Module Interface Specification for MES-ERP

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1 Revision History

Date	Version	Notes
Date 1	1.0	Notes
Date 2	1.1	Notes

2 Symbols, Abbreviations and Acronyms

See SRS Documentation at [give url —SS]
[Also add any additional symbols, abbreviations or acronyms —SS]

Contents

3   Introduction

The following document details the Module Interface Specifications for [Fill in your project name and description —SS]

Complementary documents include the System Requirement Specifications and Module Guide. The full documentation and implementation can be found at .... [provide the url for your repo —SS]

4   Notation

The structure of the MIS for modules comes from Hoffman and Strooper (1995), with the addition that template modules have been adapted from Ghezzi et al. (2003). The mathematical notation comes from Chapter 3 of Hoffman and Strooper (1995). For instance, the symbol := is used for a multiple assignment statement and conditional rules follow the form $(c_1 \Rightarrow r_1 | c_2 \Rightarrow r_2 | ... | c_n \Rightarrow r_n)$.

The following table summarizes the primitive data types used by MES-ERP.

Data Type	Notation	Description
character	char	a single symbol or digit
integer	$\mathbb{Z}$	a number without a fractional component in $(-\infty, \infty)$
natural number	$\mathbb{N}$	a number without a fractional component in $[1, \infty)$
real	$\mathbb{R}$	any number in $(-\infty, \infty)$

The specification of MES-ERP uses some derived data types: sequences, strings, and tuples. Sequences are lists filled with elements of the same data type. Strings are sequences of characters. Tuples contain a list of values, potentially of different types. In addition, MES-ERP uses functions, which are defined by the data types of their inputs and outputs. Local functions are described by giving their type signature followed by their specification.

5   Timeline

This section outlines the timeline for the implementation of the project. The timeline includes the development of all modules, testing, and deployment phases. Tasks are divided by modules, specifying responsibilities and key milestones.

5.1 Development Timeline

Week	Task	Details
Week 1	Initial Planning	Team meeting to finalize requirements and review the SRS. Assign responsibilities for each module.
Week 2	User Authentication and Profile Management Module	Development of secure login, roles, and basic profile updates. Begin unit testing for authentication.
Week 3	Expense Submission and Tracking Module	Implement submission forms for expenses, including receipt uploads and status tracking. Start unit testing.
Week 4	Budget and Funding Management Module	Develop logic for fetching budgets, validating funds, and updating department budgets. Integrate with the database module.
Week 5	Approval Workflow and Review Module	Implement dynamic routing rules and approval workflows. Integrate notifications for pending approvals. Conduct unit testing.
Week 6	Disbursement and Payment Processing Module	Create logic for issuing payments and generating logs for auditing. Integrate with external financial systems.
Week 7	Notifications and Communication Module	Build notifications for key events, such as request approvals or denials. Include dashboard alerts for overdue actions.
Week 8	Reporting and Analytics Module	Develop functionality for generating reports and tracking usage statistics. Validate with sample data.

5.2 Testing and Verification

Testing will be conducted in multiple phases:

- Unit Testing: Conducted during the implementation of each module (Weeks 2–11).

- Integration Testing: Performed once modules are integrated (Week 12).

- System Testing: Comprehensive testing of the entire system to ensure functionality and performance (Week 12–13).

- User Acceptance Testing: Gather feedback from end-users during Week 13 to identify potential areas for improvement.

5.3 Responsibilities

The following responsibilities are assigned to team members:

- Module Implementation: Each team member is responsible for implementing the modules assigned to them during the initial planning phase.

- Documentation: All team members contribute to the MIS and ensure consistency with the SRS.

- Testing: Shared responsibility for writing and executing test cases, with module developers performing unit tests.

- Deployment: Coordinated by the team lead, with support from all team members for configuration and setup.

6 Module Decomposition

The modules in this system are divided into the following levels:

Level 1	Level 2
Hardware-Hiding Module	Database Module
Behavior-Hiding Module	Approval Workflow and Review Budget and Funding Management Reporting and Analytics Policy and Compliance Management Notifications and Communication Disbursement and Payment Processing
Software Decision Module	GUI Module Integration with Other University Systems Software Design Decisions Module

Table 1: Module Decomposition

7 MIS of Approval Workflow and Review Module

7.1 Module

Approval Workflow and Review

7.2 Uses

- Budget and Funding Management Module

- Notifications and Communication Module

- Database Module

7.3 Syntax

7.3.1 Exported Constants

None.

7.3.2 Exported Access Programs

Name	Input	Output	Exceptions
routeRequest	requestID (`String`), userRole (`String`)	status (`String`)	InvalidRoleException
addNote	requestID (`String`), note (`String`)	confirmation (`Boolean`)	RequestNotFoundException
updateStatus	requestID (`String`), newStatus (`String`)	confirmation (`Boolean`)	InvalidStatusException

7.4 Semantics

7.4.1 State Variables

- requests: A mapping of request IDs to their current status and approver roles.

7.4.2 Environment Variables

- Database: Stores information about requests, user roles, and approval workflows.

- Notification System: Sends alerts for pending approvals or status updates.

7.4.3 Assumptions

- User roles are pre-validated by the authentication system.

- All approvers have access to the system during their review process.

7.4.4 Access Routine Semantics

`routeRequest(requestID, userRole):`

- Output: Returns the current status of the request or raises an InvalidRoleException if the userRole is unauthorized.

`addNote(requestID, note):`

- Transition: Adds a note to the request specified by `requestID`.

- Output: Returns `true` if successful or raises RequestNotFoundException if the request ID does not exist.

`updateStatus(requestID, newStatus):`

- Transition: Updates the status of the request specified by `requestID`.

- Output: Returns `true` if successful or raises InvalidStatusException if the new status is invalid.

7.4.5 Local Functions

None.

8 MIS of Budget and Funding Management Module

8.1 Module

Budget and Funding Management

8.2 Uses

- Database Module

- Notifications and Communication Module

8.3 Syntax

8.3.1 Exported Constants

- MAX_BUDGET: The maximum allowable budget per department.

8.3.2 Exported Access Programs

Name	Input	Output	Exceptions
getBudget	departmentID (`String`)	budgetDetails (`Object`)	DepartmentNotFoundException
validateFunds	requestAmount (`Float`), departmentID (`String`)	status (`Boolean`)	InsufficientFundsException
updateBudget	departmentID (`String`), amount (`Float`)	confirmation (`Boolean`)	BudgetOverflowException

8.4 Semantics

8.4.1 State Variables

- budgets: A mapping of department IDs to their current budget values.

8.4.2 Environment Variables

- Database: Stores information about department budgets and transactions.

8.4.3 Assumptions

- All transactions are logged for auditing purposes.

- Real-time budget data is synchronized with the university financial system.

8.4.4 Access Routine Semantics

`getBudget(departmentID):`

- Output: Returns an object containing the budget details of the specified department or raises DepartmentNotFoundException.

`validateFunds(requestAmount, departmentID):`

- Output: Returns `true` if sufficient funds are available, otherwise raises InsufficientFundsException.

`updateBudget(departmentID, amount):`

- Transition: Updates the budget for the specified department by the specified amount.

- Output: Returns `true` if successful or raises BudgetOverflowException if the update exceeds MAX_BUDGET.

8.4.5 Local Functions

None.

9 MIS of Reporting and Analytics Module

9.1 Module

Reporting and Analytics

9.2 Uses

- Database Module

9.3 Syntax

9.3.1 Exported Constants

None.

9.3.2 Exported Access Programs

Name	Input	Output	Exceptions
generateReport	filters (`Object`)	report (`PDF/CSV`)	InvalidFilterException
getUsageStats	timeframe (`String`)	stats (`Object`)	None

9.4 Semantics

9.4.1 State Variables

- reports: Stores past generated reports for caching and quick access.

9.4.2 Environment Variables

- Database: Stores analytics data related to system usage and transactions.

9.4.3 Assumptions

- Data required for analytics is periodically updated and complete.

9.4.4 Access Routine Semantics

`generateReport(filters):`

- Output: Returns a report in PDF or CSV format based on the filters provided, or raises InvalidFilterException if the filters are malformed.

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getUsageStats(timeframe):
```

- Output: Returns an object containing system usage statistics for the specified time-frame.

9.4.5 Local Functions

None.

10 MIS of Graphical User Interface (GUI) Module

10.1 Module

Graphical User Interface (GUI)

10.2 Uses

- Notifications and Communication Module

- Database Module

- Approval Workflow and Review Module

10.3 Syntax

10.3.1 Exported Constants

None.

10.3.2 Exported Access Programs

Name	Input	Output	Exceptions
renderDashboard	userID (String)	dashboardView (HTML/JSON)	UserNotFoundException
updateView	viewName (String)	success (Boolean)	ViewNotFoundException
handleInput	event (Object)	actionResponse (Boolean)	InputException

10.4 Semantics

10.4.1 State Variables

- **activeView**: The current view being displayed to the user, identified by its name (e.g., "Dashboard", "Expense Submission").

- **userSession**: Details about the currently logged-in user, including preferences and session data.

10.4.2 Environment Variables

- **Browser Window**: Displays the GUI and captures user inputs.

- **Server API**: Fetches data to dynamically update the GUI based on user interactions.

10.4.3 Assumptions

- The browser supports modern web standards (HTML5, CSS3, JavaScript).

- Users have active and authenticated sessions before interacting with the GUI.

10.4.4 Access Routine Semantics

`renderDashboard(userID):`

- **Output**: Renders the dashboard for the given `userID` or raises a `UserNotFoundException` if the user is not valid.

`updateView(viewName):`

- **Output**: Updates the active view to the one specified by `viewName` and returns `true` if successful, or raises a `ViewNotFoundException`.

`handleInput(event):`

- **Transition**: Processes user interactions, such as button clicks or form submissions, and triggers corresponding actions.

- **Output**: Returns `true` if the input is handled successfully or raises an `InputException`.

10.4.5 Local Functions

None.

11 MIS of Policy & Compliance Management Module

11.1 Module

Policy & Compliance Management

11.2   Uses

- Database Module

- Notifications and Communication Module

11.3   Syntax

11.3.1   Exported Constants

- MAX_REIMBURSEMENT: The maximum allowable reimbursement amount for a single request.

- TRAVEL_APPROVAL_LIMIT: The threshold above which travel expenses require prior approval.

11.3.2   Exported Access Programs

Name	Input	Output	Exceptions
validateRequest	requestDetails (Object)	validationStatus (Boolean)	PolicyViolationException
getPolicyRules	policyType (String)	rules (Object)	PolicyNotFoundException
logComplianceCheck	requestID (String), result (Boolean)	confirmation (Boolean)	LogFailureException

11.4   Semantics

11.4.1   State Variables

- **policies**: A mapping of policy types to their respective rules and thresholds.

- **complianceLogs**: A record of compliance checks performed on submitted requests.

11.4.2   Environment Variables

- **Policy Database**: Stores policy definitions and thresholds.

- **Audit System**: Logs compliance checks and violations for review.

11.4.3   Assumptions

- Policy rules are periodically updated to align with organizational regulations.

- Compliance checks are triggered automatically during the request submission process.

11.4.4 Access Routine Semantics

`validateRequest(requestDetails):`

- **Output**: Returns `true` if the request complies with all applicable policies or raises a `PolicyViolationException` if a rule is violated.

`getPolicyRules(policyType):`

- **Output**: Returns the rules for the specified `policyType` or raises a `PolicyNotFoundException` if the policy type is invalid.

`logComplianceCheck(requestID, result):`

- **Transition**: Records the result of a compliance check for the given `requestID`.

- **Output**: Returns `true` if the log is updated successfully or raises a `LogFailureException`.

11.4.5 Local Functions

None.

12 MIS of Integration with Other University Systems Module

12.1 Module

Integration with Other University Systems

12.2 Uses

- Database Module

- External APIs (University Systems)

12.3 Syntax

12.3.1 Exported Constants

- `STUDENT_INFO_API_URL`: The endpoint for accessing the university's Student Information System (SIS).

- `FINANCE_SYSTEM_API_URL`: The endpoint for accessing the university's financial system.

12.3.2 Exported Access Programs

Name	Input	Output	Exceptions
`fetchStudentInfo`	`studentID (String)`	`studentDetails` `(Object)`	`StudentNotFoundException`
`syncFinancialData`	`departmentID` `(String)`	`syncStatus` `(Boolean)`	`FinanceSyncFailureException`
`verifyEnrollment`	`studentID (String)`	`enrollmentStatus` `(Boolean)`	`EnrollmentVerificationException`

12.4 Semantics

12.4.1 State Variables

- **universityData**: A cache of information fetched from external university systems for performance optimization.

- **syncLogs**: A record of synchronization activities between the system and external APIs.

12.4.2 Environment Variables

- **University SIS**: Provides student details such as enrollment status, department, and contact information.

- **University Finance System**: Manages departmental budgets, account balances, and payment records.

12.4.3 Assumptions

- API endpoints for university systems are reliable and adhere to predefined contracts.

- Authentication credentials for accessing university systems are securely stored and updated as needed.

12.4.4 Access Routine Semantics

`fetchStudentInfo(studentID):`

- **Output**: Returns the details of the student identified by `studentID`, or raises `StudentNotFoundException` if no matching record is found.

`syncFinancialData(departmentID):`

- **Transition**: Synchronizes financial data for the given `departmentID` with the university's finance system.

- **Output**: Returns `true` if the synchronization is successful or raises `FinanceSyncFailureException` if an error occurs.

`verifyEnrollment(studentID):`

- **Output**: Returns `true` if the student is enrolled, or raises `EnrollmentVerificationException` if verification fails.

12.4.5   Local Functions

None.

13   MIS of Administrator and Configuration Panel Module

13.1   Module

Administrator and Configuration Panel

13.2   Uses

- Database Module

- Notifications and Communication Module

- Integration with Other University Systems Module

13.3   Syntax

13.3.1   Exported Constants

- `DEFAULT_ROLE_PERMISSIONS`: A mapping of roles to their default access permissions.

- `MAX_NOTIFICATION_TEMPLATES`: The maximum number of customizable notification templates allowed.

13.3.2   Exported Access Programs

Name	Input	Output	Exceptions
addRole	roleName (String), permissions (List)	confirmation (Boolean)	RoleAlreadyExistsException
updateApprovalChain	chainConfig (Object)	confirmation (Boolean)	InvalidChainConfigException
editNotificationTemplate	templateID (String), newTemplate (String)	confirmation (Boolean)	TemplateNotFoundException
viewLogs	timeframe (String)	logData (Object)	None

13.4   Semantics

13.4.1   State Variables

- **roles**: A mapping of roles to their permissions and associated users.

- **notificationTemplates**: A collection of templates for system notifications.

- **auditLogs**: A collection of system logs for administrative actions.

13.4.2   Environment Variables

- **Database**: Stores configuration settings, logs, and role assignments.

- **Notification System**: Delivers updates to users based on configured templates.

13.4.3   Assumptions

- Role and permission updates propagate immediately to all system components.

- Audit logs are retained and accessible for the configured retention period.

13.4.4   Access Routine Semantics

addRole(roleName, permissions):

- **Transition**: Adds a new role with the specified permissions to the system.

- **Output**: Returns true if the role is added successfully or raises RoleAlreadyExistsException.

updateApprovalChain(chainConfig):

- **Transition**: Updates the approval chain configuration based on the provided settings.

- **Output**: Returns true if the update is successful or raises InvalidChainConfigException.

editNotificationTemplate(templateID, newTemplate):

- **Transition**: Updates the specified notification template with the new content.

- **Output**: Returns `true` if the template is updated successfully or raises `TemplateNotFoundException`

`viewLogs(timeframe)`:

- **Output**: Returns log data for the specified timeframe.

13.4.5   Local Functions

None.

References

Carlo Ghezzi, Mehdi Jazayeri, and Dino Mandrioli. *Fundamentals of Software Engineering.* Prentice Hall, Upper Saddle River, NJ, USA, 2nd edition, 2003.

Daniel M. Hoffman and Paul A. Strooper. *Software Design, Automated Testing, and Maintenance: A Practical Approach.* International Thomson Computer Press, New York, NY, USA, 1995. URL http://citeseer.ist.psu.edu/428727.html.

14   Appendix

[Extra information if required. Currently, none. —SS]

15 Appendix

[Extra information if required. Currently, none. —SS]

Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Problem Analysis and Design.

The purpose of reflection questions is to give you a chance to assess your own learning and that of your group as a whole, and to find ways to improve in the future. Reflection is an important part of the learning process. Reflection is also an essential component of a successful software development process.

Reflections are most interesting and useful when they're honest, even if the stories they tell are imperfect. You will be marked based on your depth of thought and analysis, and not based on the content of the reflections themselves. Thus, for full marks we encourage you to answer openly and honestly and to avoid simply writing "what you think the evaluator wants to hear."

Please answer the following questions. Some questions can be answered on the team level, but where appropriate, each team member should write their own response:

1. **What went well while writing this deliverable?**
   Rachid: Collaborating as a team was smooth, and we were able to divide the modules effectively, which streamlined the writing process.

2. **What pain points did you experience during this deliverable, and how did you resolve them?**
   Rachid: One challenge was ensuring consistency across modules. Regular team reviews and communication helped resolve any inconsistencies.

3. **Which of your design decisions stemmed from speaking to your client(s) or a proxy (e.g., your peers, stakeholders, potential users)? For those that were not, why, and where did they come from?**
   Rachid: Many decisions, like integrating notifications, came directly from stakeholder feedback. Others, like modular decomposition, were based on best practices and team experience.

4. **While creating the design doc, what parts of your other documents (e.g., requirements, hazard analysis, etc.), if any, needed to be changed, and why?**
   Rachid: The requirements document was updated to better align with the final design, specifically in the Reporting module to include export formats.

5. **What are the limitations of your solution? Put another way, given unlimited resources, what could you do to make the project better? (LO_ProbSolutions)**
   Rachid: With unlimited resources, we could enhance system scalability and user interface design, making it more robust and user-friendly.

6. **Give a brief overview of other design solutions you considered. What are the benefits and tradeoffs of those other designs compared with the chosen design? From all the potential options, why did you select the documented**

design? (LO_Explores)

Rachid: We considered alternative approaches for managing the workflow logic, such as using external libraries, but chose an in-house solution for simplicity and better control over implementation.