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Project Title: Library Management System
Section: F

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Table of Contents

1.0 Introduction:

The Library Management System will be a web-based project that will allow the users to manage Students, Faculties and Admins according to their access levels. Libraries require a lot of data processing daily, for which an automated application will help save time and prevent any manual errors. This document outlines the plan for developing the Library Management System and the goals it hopes to achieve. The primary goal of this is to overcome the manual errors and make a computerized system that will be cost-efficient.

2.0 Project Title:

The proposed software system is titled "Library Management System."

3.0 Objectives:

The library management system aims to run a library efficiently and cheaply. The system's complete automation simplifies all aspects of the library's operations. The program handles book purchases, cataloging, indexing, circulation tracking, and stock checking. Such software removes the need for repetitive manual labor and reduces the likelihood of mistakes.

The library management system software contributes to lower operating expenses. Manually managing a library is time-consuming and involves a massive quantity of paperwork. A computerized method lowers the demand for personnel and stationery. As a result, operating costs are reduced.

Specific goals of the software system include:

- To automate the process of borrowing and returning books.
- To keep track of book inventory and availability.
- To generate reports and statistics on library usage and book circulation.
- To enable library staff to manage library resources more efficiently.
- To provide a user-friendly interface for library patrons to browse and search for books.
- To reduce operating costs for libraries.

4.0 Justification:

Several automated operations in a library management system will reduce operations costs—one of the significant expenses related to inventory management. Barcodes and RFIDs, for example, make it simple to keep track of books and other library resources, decreasing the need for paper-based records. Libraries may become more efficient and reduce staff numbers

without manual intervention, saving them time and money. The system will help librarians simplify their daily tasks and give them precise, current information on book circulation and inventory. Library customers, on the other hand, will benefit from a user-friendly interface that makes it easier to browse and search for books, and form a more efficient borrowing and returning process.

5.0 Systems Overview:

The Library management system will be used to oversee all the operations of a library. It is intended to manage the library's daily tasks, such as managing library users and employees, sorting, and categorizing books, lending, and returning books, managing library customers, and generating reports.

The Library Management System consists of various components, including:

- User Interface: The user interface component of the Library Management System is responsible for providing an easy-to-use interface for library staff and members to access the system's features.
- Catalog (sorting and categorizing): The catalog component of the system is responsible for maintaining the library's categories of books and other resources.
- Circulation: The circulation component of the system is responsible for managing the lending and returning of books and other resources.
- Reports: The reports component of the system is responsible for generating various reports, including member activity reports, overdue books reports, and others.
- Security: The security component of the system is responsible for ensuring that only authorized users can access the system and its features.
- Integration: The integration component of the system is responsible for integrating with other systems, including online library catalogs and resource sharing systems.

Below is a use case diagram that depicts the different actors and use cases involved in the Library Management System.
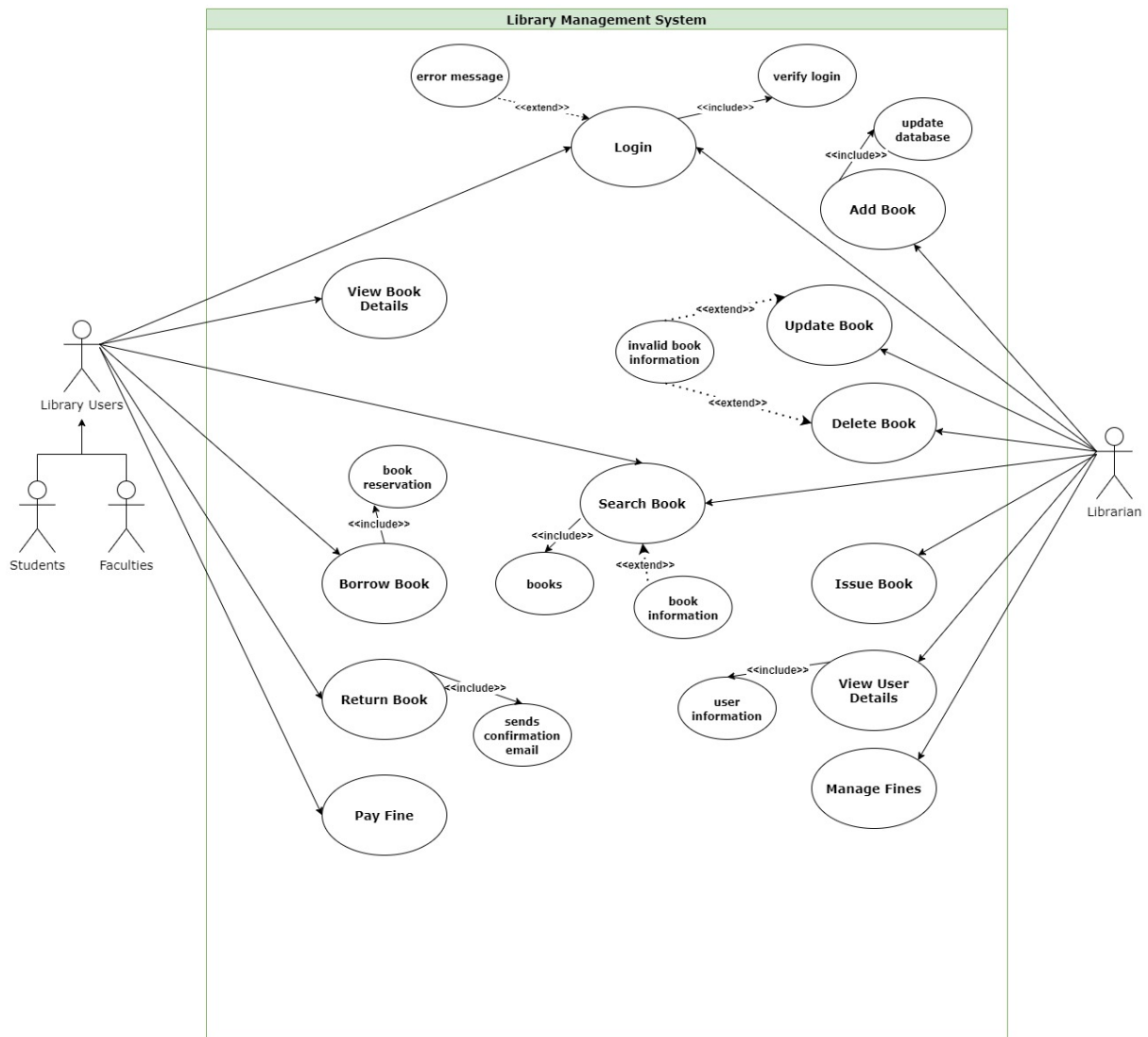
Use-Case Diagram:

Figure 1: Use-Case Diagram

6.0 Stakeholders analysis:

The Library management system will be used to oversee all the operations of a library.

- **Primary Stakeholders:**
  - I.   Librarian
  - II.   Library Staff
  - III.   Library Users (Students & Faculties)

- **Secondary Stakeholders:**

  I.   Library Board
  II.   Local Government
  III.   Vendors and Suppliers

- **Positive Stakeholders:**

  I.   Library Supporters
  II.   Community Partners
  III.   Donors and Sponsors

- **Negative Stakeholders:**

  I.   Competitors
  II.   Critics
  III.   Hackers and Cybercriminals

- **Internal Stakeholders:**

  I.   Librarian and Library Staff
  II.   IT Department
  III.   Developers

- **External Stakeholders:**

  I.   Library Users
  II.   Library Board,
  III.   Local Government,
  IV.   Vendors and Suppliers,
  V.   Library Supporters,
  VI.   Donors and Sponsors,
  VII.   Competitors

7.0 Feasibility study:

A feasibility study will assist an organization in deciding whether to pursue a project. It determines whether the proposed business ideas will succeed or fail. The project's technical and financial feasibility is demonstrated here:

- **Technical Feasibility:**

  Technical feasibility assesses the availability of the required technology, resources, and expertise for developing and implementing the Library Management System.

a. **Technical Expertise:** The development team has the necessary skills and experience in software development, database design, and user interface design to create the system, being proficient in the required programming languages, frameworks, and tools.

b. **Hardware and Software Requirements:** The system can be built using widely available hardware and software platforms, ensuring compatibility with the library's existing infrastructure and minimizing new hardware investments.

c. **Technical Tools:** The following technical tools will be utilized for the development of the Library Management System:

> Programming Languages: PHP (backend) and JavaScript (frontend)
> Web Framework: ASP.NET Core
> Database Management System: MySQL
> Frontend Frameworks: React.js and Tailwind CSS
> Version Control: Git
> Integrated Development Environment (IDE): Visual Studio
> Project Management Tools: Trello or Jira

d. **Integration with Existing Systems:** The Library Management System will be designed to integrate seamlessly with existing library systems, allowing easy adoption and utilization without disrupting workflows.

Considering these factors, the Library Management System appears technically feasible, as the necessary resources, expertise, and technical tools are available for successful development and implementation.

- **Financial Feasibility:**

Financial feasibility examines the estimated costs associated with the development, implementation, and ongoing maintenance of the Library Management System, as well as potential benefits and return on investment.

a. **Development Costs:** Development costs include expenses related to software development, such as team salaries, software licenses, and resources. These costs will be managed to ensure the project stays within budget.

b. **Implementation Costs:** Implementation costs involve expenses for hardware upgrades (if necessary), system installation, data migration, and staff training. By

leveraging the library's existing infrastructure and providing efficient training, these costs will be minimized.

c. **Maintenance and Support Costs:** Ongoing maintenance and support costs will address system issues, provide updates, and offer user support. Cost-effective maintenance strategies and prioritizing essential improvements will manage these costs.

d. **Potential Benefits:** The Library Management System is expected to provide numerous benefits, such as improved efficiency in library operations, reduced staff workload, enhanced user experience, and increased resource tracking accuracy. These benefits can result in cost savings through reduced staff hours, decreased late fees, and more effective resource utilization.

Based on the estimated costs and potential benefits, the Library Management System appears financially feasible. The system is expected to provide a return on investment (ROI) through improved efficiency, cost savings, and user satisfaction. By managing development, implementation, and maintenance costs, the library can successfully develop and implement the Library Management System within financial constraints.

8.0 Systems component:

- **User Interface Component:**

The user interface component is the primary means of interaction between the library staff, members, and the system. It is designed to be intuitive, user-friendly, and visually appealing, enabling users to access the system's features efficiently. The user interface comprises the following sub-components:

a. Login Screen: Allows authorized users to access the system using their unique credentials.
b. Dashboard: Provides an overview of the library's status, including outstanding tasks, recent activity, and system notifications.
c. Navigation Menu: Facilitates easy access to the system's various features and modules.

- **Catalog (Sorting and Categorizing) Component:**

The catalog component is responsible for managing the library's inventory of books, periodicals, and other resources. This component includes the following sub-components:

a. Book Database: Stores information about each item in the library, such as title, author, publication date, and category.
b. Search Functionality: Allows users to search for books and other resources using various criteria, such as title, author, or keyword.
c. Classification System: Organizes the library's resources into categories and subcategories based on established classification schemes (e.g., Dewey Decimal System).

- **Circulation Component:**

  The circulation component manages the lending and returning of books and other resources. This component includes the following sub-components:

  a. Borrowing: Records the borrowing of library items by members, tracking due dates and generating overdue notices as necessary.
  b. Returning: Facilitates the return of borrowed items, updating the item's status in the catalog and automatically calculating any late fees.
  c. Reservation System: Allows members to reserve items that are currently unavailable, notifying them when the item becomes available for borrowing.

- **Reports Component:**

  The reports component generates various reports to help library staff monitor and manage the library's operations. This component includes the following sub-components:

  a. Member Activity Reports: Provides an overview of each member's borrowing history, including current loans and past transactions.
  b. Overdue Books Reports: Lists all items that are currently overdue, along with associated member information and accrued late fees.
  c. Inventory Reports: Summarizes the library's holdings, including total items, item categories, and acquisition dates.

- **Security Component:**

  The security component ensures that only authorized users can access the system and its features. This component includes the following sub-components:

  a. User Authentication: Verifies user credentials, allowing only authorized users to log in to the system.
  b. Access Control: Defines user roles and permissions, limiting access to certain features based on each user's role within the library.

    c. Data Encryption: Protects sensitive information by encrypting data during storage and transmission.

- **Integration Component:**

   The integration component enables the Library Management System to communicate with external systems and services. This component includes the following sub-components:

       a. Online Library Catalog Integration: Connects the system to online library catalogs, allowing users to search for and request resources from other libraries.
       b. Resource Sharing System Integration: Facilitates inter-library loans and resource sharing between libraries within a network.
       c. Third-Party Software Integration: Supports integration with other software tools, such as accounting systems or calendar applications, to streamline library operations.

9.0 Process Model to be followed:

The **Waterfall Model** will be utilized as the software development approach for the Library Management System. The Waterfall Model is a sequential and linear method of software development in which each phase of the process must be completed before proceeding to the next. This model provides a structured and systematic approach to software development, guaranteeing that all criteria are fulfilled and producing a high-quality result.
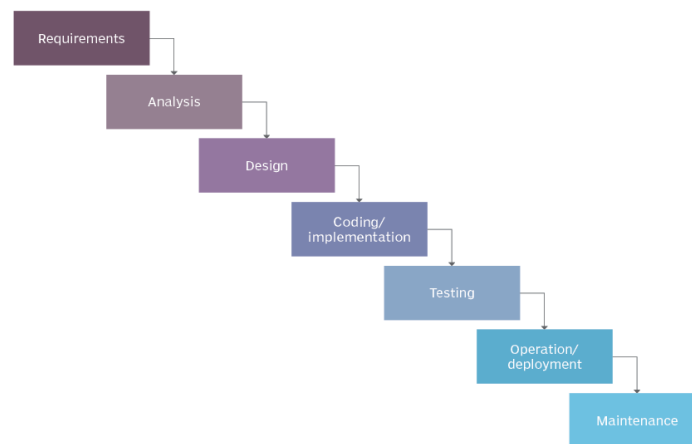
The Waterfall Model consists of the following phases:

Requirements Analysis, Design Analysis, Development, Testing, Deployment and Maintenance.

- Requirements Analysis: The team gathers and documents the Library Management System requirements through interviews, reviewing processes, and analyzing library needs. The output is a comprehensive requirements document.
- Design Analysis: Based on the requirements, the team designs the system's architecture, components, user interfaces, and database schema. This design is documented in a detailed specification.
- Development: The development team writes the code following the design specifications, creating components, modules, and interfaces. Thorough testing of each component is conducted during this phase.
- Testing: After implementation, rigorous testing is performed, including unit, integration, system, and user acceptance testing, ensuring the system meets requirements and is free of critical issues.

- Deployment: The Library Management System is deployed in the library environment, including installation, configuration, staff training, and data migration from existing systems.
- Maintenance: Post-deployment, the team provides ongoing maintenance, support, bug fixes, enhancements, and user support, ensuring the system continues to meet the library's evolving needs.

Waterfall model

Figure 2: Waterfall model phases.

Justification for choosing Waterfall Model:

The Waterfall Model was chosen for the Library Management System development due to the following key factors:

- Clear and stable requirements: The Waterfall Model thrives in situations with well-defined requirements, which is the case for the Library Management System, based on established library processes and operations.
- Structured approach: The linear and sequential nature of the Waterfall Model allows for clear milestones and deliverables, making it easier to monitor progress and ensure all requirements are met.
- Minimal changes: The Waterfall Model discourages frequent changes to project requirements, ensuring a smooth development process for the Library Management System.
- Ease of management: The straightforward nature of the Waterfall Model simplifies resource allocation and progress tracking, promoting efficient use of resources and timely completion.

- Thorough testing: The Waterfall Model emphasizes rigorous testing before deployment, resulting in a reliable and high-quality final product for the Library Management System.

The project team can use the Waterfall Model's systematic approach, defined requirements, and extensive testing processes to effectively construct a Library Management System that satisfies the library's and its users' demands by selecting it.

10.0 Efforts estimation:

To estimate the required effort, we need to breakdown the project into its component parts. We used the **Hybrid Work Breakdown Structure** (WBS) to break down the entire project into smaller components. The Hybrid WBS outline will consist of the following tasks:

- Project Initiation
  - Project Scope
  - Identify Stakeholders
  - Project Charter

- Requirements Analysis
  - Conduct Interviews
  - Analyze Requirements
  - Document Requirements
  - SRS Documentation

- Design
  - System architecture
  - System components
  - UI Design
  - Database Schema
  - Design Documentation

- Development
  - System Components
  - User Interface
  - Catalog Component
  - Circulation Component
  - Reports Component
  - Security Component
  - Integration Component
  - Integrate Components

- Testing
  - Test Plans
  - Unit Testing
  - Integration Testing
  - System Testing
  - User Acceptance Testing

- Deployment
  - Plan Deployment Activities
  - Install System
  - Data Migration
  - Training Staff
  - Deliver System

This Hybrid WBS outline helps in identifying and organizing tasks, ensuring that all aspects of the Library Management System project are covered and managed efficiently throughout the project lifecycle.
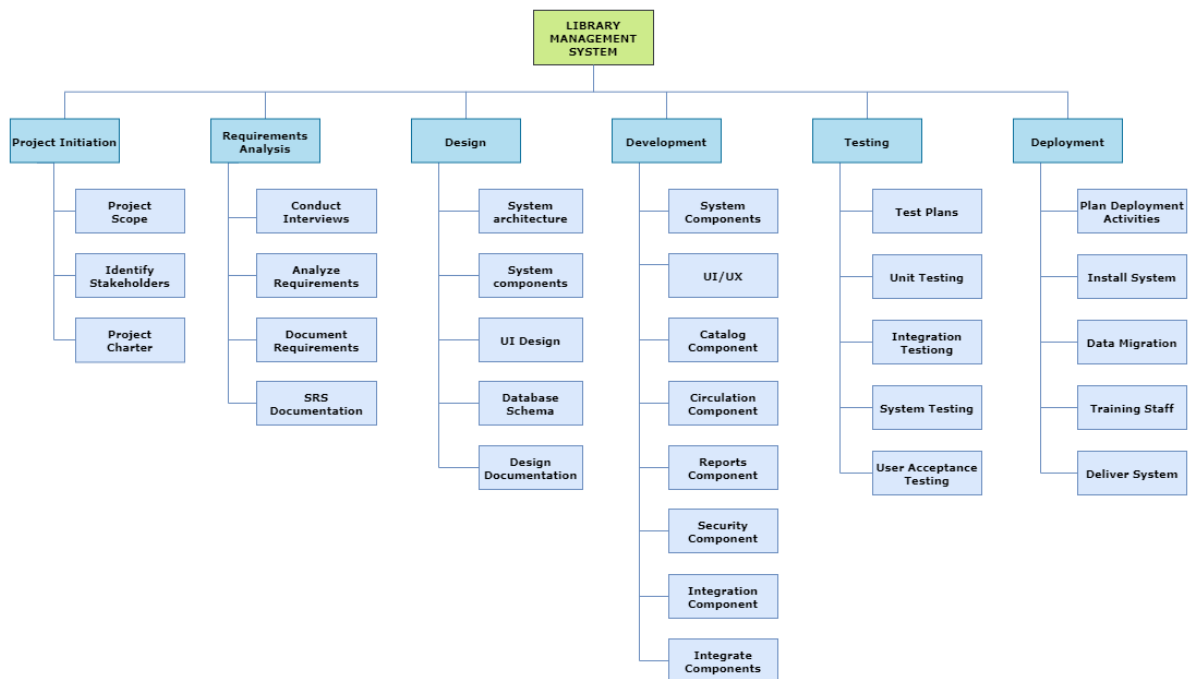
Figure 3: Work Breakdown Structure (WBS)

a. **Effort Estimation Approach 1: COCOMO (COnstructive COst Model)**

Table 1: COCOMO (COnstructive COst Model)

Tasks	SLOC
System Components	16800
UI/UX	2500
Catalog Component	1500
Circulation Component	2000
Reports Component	1500
Security Component	3000
Integration Component	1500
Integrate Components	1200
Total	**30,000**

Here, the Software Project Type is **Organic**:
Therefore, **Coefficient = 2.4**
Project complexity (P) = 1.05
SLOC-dependent coefficient (T) = 0.38

Let's assume that the project will take up **30,000 SLOC** from the above table. The effort, development time, and required number of programmers must now be calculated.

Effort = PM = Coefficient*(SLOC/1000)^P

So, Effort = PM = 2.4*(8000/1000)^1.05
= 85.35 ≈ 85

Development time = DM = 2.50*(PM)^T
= 2.50*(85)^0.38
= 13.52 ≈ 14 months

Required number of people = ST = PM/DM
= 85/14
= 6.07 ≈ 6 programmers

From using COCOMO approach, 6 programmers are required to implement the project within 14 man-months (56 weeks).

b. Effort Estimation Approach 2: Expert Judgement

According to an expert, all the phases will take approximately the following duration each as shown in the table below:

Table 2: Expert Judgement

Phases	Duration (weeks)
Planning	4
Requirements Analysis	12
Design Analysis	6
UI/UX Design	8
Development	60
Testing	18
Deployment	4
Total	**112**

Total duration = 112 weeks = 28 man-months.

According to the two estimation methods used above, 6 programmers are required develop the project in 28 man-months.

11.0 Activity Network Diagram:

The list of activities is identified and specified in the WBS along with the associated durations, which has been calculated in effort estimation. The following table represents the activities, their durations and precedence's:

Table 3: Activity Precedence Table

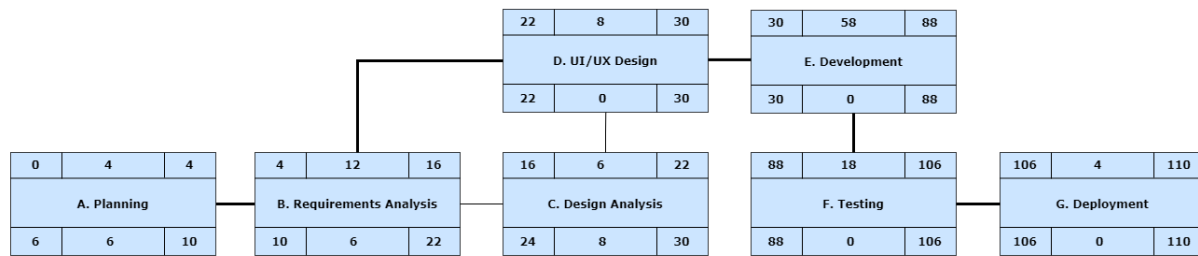|	Activity	Duration (weeks)	Precedents
A	Planning	4	None
B	Requirements Analysis	12	A
C	Design Analysis	6	B
D	UI/UX Design	8	B, C
E	Development	58	D
F	Testing	18	E
G	Deployment	4	F

Figure 4: Activity Network Diagram

Critical Path: A -> B -> D -> E -> F -> G

Therefore, the project will take **110 weeks** to be completed.

12.0 Risk Analysis:

A project's risk is the potential for an unexpected occurrence to occur. A risk analysis is critical after obtaining the requirements since it helps identify potential problems that may arise during and after the development of the project. There are a certain number of specific hazards that come with any undertaking. Library management systems are the focus of our research. Here, we assess the categories of risk where we identify the probable unknown occurrences of the future and their causes and consequences to examine the risk factors. In terms of potential danger, the following are the most significant classes.

Table 4: Risk Table

Possible Risks	Category	Likelihood	Impact	Risk Exposure
Resource uncertainty	DE	5	7	35
Late changing to requirements	PS	8	4	32
Output uncertainty	BU	4	10	40
Low estimation of the size	PS	7	7	49
Less number of users than planned	PS	5	8	40
Delivery date may be missed	BU	6	3	18

The **likelihood (probability of occurrence)** and **impact (potential damage)** have been graded on a scale of 1 to 10. The higher the rating, the more serious the hazards; the lower the rating, the less serious the risks. The term "risk exposure" refers to the unknown commercial consequence of our undertaking. As we are done with identifying risk, we must plan our risk. There are some steps of planning where we will decide what to do with risks.

Risk Exposure = (Potential damage)*(Probability of occurrence)

13.0 Required Resources:

The required resources that are critical to ensure the project is completed efficiently and on schedule are listed below:

- **Human Resources:**

  a. Project Manager: Responsible for overall project planning, execution, and monitoring.
  b. Business Analyst: Responsible for gathering requirements, analyzing library processes, and creating functional specifications.
  c. System Architect: Responsible for designing the system architecture and overseeing technical aspects.
  d. Developers (Frontend and Backend): Responsible for coding the system components, modules, and user interfaces.
  e. Database Administrator: Responsible for designing, managing, and maintaining the database schema and data migration.
  f. Quality Assurance Engineers: Responsible for testing the system and ensuring it meets the requirements and performs as expected.
  g. Technical Support Staff: Responsible for providing support and training to library staff during deployment and ongoing maintenance.

- **Hardware Resources:**

  a. Development Workstations: Computers with adequate processing power, memory, and storage for efficient software development.
  b. Test Environment: Separate hardware for testing the system without interfering with the development environment.
  c. Library Servers: Servers for hosting the Library Management System, including backup servers for redundancy.

- **Software Resources:**

  a. Development Tools: PHP, JavaScript, MySQL, Visual Studio and .
  b. Version Control System: Git for managing code revisions and collaboration among team members.
  c. Project Management Tools: Trello or Jira for task tracking, scheduling, and team collaboration.

d. Testing Tools: Automated testing tools for conducting unit, integration, and system testing.

- **Networking Resources:**

  a. Internet Connectivity: Reliable and high-speed internet access for communication, research, and software updates.
  b. Network Infrastructure: Adequate networking equipment (switches, routers, etc.) to support the system's deployment and use.

- **Training Resources:**

  a. Training Material: User manuals, video tutorials, and other training resources to facilitate library staff learning.
  b. Training Sessions: In-person or virtual training sessions to ensure library staff is proficient in using the system.

14.0 Budget for the project:

The figure below provides a thorough breakdown of the expenses associated with development and other associations to the project.

PROJECT RESOURCE ENGAGEMENT (GENERIC)		Dev HOUR :		3000	PROJECT RATE	
SL	POSITION	QTY	RATE/HR	% of WORK	TOTAL HOUR	TOTAL RATE
1	PROJECT MANAGER	1	250	9%	267	66750
2	BUSINESS ANALYST	1	200	8%	237	47400
3	TECHNICAL LEAD	1	250	7%	210	52500
4	DATABASE ADMINISTRATOR	1	200	4%	120	24000
5	WEB DEVELOPER	6	250	16%	2880	720000
8	UI/UX DEVELOPER	1	180	6%	180	32400
9	QA ENGINEER	1	200	9%	270	54000
10	NETWORK ENGINEER	1	150	2%	45	6750
11	TECHNICAL WRITER	1	150	3%	90	13500
12	TRAINER	1	100	2%	54	5400
	SUB TOTAL:				4353	1022700
OTHERS						
13	D&C FOR PROPOSAL	1	100	1%	24	2400
14	LEGAL AFFAIRS	0	150	0%	0	0
15	Administrative	1	200	1%	24	4800
	SUB TOTAL:				48	7200
	GRAND TOTAL:		183	66.7%	4401	1029900

Figure 5: Cost Analysis.

The cost assessment and budget analysis have been carried out. This procedure entailed completely reviewing all financial factors and carefully analyzing all potential charges. Consequently, the overall anticipated cost for this project is approximately **1,100,000 BDT**.

15.0 Conclusion:

To summarize, developing and deploying the Library Management System is a huge endeavor that addresses several problems while yielding encouraging outcomes. The initiative hopes to simplify library operations, maximize resource usage, and increase user engagement. The system will handle and simplify complex library functions, including book issuing and return, inventory management, and user tracking. Its robust architecture will demonstrate flexibility to various library sizes and operational difficulties, making it a valuable tool in library administration.

While the proposed system will accomplish the set objectives, there is room for future improvements and modifications to ensure flexibility in changing library demands and technological breakthroughs. In conclusion, the Library Management System project will demonstrate the potential of digital solutions in reforming old operating paradigms and improving user experiences through its effective execution and beneficial impact.