

Practical 1

Problem Statement with Purpose, Scope, Literature Review, and Future Scope.

Aim: Identify a relevant problem or project definition. Write a detailed problem statement for the “Hospital Management System”, along with its Purpose, Scope, Existing system details with a literature review and mention Future scope of the system.

Hospital Management System

1. Introduction

Managing a hospital efficiently is a complex task that involves handling patient records, appointments, billing, staff management, and inventory. Many healthcare institutions still rely on manual processes, leading to inefficiencies, errors, and time-consuming workflows. A Hospital Management System (HMS) provides an integrated solution to streamline hospital operations, ensuring better patient care, improved administrative efficiency, and reduced operational costs.

1.1 Problem Statement

The current hospital management process is fragmented, with patient records often maintained in physical files or multiple software systems that do not communicate seamlessly. This disorganization results in delays in patient care, difficulties in retrieving medical histories, and inefficiencies in scheduling appointments. Manual billing processes are prone to errors, leading to financial discrepancies. Additionally, inventory mismanagement can cause shortages of essential medical supplies. These challenges highlight the need for a comprehensive digital solution to centralize hospital operations, improve accuracy, and enhance the patient experience.

1.2 Purpose of the System

The Hospital Management System (HMS) is designed to automate and streamline hospital operations, minimizing human errors and improving overall efficiency. The system aims to:

- Maintain a centralized digital record of patient information, including medical history, prescriptions, and treatment plans.
- Automate appointment scheduling, reducing waiting times for patients and optimizing doctors' schedules.
- Manage billing and insurance claims efficiently, ensuring accurate and timely transactions.
- Improve inventory tracking of medical supplies and equipment to prevent shortages or wastage.
- Enhance communication among different hospital departments, ensuring seamless coordination in patient care.

1.3 Scope of the System

The HMS covers multiple aspects of hospital management, including:

- **Book Patient Management:** Digital storage of patient records, appointment tracking, and real-time status updates.
- **Doctor and Staff Management:** Scheduling shifts, managing workloads, and tracking availability.
- **Billing and Insurance Processing:** Automated generation of invoices, insurance claim submissions, and payment tracking.
- **Pharmacy and Inventory Management:** Tracking medicine stock levels, predicting supply needs, and automating restocking alerts.
- **Reports and Analytics:** Generating reports on patient visits, hospital revenue, staff performance, and resource utilization.

The system will be designed primarily for medium to large hospitals, ensuring smooth day-to-day operations but will not cover advanced AI-driven diagnostic capabilities or telemedicine services in its initial implementation.

1.4 Limitation

While the Hospital Management System provides significant improvements over manual processes, it also has certain limitations:

- **High Initial Implementation Cost:** Setting up a comprehensive HMS requires significant investment in infrastructure and software licensing.
- **Training Requirements:** Staff members need proper training to effectively use the system, which can take time.
- **Data Security Concerns:** Handling sensitive patient data requires strict security measures to prevent breaches and unauthorized access.
- **Internet Dependency:** Cloud-based solutions may experience downtime or disruptions due to network issues.
- **Customization Challenges:** While many HMS solutions are customizable, some hospitals may require specialized features that are difficult to implement without additional costs.

1.5 Existing System and Literature Review

Hospitals traditionally relied on manual systems for managing patient records, appointments, and billing, leading to inefficiencies and a higher risk of human errors. Early standalone software solutions helped digitalize individual hospital functions but lacked integration, requiring multiple systems for different tasks.

Modern cloud-based HMS solutions provide real-time access to medical records, allowing hospitals to operate more efficiently. Systems like Meditech, EPIC, and Cerner offer comprehensive management tools, integrating electronic health records (EHR), financial management, and staff administration. The rise of AI-powered analytics and IoT-enabled

medical devices has further enhanced hospital management, providing predictive insights into patient care and resource allocation.

Despite advancements, challenges remain, including high implementation costs, data security concerns, and resistance to transitioning from legacy systems. Open-source platforms like OpenMRS offer cost-effective alternatives, though they require technical expertise for customization.

2. Future Scope

The Hospital Management System will continue evolving with advancements in technology, introducing new features to enhance efficiency and patient care:

1. Artificial Intelligence & Predictive Analytics

- AI-driven diagnostic assistance to help doctors in decision-making.
- Predictive analysis to forecast patient admission rates and optimize hospital resources.

2. IOT and Smart Healthcare

- Real-time monitoring of patient vitals through IoT-enabled devices.
- Automated alerts for critical health conditions to notify doctors instantly.

3. Blockchain for Data Security

- Secure patient records using blockchain to prevent unauthorized access and ensure data integrity.
- Smart contracts for seamless and secure insurance claims processing.

4. Mobile Integration & Telemedicine

- A mobile app for patients to schedule appointments, access medical records, and receive real-time updates on treatment progress.
- Telehealth services for remote consultations, improving accessibility to healthcare.

5. Cloud-Based Multi-Hospital Integration

- A Centralized system allowing hospitals to share patient records securely across branches.
- Real-time synchronization for seamless patient transfers between hospital departments.

3. Conclusion

A Hospital Management System is a crucial tool for modernizing healthcare facilities, enhancing patient care, and improving administrative efficiency. By automating critical hospital functions, the system minimizes human errors, reduces operational costs, and ensures a better experience for patients and medical professionals. As technology advances, future integrations with AI, IoT.

Practical 2

Planning and Scheduling, for System Development.

Aim: Perform Project Planning & scheduling by define and design effective policies, methodologies, and strategies to achieve the objectives of the “Hospital Management system”. Create a schedule by assigning tasks, allocating resources, and estimating budgets and time frames.

Project Planning and Scheduling involve defining the project objectives, breaking down tasks, allocating resources, and estimating timelines to ensure the successful completion of the project. For a Hospital Management System (HMS), project planning includes defining system features, designing the architecture, developing the application, and ensuring timely delivery. Scheduling assigns deadlines and milestones to ensure all activities progress smoothly. A clear timeline helps in tracking progress, mitigating risks, and allocating resources effectively.

Hospitals often face challenges in managing patient records, appointments, staff coordination, billing, and inventory management. A Hospital Management System (HMS) automates these processes, improving efficiency and accuracy. This system will include features like “patient registration, doctor scheduling, medical records management, billing, pharmacy management, and reporting capabilities”, ensuring better service delivery and operational transparency.

2. Project Planning and Objectives

Effective project planning defines goals, tasks, resources, and schedules, ensuring a smooth development process. The **Hospital Management System (HMS)** project focuses on “automating hospital workflows, creating a user-friendly interface for doctors, nurses, and administrative staff, and providing secure, accurate data storage”. The planned steps aim to complete the project within the designated timeline while meeting user requirements effectively.

2.1 Choice of Process Model: Waterfall Model

The Waterfall Model is a traditional software development methodology that follows a linear and sequential approach. Each phase must be fully completed before moving to the next. This model is ideal for projects like the Hospital Management System, where requirements are well-defined, and changes during development are minimal.

Reason for Choosing the Waterfall Model:

- **Well-Defined Requirements:** The HMS scope includes clear features like patient record management, appointment scheduling, billing, pharmacy, and reporting.
- **Clear Phase Separation:** Each stage—analysis, design, development, testing, and deployment—has distinct deliverables, ensuring a structured workflow.
- **Minimal Uncertainty:** Hospital management follows standardized workflows, making a linear approach effective.

- **Comprehensive Documentation:** Detailed documentation ensures future scalability and maintainability.
- **Risk Management:** Testing all modules after integration reduces the risk of inconsistency and ensures robust system performance.

Phases of the Waterfall Model Applied to HMS

Requirement Analysis

Understanding hospital workflows and gathering functional and non-functional requirements from doctors, nurses, and administrative staff.

Key Requirements for HMS:

- Patient registration and medical record management
- Appointment scheduling and doctor-patient management
- Billing and insurance claims processing
- Pharmacy inventory and medication tracking
- Staff and resource management
- Data security, compliance, and reporting

Deliverable: Requirements Specification Document

System Design

Converts requirements into a blueprint for development, including technical architecture, database schema, and system workflows.

Design Steps:

- Define the database model for patient records, appointments, billing, and inventory.
- Create UML diagrams (use case, activity, class diagrams) to represent system processes.
- Develop UI mockups for intuitive system interaction.

Deliverable: Design documents, database schemas, system workflow diagrams

Implementation

Developing the actual HMS based on the design documents, ensuring smooth module integration.

Development Steps:

- **Patient Management Module** (Registration, Medical History)
- **Appointment Scheduling Module** (Doctor-patient booking, time slots)
- **Billing Module** (Payment processing, insurance claims)
- **Pharmacy Module** (Inventory tracking, prescriptions)
- **Staff and Resource Management** (Duty allocation, HR management)
- **Reporting and Analytics Module** (Performance monitoring, data insights)

Deliverable: Functional system modules for HMS

Integration and Testing

Once modules are developed, they are integrated and tested to ensure smooth operation.

Testing Includes:

- **Unit Testing:** Validating individual modules (e.g., billing, pharmacy)
- **Integration Testing:** Ensuring seamless data flow (e.g., patient records linked to

- appointments and billing)
- **System Testing:** Checking reliability, security, and compliance
- Deliverable:** Fully integrated and tested Hospital Management System

Deployment and Maintenance

Deploying HMS in the hospital environment with necessary training for staff.

Deployment Steps:

- Install HMS on **hospital servers or cloud infrastructure**
- Conduct **training sessions** for hospital staff
- Provide **ongoing support** for bug fixes and updates

Deliverable: Fully operational HMS with post-deployment support

2.2 Project Scheduling

Project scheduling organizes tasks, resources, and timelines for timely delivery. It involves task breakdown, defining dependencies, estimating task duration, and resource allocation.

Purpose of Scheduling:

- **Organize Tasks:** Define steps for smooth HMS development
- **Define Priorities:** Identify dependencies (e.g., UI design before implementation)
- **Allocate Resources:** Assign personnel to tasks efficiently
- **Monitor Progress:** Track project completion against planned timelines
- **Avoid Delays:** Minimize risks of deadline failures

Key Scheduling Elements:

- **Task Identification:** Define development and deployment activities
- **Task Sequencing & Dependencies:** E.g., "Appointment Module depends on Patient Registration Module"
- **Estimating Task Duration:** Assign time estimates based on complexity
- **Resource Allocation:** Assign tasks to developers, UI designers, testers
- **Milestones:** Key checkpoints (e.g., requirement completion, testing, deployment)

2.3 Overview of the Schedule

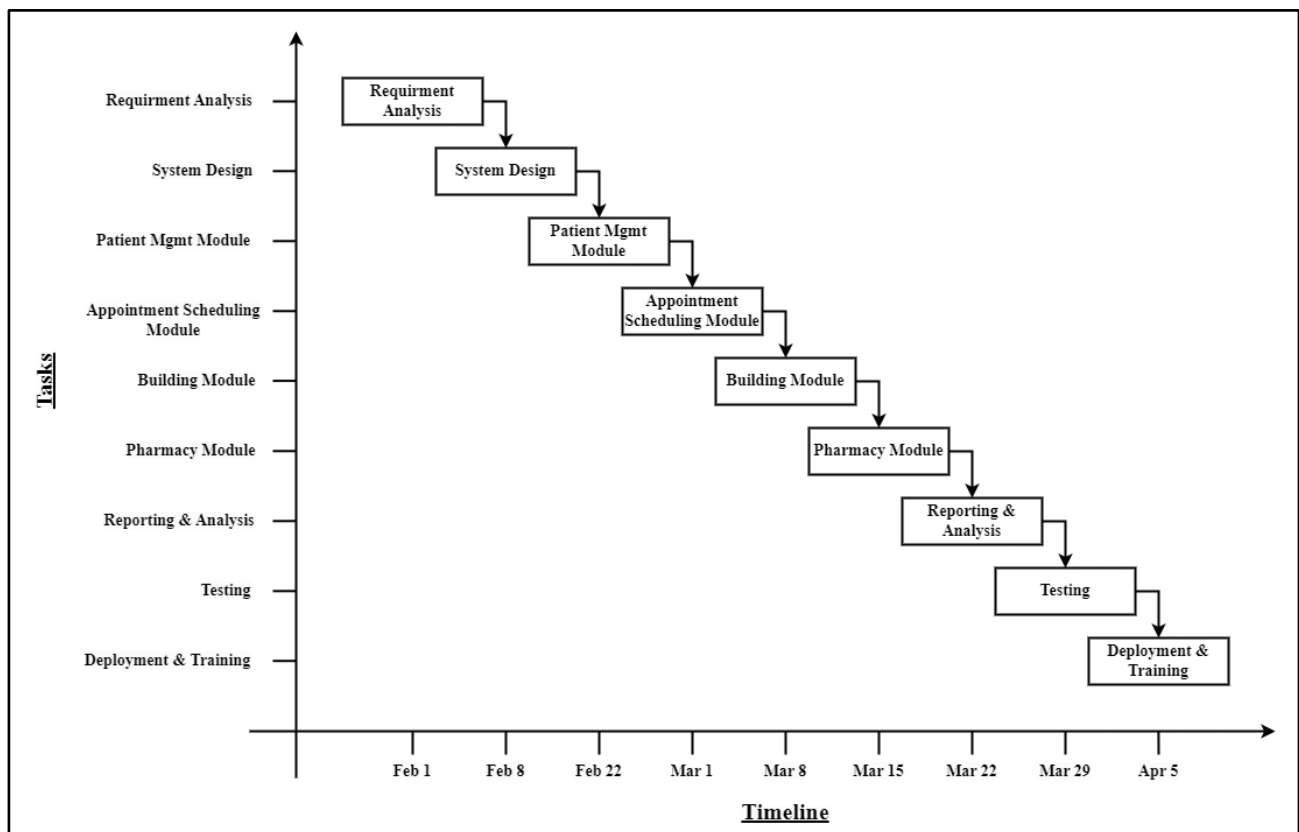
HMS Project Timeline (10 Weeks)

Task	Duration	Description
Requirement Analysis	1 week	Collect and document system requirements
System Design	2 weeks	Create architecture, data flowcharts, and UI mockups
Patient Management Module	1 week	Develop patient registration, medical record features
Appointment Scheduling Module	1 week	Implement doctor-patient booking and scheduling
Billing Module	1 week	Develop payment, insurance claims processing
Pharmacy Module	1 week	Implement inventory tracking and prescription management

Task	Duration	Description
Reporting & Analytics	1 week	Generate patient and operational reports
Testing	1 week	Perform unit, integration, and system testing
Deployment & Training	1 week	Deploy HMS and train hospital staff

2.3.1 Project scheduling Using Gantt Chart

A Gantt Chart is a visual scheduling tool that shows tasks along a timeline, their durations, dependencies, and milestones. Below is an illustration of how the HMS tasks are scheduled over 10 weeks.



2.4 Resource Allocation

Efficient resource allocation ensures smooth execution.

Key Roles in HMS Development:

- Project Manager: Oversees planning, scheduling, and deliverables
- System Analyst: Gathers requirements and documents workflows
- Database Developer: Designs hospital database schema
- Front-End Developer: Builds UI for hospital staff and patients
- Back-End Developer: Implements APIs, logic for system modules

- QA Engineer: Conducts system testing

2.5 Risks and Mitigation

Common Risks:

- Scope Creep: Prevented by setting clear requirements
- Resource Shortages: Mitigated through cross-training team members
- Technical Challenges: Addressed via regular code reviews and updates

2.6 Deliverables

Final Deliverables:

- Requirements Document: Detailed system specification
- System Design Artifacts: UML diagrams, schemas
- Functional HMS: Fully developed hospital management system
- Training Materials: User guides, manuals for hospital staff
- Testing Reports: Documentation of quality assurance results

This detailed & well-structured planning and scheduling approach ensures the **Hospital Management System** is developed efficiently using the **Waterfall Model**, meeting all hospital requirements.

Practical 3

Problem Statement with Purpose, Scope, Literature Review, and Future Scope.

Aim: Perform a cost and effort estimation for the Hospital Management System by understanding the scope of the software to be developed.

Cost estimation and effort analysis are essential for planning and managing software projects, helping predict the required resources, time, and budget. Function Point Analysis (FPA) is a widely used method to estimate software size, effort, and cost. It measures the functionality delivered to the user, independent of programming languages or technologies. Function points are calculated based on five key components: External Inputs (EI), External Outputs (EO), External Inquiries (EQ), Internal Logical Files (ILF), and External Interface Files (EIF). Each component is assigned a weight based on its complexity (Low, Medium, High), and these are summed up to determine the system's size. This quantitative measure is then used with productivity rates or cost factors to estimate the total effort (in person-hours) and cost of the project, ensuring accurate and standardized planning.

3. Cost and Effort Estimation

To estimate the cost and effort for developing a **Hospital Management System** using Function Point Analysis (FPA), the following steps can be used:

3.1 Understand the Scope of the System

A Hospital Management System typically includes the following modules:

- **Patient Management:** Register and manage patient records.
- **Appointment Scheduling:** Book, modify, or cancel appointments.
- **Doctor Management:** Maintain doctor profiles and schedules.
- **Billing and Payments:** Generate invoices and manage payments.
- **Reports:** Generate reports on patient history, billing, and hospital revenue.
- **Authentication:** Secure login/logout functionality for users and admins.

3.2 Identify and Classify Function Types

FPA involves categorizing system components into five elements:

- **External Inputs (EI):** Inputs provided to the system.
- **External Outputs (EO):** Outputs generated by the system.
- **External Inquiries (EQ):** User-driven queries.
- **Internal Logical Files (ILF):** Logical files/data tables maintained within the system.
- **External Interface Files (EIF):** Files/data from external systems.

Table 3.1: Functionality breakdown

Functionality	Type	Complexity	Count
Patient Registration	EI	Low	1
Login/Logout	EI	Low	1
Book/Cancel Appointment	EI	Medium	2
Search Patient Records	EQ	Medium	2
View Billing History	EO	Medium	1
View Doctor Schedule	EO	Medium	1
Patient Table	ILF	Medium	1
Doctor Table	ILF	Low	1
Appointment Table	ILF	Medium	1

Table 3.2: Assigning weight for functions

Type	Low	Medium	High
EI	3	4	6
EO	4	5	7
EQ	3	4	6
ILF	7	10	15
EIF	5	7	10

3.3 Calculating Unadjusted Function Points (UFP):

Using the counts and weights from Table 3.1 and Table 3.2:

Formula: $UFP = \sum (\text{Function Count} \times \text{Weight})$

Type	Complexity	Count	Weight	Total FP
EI	Low	2	3	6
EI	Medium	2	4	8
EQ	Medium	2	4	8
EO	Medium	2	5	10
ILF	Low	1	7	7
ILF	Medium	2	10	20
	Total UFP	59		

3.4 Adjust for Complexity Factors

The Value Adjustment Factor (VAF) is a multiplier applied to the Unadjusted Function Points (UFP) to account for specific system characteristics.

General System Characteristics for HMS and Ratings

- **0** = No influence on the system.
- **5** = Strong influence on the system.

Formula: $VAF = 0.65 + (TDI \times 0.01)$

Adjusted Function Points (AFP):

$$AFP = UFP \times VAF$$

Where **TDI (Total Degree of Influence)** is the sum of the ratings for all 14 GSCs.

Table 3.4: General System Characteristics for HMS and ratings

Characteristic	Description	Rating (0–5)
Data Communications	System interacts with insurance databases	3
Performance Requirements	Fast response for patient records and billing	4
Transaction Rate	Frequent patient check-ins and payments	5
On-Line Data Entry	Real-time appointment booking and updates	5
End-User Efficiency	User-friendly interface for hospital staff	4
On-Line Update	Real-time updates to patient history and schedules	5
Complex Processing	Billing calculations, insurance verification	3
Multiple Sites	Used across multiple hospital branches	3

TDI (Total Degree of Influence) = 42

VAF Calculation: $VAF = 0.65 + (TDI \times 0.01) = 0.65 + (42 \times 0.01) = 1.07$

Adjusted Function Points (AFP): $AFP = UFP \times VAF = 59 \times 1.07 = 63$

3.5 Effort Estimation

Effort is estimated based on AFP and productivity rate.

Typical Productivity Rates:

- Simple systems: **25–30 FP/Person-Month**
- Moderately complex systems: **15–20 FP/Person-Month**

- **Highly complex systems: 7–10 FP/Person-Month**

For **Hospital Management System**, we assume:

- **Moderate complexity**
- **Productivity Rate = 20 FP/Person-Month**

Effort = AFP / Productivity Rate = 63 / 20 \approx 3.15 Person-Months

Cost Estimation

Assuming:

- **Developer Monthly Cost = \$5,000**

Cost = Effort \times Developer Monthly Cost = 3.15 \times 5000 = \$15,750

Conclusion:

The **Hospital Management System** is estimated to require **3.15 person-months** of effort and cost approximately **\$15,750**. The cost and effort values are based on assumptions and may vary depending on project requirements and team efficiency.