



SOFTWARE ANALYSIS AND DESIGN REPORT: JEWELRY MS SYSTEM SOFTWARE

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“This report provides a comprehensive introduction what the project is about and how it will be created to benefit the jewelry business establishment TwentyOne Gold.”



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2. Abstract

This report presents a comprehensive Software Analysis and Design (SAD) project for the TwentyOne Gold Jewelry Management System—an integrated platform proposed to optimize critical functions such as inventory, production, customer relations, finance, and human resources within a luxury jewelry business. The system replaces fragmented, manual processes with a unified, real-time solution that enhances operational efficiency and supports data-driven decision-making. Key components include detailed requirements specifications (both functional and non-functional), stakeholder and user analysis, UML models, process diagrams, system architecture, database schema, and UI/UX design. By employing structured methodologies (use-case modeling, BPMN, UML, and ER diagrams) alongside modern tools (Figma, Visual Paradigm, BPMN.io), we walk through each phase—from requirements gathering through implementation, testing, deployment, and future enhancements. The report concludes with lessons learned, challenges encountered, and recommendations for ongoing improvement. All design decisions are justified with academic rigor and citations to authoritative sources.



3. Introduction and Problem Statement

TwentyOne Gold Jewelry, a luxury jewelry business known for its high-quality designs and craftsmanship, faces increasing operational complexity as it grows. Managing diverse product lines, complex production processes, inventory, and customer orders manually or with fragmented systems has become impractical. The company recognizes that existing manual processes and disparate software solutions are no longer sufficient and needs an integrated, real-time management system to coordinate functions across departments. The proposed system's purpose is to streamline essential business functions—including inventory, production, customer relations, financials, and HR—into a single platform. This addresses critical problems: data silos between departments, delays in decision-making due to lack of real-time information, inventory stockouts or overstock, and inefficient resource planning. By adopting a unified system, TwentyOne Gold aims to reduce inefficiencies, improve data accuracy, and maintain high customer service standards in a competitive market.

In summary, the problem statement is: How can TwentyOne Gold Jewelry design a comprehensive management system that integrates inventory, production, sales/CRM, finance, and HR functions to improve operational efficiency, decision-making, and customer satisfaction? The system must replace existing ad-hoc processes with automated workflows, real-time monitoring, and data analytics to support continued growth and competitiveness.

4. Objectives and Scope



The primary objectives of the proposed system are to:

1. **Integrate key business functions across the company.** Establish a unified platform that seamlessly connects inventory, production, sales/CRM, finance, and HR processes.
2. **Automate routine tasks.** Replace manual workflows—such as inventory tracking, invoicing, and report generation—with automated processes to reduce errors and free staff for higher-value activities.
3. **Provide real-time data and insights to management.** Offer up-to-date dashboards and analytics so decision-makers can respond immediately to changes in demand, production status, cash flow, and staffing.
4. **Enhance customer service through improved CRM and support.** Centralize customer data (contact information, purchase history, warranty records, feedback) to enable personalized service, timely follow-up, and accurate sales forecasting.

Specifically, the system will help TwentyOne Gold to:

- Generate on-demand, accurate management reports (sales trends, production capacity, inventory levels) for better decision-making.
- Streamline production planning by allocating resources (materials, labor, equipment) based on real-time usage and demand projections.
- Prevent stockouts or overstock by monitoring inventory turnover and triggering automated reorder alerts.
- Ensure financial accuracy by automating invoicing, transaction recording, budget tracking, and regulatory compliance.
- Manage human resources efficiently through integrated scheduling, payroll processing, performance tracking, and training/certification workflows.

By achieving these objectives, TwentyOne Gold will maintain its reputation for superior craftsmanship and customer care while expanding production capacity and adapting quickly to market changes.

Scope

The proposed management system will encompass the following key domains:

1. Inventory & Material Management



- Track raw materials, work-in-progress (WIP), and finished goods in real time.
 - Provide automated reorder notifications when stock levels fall below predefined thresholds.
 - Generate usage and inventory turnover reports to identify fast-moving SKUs and slow-moving items.
- 2. Production Management**
- Plan and monitor production workflows from raw materials to finished jewelry pieces.
 - Schedule jobs on equipment and allocate workforce based on capacity and deadlines.
 - Track progress on each production order, including quality-control checkpoints at critical stages.
 - Record production yields, scrap rates, and rework requirements for continuous improvement.
- 3. Sales & Customer Relationship Management (CRM)**
- Maintain a centralized customer database with contact details, purchase history, preferences, and warranty records.
 - Enable personalized communications (promotions, after-sales reminders, service notifications).
 - Support sales forecasting by analyzing historical sales data and seasonal trends.
 - Manage after-sales support workflows (returns, repairs, warranty claims, customer feedback).
- 4. Financial & Accounting Operations**
- Automate invoicing, payment processing, and integration with banking systems.
 - Record all financial transactions in real time to facilitate accurate ledgers and trial balances.
 - Support budgeting and forecasting modules to compare actuals versus targets.
 - Ensure compliance with relevant accounting standards and generate regulatory reports as required.
- 5. Human Resource Management**
- Maintain employee master records (personal details, roles, compensation, certifications).
 - Automate payroll calculations, tax withholdings, and benefit deductions.
 - Manage shift scheduling according to labor requirements, skill sets, and availability.
 - Track performance evaluations, training schedules, and professional development plans.
- **Out-of-Scope Clarifications**



- Retail e-commerce (online storefronts, payment gateways external to wholesale/order management) is not covered in this system.
- Customer self-service portals (e.g., for placing orders directly online) are considered outside the current scope.
- Any specialized point-of-sale (POS) hardware integrations for brick-and-mortar storefronts will be addressed in a future phase.

This defined scope ensures that all critical internal operations are integrated, leveraging real-time data to meet the objectives of improving operational efficiency, accelerating decision-making, and elevating customer satisfaction.

5. Software Requirements Specification

This section outlines the **functional** and **non-functional requirements** for the proposed *TwentyOne Gold Jewelry Management System*. These requirements have been derived from stakeholder interviews, domain



research, and industry-standard practices. They serve as the foundation for the system's design and implementation.

5.1 Functional Requirements

Functional requirements define the essential capabilities the system must offer to meet business needs. These include features directly related to user interactions, internal workflows, and data handling. Key functional requirements are:

- **User Authentication & Role Management**
The system shall enforce secure login for all users. Role-based access control must be implemented, where users (e.g., admin, manager, staff) are granted permissions based on their assigned roles.
- **Inventory Management**
Users must be able to add, update, view, and delete information about raw materials and finished products. The system should display real-time stock levels and generate alerts when quantities fall below predefined reorder thresholds.
- **Production Order Management**
Production managers can create and schedule production orders for specific jewelry items. The system will track each order's progress (e.g., initiated, in-process, completed) and ensure materials are allocated accordingly.
- **Product Catalog Management**
Administrators shall define product templates, including design specifications, material requirements, and pricing. The system must support version control for updated or discontinued items.
- **Sales Order Processing**
Sales personnel can create new orders linked to existing customer profiles. The system will reserve inventory for active orders and automatically generate customer invoices.
- **Customer Relationship Management (CRM)**
Customer records shall include contact information, purchase history, preferences, and communication logs. Staff must be able to update and query customer data to provide personalized support.
- **Financial Transactions**
The system shall support invoicing, payment tracking, and accounting journal entries (e.g., general ledger, tax records). It must



interface with the financial reporting module for transparency and compliance.

- **Reporting and Analytics**

The system must generate reports across various modules, such as sales performance, inventory valuation, financial statements, and HR summaries. Reports should be exportable (PDF, Excel) and filterable by date, category, or user.

- **Human Resource Management**

HR functions include managing employee profiles, attendance tracking, payroll processing, shift scheduling, and onboarding workflows. Historical data such as training certifications and performance reviews must be stored securely.

- **Notifications and Alerts**

Automatic notifications should be triggered by specific events such as low inventory, overdue tasks, pending approvals, or upcoming deadlines. Users should be able to configure alert preferences.

These functional requirements ensure the system addresses operational, managerial, and strategic needs across all departments. They will be elaborated through detailed use case diagrams and modeled with sequence, activity, and state diagrams during the design phase.

5.2 Non-Functional Requirements

Non-functional requirements (NFRs) define the quality attributes and constraints of the system. These aspects ensure that the solution is robust, secure, and scalable beyond basic functionality.



- **Usability**
The user interface shall be intuitive, responsive, and consistent with modern design principles. Features such as structured navigation, tooltips, error feedback, and input validation must be implemented to enhance the user experience.
- **Performance**
The system must respond to common user actions (e.g., page loads, report generation) within 2 seconds under typical load conditions. It must support concurrent access by dozens of users without noticeable delays.
- **Reliability and Availability**
The system should maintain an uptime of at least 99%, ensuring availability during business hours. All operations must preserve data integrity, with mechanisms for backup, rollback, and error recovery in case of failure.
- **Security**
Sensitive information (e.g., customer data, payroll, financials) must be encrypted both in transit and at rest. Strong authentication mechanisms (e.g., password policies, multi-factor authentication) and role-based access control must be enforced. The system must comply with applicable data protection regulations.
- **Scalability**
The system architecture shall allow for horizontal or vertical scaling. Database schemas and application layers should be designed to handle increased transaction volume and user load as the company grows.
- **Maintainability**
The codebase must follow established programming standards and be modular for ease of maintenance. Technical documentation must include API references, system diagrams, and change logs to facilitate ongoing development.
- **Localization and Internationalization**
The system should support multiple currencies, languages, and date/time formats to accommodate regional expansion or multi-national operations.

These non-functional requirements ensure the system not only fulfills business needs but does so with high standards of quality, performance, and long-term viability.

6. User Stories



User stories are a core component of Agile software development and provide insight into how different users interact with the system. They help define the system's behavior from the user's perspective and establish a basis for planning, development, and testing. The user stories below are categorized by functional area and are detailed using the standard "As a... I want to... So that..." format, accompanied by acceptance criteria for clarity.

6.1 Inventory & Material Management

User Story 6.1.1: Track Inventory in Real-Time

As a Warehouse Staff, I want to track inventory levels of raw materials and finished jewelry in real-time so that I know what's available at all times.

Acceptance Criteria:

1. Inventory updates in real-time
2. Low stock alerts appear
3. Items can be searched by material or product

User Story 6.1.2: Manage BOM (Bill of Materials)

As a Production Manager, I want to create and manage a BOM for each jewelry item to track materials and costs.

Acceptance Criteria:

1. BOM is editable and links to product orders
2. Lists materials, costs, and quantities

User Story 1.3: Track Material Usage

As a Warehouse Staff, I want the system to notify me when material stocks are low, so I can reorder raw materials before production is affected.

Acceptance Criteria:

1. Usage tracked automatically
2. Alerts for low stock
3. Reorder threshold is visible

6.2 Production Management

User Story 6.2.1: Work Order Creation

As a Production Manager, I want to create work orders detailing materials, stages, and deadlines so that artisans know what they need to



work on.

Acceptance Criteria:

1. Work orders include detailed specs
2. Artisans receive real-time assignments
3. Status tracking for work orders

User Story 2.2: Scheduling Work Orders

As a Production Manager, I want to assign tasks to artisans based on skills and availability to ensure smooth production.

Acceptance Criteria:

1. Skill and availability profiles for artisans
2. Automatic assignment with manual override

User Story 6.2.3: Track Custom Orders

As a Sales/Customer Service Team member, I want to track custom orders to ensure customer needs are met and deadlines followed.

Acceptance Criteria:

1. Custom and standard orders are differentiated
2. Status tracking for each order
3. Internal communication between sales and production

User Story 6.2.4: Quality Control Tracking

As a Quality Control Manager, I want to monitor the quality of jewelry at different production stages to catch defects early.

Acceptance Criteria:

1. Stage-based QC checks
2. Flagging defective items
3. Generate QC reports

User Story 6.2.5: Defect & Rework Management

As a Production Manager, I want to keep track of defective items and assign rework tasks.

Acceptance Criteria:

1. Log defects with descriptions



2. Assign and track rework
3. Status visibility for reworked items

6.3 Sales & Customer Management

User Story 6.3.1: Sales Integration

As a Store Manager, I want to see a unified view of online and physical store sales for accurate decision-making.

Acceptance Criteria:

1. Combined dashboard
2. Filter by location or channel
3. Reports for analysis

User Story 6.3.2: Customer Profile Management

As a Sales Team member, I want to maintain customer profiles with history and preferences for personalized service.

Acceptance Criteria:

1. Editable customer profiles
2. History and preference tracking
3. Recommendation support

User Story 6.3.3: Order Tracking for Customers

As a Customer, I want to track my order status in real-time to know when it will be delivered.

Acceptance Criteria:

1. Web/app tracking portal
2. Live updates
3. Contact option for support

User Story 6.3.4: Order Fulfillment Tracking

As a Customer, I want to track order stages from production to delivery for visibility.

Acceptance Criteria:

1. Multi-stage order progress bar
2. Estimated delivery window



User Story 6.3.5: Loyalty Program Management

As a Sales Team member, I want to manage loyalty programs and promotions to retain customers.

Acceptance Criteria:

1. Create/manage loyalty tiers
2. Track points and redemptions
3. Custom promotions based on history

6.4 Financial & Accounting Management

User Story 6.4.1: Track Expenses

As an Accounting Staff member, I want to monitor material, labor, and overhead costs for accurate reporting.

Acceptance Criteria:

1. Expense logging by category
2. Exportable financial reports

User Story 6.4.2: Profitability of Jewelry

As a Business Owner, I want to view profitability by item for pricing decisions.

Acceptance Criteria:

1. Compare cost vs revenue
2. View data in dashboards

User Story 6.4.3: Generate Tax Reports

As an Accounting Staff member, I want to generate tax reports based on categorized financial data.

Acceptance Criteria:

1. Accurate tax categorization
2. Auto-generated reports
3. Export format supported

6.5 Resource & Labor Management

User Story 6.5.1: Employee Scheduling

As an Artisan Supervisor, I want to schedule artisans based on availability and skills to keep production efficient.

Acceptance Criteria:



1. Artisan profiles with availability
2. Auto-generated schedules
3. Editable calendars

User Story 6.5.2: Machine Tracking & Maintenance

As a Production Manager, I want to monitor machine usage and schedule maintenance to reduce downtime.

Acceptance Criteria:

1. Usage log for machines
2. Auto-maintenance alerts

6.6 Custom Dashboards

User Story 6.6.1: Customizable Dashboards

As a Business Owner, I want customizable dashboards with real-time KPIs for decision-making.

Acceptance Criteria:

1. Add/remove widgets
2. Filter by department or metric
3. Real-time updates

6.7 Customer Experience & Order Fulfillment

User Story 6.7.1: Order Fulfillment Tracking

As a Customer, I want to track my order from production to delivery to know when I'll receive it.

Acceptance Criteria:

1. Track each production/shipping stage
2. Real-time delivery estimates

User Story 6.7.2: Loyalty Program Management

As a Sales Team member, I want to manage loyalty programs and promotions to reward loyal customers.

Acceptance Criteria:

1. Track points and rewards



2. Customize promotional offers

7. User Scenarios

User scenarios describe real-world contexts in which users interact with the system. These narratives illustrate how the platform supports user goals, decisions, and workflows. Each scenario below includes the user role, task, and design implications for the system.

7.1 Warehouse Staff

Scenario: Track Inventory and Material Usage

Warehouse staff monitor live inventory levels of raw materials and finished products. When stock approaches predefined thresholds, the system sends alerts. Staff can then initiate reordering promptly to avoid delays.

Design Implication:

Requires real-time stock tracking, configurable reorder thresholds, and an alert notification system.

7.2 Production Manager

Scenario: Create and Schedule Work Orders

Production managers create work orders detailing material lists, deadlines, and assigned artisans. Orders are automatically scheduled based on artisan skills and current workload but can be manually adjusted if necessary.

Design Implication:

Scheduling engine must account for artisan availability, skills, and task urgency.

Scenario: Manage Bill of Materials (BOM)

Managers define the BOM for each jewelry piece, specifying raw materials, quantities, and linking directly to inventory.

Design Implication:

The BOM system must be dynamic, editable, and integrated with cost tracking.

**Scenario: Track Custom Orders**

Production managers track progress on custom orders to ensure specifications are met and deadlines adhered to.

Design Implication:

System must distinguish between regular and custom workflows.

Scenario: Monitor Quality Control (QC) & Machines

Managers track quality across production stages, assign rework tasks, monitor machine usage, and schedule preventative maintenance automatically.

Design Implication:

Integration of QC checkpoints, machine usage logs, and rework tracking is essential.

7.3 Sales Manager

Scenario: View Sales Across Channels

Sales managers view consolidated sales data from both in-store and online channels through a unified dashboard.

Design Implication:

Requires multi-channel data aggregation, visual analytics, and advanced filtering.

Scenario: Manage Loyalty Programs and Customer Profiles

Sales managers create targeted promotions, adjust program rules, and access detailed customer histories.

Design Implication:

Integration between sales data, loyalty program management, and customer profile systems is needed.

7.4 Owner

Scenario: Use Custom Dashboards

Owners build personalized dashboards to monitor KPIs such as sales, production, and customer trends. Dashboards update in real-time to support strategic decision-making.

**Design Implication:**

Widget-based, role-specific dashboards with real-time data feeds.

7.5 Customer

Scenario: Track Order Fulfillment

Customers receive real-time updates on their order status, from confirmation through delivery.

Design Implication:

Real-time order tracking and a customer notification system are required.

7.6 Production Staff

Scenario: Follow Detailed Order Instructions

Artisans receive detailed breakdowns of material requirements, production phases, and deadlines. Notifications keep them updated on any changes.

Design Implication:

Role-based views and timely alerts for production details.

7.7 Sales Staff

Scenario: Personalize Customer Interaction

Sales representatives access customer profiles, view preferences and past purchases, and provide personalized recommendations.

**Design Implication:**

Fast access to complete customer histories and a dynamic suggestion engine.

Scenario: Support Custom Orders and Promotions

Sales staff track custom order statuses, apply discounts, manage promotions, and support reward programs.

Design Implication:

Integration of notification and promotion engines with order management.

8. Stakeholders

8.1 Primary Stakeholders

Stakeholder	Role/Responsibility	Influence	Interest	Key Interests	Concerns
Owner	Oversees strategic direction and approves resources. Not a direct system user but invested in outcomes.	High	High	Profitability, ROI, competitive edge, and long-term growth.	ROI risks, market competition, missed business opportunities.
Executive Leadership	Includes senior decision-makers responsible for ensuring that the system aligns with the organization's strategic goals.	High	High	Operational efficiency, data-driven decision-making, adoption success.	Poor system adoption, inadequate reporting, resistance from departments.

8.2 Departmental and Operational Stakeholders

Stakeholder	Role/Responsibility	Influence	Interest	Key Interests	Concerns
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Sales Manager	Manages the sales team, monitors performance, and uses the system for reporting and customer analytics.	Medium	High	Sales trends, customer relationships, report accuracy.	Data inconsistencies, lack of actionable insights, software limitations.
Artisan Manager	Supervises artisans and production quality. Uses system for team coordination and production monitoring.	Medium	Medium	Quality control, team efficiency, on-time delivery.	Missed deadlines, production errors, lack of visibility.
Department Heads (Finance, HR, Inventory, Production)	Define and oversee system use within their domains. Responsible for the configuration and utility of specialized modules.	High	High	Accurate module-specific reporting, data integrity, cross-functional integration.	Inflexibility, lack of domain-specific customization, delayed data access.

8.3 Technical and Administrative Stakeholders

Stakeholder	Role/Responsibility	Influence	Interest	Key Interests	Concerns
Software Developers	Design, build, and maintain the system. Work with defined requirements to implement technical solutions.	Low	Medium	Code quality, system stability, clear requirements.	Unclear specs, unrealistic timelines, technical debt.
IT Support / System Admins	Responsible for deployment, maintenance, troubleshooting, and user support.	Medium	Medium	System uptime, ease of configuration, documentation.	Downtime, undocumented errors, lack of vendor support.

8.4 End Users



Stakeholder	Role/Responsibility	Influence	Interest	Key Interests	Concerns
Sales Staff	Use the system to process orders and manage customer interactions.	Medium	High	Usability, efficiency, responsiveness.	System lag, input errors, complex interface.
Artisans	Execute production tasks based on system work orders. Depend on accurate and timely data.	Medium	Medium	Workflow clarity, task visibility.	Disruptions in process, unclear instructions.
Warehouse Staff	Handle inventory and logistics, rely on system for stock management.	Low	Medium	Real-time stock tracking, error-free operations.	Inventory discrepancies, software complexity.
Customers (Indirect)	Not direct users, but outcomes of the system affect them via service quality and delivery.	Low	High	Faster delivery, personalized service, accurate billing.	Delays, order errors, poor communication.

8.5 Summary of Stakeholder Influence and Interest

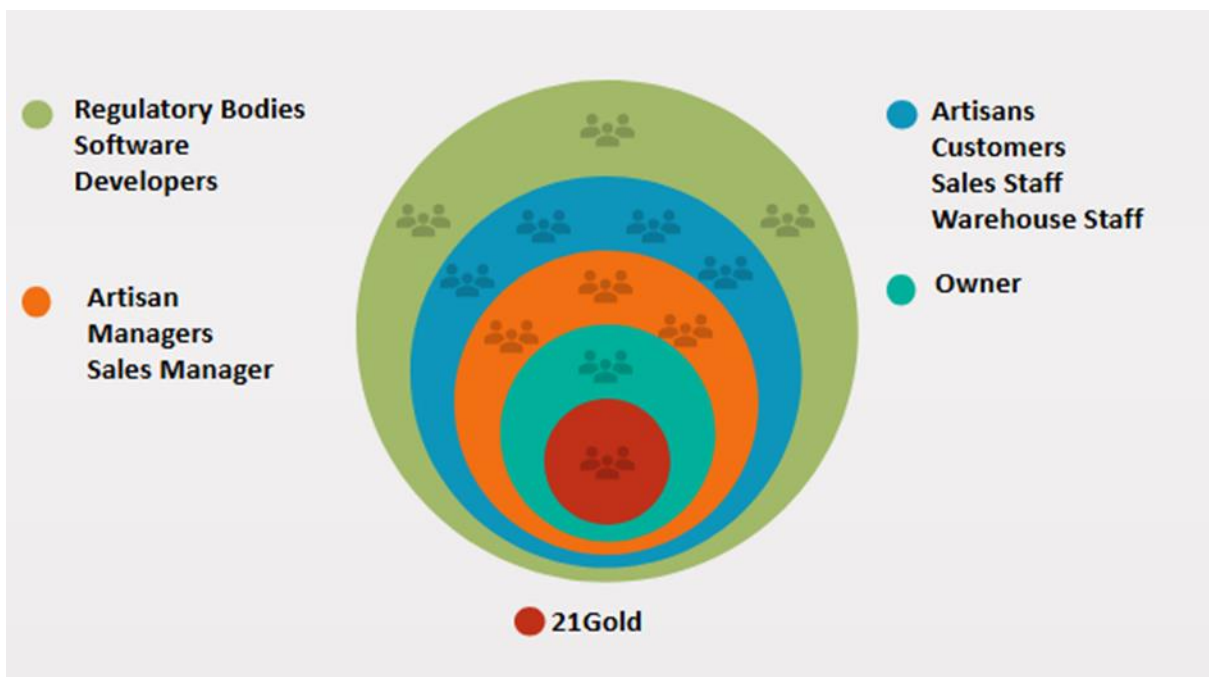
Category	Examples	Influence	Interest
High Influence, High Interest	Owner, Executive Team, Department Heads	High	High
Medium Influence, High Interest	Sales Manager, Artisans, Operational Staff	Medium	High
Low Influence, Medium/High Interest	Warehouse Staff, Customers, Software Developers	Low–Medium	Medium–High
Medium Influence, Medium Interest	IT/Admin Support	Medium	Medium



8.6 Engagement Strategy

Engagement with each stakeholder group should be tailored:

- **Executive stakeholders** must be consulted during major design and milestone reviews.
- **Department heads and managers** should be involved in requirements validation and module testing.
- **End users** require continuous feedback loops (e.g., user testing, surveys) to ensure the system aligns with real-world usage.
- **Technical stakeholders** (developers, IT) should maintain documentation and participate in retrospectives to ensure maintainability and scalability.

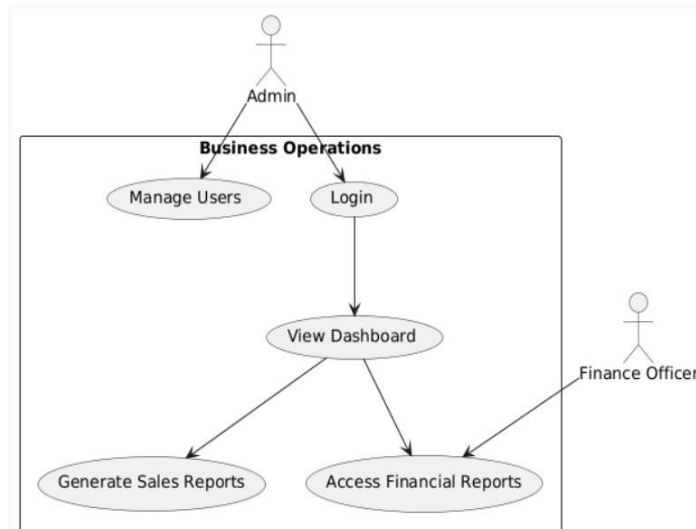


Onion Diagram



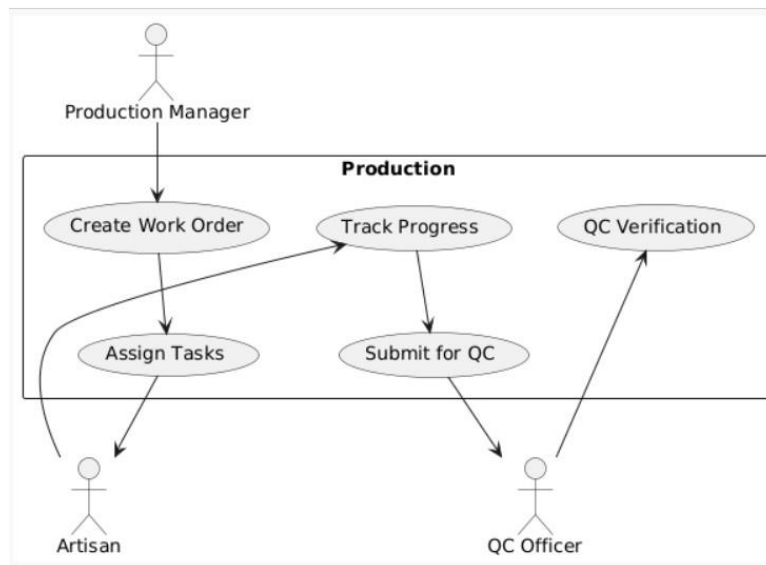
9. Jewelry Store System – Use Cases Analysis

This section presents a complete set of core and subsystem use cases that describe the interaction between actors and the system across various domains of the TwentyOne Gold Jewelry Management System.



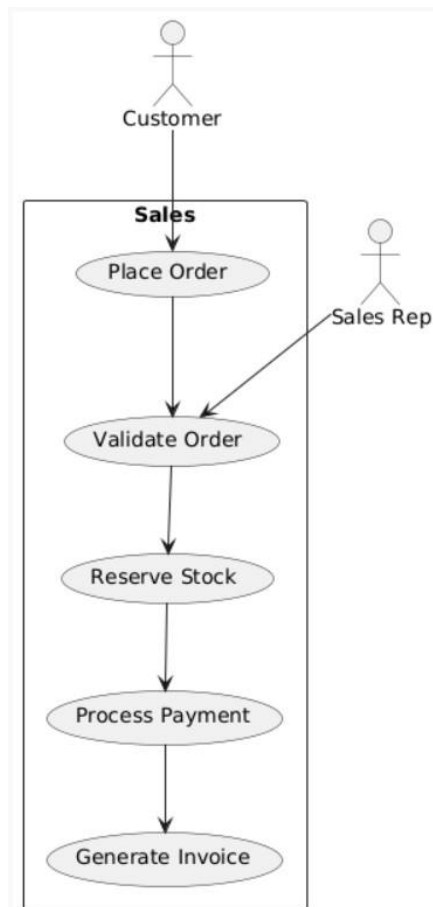
Business Operations Use Case

- **Primary Actors:** Admin, Finance Officer
 - **Description:**
 - Provides centralized administrative control over core business operations.
 - Admin can manage user accounts and system login access.
 - Both Admin and Finance Officer can view a centralized dashboard.
 - The dashboard grants access to key business metrics, sales performance, and financial reports.
 - **System Benefits:**
 - Centralized management of administrative and reporting functions.
 - Role-based access to sensitive business data.
 - Real-time oversight of strategic metrics.
 - Strengthens system security and governance through proper user management.
-



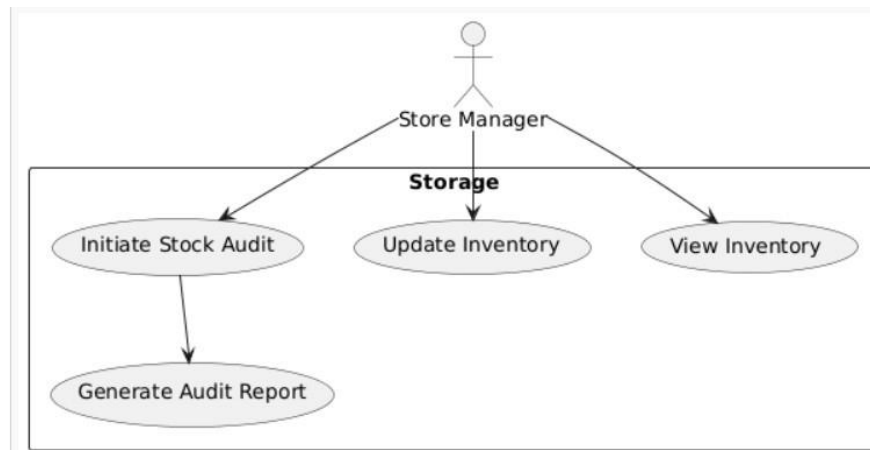
Production Use Case

- **Primary Actor:** Production Manager
 - **Supporting Actors:** Artisan, Quality Control Officer (QC Officer)
 - **Description:**
 - Manages the full lifecycle of jewelry production.
 - Production Manager initiates work orders and assigns them to Artisans.
 - Tracks production progress and manages workflow stages.
 - QC Officer verifies product quality and can trigger rework when needed.
 - **System Benefits:**
 - Streamlined production process management.
 - Built-in quality control and traceability.
 - Real-time visibility into work order status.
 - Promotes collaboration across production roles.
-



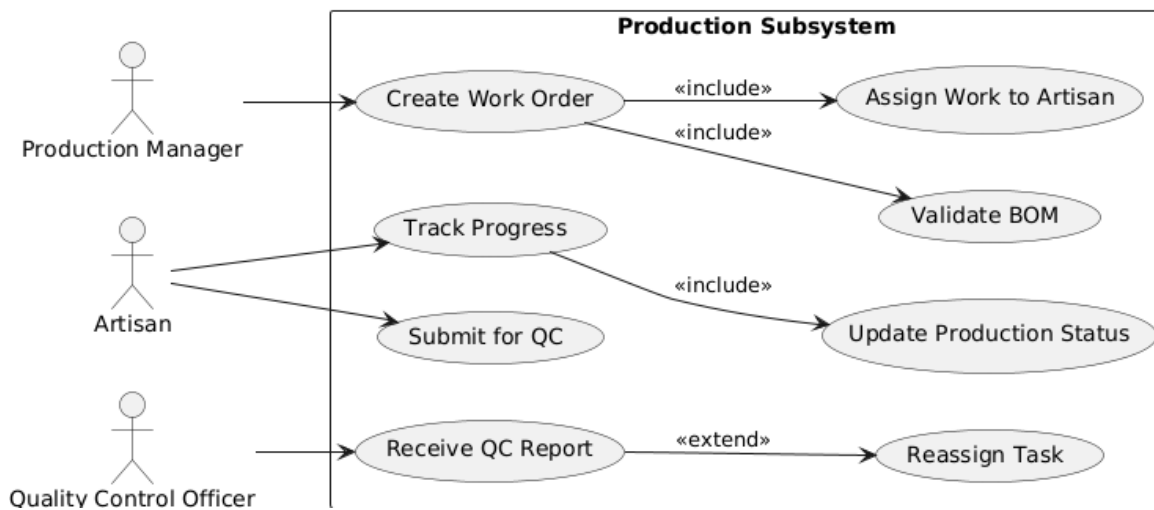
Sales Use Case

- **Primary Actor:** Customer
- **Supporting Actor:** Sales Representative
- **Description:**
 - Manages the end-to-end customer purchase journey.
 - Customers place orders with assistance from Sales Representatives.
 - System validates stock availability, reserves items, processes payments, and issues invoices.
- **System Benefits:**
 - Enhances customer experience and satisfaction.
 - Guarantees inventory availability before finalizing transactions.
 - Streamlined transaction handling and record keeping.
 - Supports both in-store and assisted sales.



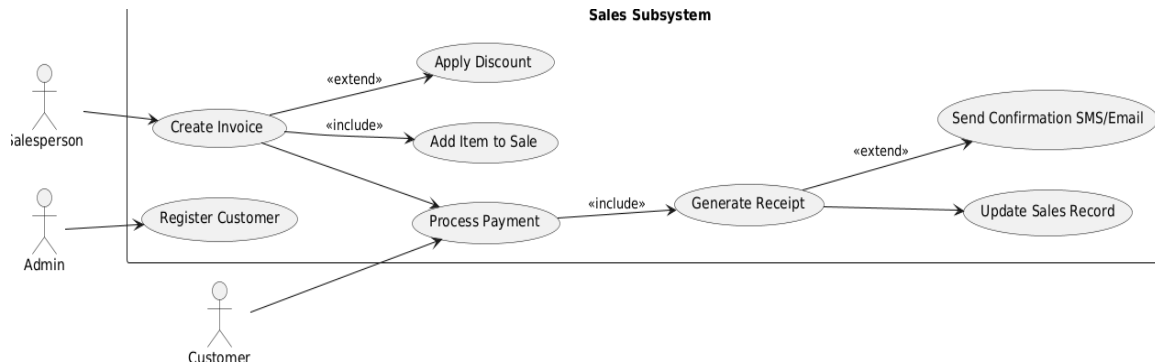
Storage/Inventory Use Case

- **Primary Actor:** Store Manager
 - **Description:**
 - Manages inventory audits, updates, and stock status checks.
 - Allows initiation of inventory audits for reconciliation.
 - Supports stock level adjustments and generates compliance audit reports.
 - **System Benefits:**
 - Promotes inventory accuracy and data reliability.
 - Offers real-time visibility into stock levels.
 - Ensures traceability for compliance and oversight.
 - Facilitates proactive inventory decision-making.
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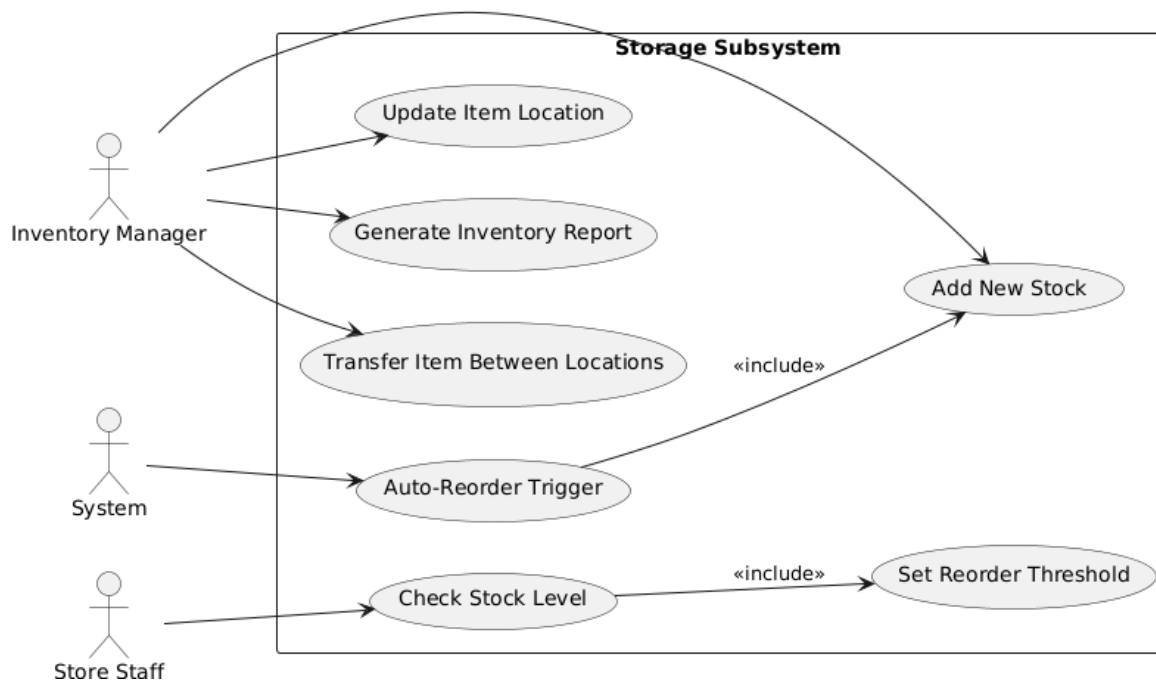
Production Subsystem Use Case

- **Primary Actors:** Production Manager, Artisan, Quality Control Officer
- **Description:**
 - Represents a detailed production workflow using **include/extend** relationships.
 - Work orders include artisan assignments and BOM (Bill of Materials) validations.
 - Artisans update progress and submit items for QC review.
 - QC Officer receives quality reports and may extend workflow to trigger task reassignment or rework.
- **System Benefits:**
 - Detailed modeling of production tasks and dependencies.
 - Full traceability across all production roles.
 - Embedded quality checks and rework handling.
 - Seamless coordination across production and QA teams.



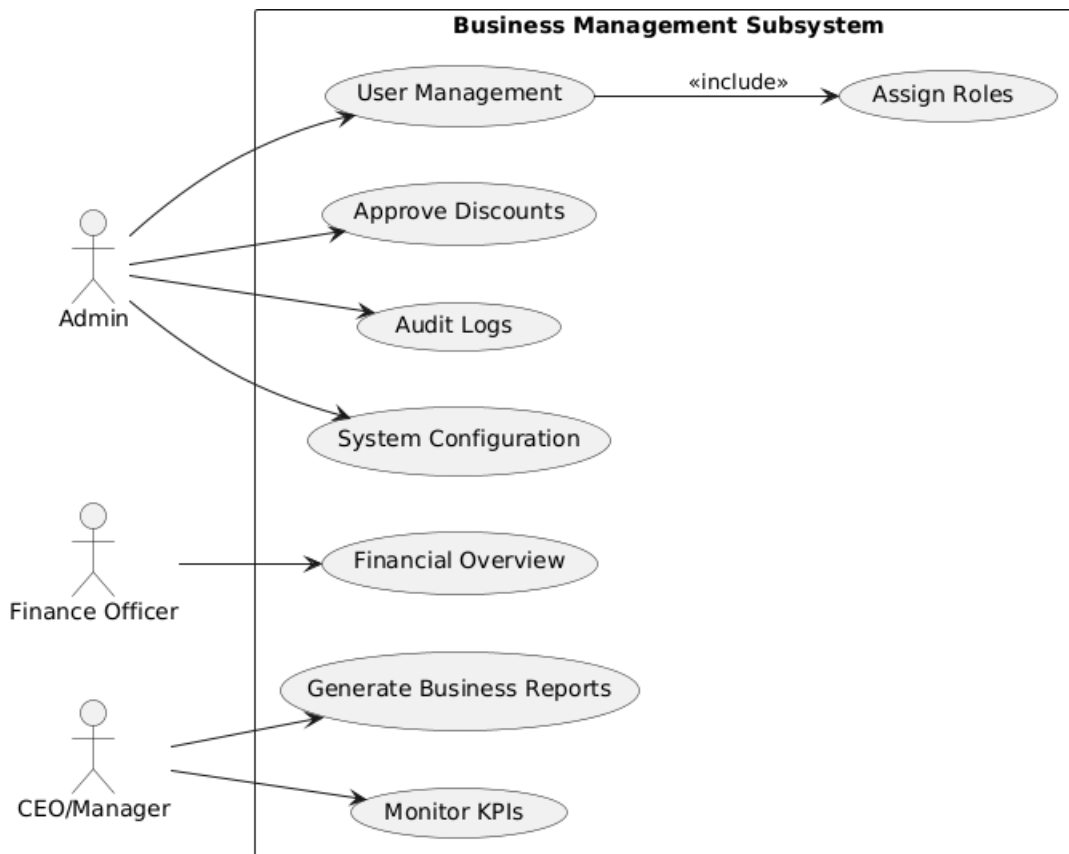
Sales Subsystem Use Case

- **Primary Actors:** Salesperson, Admin, Customer
 - **Description:**
 - Manages complex sales operations with functional extensions.
 - Salesperson generates invoices, adds items, and processes payments.
 - Discount application and receipt generation extend the invoice workflow.
 - Admin manages customer registration.
 - The system automatically sends confirmation and follow-up communications.
 - **System Benefits:**
 - Supports flexible pricing and promotional capabilities.
 - Ensures accurate and complete transaction records.
 - Integrates customer relationship management workflows.
 - Automates post-sale customer communication.
-



Storage Subsystem Use Case

- **Primary Actors:** Inventory Manager, System, Store Staff
- **Description:**
 - Provides advanced inventory management with automation features.
 - Inventory Manager updates stock locations, generates inventory reports, and oversees transfers.
 - System triggers automated reorders based on stock thresholds.
 - Store Staff monitor inventory status and set reorder levels.
- **System Benefits:**
 - Enables proactive stock replenishment.
 - Automates multi-location inventory tracking.
 - Reduces risk of stockouts or overstocking.
 - Enhances logistical efficiency across departments.



Business Management Subsystem Use Case

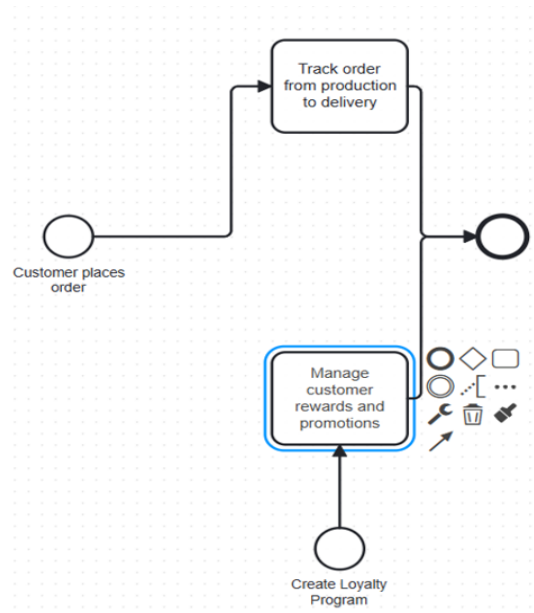
- **Primary Actors:** Admin, Finance Officer, CEO/Manager
- **Description:**
 - Offers high-level administrative and financial control.
 - Admin oversees user management, role assignments, system configurations, and audit logs.
 - Finance Officer accesses and analyzes financial performance reports.
 - CEO/Manager monitors KPIs and generates strategic business reports.
- **System Benefits:**
 - Enables real-time access to key business intelligence.
 - Supports strategic decision-making with accurate data.
 - Facilitates compliance and auditing processes.
 - Strengthens administrative governance through role-based controls.



10. BPMN Diagrams

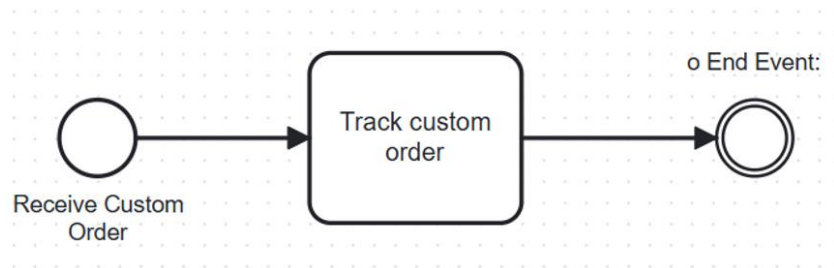
Business Process Model and Notation (BPMN) diagrams capture **workflow processes**. The system architecture of the TwentyOne Gold Jewelry Management System is visually represented through a collection of BPMN diagrams that depict key business workflows. These diagrams illustrate how the system supports operations across customer engagement, production, inventory, finance, and HR functions. The following is a refined explanation of what each diagram represents, focusing on their role in the broader system rather than evaluating them.

10.1 Diagram Explanations



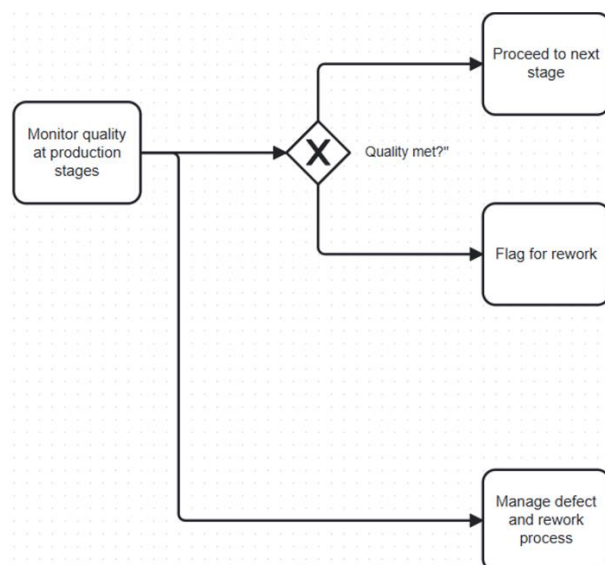
Customer Order Processing & Loyalty Management

This diagram outlines the end-to-end workflow of handling customer orders, including post-sale loyalty engagement. It starts from the moment a customer places an order, proceeds through internal order processing and delivery, and concludes with the integration of loyalty rewards. The loyalty component includes promotional eligibility checks and reward points assignment, positioning customer satisfaction as a recurring objective.



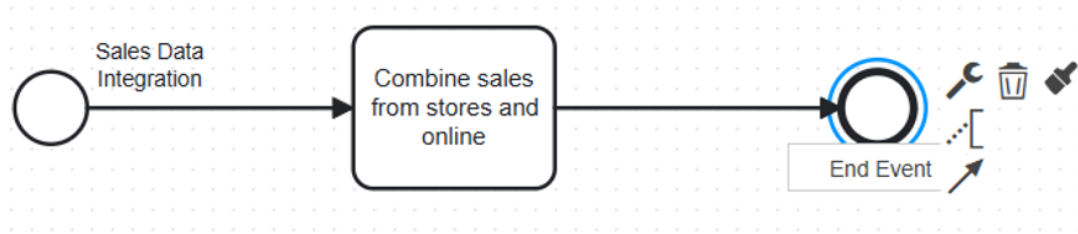
Custom Order Tracking

Designed for bespoke jewelry workflows, this diagram focuses on tracking individual custom orders. It provides a linear view of how orders move from creation to completion. It highlights the custom production path as distinct from standard inventory processes and offers visibility into the journey of a personalized order.



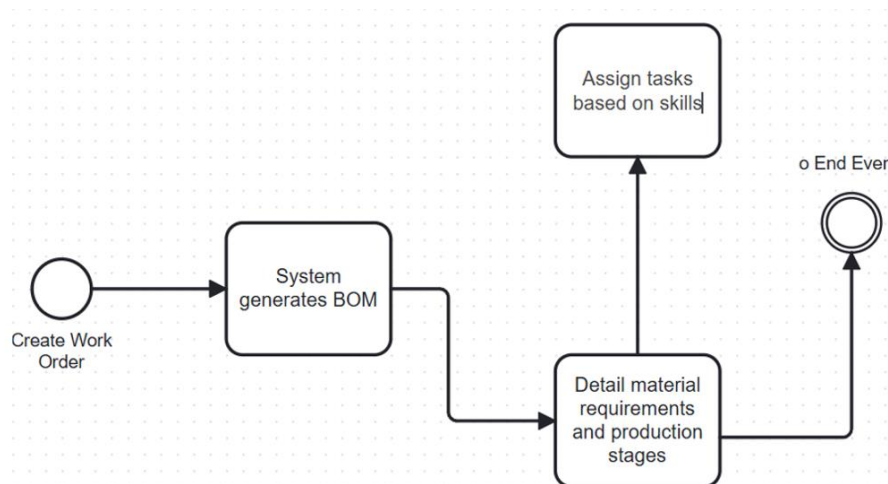
Quality Control Process

This diagram shows how quality assurance is embedded into the production workflow. As products pass through various stages, quality control checkpoints evaluate whether standards are met. Based on these evaluations, items may either proceed or be redirected for rework. It emphasizes the system's ability to maintain product quality and traceability through decision gateways.



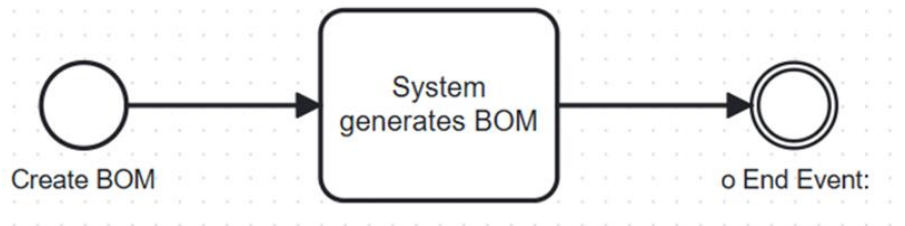
Sales Data Integration

This diagram depicts how the system aggregates sales data from multiple channels, such as physical stores and online platforms. It provides a basic overview of how sales records are collected and combined into a central repository to support reporting and analytics. The intent is to consolidate data to create a unified sales dashboard.



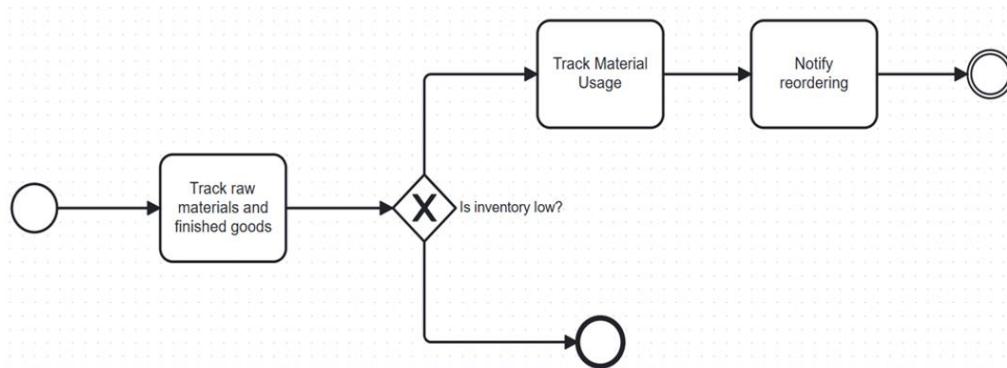
Work Order Management with BOM

This diagram models the workflow for initiating and executing work orders tied to a Bill of Materials (BOM). It includes the creation of work orders, generation of BOMs, and the assignment of tasks based on material and skill requirements. It links resource planning to production activities, ensuring manufacturing readiness.



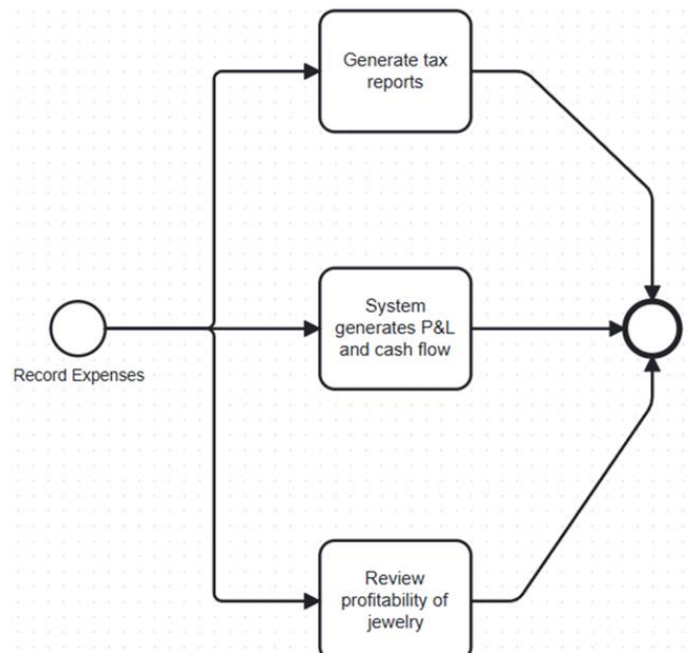
BOM Generation

This process focuses specifically on the automated generation of BOMs. Triggered by a production requirement or a new product configuration, the system produces a BOM that outlines required materials and quantities. It serves as the foundation for production scheduling and inventory preparation.



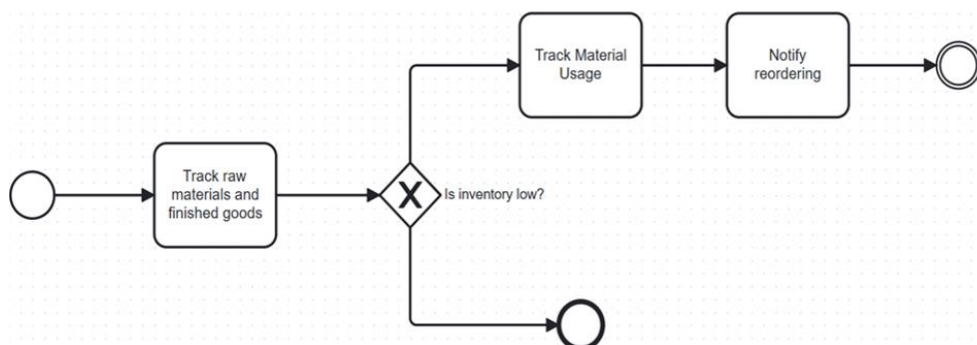
Inventory Management

This workflow illustrates how the system monitors stock levels and triggers restocking actions when thresholds are met. It covers the tracking of both raw materials and finished goods, and includes logic for determining when to reorder based on predefined rules. It supports the continuous availability of critical materials.



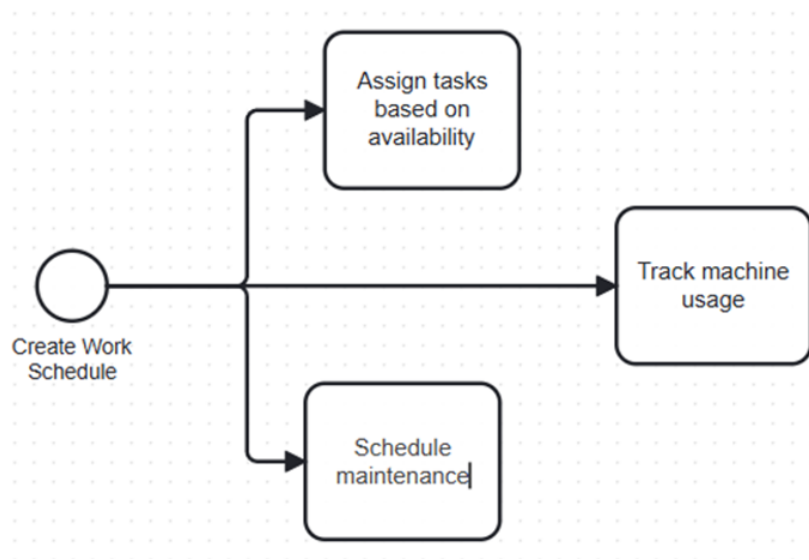
Financial Reporting & Analysis

The diagram maps out how financial data is collected, processed, and reported within the system. It includes processes for recording transactions, generating tax and profit/loss reports, and analyzing cash flows. This structure ensures that financial oversight is integrated into daily operations.



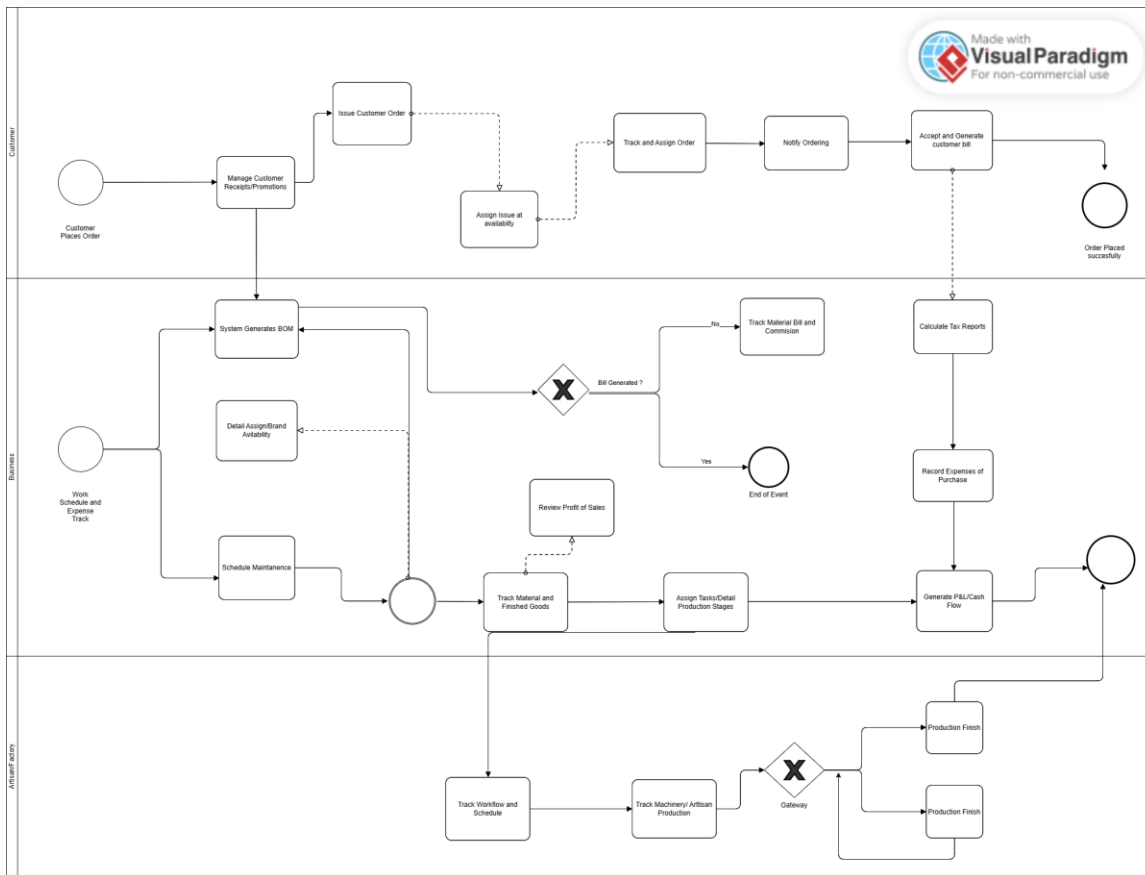
Simplified Inventory Management

This is a simplified variation of the inventory management workflow shown in Diagram 7. It outlines the same processes in a more basic format, highlighting the flow from inventory checks to stock adjustments without additional layers of automation or logic.



Work Schedule Management

This diagram models how the system manages employee and machine schedules. It includes the creation of work schedules, task allocation, equipment usage monitoring, and maintenance planning. It enables parallel coordination of human and technical resources across departments.



Comprehensive Manufacturing Process

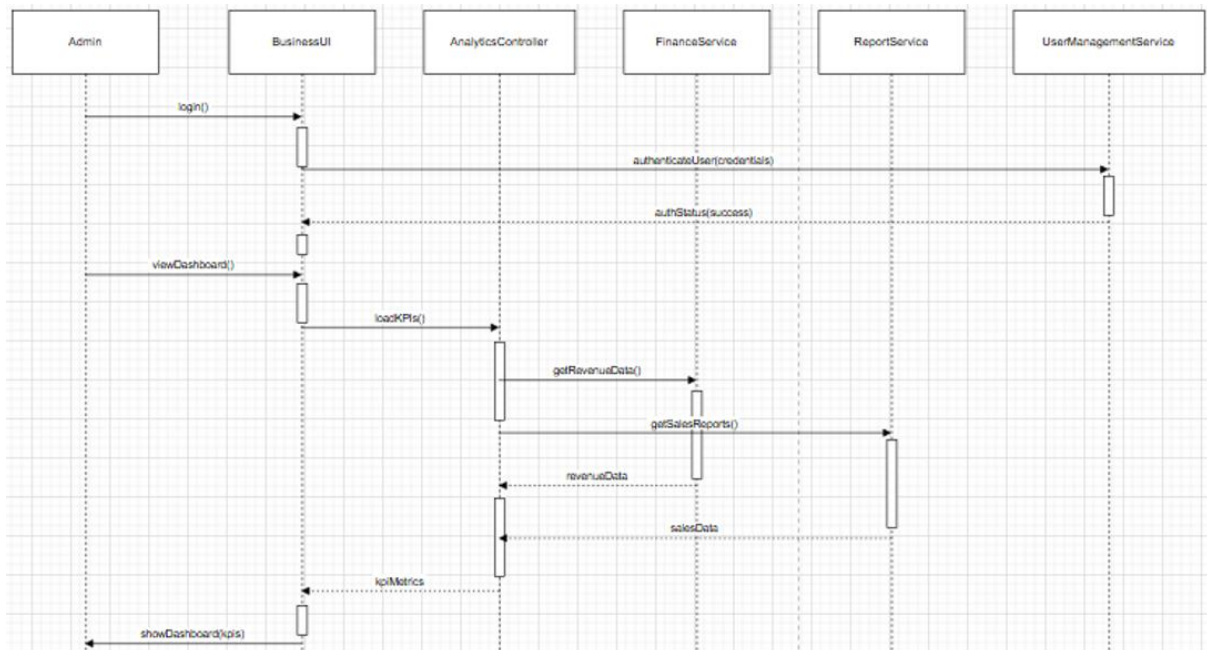
This integrated diagram combines all major functions—order intake, production, quality control, financials, and HR—into a single unified view. It showcases the end-to-end lifecycle of a jewelry item from initial customer interaction through to delivery, accounting, and team scheduling. It serves as the conceptual backbone of the entire system.



11. UML Diagrams Explanation

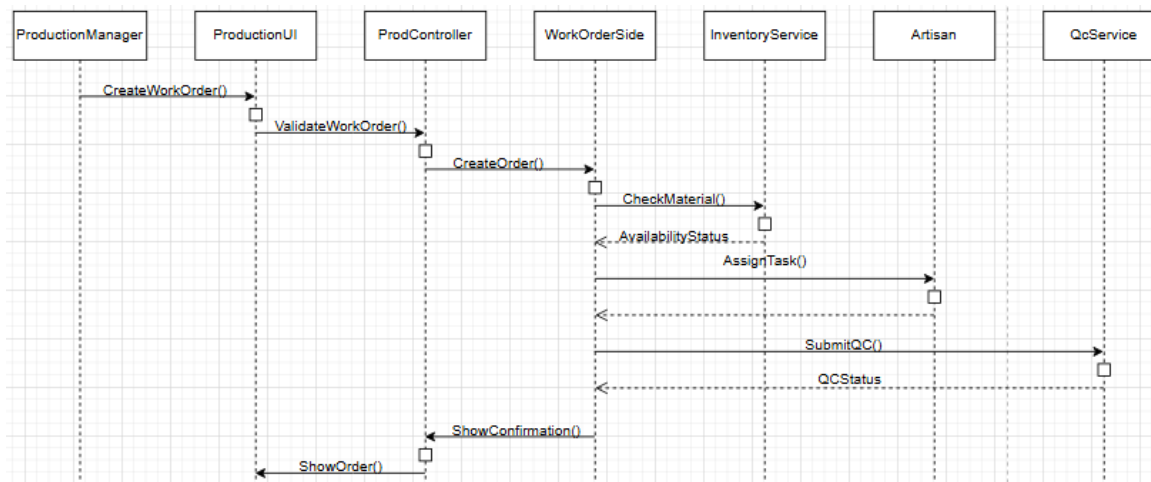
This section provides a descriptive overview of the UML diagrams developed for the TwentyOne Gold Jewelry Management System. These diagrams serve to model both the behavioral and structural aspects of the system, spanning across financial, production, sales, and inventory domains. Rather than evaluating performance, this section strictly focuses on what each diagram communicates and the processes it represents.

11.1 Behavioral Diagrams (Sequence Diagrams)



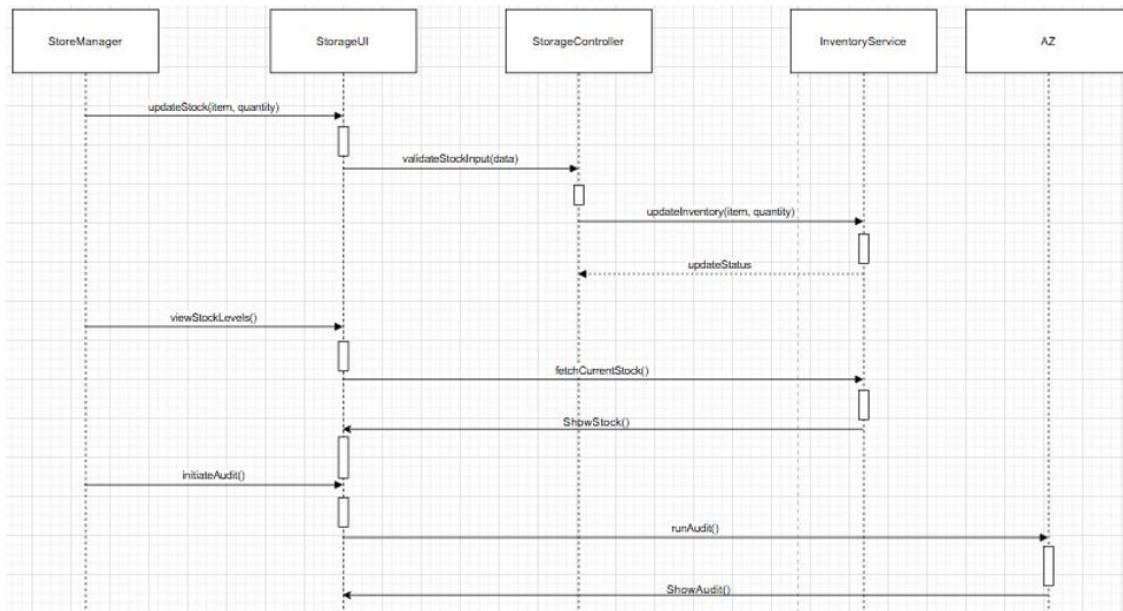
Financial Management Sequence Diagram

This diagram maps out the workflow involved in user authentication, financial data access, and report generation. It involves interactions between the user interface, controller layer, and backend financial and analytics services. The process begins with user login and proceeds to dashboard access where various financial services are requested, analyzed, and responded to. It also includes user management tasks such as account updates.



Production Management Sequence Diagram

This sequence diagram details the flow of operations in the jewelry production process. It begins with the Production Manager initiating a work order, which triggers inventory checks for material availability. Once materials are confirmed, tasks are assigned to Artisans, and production progresses through quality control checkpoints. Each component—material handling, task assignment, and QC feedback—is modeled as an interaction between system components.



Sales & Order Management Sequence Diagram

This diagram represents the complete customer order lifecycle. It starts with order placement through the Sales UI, followed by inventory checks and stock reservation. Once items are confirmed, the payment gateway processes transactions, and the system generates an invoice. The process concludes with order confirmation, showing an integrated approach to sales, inventory, and billing.



11.2 Structural Diagrams (Class/Data Model Diagrams)

Manufacturing & Production

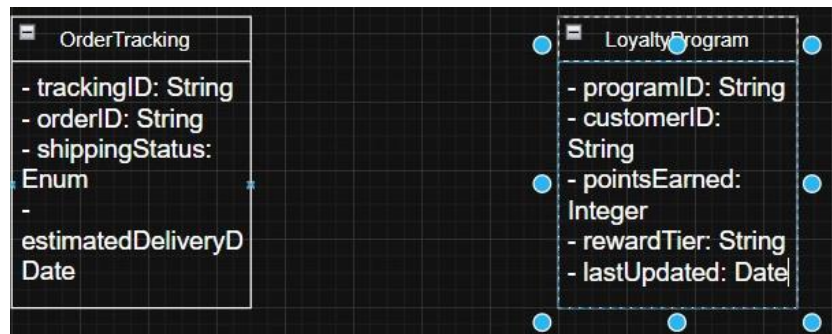
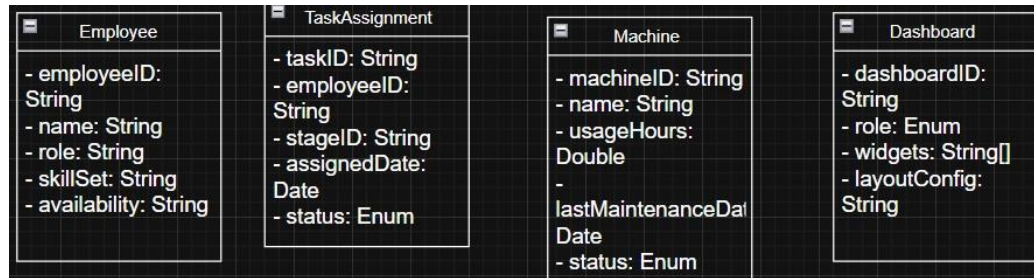
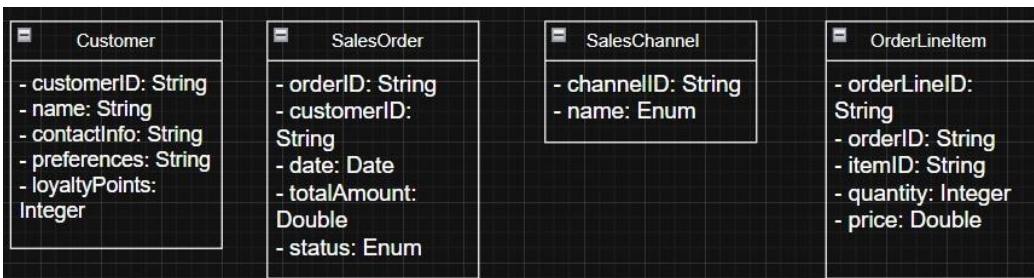
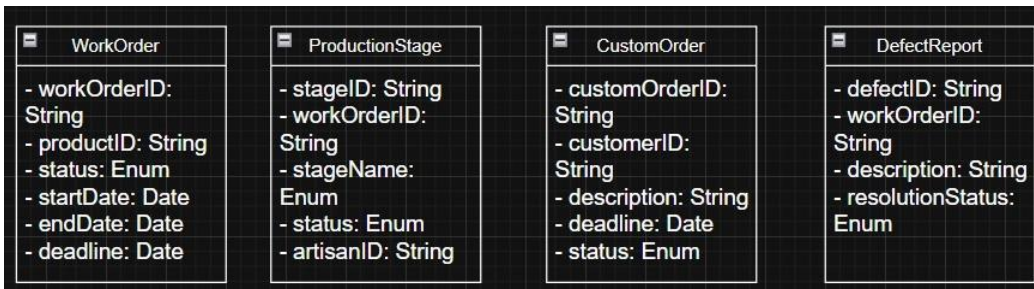
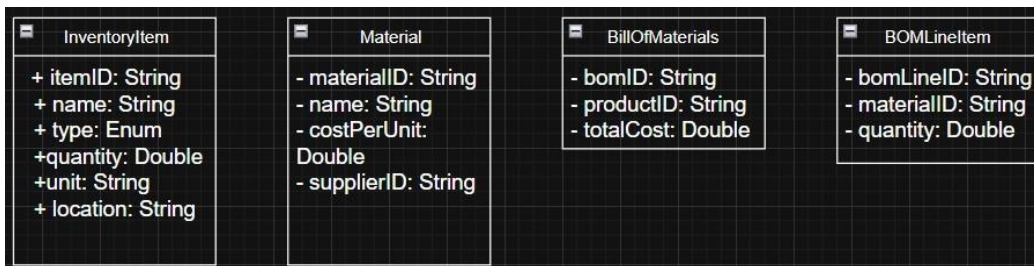
- **InventoryItem**: Represents items in storage, with attributes for location, type, and status.
- **Material**: Defines raw materials, including supplier and cost information.
- **BillOfMaterials (BOM)**: Represents product structure, detailing how finished products are assembled.
- **BOMLineItem**: Specifies individual material components in a BOM.
- **WorkOrder**: Models production scheduling, tracking progress, and resource use.
- **ProductionStage**: Breaks down work orders into steps, each with assigned personnel and equipment.
- **DefectReport**: Captures quality issues, linking them back to production stages.

Sales & Customer Management

- **Customer**: Central entity holding customer data, loyalty tier, and transaction history.
- **SalesOrder**: Tracks customer purchases, including order state and associated items.
- **SalesChannel**: Distinguishes between different sales streams (online, retail, etc.).
- **OrderLineItem**: Breaks down sales orders into specific products and quantities.

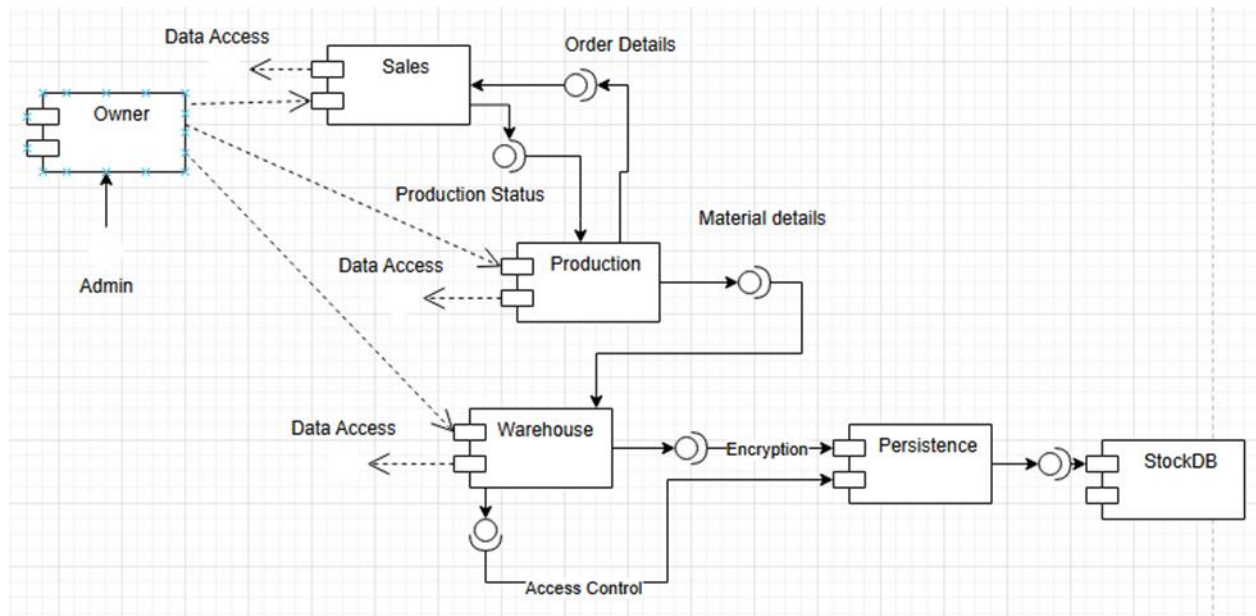
Operations & Management

- **Employee**: Maintains employee details, assigned roles, and scheduling.
- **TaskAssignment**: Links employees to specific jobs or tasks within the system.
- **Machine**: Represents machinery used in production, with attributes for maintenance.
- **Dashboard**: Provides a configurable UI layer based on user roles.
- **OrderTracking**: Manages delivery status and shipment visibility.
- **LoyaltyProgram**: Models incentive mechanisms for returning customers.





11.3 Compotent Diagram

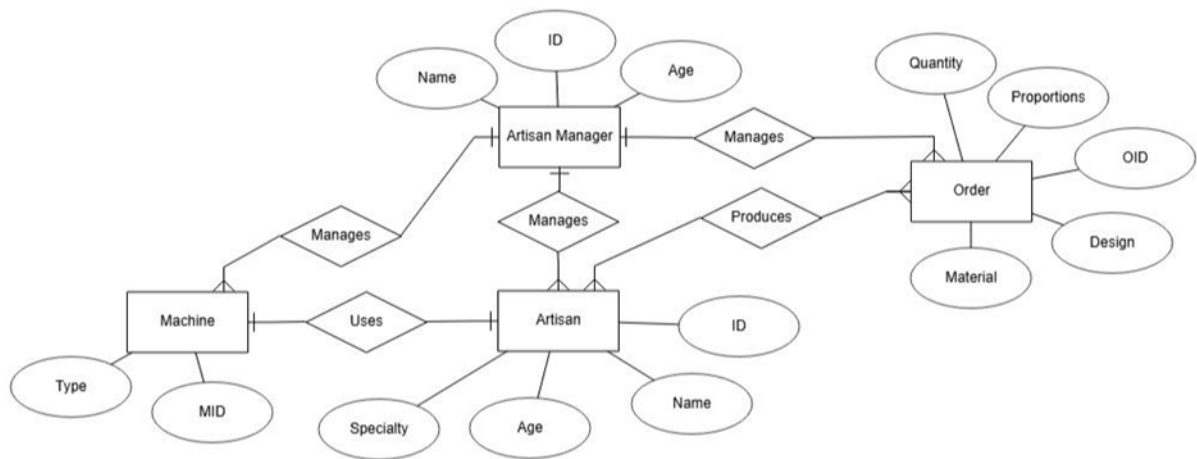


The diagram shown above depicts how the individual components interact, showing their dependencies, provided and required interfaces, and the high-level relationships among them. The admin interacts with the Owner component, which has a Data Access interface. Sales, Production, and Warehouse components all depend on this Data Access interface. Sales component handles incoming orders and provides an Order Details interface to Production. Production uses this interface to get the orders and then gives status updates back to Sales through the Production Status interface. Production also sends Material Details to Warehouse so Warehouse knows exactly what materials it should pick or reserve. Before Warehouse updates any inventory data, it first checks permissions through Owner's Access Control interface. Then Warehouse uses an Encryption interface to send data safely to the Persistence module. Finally, the Persistence module securely stores the encrypted data into the StockDB database.



12. Entity Relationship Diagrams (ERDs)

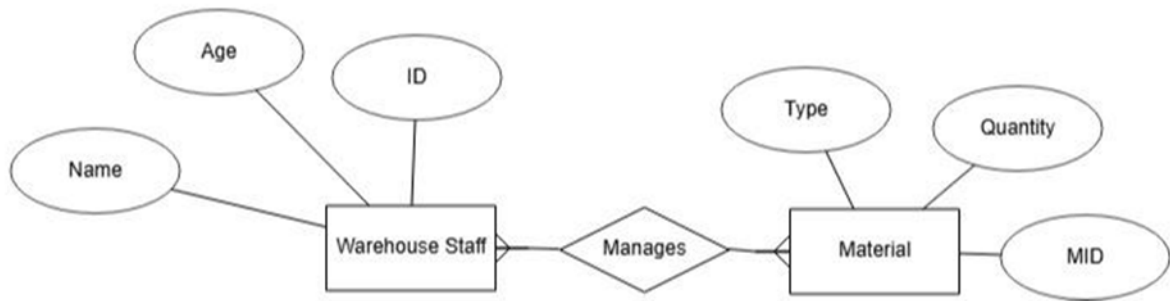
The ERDs model how entities relate within the distinct business areas of production, warehouse, sales, human resources, and the entire organization.



Production Sector

This diagram represents the relationships between the Staff Manager, Artisans, Orders, and Machines. It shows:

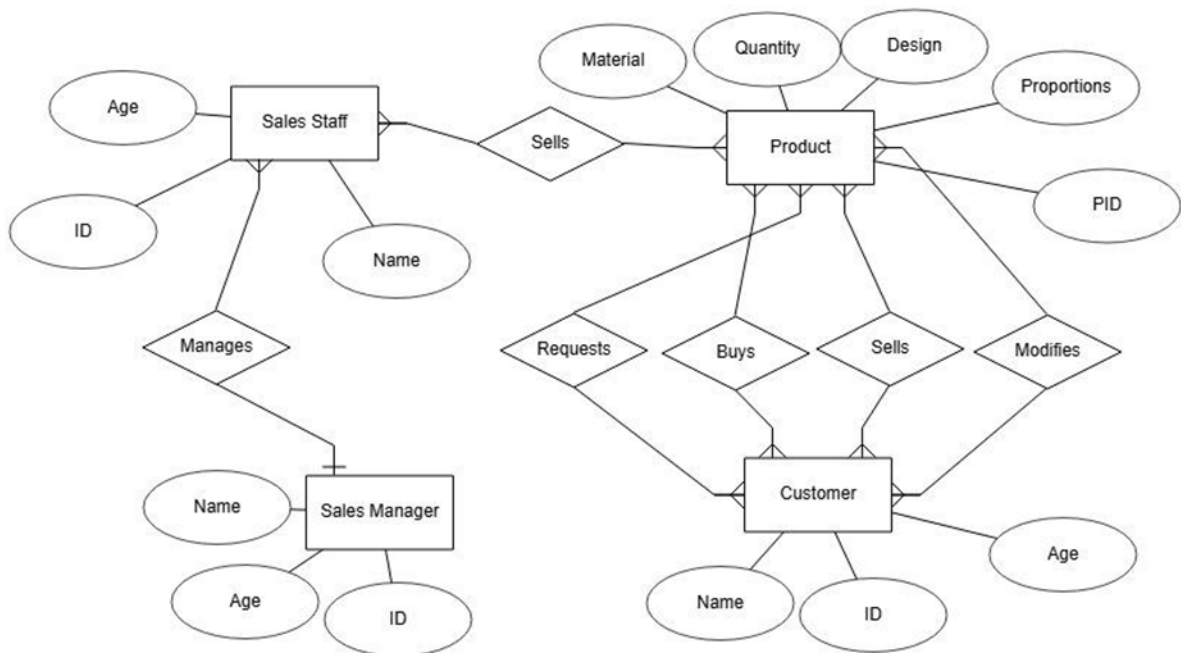
- A one-to-many (1:M) relationship between the Staff Manager and each of the following: Artisans, Orders, and Machines.
- A many-to-many (M:M) relationship between Artisans and Machines, indicating shared usage.
- A many-to-many (M:M) relationship between Artisans and Orders, representing collaborative efforts on multiple orders.



Warehouse Sector

This diagram depicts the relationship between Warehouse Staff and Raw Materials.

- A many-to-many (M:M) relationship indicates that multiple staff members manage multiple types of raw materials, highlighting shared responsibility and resource control.

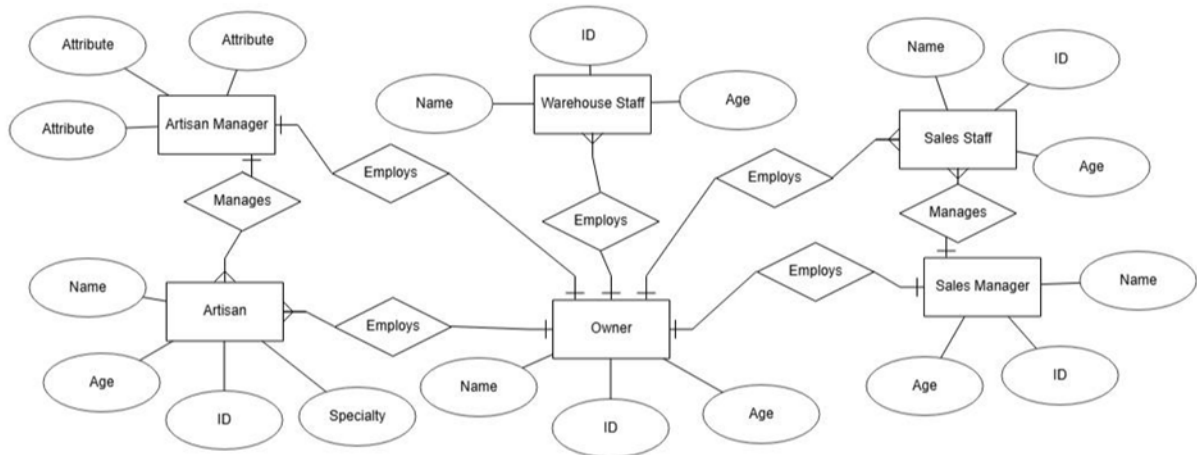


Sales Sector

This diagram models the interactions between the Sales Manager, Sales Staff, Products, and Customers.



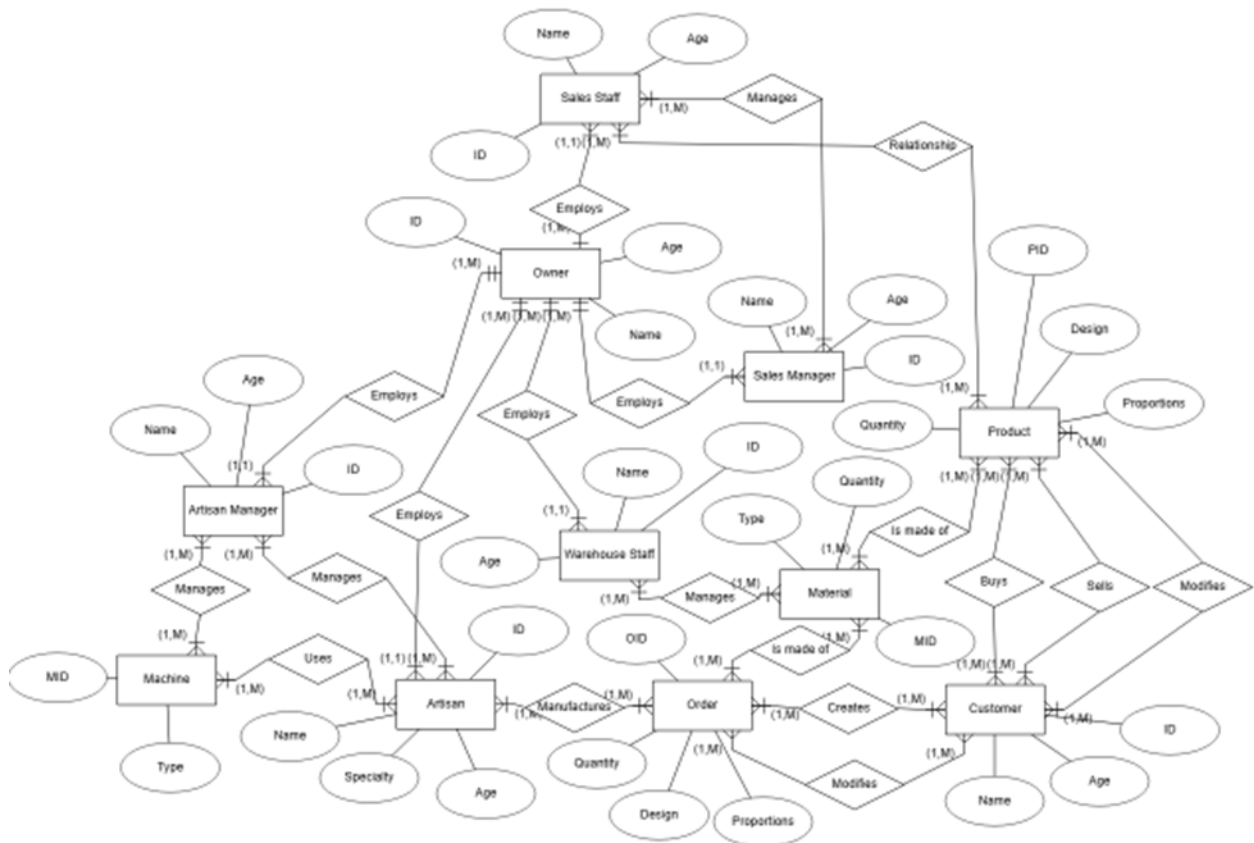
- Sales Manager to Sales Staff is a one-to-many (1:M) relationship.
- Sales Staff and Products share a many-to-many (M:M) relationship.
- Customers are shown to engage in buying, requesting, modifying, and returning Products, also represented with a many-to-many (M:M) relationship.



Workplace HR Structure

This diagram outlines relationships among organizational staff:

- The Owner employs Managers (1:1) and other Staff (1:M).
- Managers oversee different sectors (Sales, Production, Warehouse), each in a one-to-many (1:M) relationship.



Organization-Wide View

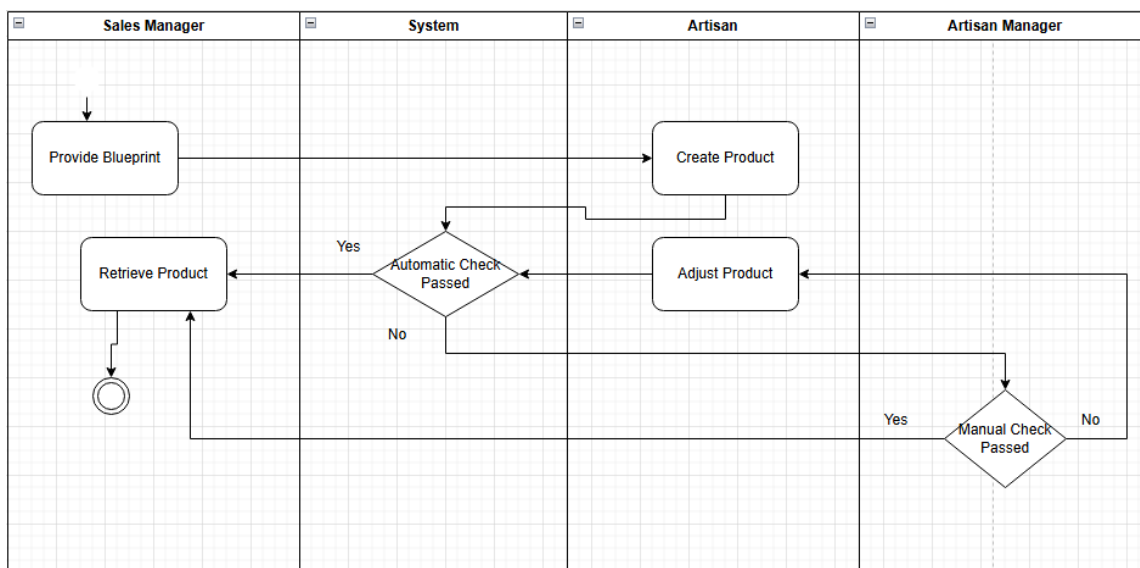
This comprehensive ERD connects all core entities across departments, illustrating how production, sales, inventory, HR, and customer engagement intersect.



13. Activity Diagram Analysis

This section outlines and analyzes core workflows in the form of Activity Diagrams. These diagrams visualize the operational processes across departments in the TwentyOne Gold Jewelry Management System. Each diagram is presented with an overview, participants, and detailed step-by-step flow.

13.1 Material Request and Supply Process



Participants: Artisan Manager, System, Warehouse Staff

Workflow Description: This activity diagram models the request and supply of raw materials needed for production. It incorporates decision-making for material availability and concurrent processing for supply and documentation.

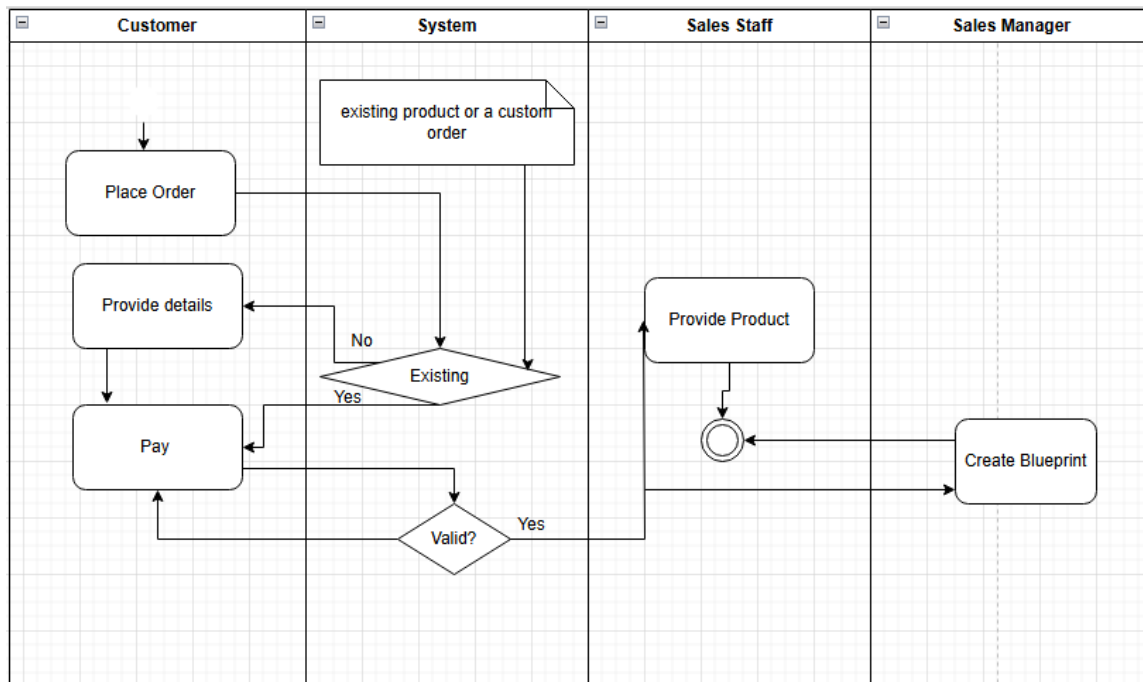
Process Steps:

1. **Request Initiation:** Artisan Manager submits a request for specific raw materials.



2. **System Availability Check:** The system verifies whether requested materials are currently in stock.
3. **Decision Point:**
 - **Materials Available:** Warehouse Staff immediately prepares and provides the materials.
 - **Materials Unavailable:** System triggers a restocking procedure (e.g., supplier order), and once restocked, materials are provided.
4. **Parallel Processing:**
 - While the Artisan Manager receives the materials,
 - Warehouse Staff generates a corresponding Bill of Materials (BOM).
5. **Completion:** Process concludes when both material handover and BOM creation are completed.

13.2 Customer Order Processing Workflow



Participants: Customer, System, Sales Staff, Sales Manager

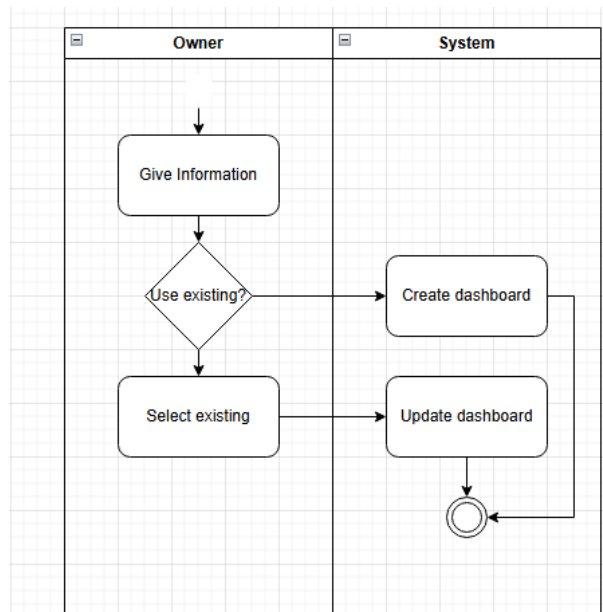


Workflow Description: This diagram represents the full order lifecycle from customer engagement to payment. It supports both standard and custom orders with decision handling for order types.

Process Steps:

1. **Order Placement:** Customer initiates an order through the online platform or in-store interface.
2. **Product Type Verification:** System evaluates whether the item is a standard or custom product.
3. **Decision Point:**
 - **Standard Product:** Customer proceeds directly to payment.
 - **Custom Product:** Sales Staff assists in gathering requirements → Sales Manager creates a product blueprint.
4. **Order Finalization:** The system performs final order validation before payment processing.
5. **Completion:** Payment is processed, and the order is confirmed.

13.3 Dashboard Management Workflow





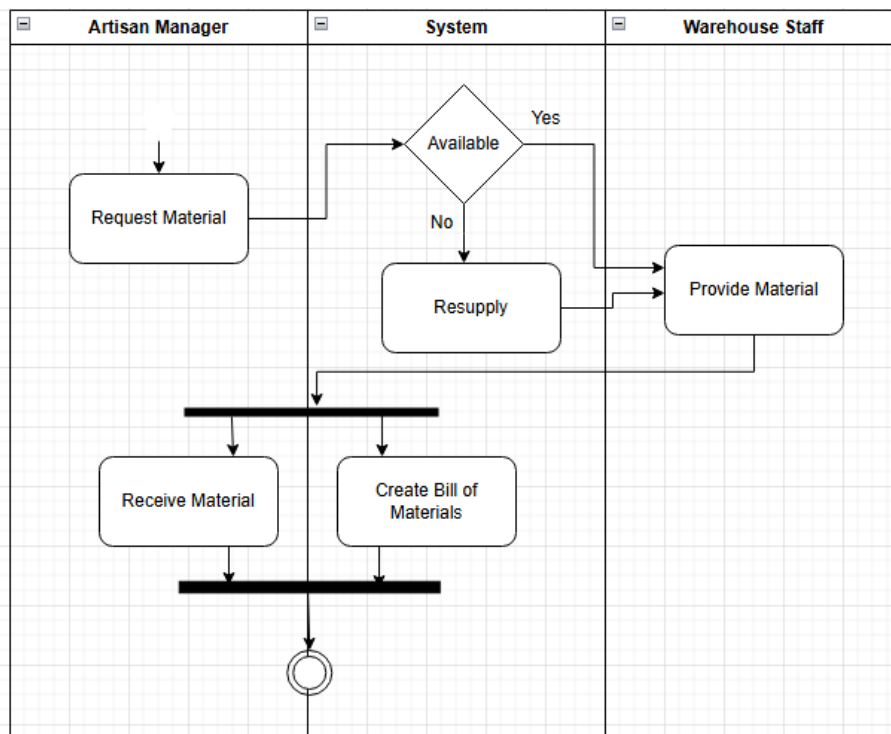
Participants: Owner, System

Workflow Description: This activity illustrates how the system administrator (Owner) interacts with dashboards—either updating existing ones or creating new analytics views.

Process Steps:

1. **Input Phase:** Owner submits business goals or KPIs to track.
2. **Decision Point:**
 - **Use Existing Dashboard:** Owner selects a pre-configured dashboard → Updates KPIs or views.
 - **Create New Dashboard:** System walks through dashboard creation steps and generates a new visualization.
3. **Completion:** Dashboard is saved and ready for use or further configuration.

13.4 Product Quality Control Workflow





Participants: Sales Manager, Artisan, Artisan Manager, System

Workflow Description: This diagram models the quality control process for jewelry items during or after production. It includes automated and manual inspection paths with feedback loops.

Process Steps:

1. **Blueprint Distribution:** Sales Manager provides a detailed blueprint to Artisan for item creation.
2. **Production Phase:** Artisan manufactures the jewelry based on blueprint specifications.
3. **Automated QC:** System performs an initial automated quality inspection.
4. **Decision Point:**
 - **QC Passed:** Sales Manager retrieves the completed product.
 - **QC Failed:** The system flags the product, and the Artisan Manager initiates manual inspection.
5. **Manual Review Branch:**
 - **Manual Check Passed:** Product is approved and workflow completes.
 - **Manual Check Failed:** Artisan makes required adjustments → Item resubmitted for QC.

14. Database Design and Architecture Report

This section provides a detailed overview of the database structure underpinning the TwentyOne Gold Jewelry Management System. The system supports diverse business operations including production, inventory, sales, finance, and human resources. A carefully structured relational database ensures data consistency, referential integrity, performance efficiency, and scalability across all modules.

14.1 Database Objectives

The core objectives of the database design are:

- To support complex business transactions (orders, production workflows, payroll, audits)



- To maintain relational integrity between departments (e.g., sales linked to inventory, finance linked to production)
- To facilitate reporting and analytics
- To ensure data normalization for performance and storage efficiency
- To enable role-based data access and modification

14.2 Core Data Domains and Key Tables

1. Customer and Sales Domain

- **Customer:** Stores customer profiles, loyalty tier, contact information, and preferences
- **SalesOrder:** Tracks orders placed by customers, with links to order details and status
- **OrderLineItem:** Details of products purchased per order, quantity, pricing, and applied discounts
- **Invoice:** Contains generated invoice information for each completed order
- **SalesChannel:** Indicates the origin of the sale (in-store, online, mobile)

2. Product and Inventory Domain

- **Product:** Master list of jewelry pieces available for sale
- **InventoryItem:** Tracks all stock, including quantity on hand, location, and reorder levels
- **Material:** Represents raw materials used in production, including cost and supplier data
- **BillOfMaterials (BOM):** Structured composition of materials required to produce each product
- **BOMLineItem:** Breaks down BOMs into specific raw material requirements

3. Production Domain

- **WorkOrder:** Tracks production orders from creation to completion
- **ProductionStage:** Sequential stages of the production process
- **Artisan:** Staff members executing production work
- **Machine:** Equipment used in production workflows
- **DefectReport:** Records instances of product defects during manufacturing



4. Warehouse and Logistics Domain

- **WarehouseStaff:** Users responsible for managing raw materials
- **StockTransfer:** Tracks movement of inventory between locations
- **AuditRecord:** Records results of manual and system-generated inventory audits

5. Finance and HR Domain

- **Employee:** Stores employee profiles, roles, departments, and credentials
 - **PayrollRecord:** Stores salary, payment dates, deductions, and bonuses
 - **TaskAssignment:** Links employees to specific roles or daily responsibilities
 - **FinancialReport:** Stores data for tax filings, P&L reports, and budgeting
-

14.3 Key Relationships and Constraints

- **Customer-SalesOrder (1:M):** A customer can have multiple sales orders.
 - **SalesOrder-OrderLineItem (1:M):** Each order contains multiple line items.
 - **WorkOrder-ProductionStage (1:M):** Each production order goes through multiple stages.
 - **BOM-BOMLineItem (1:M):** Each BOM consists of multiple raw materials.
 - **Employee-TaskAssignment (1:M):** Each employee may be assigned to several tasks.
 - **InventoryItem-Material (1:M):** Materials are represented as inventory items.
-



14.4 Normalization Strategy

The database design follows 3NF (Third Normal Form) normalization principles:

- All non-key attributes are fully functionally dependent on the primary key
 - No transitive dependencies exist between non-key attributes
 - Repeating groups and redundant data are avoided using associative tables (e.g., OrderLineItem, BOMLineItem)
-

14.5 Data Integrity and Security

- **Primary and Foreign Keys:** Enforce referential integrity between related tables
 - **Unique Constraints:** Applied to critical fields (e.g., email, SKU codes)
 - **Check Constraints:** Validate values such as stock quantity ≥ 0
 - **Role-Based Access:** Access is restricted based on employee role (Admin, Manager, Staff)
 - **Audit Trail:** Key transactions (logins, stock edits, order status changes) are recorded in audit logs
 - **Backup Strategy:** Daily backups with redundancy and rollback mechanisms
-

14.6 Performance Optimization

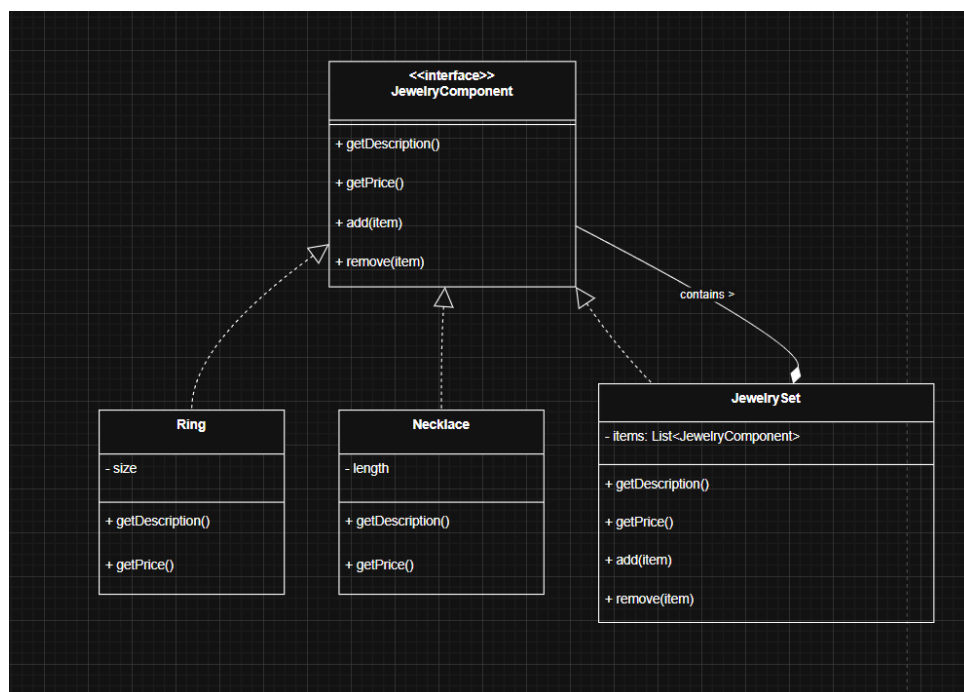
- **Indexes:** Created on frequently queried columns such as customer ID, product ID, and order status
- **Partitioning:** Considered for high-volume tables (e.g., SalesOrder, AuditRecord)
- **Caching:** Frequently accessed data like dashboards and KPIs cached at the service layer
- **Materialized Views:** Used for report summaries to reduce real-time query load



15. Design Patterns and System Architecture

This section describes the various design patterns applied within the TwentyOne Gold Jewelry Management System to ensure flexibility, maintainability, and extensibility of the software architecture. Each pattern is explained with its role in the system, key components, and benefits.

15.1 Composite Pattern – JewelryComponent

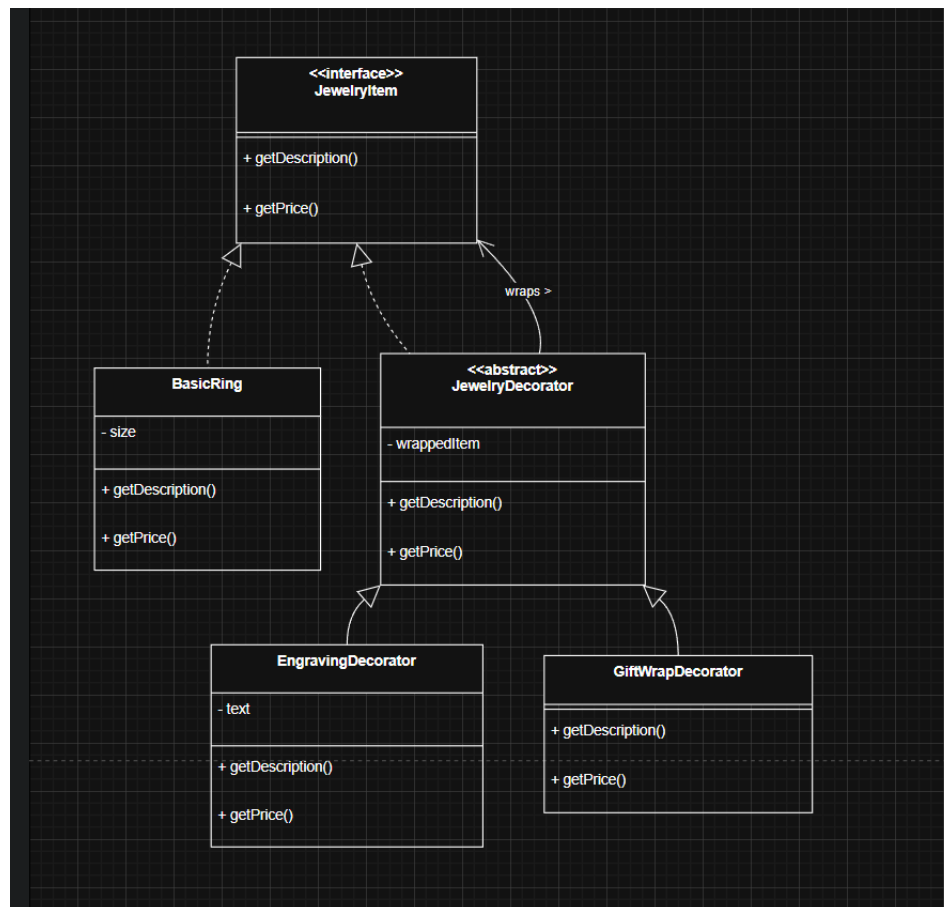


- **Purpose:** To treat individual jewelry items and collections uniformly.
- **Structure:**
 - JewelryComponent interface: Declares methods like `getDescription()`, `getPrice()`, `add()`, `remove()`.



- Ring, Necklace: Leaf components with attributes such as size and length.
- JewelrySet: Composite that can contain multiple components.
- **System Benefit:** Simplifies inventory and product management by enabling recursive operations across individual items and collections.

15.2 Decorator Pattern – JewelryDecorator

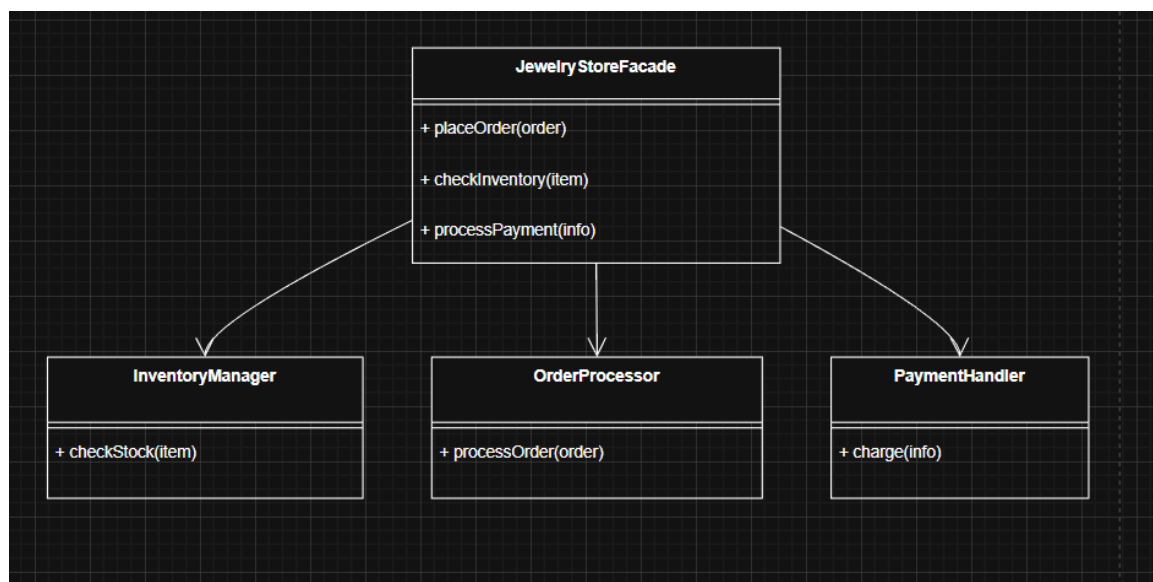


- **Purpose:** To add custom features to jewelry items dynamically without altering their structure.
- **Structure:**
 - JewelryItem interface: Defines base methods.
 - BasicRing: A base product.
 - JewelryDecorator: Abstract decorator.



- EngravingDecorator, GiftWrapDecorator: Concrete decorators.
- **System Benefit:** Allows customization like engraving, gift wrapping, and easy future extension without modifying core classes.

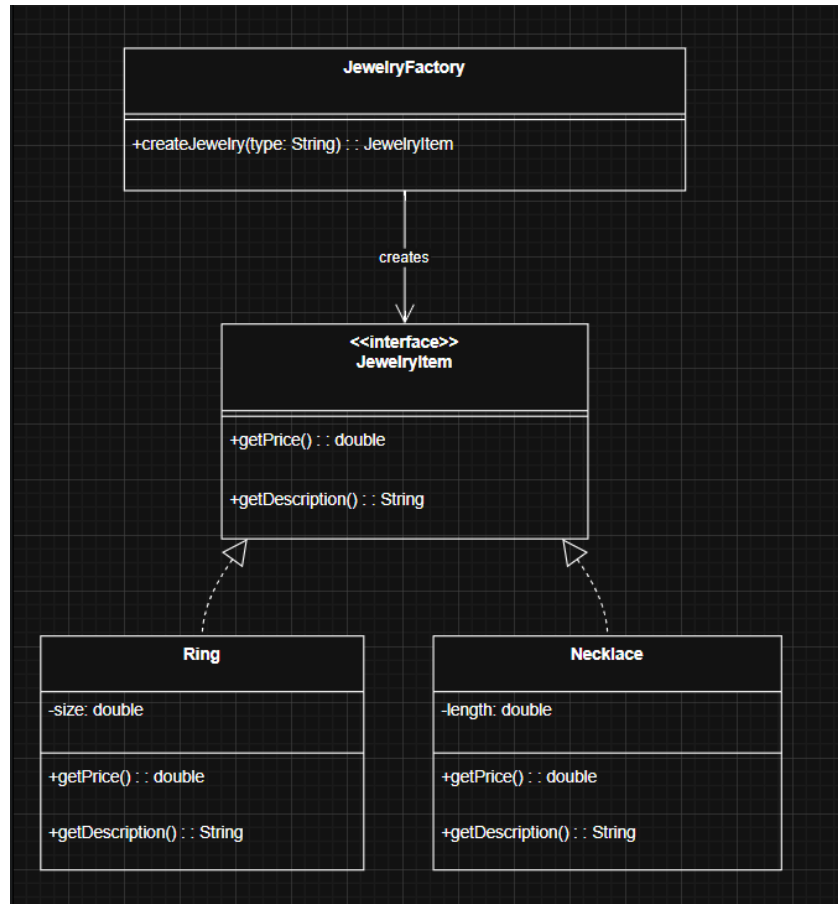
15.3 Facade Pattern – JewelryStoreFacade



- **Purpose:** To provide a simplified interface to a complex subsystem.
- **Structure:**
 - Interfaces with **InventoryManager**, **OrderProcessor**, **PaymentHandler**.
 - High-level methods like `placeOrder()`, `checkInventory()`, `processPayment()`.
- **System Benefit:** Reduces complexity for users and external clients by centralizing core workflows.



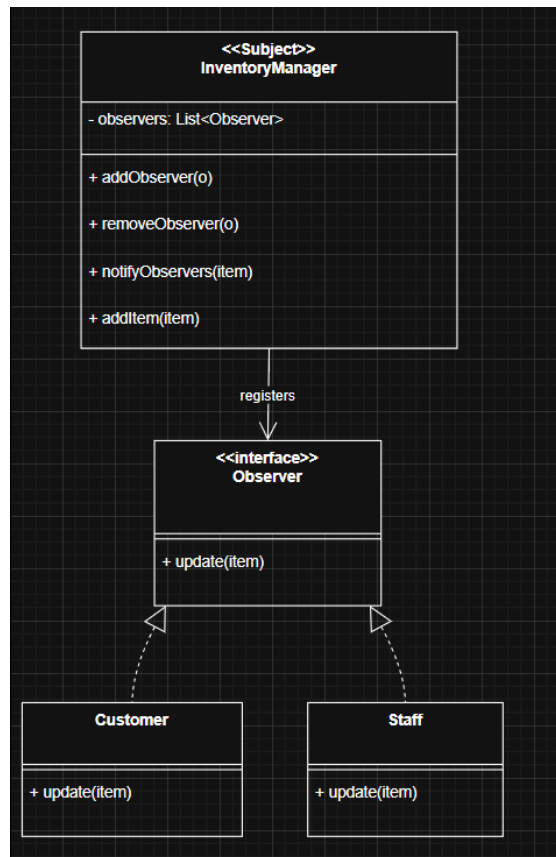
15.4 Factory Pattern – JewelryFactory



- **Purpose:** Centralized object creation for jewelry types.
- **Structure:**
 - JewelryFactory uses `createJewelry(String type)` to instantiate specific items.
- **System Benefit:** Decouples client logic from concrete implementations, simplifies object creation, and supports extensibility.



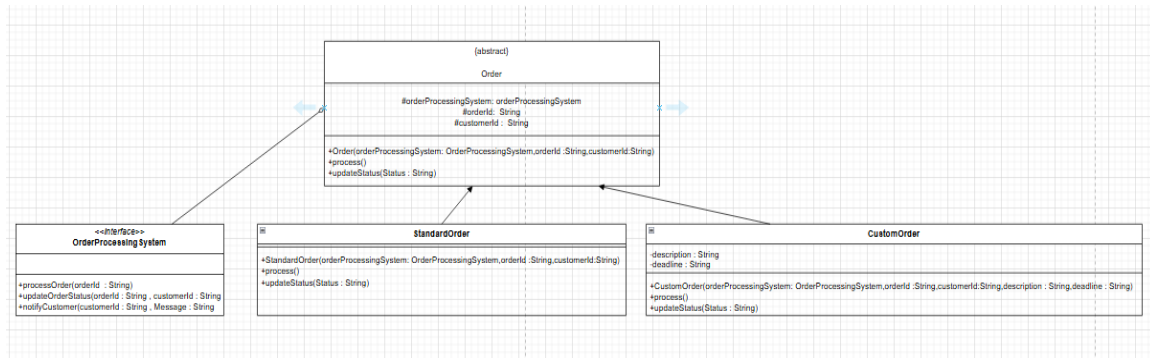
15.5 Observer Pattern – InventoryManager



- **Purpose:** Notify interested parties when inventory changes.
- **Structure:**
 - InventoryManager (Subject)
 - Observer interface
 - Customer, Staff as observers
- **System Benefit:** Real-time updates for stock changes, automatic customer notifications, and system-wide consistency.



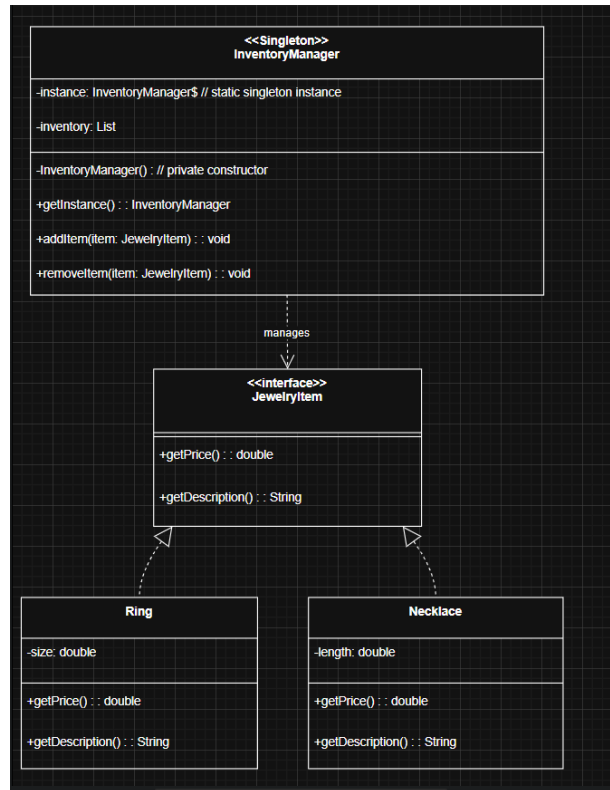
15.6 State Pattern – Order Processing



- **Purpose:** Handle order behavior based on its current processing state.
- **Structure:**
 - Order class maintains a reference to a State
 - StandardOrder, CustomOrder are concrete states
- **System Benefit:** Encapsulates state-dependent logic and ensures clean transitions between order stages.

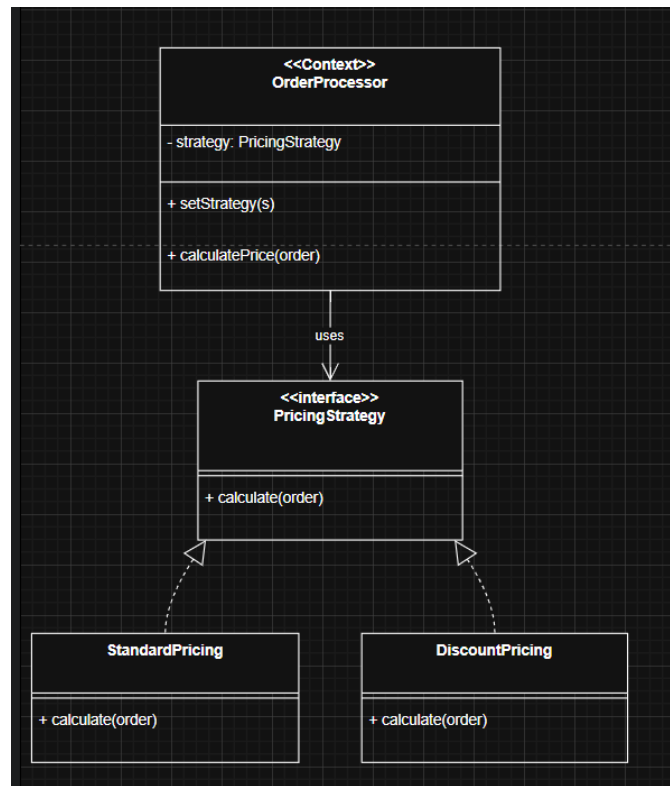


15.7 Singleton Pattern – InventoryManager



- **Purpose:** Ensure a single instance of the inventory manager.
- **Structure:**
 - Private constructor
 - Static `getInstance()` method
- **System Benefit:** Prevents data inconsistency, centralizes inventory access, and supports thread-safe operations.

15.8 Strategy Pattern – OrderProcessor



- **Purpose:** Encapsulate various pricing algorithms.
- **Structure:**
 - **OrderProcessor** context with a **PricingStrategy** reference
 - **StandardPricing**, **DiscountPricing** as concrete strategies
- **System Benefit:** Allows runtime switching of pricing logic, supports dynamic pricing models, and removes conditional code blocks.

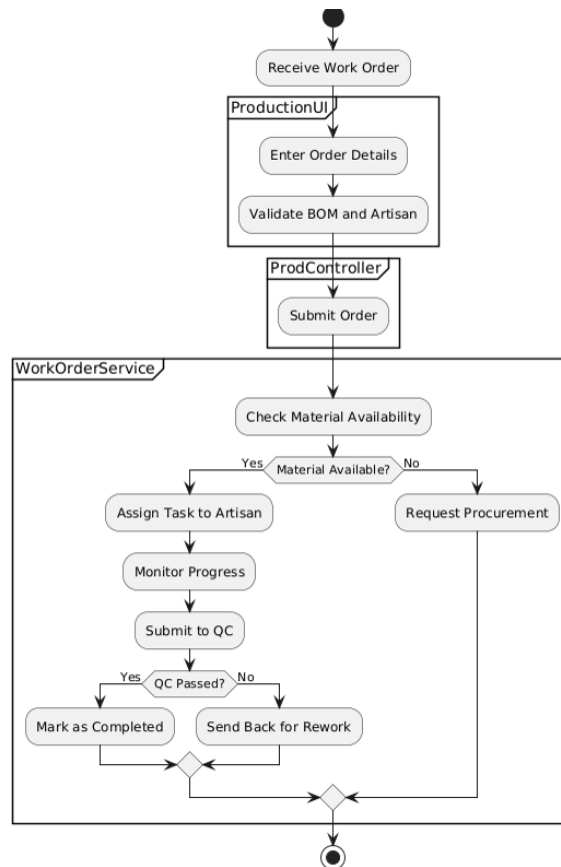
16. Interaction Overview Diagrams (IOD) Analysis

Interaction Overview Diagrams (IODs) provide a high-level visualization of the dynamic behavior of the TwentyOne Gold Jewelry Management System. These diagrams combine aspects of activity and sequence



diagrams to show how control flows across multiple processes and subsystems.

16.1 Production Work Order Process



- **Process Type:** Manufacturing/Production Workflow
- **Overview:** This IOD captures the complete lifecycle of a custom jewelry work order—from initial submission to quality control and final approval.

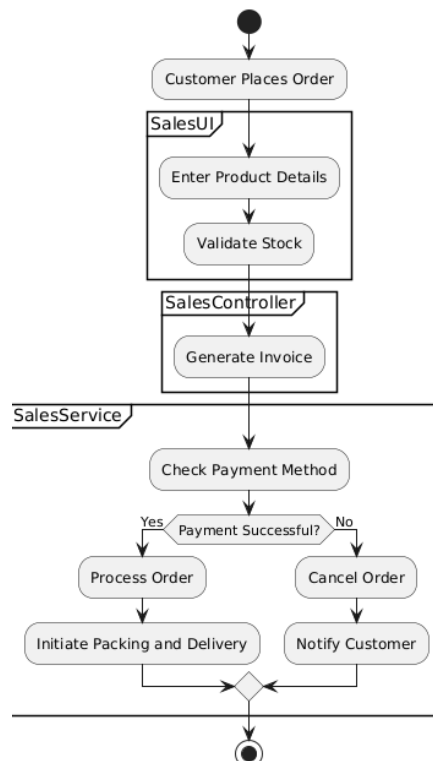
- **Key Components:**

- ProductionUI: Initiates and validates work order and BOM.
- ProdController: Submits validated data.



- WorkOrderService: Manages core tasks like material checks, artisan assignment, production monitoring, QC, and marking completion or rework.
- **System Advantages:**
 - Provides structured processing from creation to completion.
 - Integrates material validation before work begins.
 - Quality control checkpoints embedded in the flow.
 - Supports rework loops for failed quality checks.

16.2 Sales Order Processing

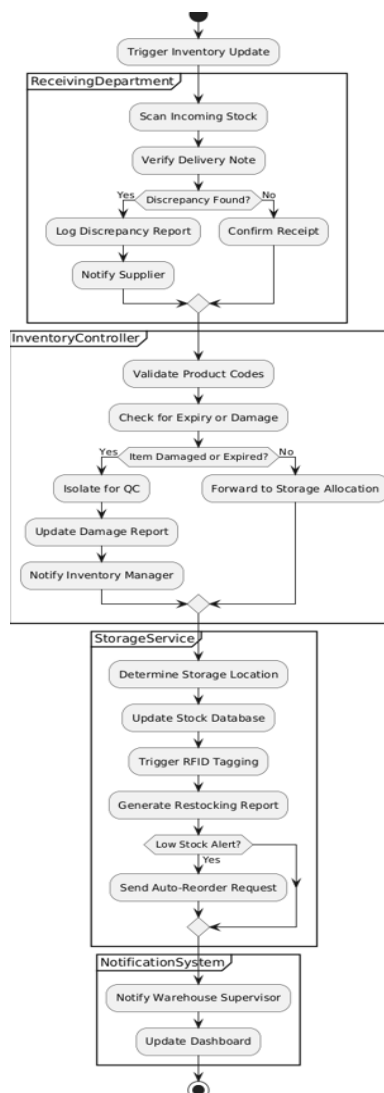


- **Process Type:** Sales Transaction Workflow
- **Overview:** This diagram represents the customer purchase journey from order to delivery, capturing stock validation, payment, fulfillment, and customer communication.
- **Key Components:**
 - SalesUI: Captures customer order.
 - SalesController: Confirms stock, generates invoices.



- SalesService: Verifies payment, handles fulfillment or cancellation.
- **System Advantages:**
 - Seamlessly connects sales, inventory, and payment systems.
 - Clearly defined success/failure branches for payments.
 - Real-time notifications and customer updates.

16.3 Inventory Management Process

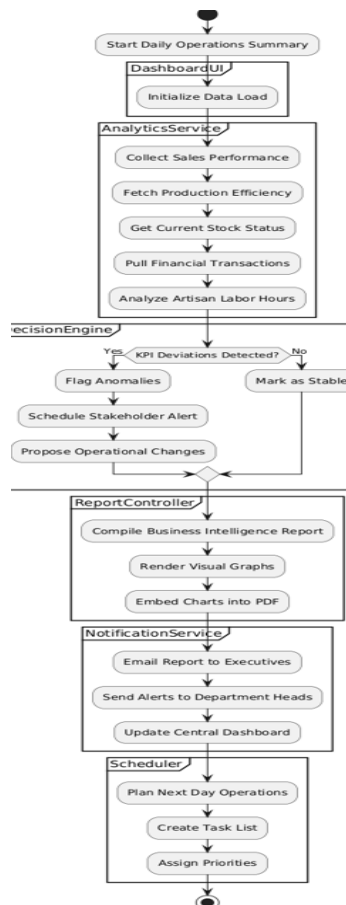


- **Process Type:** End-to-End Inventory Control



- **Overview:** This IOD models how the warehouse receives, verifies, stores, and monitors stock levels, integrating with procurement and quality assurance.
 - **Key Components:**
 - ReceivingDepartment: Scans and verifies deliveries.
 - InventoryController: Performs quality checks.
 - StorageService: Allocates storage, applies tracking, updates inventory levels.
 - NotificationSystem: Alerts stakeholders of changes or issues.
 - **System Advantages:**
 - Enforces quality control and delivery validation.
 - Uses RFID for tracking and audit trails.
 - Automates reorder alerts and discrepancy handling.
-

16.4 Business Intelligence & Reporting Process



- **Process Type:** Data Analytics and Strategic Oversight



- **Overview:** This IOD defines how business metrics are gathered, processed, analyzed, and reported.
 - **Key Components:**
 - DashboardUI: Triggers reporting routines.
 - AnalyticsService: Gathers data across departments.
 - DecisionEngine: Analyzes KPIs, flags issues, and recommends changes.
 - ReportController: Compiles visual reports.
 - NotificationService: Distributes results.
 - Scheduler: Prepares next cycle of analysis.
 - **System Advantages:**
 - Offers automated reporting with visual insights.
 - Enables proactive issue detection and strategic planning.
 - Consolidates multi-domain data for holistic management decisions.
-

16.5 Integrated System Insights

Process Integration:

- Production starts from customer input and flows through material validation, quality checks, and fulfillment.
- Sales and inventory are tightly coupled—orders trigger stock validation and updates.
- Inventory supports both upstream production and downstream sales.
- Reporting aggregates data from all subsystems for executive oversight.

Data Flow:

- Real-time synchronization between production, inventory, sales, and finance.
- Automatic data propagation from order entry to stock and reporting.
- Quality control data impacts reporting and future decisions.



Operational Excellence:

- Checkpoints ensure data accuracy and product standards.
- Automated alerts prevent operational disruptions.
- Reorder systems and stock monitoring reduce material shortages.

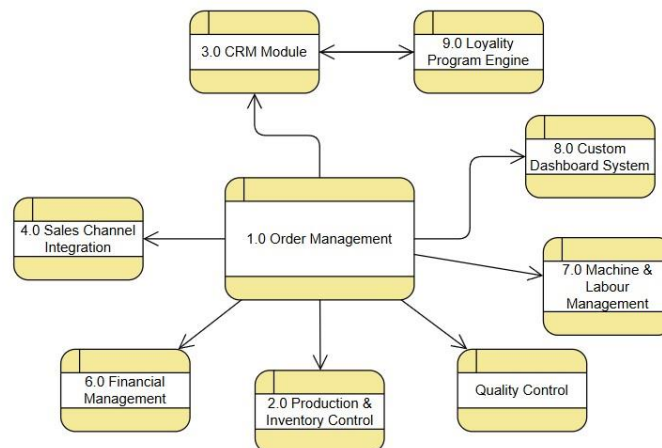
Customer Experience:

- Transparent sales flow with payment and order updates.
- Custom production linked with quality controls ensures satisfaction.
- Business intelligence enhances service through optimization.

17. Data Flow Diagrams (DFDs) and Use Case Analysis

This section presents detailed data flow diagrams (DFDs) that map how data moves within the TwentyOne Gold Jewelry Management System. These diagrams are accompanied by a comprehensive use case analysis to capture functional requirements from the user perspective.

17.1 Level 0 DFD – Context Diagram





The Level 0 diagram represents the entire system as a single process and identifies external entities interacting with the system.

External Entities:

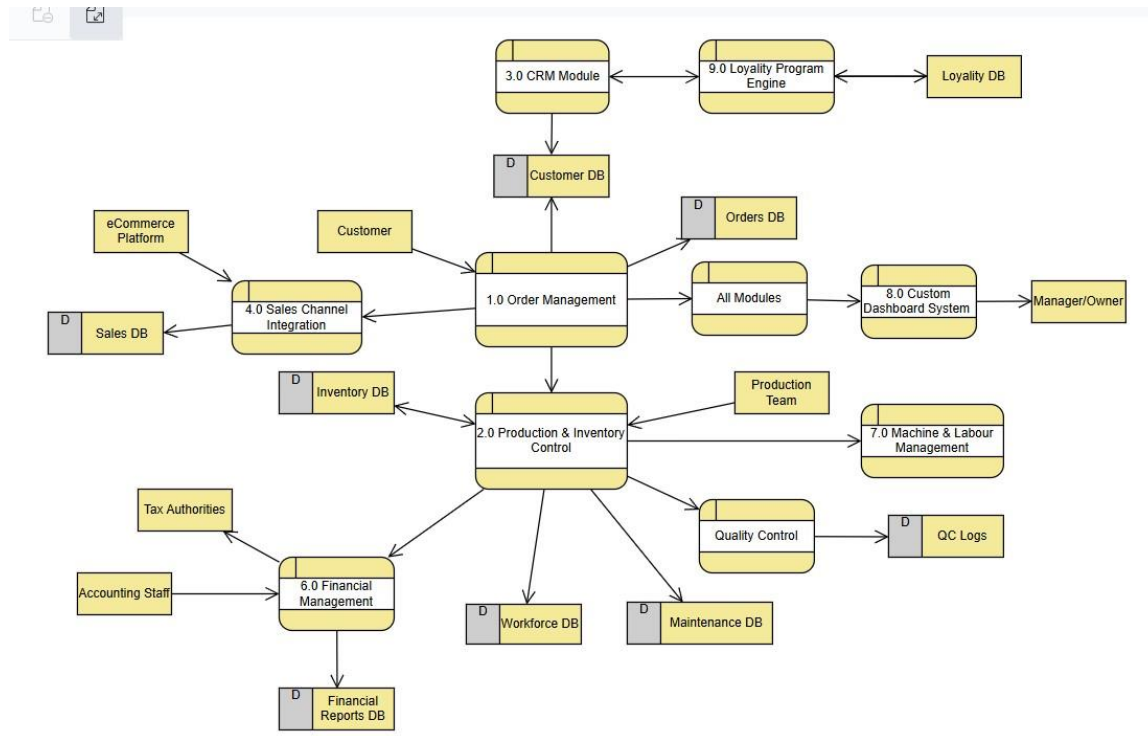
- **Customer:** Submits orders, makes payments, and receives confirmations.
- **Employee:** Manages inventory, assists customers, and processes returns.
- **Supplier:** Provides raw materials and restocking data.

Primary System Processes:

- **Process Sale**
 - Input: Customer order
 - Output: Invoice, inventory deduction, order status
 - **Manage Inventory**
 - Input: New stock or usage
 - Output: Inventory database update, low-stock alerts
 - **Generate Report**
 - Input: Sales, finance, HR data
 - Output: Business intelligence reports in PDF/Excel formats
-



17.2 Level 1 DFD – Expanded System Processes



A. Sales Workflow

- **Customer Interaction:**
 - Selects product via SalesUI
 - System checks inventory availability
 - Discounts applied if eligible (e.g., loyalty, promotions)
 - Order submitted for payment
 - Receipt generated and emailed upon successful transaction
- **Data Stores & Flows:**
 - Sales Database
 - Payment Gateway
 - Inventory System
 - Notification Service

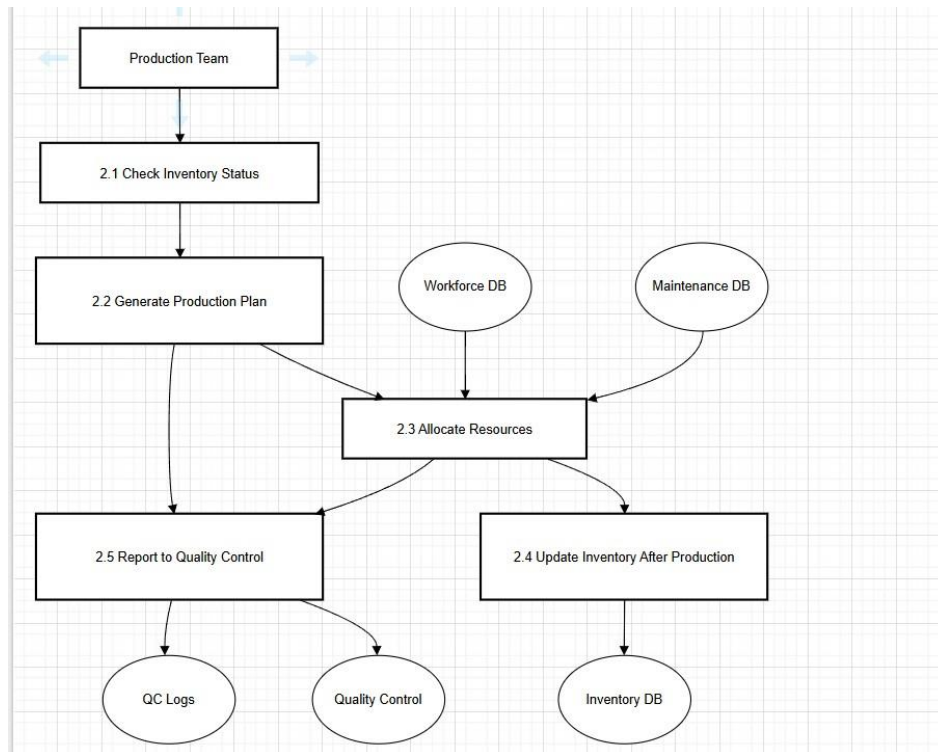


B. Inventory Workflow

- **Employee Interaction:**
 - Scans incoming items and updates system records
 - Monitors current stock levels
 - If stock falls below threshold, triggers reorder or alert to Warehouse Manager
- **Data Stores & Flows:**
 - Inventory Database
 - Audit Log
 - Supplier Portal

C. Reporting Workflow

- **Manager Interaction:**
 - Selects date ranges, categories, or departments
 - System aggregates data from sales, inventory, HR, and finance
 - Visual charts created (e.g., best-selling items, low-margin products)
 - Report exported or distributed via Notification System
- **Data Stores & Flows:**
 - Analytics Engine
 - Sales Reports
 - Financial Logs



Level 2 DFD Diagram

17.3 Use Case Diagram Overview

The system supports multiple users with distinct responsibilities. The Use Case Diagram includes the following primary actors:

- **Customer**
- **Employee**
- **Manager**
- **Supplier**

17.3.1 Customer Use Cases

- **Browse Catalog**
 - Filter products by price, material, style
- **Purchase Item**
 - Add to cart, apply promo codes, complete checkout
- **Track Order**
 - Receive email/SMS status updates for shipping, delivery, or delays



17.3.2 Employee Use Cases

- **Process Return**
 - Validate receipt, check condition, restock item
- **Check Stock**
 - Access inventory levels in real-time from any terminal

17.3.3 Manager Use Cases

- **Approve Discounts**
 - Manually override pricing for VIP or high-value customers
- **Analyze Profit Margins**
 - Compare item cost vs. revenue across categories
- **View Reports**
 - Access sales, inventory, HR metrics and generate performance summaries

17.3.4 Supplier Use Cases

- **Update Restocking Info**
 - Upload availability schedules, lead times
- **Confirm Shipments**
 - Acknowledge orders placed by the system and provide estimated delivery

17.4 Benefits of DFD and Use Case Modeling

- **Enhanced Clarity:** Both diagrams clarify the scope of system functions.
- **User-Centric:** Use case modeling ensures user needs are prioritized in design.
- **Process Visibility:** DFDs highlight system bottlenecks and improvement opportunities.
- **Efficient Planning:** Helps teams define interfaces and interactions early in development.



18. User Interface

The User Interface (UI) serves as the critical touchpoint between users and the system, mediating all interactions across diverse roles — from warehouse staff to production managers, sales teams, and customers. Designing an effective UI for this platform requires balancing complex functional demands, real-time data flows, role-specific workflows, and a seamless user experience that supports operational efficiency, decision-making, and customer satisfaction.

This report section critically examines the UI design considerations for the system, emphasizing advanced interaction models, data visualization, responsive design, and personalization capabilities that address the nuanced needs identified in the user scenarios.

18.1 Role-Based Interface Customization

A fundamental principle derived from the user scenarios is that each user role interacts with unique data sets and workflows. The UI must therefore offer dynamic, role-specific interfaces that maximize relevance and minimize cognitive load:

- **Warehouse Staff** require real-time inventory dashboards with alert prioritization, actionable reorder workflows, and simple confirmation dialogs to reduce errors and delays.
 - **Production Managers** need complex scheduling and BOM management tools with drag-and-drop functionality, version control, and inline editing to adapt to dynamic manufacturing demands.
 - **Sales Managers and Staff** benefit from integrated sales analytics dashboards, customer profiling panels, and promotional campaign builders that leverage AI-driven recommendation engines.
 - **Owners** demand customizable, KPI-focused dashboards with real-time data streaming and predictive insights to facilitate proactive decision-making.
 - **Customers** expect clean, transparent order tracking interfaces with timely notifications and intuitive support channels.
-



18.2 Real-Time Data Integration and Feedback

The system's heavy reliance on real-time updates — inventory levels, order statuses, quality control checkpoints, and sales data — demands a UI that not only presents up-to-the-second information but also responds fluidly to changes.

- **Challenge:** Maintaining UI responsiveness and data accuracy without sacrificing performance or user experience.
 - **Solution:** Employing **WebSocket or Server-Sent Events (SSE)** protocols allows for persistent, low-latency communication channels. The UI can push updates immediately, enabling instant alerts and dashboard refreshes. Coupled with **optimistic UI updates**, users receive immediate feedback on their actions, reducing perceived latency.
 - **Visual Design:** Real-time indicators, such as animated loading spinners, color-coded alerts, and incremental progress bars, communicate system state effectively. For example, a “stock low” alert flashes in a distinct color with an associated call-to-action button to reorder materials.
-

18.3 Advanced Data Visualization and Analytics

Given the volume and complexity of data—from multi-channel sales figures to production KPIs and custom order tracking—effective visualization is key to insight generation and decision support.

- **Interactive Dashboards:** Users should be able to customize views by selecting widgets (charts, tables, heatmaps) that update in real-time and support drill-down capabilities for granular analysis.
 - **Accessibility:** Visualizations must adhere to WCAG guidelines to ensure usability for color-blind or visually impaired users, including options for high contrast modes and text alternatives.
-



18.4 Seamless Multi-Device and Cross-Platform Experience

The diverse user base will access the system from desktop terminals in warehouses, tablets on production floors, and mobile devices in retail or remote settings.

- **Responsive Design:** The UI must dynamically adapt layouts and interaction patterns to different screen sizes and input methods (mouse, touch, keyboard).
 - **Offline Support:** For warehouse and production staff working in areas with limited connectivity, a **Progressive Web App (PWA)** approach can enable offline access and sync data once the connection is restored.
 - **Cross-Platform Consistency:** Employing design systems (e.g., Material Design or Fluent UI) ensures a coherent look and feel across platforms, reducing user retraining and increasing productivity.
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18.5 Intelligent User Assistance and Automation

To reduce manual effort and enhance accuracy, the UI should incorporate intelligent assistance features:

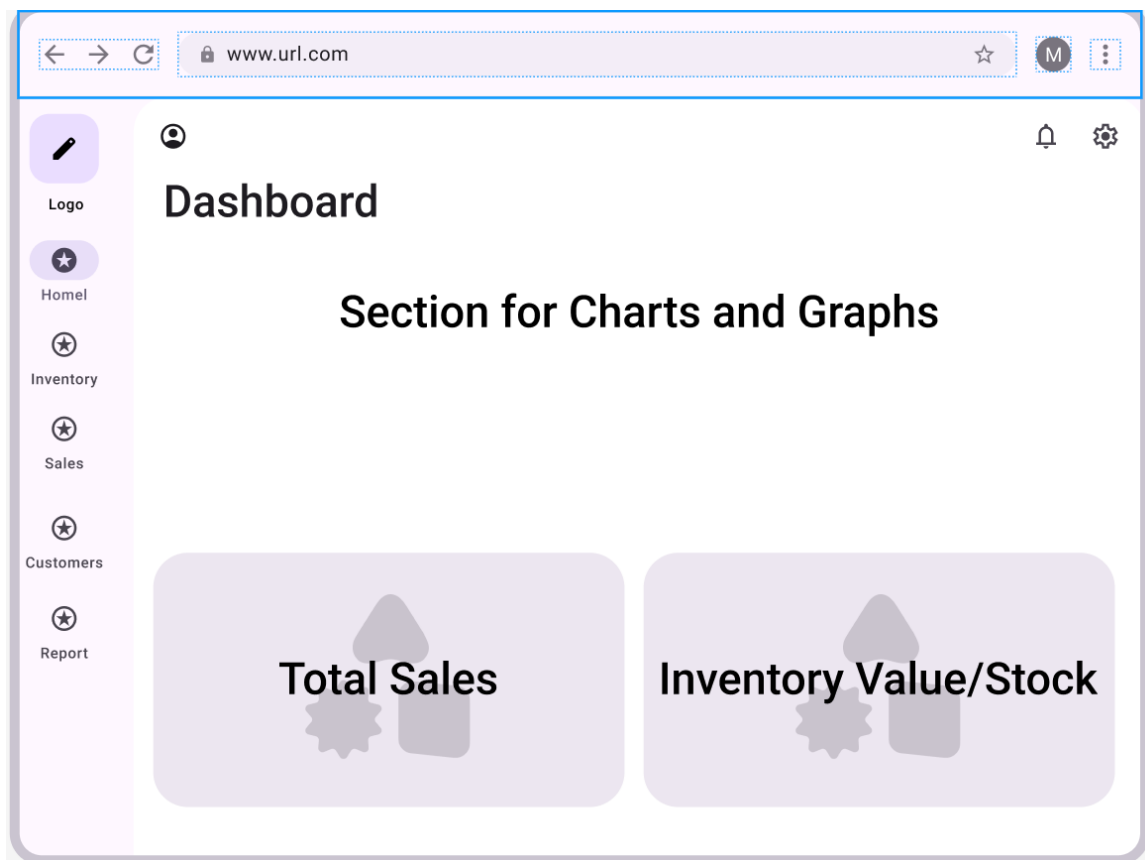
- **Contextual Help and Tooltips:** Embedded guidance tailored to user roles and tasks reduces errors and accelerates onboarding.
 - **Automation Integration:** Examples include auto-scheduling work orders based on artisan skills, automated reorder triggers, and AI-powered suggestion engines in sales.
 - **Natural Language Interfaces:** Incorporating conversational UI elements or chatbots can facilitate faster data retrieval and task completion, especially for sales and support staff.
-



18.6 Security and Privacy by Design

With access to sensitive business data and customer information, the UI design must prioritize security without compromising usability:

- **Role-Based Access Controls (RBAC):** The interface should dynamically restrict or reveal features and data based on authenticated user roles.
- **Audit Trails and Notifications:** The UI must provide transparent logging of user actions and alert users to any suspicious activities.
- **Data Minimization:** Only necessary data is displayed to users, reducing the risk of exposure and cognitive overload.

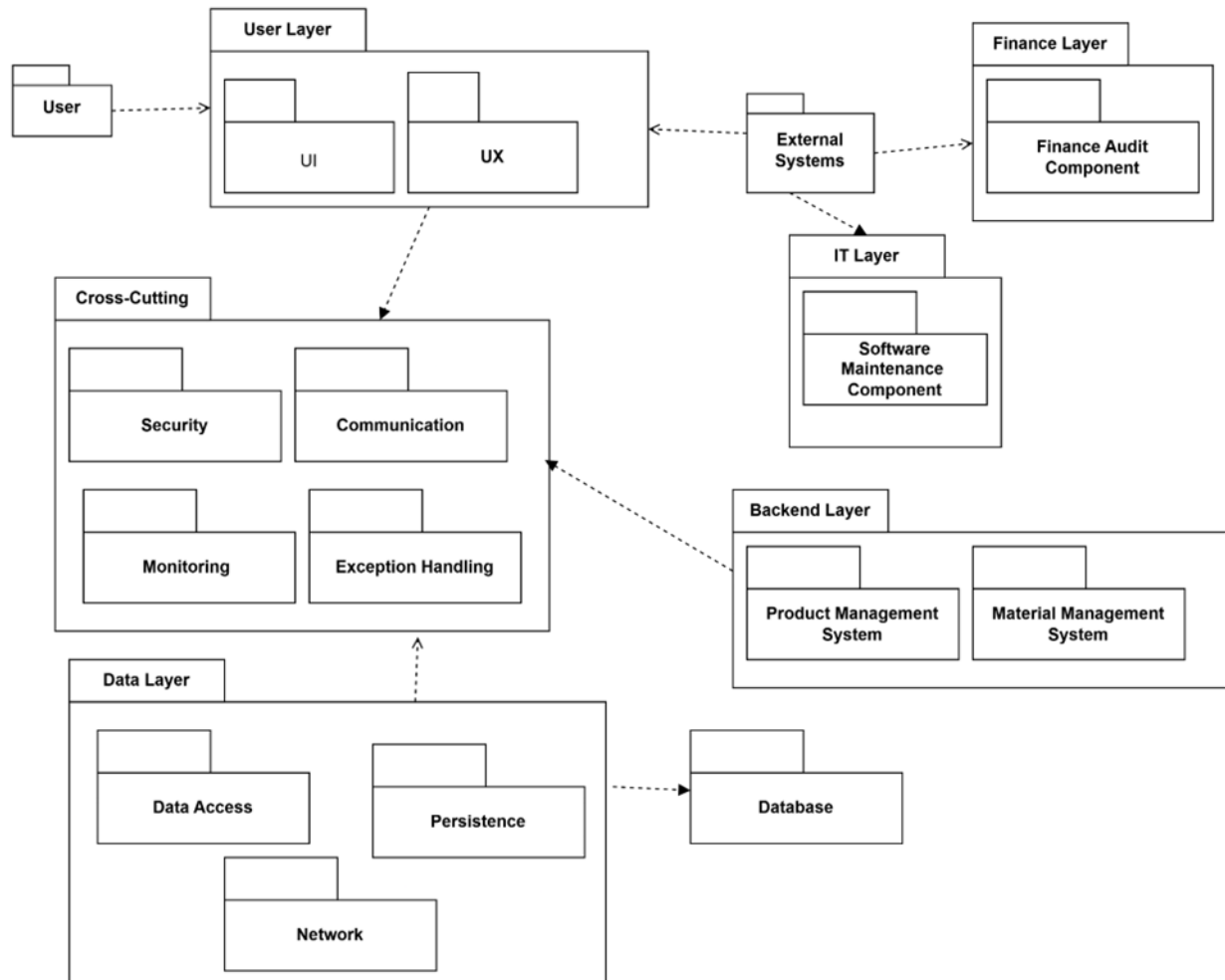


An example of what the Interface and Prototype of the system will be



19. Package and Object Diagram

19.1 Package Diagram



1. User Layer

- **UI** and **UX** are drawn as nested packages inside User Layer, indicating that all user-interface classes and all user-experience/navigation classes live here.



2. Cross-Cutting

- Contains four sibling packages—**Security**, **Communication**, **Monitoring**, **Exception Handling**—to show that these concerns are not owned by a single layer but are used throughout the system.

3. Backend Layer

- Holds **Product Management System** and **Material Management System**, the two core domain subsystems responsible for product catalog operations and materials/inventory workflows.

4. Finance Layer

- Contains the **Finance Audit Component** package, which encapsulates all auditing, reporting, and compliance logic for monetary transactions.

5. IT Layer

- Contains a **Software Maintenance Component** package for deployment, version control, backups, and other operational support tasks.

6. Data Layer

- Encloses **Data Access** (repositories or DAOs), **Persistence** (ORM mappings, schema definitions, transactions), and **Network** (connection pooling, database connectivity) as three cohesive subpackages.

7. External Systems

- A standalone package representing any third-party or legacy services (payment gateways, messaging platforms, hardware interfaces) the application calls out to.

8. Database

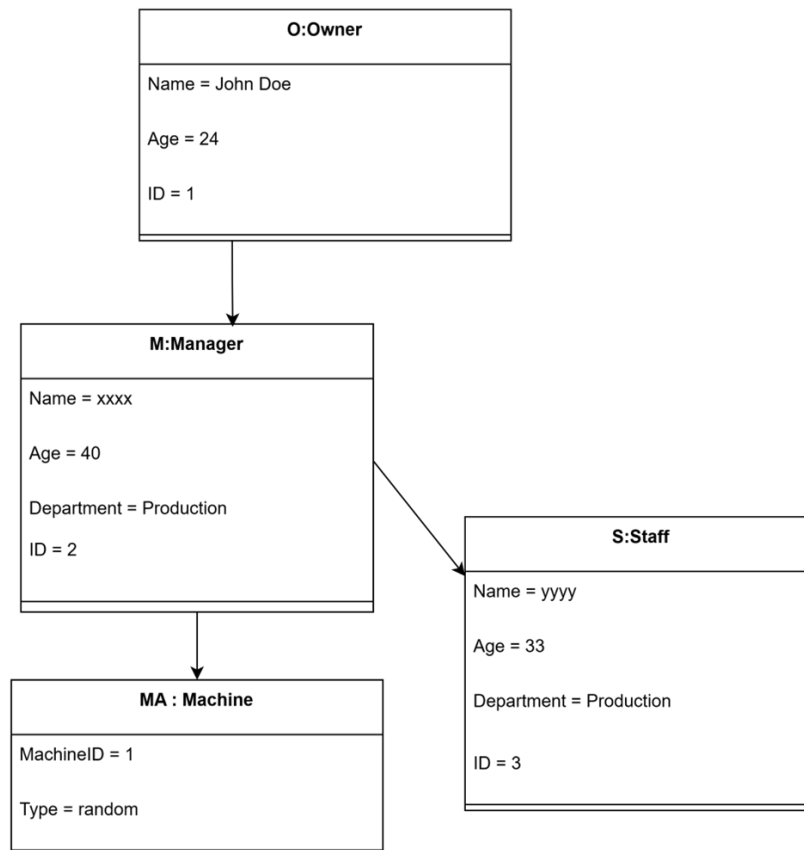
- Another standalone package indicating the physical data store that all persistence packages depend upon.



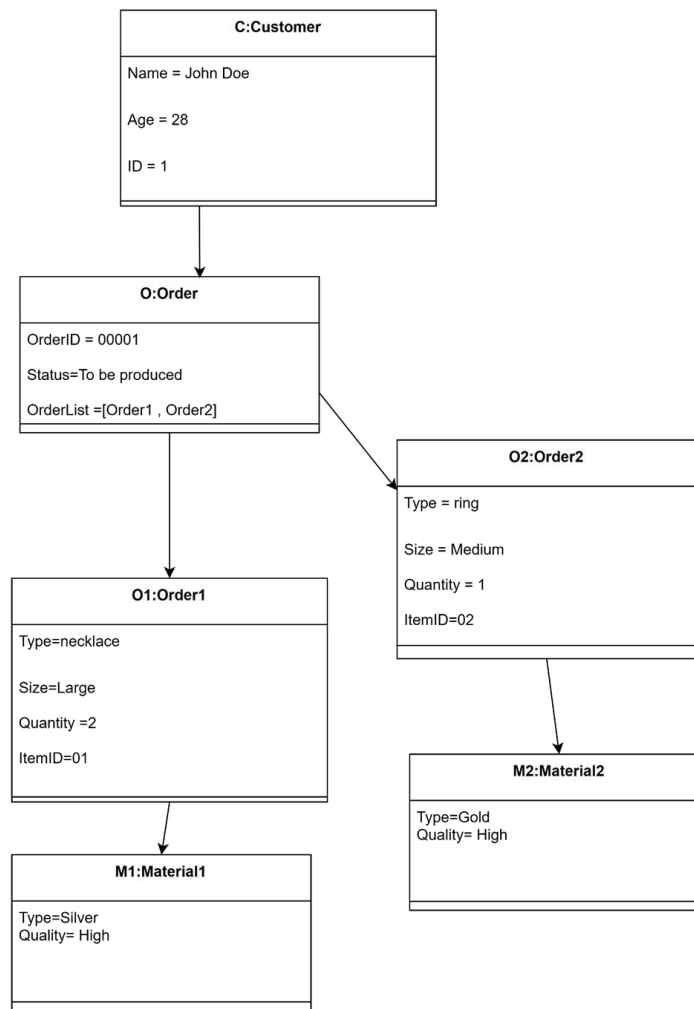
Dependencies (in words):

- The **User Layer** depends on (i.e. “uses”) the **Cross-Cutting** services and the **Backend Layer** subsystems.
- Both **Backend** and **Finance** layers depend on the **Data Layer** to load and store their data.
- All persistence-related packages in the Data Layer in turn depend on the **Database**.

19.2 Object Diagram



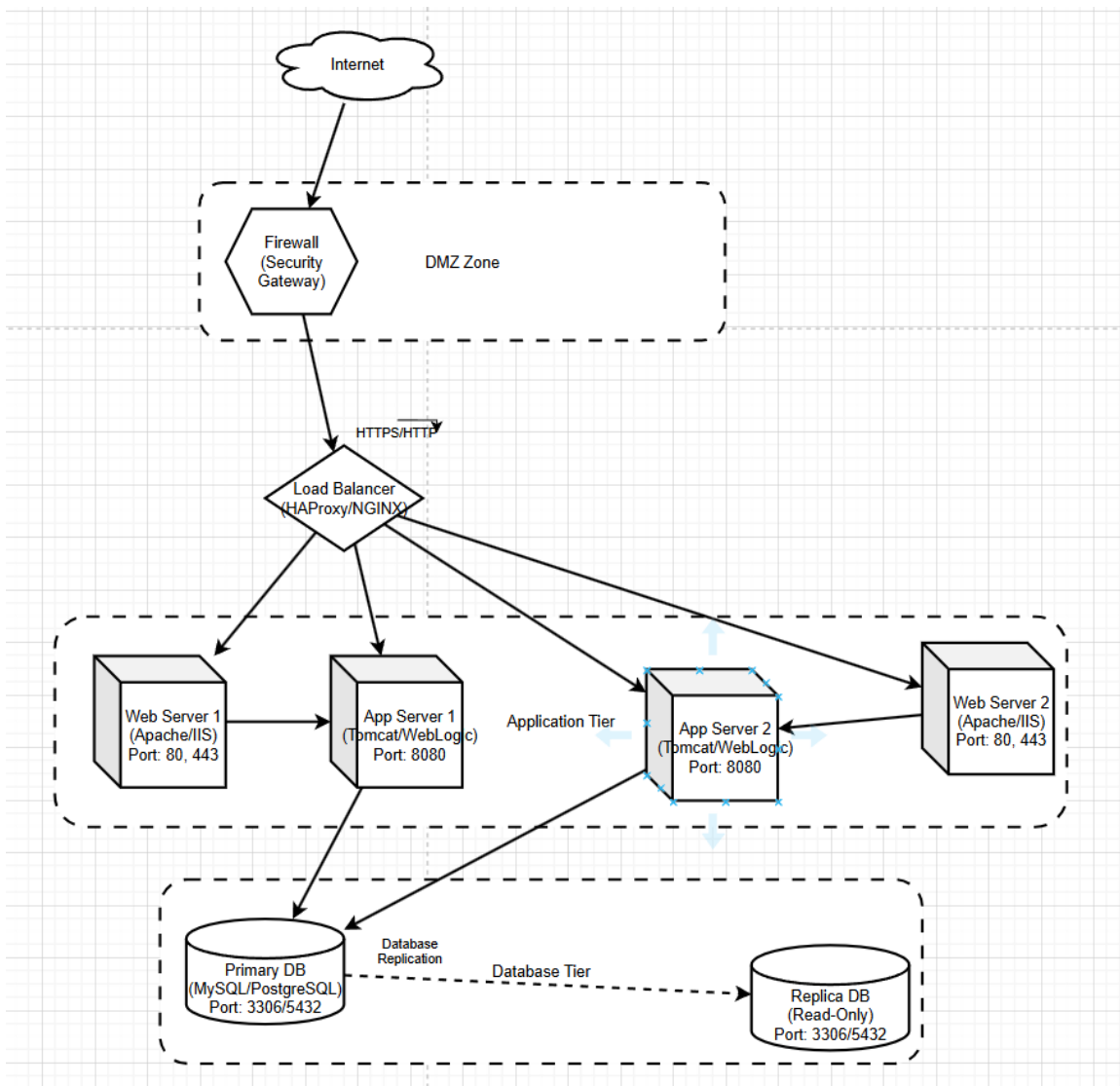
This is a simple **object diagram**—a “snapshot” of four live objects in memory (Owner, Manager, Staff, Machine) and exactly which one-way pointers they hold to each other: the **Owner** object points to a particular **Manager**, that **Manager** points to a specific **Staff**, and that **Staff** points to a given **Machine**. Each arrow means “this object has (i.e. holds a reference to) that object,” showing who “knows about” whom at this instant in time



This object diagram is a snapshot of a customer's order and its parts at runtime: the **C:Customer** object holds a reference to one **O:Order** object, that **O:Order** object in turn refers to two distinct sub-orders (**O1:Order1** and **O2:Order2**), and each of those sub-orders holds its own material reference (**M1:Material1** for Order1 , **M2:Material2** for Order2).



20. Testing and Deployment Diagram



1. Firewall (Abstract Control Layer)

- **Design Role:** Logical security boundary.
- **Function in S&D:**
 - Defines trust zones between external and internal software layers.
 - Represents constraints on communication in sequence diagrams or deployment diagrams.
 - Modelled in system constraints or access policies.



2. Web Server with ECOM Components (Presentation Layer + Thin Logic)

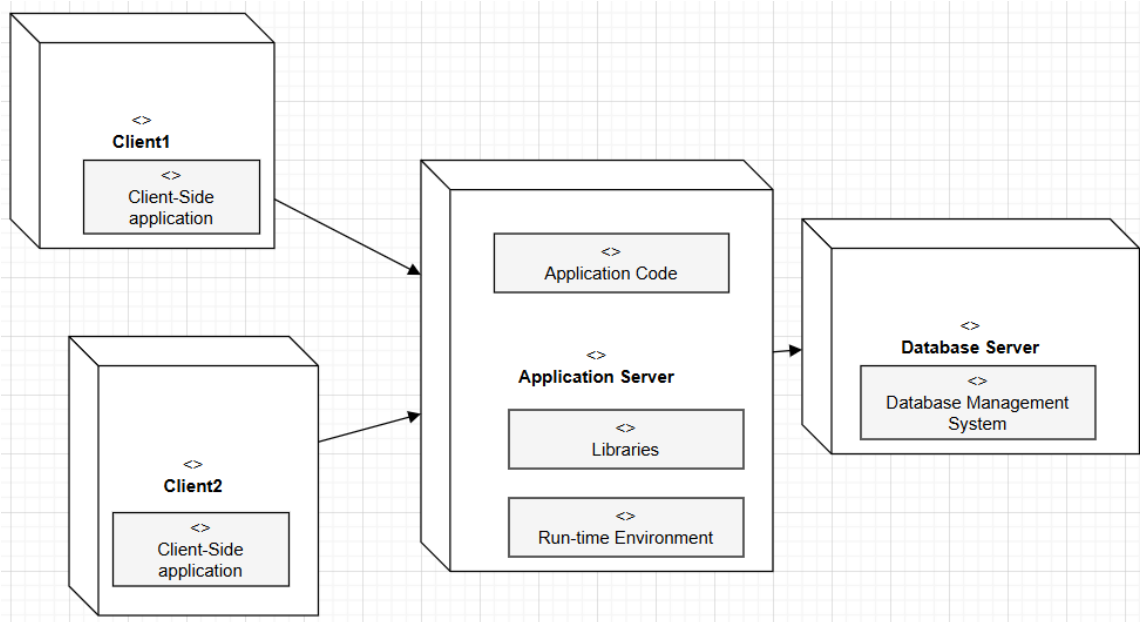
- **Role:** Entry point for user interaction.
- **Design Responsibilities:**
 - Handles user interface rendering (Model-View-Controller view layer).
 - Initiates request-handling sequence toward the core logic.
 - Manages user session, input validation (boundary objects in UML).
 - ECOM Components include modular subsystems (CatalogComponent, CheckoutComponent, AuthComponent), typically defined as interfaces and concrete implementations.
- **Design Tools:** Sequence diagrams (showing request-response), component diagrams (showing module boundaries).

3. Application Server (Business Logic Layer)

- **Role:** Implements system use cases and rules.
- **Design Responsibilities:**
 - Central unit for inter-module orchestration.
 - Contains Controllers and Services (e.g., OrderService, PaymentProcessor).
 - Coordinates between ECOM modules and data layer.
 - Designed as a collection of classes and subsystems, often using Design Patterns (Factory, Strategy, Observer).
- **Object-Oriented Focus:** Defines domain models and their behavior, typically using class diagrams and interaction diagrams.

4. Database (Data Persistence Layer)

- **Role:** Storage and retrieval of domain data.
- **Design Responsibilities:**
 - Entity-Relationship Models (ERDs) map to persistent domain classes (ORM or DAO).
 - Interfaces with the application layer through Data Access Objects or Repositories.
 - Manages referential integrity and transactional consistency.
- **Design View:** Can be abstracted in UML as persistent storage components or as a class with CRUD operations.





21. Conclusions

Through a disciplined selection of analysis and design technologies—draw.io for rapid iteration, Visual Paradigm for comprehensive UML/BPMN modeling, bpmn.io for focused process design, and Figma for UI prototyping—we established a robust SAD foundation for the TwentyOne Gold Jewelry Management System. Key reflections include:

- **Traceability and Alignment:** By integrating requirement IDs into UML elements and maintaining a centralized GitHub repository, we ensured that every design artifact ties back to a specific user need. This traceability minimizes the risk of “scope creep” and simplifies impact analysis when requirements evolve.
- **Consistency and Validation:** Automated model checks in Visual Paradigm and bpmn.io’s syntax linters caught structural inconsistencies early—preventing downstream confusion during implementation. Peer walkthroughs further validated that our class diagrams, sequence flows, and activity diagrams faithfully represent actual business workflows.
- **Collaborative Efficiency:** The blend of tools—ranging from quick sketching in draw.io to high-fidelity prototypes in Figma—enabled disparate stakeholders (warehouse staff, production managers, sales reps) to provide actionable feedback at each fidelity level. This collaborative ethos reduced rework during the coding phase and aligned development priorities with real-world user expectations.
- **Future-Ready Design Practices:** Our SAD artifacts, built using industry-standard notations (UML 2.x, BPMN 2.0) and exported in portable formats (XML, SVG, BPMN XML), position TwentyOne Gold to adopt advanced methodologies down the line—be it model-driven code generation, automated workflow execution, or cloud-hosted collaborative modeling.

Ultimately, by investing in a rigorous SAD process, meticulously validated through automated checks and stakeholder reviews, we have produced a blueprint that not only captures current requirements but also scaffolds future expansions—whether that means integrating IoT sensors, supporting multi-store architectures, or embedding AI-driven analytics. The result is a cohesive, resilient design framework that de-risks implementation, streamlines collaboration, and lays the groundwork for TwentyOne Gold’s long-term digital transformation.