path Method (CPM):** Automatically calculate and visually highlight the critical path (the longest sequence of dependent tasks) on timeline views.

#### **Module 2: Visualizing Workflows - Interactive Views**

The application must present data through multiple, fully interchangeable views. A user must be able to switch between views with a single click, and the system should instantly re-render the same set of tasks in the new format.

1. **Gantt Chart:** A dynamic and interactive timeline view.
   * Support drag-and-drop adjustments for task dates and durations.
   * Allow visual creation of tasks, milestones, and dependencies.
   * Clearly highlight the critical path.
   * All changes must automatically trigger cascading schedule updates.
2. **Kanban Board:** A visual workflow for Agile and continuous flow management.
   * Allow users to customize columns to match their workflow.
   * Support drag-and-drop functionality to move task cards between columns.
   * Implement Work-in-Progress (WIP) limits that can be set for each column.
3. **Calendar View:** A standard monthly/weekly/daily grid view of tasks based on their due dates.
   * Support drag-and-drop rescheduling.
   * Integrate with external calendars (Google Calendar, Outlook).
4. **List View:** A compact, spreadsheet-like interface for managing tasks in bulk.
   * Provide powerful sorting, filtering, and grouping capabilities by any task attribute, including custom fields.
5. **Customizable Dashboards:** A widget-based "command center" for at-a-glance insights.
   * Allow users to build personalized dashboards by adding and arranging widgets (e.g., My Tasks Due This Week, Project Budget vs. Actual, Team Workload Overview, Burndown Chart).

#### **Module 3: Collaboration Engine**

Embed communication directly into the workflow to create a single, contextual hub for team interaction.

1. **Contextual Communication:**
   * **Task Commenting:** Each task must have its own comment thread.
   * **@Mentions:** Allow users to tag team members in comments to trigger notifications.
   * **Rich Text & Emojis:** Support formatting (bold, italics, lists) and emojis in comments.
2. **File Management:**
   * **File Attachments:** Allow file uploads from a local computer and integration with cloud storage providers (Google Drive, Dropbox, OneDrive).
   * **Version Control & Proofing:** Enable contextual comments directly on images and PDFs to streamline feedback.
   * **Security & Permissions:** Provide granular control over who can view, edit, or download files.
3. **Notification System:**
   * **Customizable Notifications:** Users can control which events trigger notifications (e.g., new assignment, @mention, approaching deadline) and their preferred delivery channel (in-app, email, mobile push).
   * **Digest Options:** Offer daily or weekly summary emails to reduce notification fatigue.
   * **Actionable Notifications:** Allow users to reply to an email notification and have the reply automatically posted to the correct comment thread in the app.

#### **Module 4: Advanced Capabilities**

Incorporate strategic features for comprehensive project oversight.

1. **Resource & Workload Management:**
   * **Capacity Planning:** Define each team member's weekly availability, accounting for time off.
   * **Workload Visualization:** Provide a timeline or heatmap view showing each person's assigned work against their capacity.
   * **Over-allocation Alerts:** Automatically flag when a team member's workload exceeds their defined capacity.
2. **Financial Management:**
   * **Project Budgeting:** Support both top-down and bottom-up budgeting with customizable cost categories.
   * **Real-Time Cost Tracking:** Include integrated time tracking (billable/non-billable hours) and a simple interface for logging expenses.
   * **Budget vs. Actual Reporting:** Offer a real-time dashboard comparing planned budget to actual spending, with forecasts for final project cost.
3. **Risk Management:**
   * **Risk Register:** A central repository to log and track project risks with fields for *Description*, *Category*, *Probability*, *Impact*, *Risk Score*, *Mitigation Plan*, and *Risk Owner*.
   * **Risk Visualization:** Display risks on a Probability/Impact matrix.
4. **Workflow Automation:**
   * **No-Code Rule Builder:** A simple "When this happens, then do that" interface for creating custom automation rules.
   * **Common Use Cases:** Automate actions like changing a task's status and assigning it to a manager, or sending reminders for upcoming due dates.

#### **Module 5: Analytics and Reporting**

Transform operational data into actionable insights.

1. **Progress Reporting:**
   * **Automated Status Reports:** Schedule customizable daily, weekly, or monthly status reports that include an executive summary, project health indicators, key accomplishments, and upcoming milestones.
   * **Report Templates:** Provide pre-built templates for different audiences (e.g., Executive Summary, Resource Workload, Budget vs. Actual).
2. **Agile Metrics:**
   * **Burndown/Burnup Charts:** Automatically generate charts to visualize work remaining versus work completed over time.
   * **Flow Metrics:** Automatically track and report on Velocity, Lead Time, and Cycle Time.
   * **Cumulative Flow Diagram (CFD):** Generate a CFD to visualize workflow and identify bottlenecks.
3. **AI-Powered Insights:**
   * **Predictive Analytics:** Use historical data to predict the likelihood of meeting future deadlines and flag high-risk tasks.
   * **Automated Summaries:** Employ generative AI to create concise summaries of long comment threads or project updates.

#### **Module 6: Project Portfolio Management (PPM)**

Provide executive-level oversight to manage all projects as a cohesive portfolio.

1. **Portfolio Visibility:**
   * **Portfolio Dashboard:** A centralized dashboard showing the health of all projects (Status, Budget, Resources, % Complete).
   * **Strategic Alignment:** Allow projects to be linked to specific business objectives or OKRs.
2. **Demand Management:**
   * **Idea & Request Capture:** A formalized intake system (using customizable forms) for submitting new project proposals.
   * **Prioritization & Scoring:** A framework for scoring new proposals against predefined criteria (e.g., Strategic Alignment, ROI, Risk) to enable objective prioritization.

### **Technical Specification: Microsoft Excel Export**

A critical feature for user adoption is the ability to export data into well-structured Excel files. You must implement export functionality for the following reports with the exact column headers and data types as specified in the provided research document.

1. **Gantt Chart and Project Timeline Export:** (Table 7.1 specification)
2. **Kanban Board and Task List Export:** (Table 7.2 specification)
3. **Financial and Budget Report Export:** (Table 7.3 specification)
4. **Burndown Chart Data Export:** (Table 7.4 specification)
5. **Risk Register Export:** (Table 7.5 specification)

### **Final Deliverable**

The final product should be a robust, fully functional, and intuitive project management suite that empowers teams to plan, execute, and collaborate effectively. The architecture must be scalable and prioritize a seamless user experience, with a clean and modern user interface.