**London Metropolitan University, Faculty of Computing**

# CS6003ES Advanced Software Engineering

**Coursework Assignment, Semester 2 (part 2), 2023/224**
**Module Leader:** Dr. Lochandaka Ranathunga

**Part 2 weighting: 30% in total**

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Submission deadline: 30th November 2024

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## Coursework Details

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# CS6003ES – Advanced Software Engineering

BEng (Hons) in Software Engineering

Project Plan Report

Web-based system to reserve taxis

“City Taxi”

## Generic Information

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## Glossary

Table 1: Glossary

| Acronyms | Expansion | Description |
|---|---|---|
| GPS | Global Positioning System | A satellite-based system of navigation to determine the precise location. |
| ETA | Estimated time of arrival | The expected time when a vehicle or person will arrive at one particular location. |
| API | Application Programming Interface | A collection of protocols and tools for constructing software applications. |
| AWS | Amazon Web Services | A platform that offers all infrastructure and services of a cloud computing platform. |
| HTTPS | Hypertext Transfer Protocol Secure | The protocol to use when communicating securely over the web using encryption. |
| QA | Quality Assurance | This is a process of ensuring the product satisfy the required quality standards. |
| UI/UX | User Interface/User Experience | UI is the space to interact, UX is the experience the user has. |
| CEO | Chief Executive Officer | A highest ranking executive in a company supervising all operations. |
| COO | Chief Operating Officer | In charge of the day to day running of the company. |
| CFO | Chief Financial Officer | The person in charge of the organization of the financial activities of the company. |
| HR | Human Resources | Organizational unit responsible for staff relations, recruitment and payments. |
| DevOps | Development Operations | A set of principles that unites software development and IT operations in the direction of speeding up the development lifecycle. |
| WBS | Work Breakdown Structure | A structured decomposition of a project's total scope of work to be done by the project team. |
| UAT | User Acceptance Testing | It is a phase in the software development life cycle, in which end users provide their input about the functionality of software. |
| N/A | Not Applicable | Indicating something that does not apply in a specific context. |
| AON | Activity On Node | It is a project management technique that uses node to represent activities within a network diagram. |
| AOA | Activity On Arrow | A technique of project management by which activities in a network diagram are represented by arrows. |
| SRS | Systems Requirements Specification | A document outlining functional and non functional system requirements. |
| FT | Full Time | A status of employment in which an employee works the normal number of hours (usually 40 hours a week). |
| PT | Part Time | An employment status meaning that an employee works less than a full-time employee does. |

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# 1. Introduction

## 1.1 Purpose

City Taxi system aim is to be an easy to use, affordable and efficient way to book a taxi for passengers. To help people, especially the less well-off and those in the middle class, irrespective of this group, to book rides as fast and reliable as possible. The system attempts to make transportation more convenient and trustworthy by using modern technology (live tracking, online payments etc.). It also guarantees that drivers and operators can manage their tasks more effectively in providing high quality service to the passengers. The goal of this project is to enhance the experience of taxi booking, while specifically improving by making it more affordable, more reliable, and increasing customer satisfaction.

## 1.2 Project Background

City residents depend heavily on available, affordable and efficient transportation to meet their travel needs, and it is a truly critical component of daily life. However, traditional taxi services have been known to fall short of customer expectations, from poor customer service, late arrivals, high costs, and on a very real level, opacity in fare structure. Especially for low- and middle-income earners who need their transportation to be reliable and cost effective.

City Taxi does aim, though, to set themselves apart by focusing on important features such as live driver tracking, honest fare estimation, variety of payment methods and the customer feedback mechanism, improving the travel experience of residents of the cities it operates in. The main purpose of this project is to be the most accessible taxi service provider to everyone while simultaneously providing comfortable and safe taxis as well as an efficient operation.

## 1.3 Problem Statement

There are many passengers with challenges using existing transportation services in urban areas. The issues with these systems vary, and include inconsistent arrival times, unclear fare structures, high costs, and poor customer service. However, for low- and middle-income earners, reliable and affordable transportation options are limited, and there is an opening in the market for a high-quality service that fits their needs.

However, most of the existing taxi services also don’t include modern features like real time driver tracking, transparent rates and smooth payment system. There is unpredictability and delays, which in turn causes dissatisfaction for the passengers.

These challenges have led to the requirement of a holistic solution to deal with the passenger and the driver’s concerns in smooth operational management. To address these problems, the City Taxi system wants to provide a reliable, affordable, and technology driven transportation service for passengers to book rides, track drivers and receive a high-quality service at an affordable price.

# 2. Project Overview

## 2.1 Objectives

The main Objective of the City Taxi system is to build up a dependable, available and effective transportation administration to serve urban guests, especially those from the low and center wage gatherings. The goal is to improve the entire experience for the passengers, drivers and operators. The following key objectives guide the development of the system:

- **Simplified Ride Booking Process**
  Allow passengers to book rides quickly and efficiently by inputting pick up and drop off addresses, selecting different vehicle types as is, and booking.

- **Affordable Transportation for All**
  Affordable taxi services to reach a wider population with affordable pricing for day-to-day travel and to make use of a large set of passengers with variety of taxi options like low-cost cars to luxury cars.

- **High-Quality Service with Safety and Comfort**
  Make sure all rides are comfortable, clean and safe. The drivers are trained to give service to the passengers in the way they expect to get.

- **Real-Time Tracking and Timely Pickups**
  Passengers should utilize GPS and live tracking technologies that allow them to see their driver’s real time location, including their updated ETA, increasing certainty and reducing waiting times.

- **Seamless Integration of Technology**
  To maintain the system for scalability, reliability and user friendly among all the parties in the project we are going to use Google Maps API, AWS Cloud Hosting and PostgreSQL databases and leverage the power of their advanced technologies.

- **Operational Efficiency for Drivers and Operators**
  Operators can create trips manually for passengers, track passenger and driver activities and manage trips, while drivers get tools to manage their schedules, track their earnings and get paid.

- **Feedback Mechanism for Continuous Improvement**
  Ensure you have a star rating and feedback system where passengers can rate their drivers and give their feedback about the quality of service they are rendered—in terms of time, etc., and the speed with which they respond to their concerns.

- **Secure and Transparent Payment System**
  The rides are available for the passengers paying cash or card and built with fare calculation displayed to build trust and reliability.

## 2.2 Scope

1. **Passenger Scope**
   Essentially, the application ensures that passengers get the best booking experience possible. Key features include:
   - Live driver tracking for real time ride booking.
   - Fair fare calculation along with several payment options.
   - An intuitive and user friendly interface to easy navigate and feedback submission.
   - Quality assurance ability to rate and review drivers.

2. **Driver Scope**
   The tools turn drivers into managers of their schedules and trips. Key functionalities include:
   - Receiving and accepting ride requests with detailed trip details.
   - Use Google Maps for real time navigation.
   - To track earnings and make payment information easier to manage.
   - By set availability status 'Available' or 'Busy'.

3. **Operator Scope**
   The application provides tools for operators to watch and control the whole system. Features include:
   - Registration and updating of Passenger and Driver profile including the management of their accounts.
   - Manual assignment of rides for unregistered passengers.
   - Keeping a tap on ongoing trips to ensure no operation hiccups.
   - They generate reports on system performance and respond to customer issues with speed.

4. **Technical Scope**
   The City Taxi system is designed with scalability, reliability, and security in mind:

- A cloud based backend in use on AWS for enhanced scalability and performance.
- Integration with Google Maps API for accurate tracking and navigation.
- Compatibility is ensured with modern web browsers and modern devices, with access to Android, iOS and desktop users.
- Communication channels use HTTPS and data encryption to secure user's information.

## 2.3 Assumptions and Constraints

### 2.3.1 Assumptions

1. **Stable Internet Connection -** All users (passengers, drivers, and operators) are assumed to have access to a reliable internet connection because virtually all the system functionality relies on real time data exchange for tracking of the ride, calculation of the fare, and sending out of notifications.

2. **Device Compatibility -** This system is assumed to operate as intended on modern equipment, such as smartphones, tablets, or desktops using up to date browsers or operating systems supporting the application.

3. **User Adoption -** All passengers, drivers and operators are assumed to be willing to assimilate the City Taxi application into their daily lives. Its success depends largely upon its acceptance and use by all stakeholders.

4. **Third-Party Service Availability -** Development of the application is built across third party services like Google Maps for localization, and cloud hosting being on AWS. These services assume that they will stay operational and available.

5. **Security and Privacy Compliance -** The system follows all relevant data protection including the safe and confidential handling of the user's personal and financial information.

6. **Working Days** – City taxi project is a critical project. Because every team member works daily without Sunday every week until the end of the project. And Project will be started from 27/11/2024.

7. **Budget and Effort -** Budget and Efforts are not calculated for Project Maintenance (Post bug fixing, Enhancements). Project Maintenance will be performed after the project closure.

### 2.3.2 Constraints

1. **Device and Browser Compatibility -** A device and browser compatible application for different platforms. It can become challenging to deliver a consistent user experience on a wide spectrum of devices and browsers, particularly 'old' ones.

2. **Real Time & Communication Dependency** - In this system there is great dependency upon real time updates and communication, therefore data connection is necessary. In areas with poor connectivity, little or no functionality may be available to users.

3. **Scalability Requirements** - As more people use the system, they will need more traffic, and more data processing and real time update without performance degradation. This scalability must be accomplished with the resources (technical and financial) that are currently available.

4. **Third Party Integration Limitation** – The system depends on external services such as Google Maps API and AWS cloud hosting, so it would be limited by the API request limit, unavailability of service, or unexpected change in the pricing to construct the system to perform as expected and maintain cost.

5. **Limited Funding** - Budget available and there is no amount budgeted as contingency. If there is no limit on how much money you can spend on building, then you have almost an infinite amount of money to purchase extra resources when you encounter unforeseen problems, or to grow your team if you need more people.

6. **Tight Schedule -** Given three months for the project to be completed there is little time for design, development, testing, and deployment. Compressed timeline may be even risky regarding the QA and the completeness of the feature.

## 2.4 Deliverables

Table 2: Deliverables

| Deliverable | Description | Due Date |
|---|---|---|
| Project Plan Report | A complete plan to scope, schedule, budget, and approach for building the City Taxi system. | 30/11/2024 |
| Requirements Document | A document that presents the functional and non-functional requirements of the system. | 07/12/2024 |
| System Design Document | Backend, Frontend, and database architecture of the system detailed design specifications. | 19/12/2024 |
| Test Report | Report that consists of a comprehensive summary of test results (bugs, performance) from system testing. | 10/02/2025 |
| Final Product (City Taxi Application) | Application which has been fully developed and operational, application ready to deploy having all required features. | 11/02/2025 |
| User Manual and Technical Document | Detailed documentation for end users (passengers, drivers and operators) | 12/02/2025 |

## 2.5 Schedule Summary

The City Taxi project will be completed over 12 weeks (71 working days), divided into key phases: They are used to plan, design, develop, test, deploy and maintain. In Week 1, the Planning Phase will determine objectives, what deliverables need to be produced, the schedule for each phase, and resources required. This will touch requirement gathering and design from weeks, 2-3 (system architecture and UI/UX prototyped).

Then, from weeks 4 – 7 will cover the development (backend and frontend), API integration, and testing. Unit tests, integration tests and UAT are included in Testing Phase (Week 8 – 10). The user training will be deployment for Week 11 and user training for Week 12. After launch, the Maintenance Phase shall handle bug fixes and system updates, to run the system successfully.

### 2.6 Budget Summary

City Taxi has a £100k budget that’s spent the whole on team salaries for 12 weeks (71 working days). Full time will be 568 hours for employees and 284 hours for part time employees for a total of 2,556 hours.

Project Manager’s salary breaks down as £7,100, Architect’s as £28,400, Full Stack Engineer and QA Engineer as £19,880 each, UI/UX Engineer’s as £14,200 and Business Analyst’s as £9,940. If all goes well the total cost is £99,400 leaving a surplus for contingencies of £600.

# 3. Project Organization

The Project organization of the City Taxi project is designed to accomplish the transparency for roles, smooth communication and well cohered work from everyone. It consists of a Project Manager with a Software Architects, Developers, Quality Assurance Engineers and Business Analysts team etc. Project objectives are well defined, and each member knows their responsibilities well to reach them and a structured hierarchy provides smooth decision making and reporting. This setup enables a seamless coordination, on time progress, and high quality delivery in accordance to the project constraints.

## 3.1 Company Organization

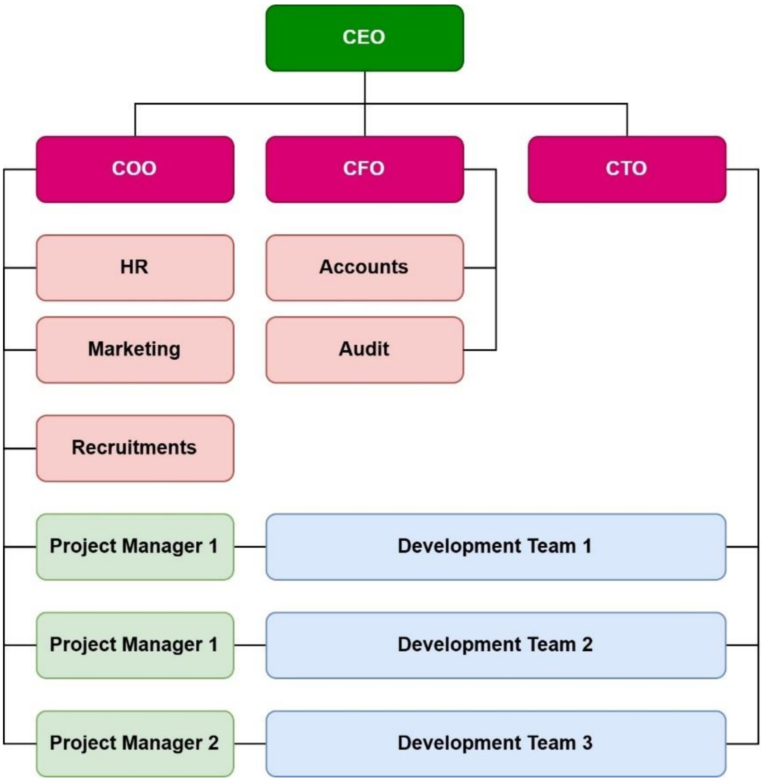


Figure 1: Company Organization

In the organization, the CEO is the leader while other individuals are leading COO, CFO and CTO. The operations are managed by the COO (managing HR, Marketing, Recruitment) and the CFO (managing Accounts, Audit). Those overseeing technical direction and number of development teams report to the CTO. These development teams are led by Project Managers who support efficient execution of these projects and also ensure that they align with Company Goals. The structure makes things easier and project management effective.

### 3.2 Project Team Structure

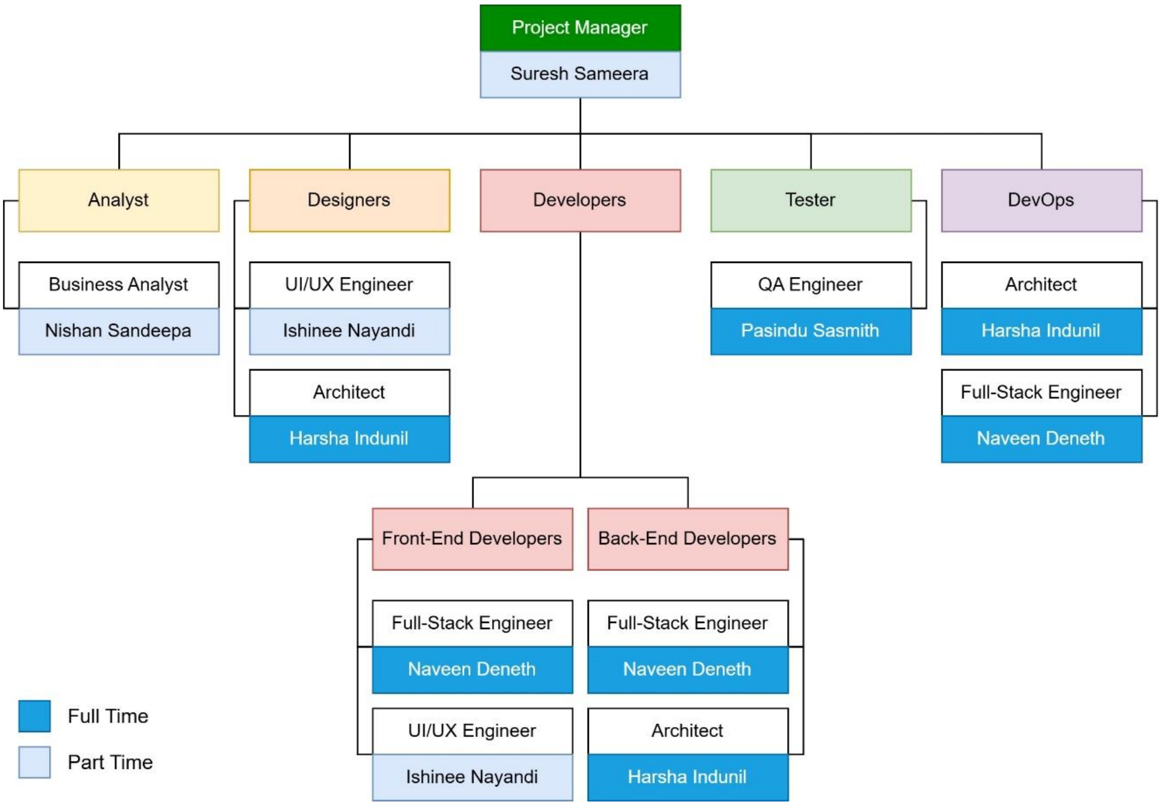


Figure 2: Project Team Structure

City Taxi project team is organized hierarchically headed by the Project Manager Suresh Sameera who directly works with all functional teams to align with the larger picture mentioned. As a part time Business Analyst, Nishan Sandeepa leads the Analyst team to gather and communicate requirements to support the design & development teams.

UI/UX Engineer Ishinee Navandi is a part of the Design Team who takes care of the user friendly interfaces and supports the frontend tasks with ReactJS, and Architect Harsha Indunil supports the backend alignment and system scalability. Full stack engineer Naveen Deneth leads the Development team that is responsible for the frontend and backend implementation and works closely with Harsha for technical requirements.

QA Engineer Pasindu Sasmitha, who is responsible for testing and solving developer issues, manages quality assurance. In DevOps, Harsha and Naveen are part of this team as they are responsible for deployment and system reliability. This structure guarantees of clear roles, good collaboration, and fast project delivery.

### 3.3 Team Composition and Roles

Table 3: Team Members

| Employee ID | Name | Background/ Specialization | Full/Part Time |
|---|---|---|---|
| EID-058 | Suresh Sameera | Expert Project Manager with 5+ years Project management experience in project planning, project monitoring, communications; and control according to ISO 12207 process compliance. | PT |
| EID-021 | Harsha Indunil | With 8+ years of experience in working with software architecture, designing scalable systems, and writing technical documentation as well as supporting backend development teams, expert in software architecture. | FT |
| EID-024 | Naveen Deneth | Experienced Full Stack Engineer with backend (Spring Boot) and frontend (ReactJS) development expertise, 5+ years of experience on building robust applications. | FT |
| EID-030 | Pasindu Sasmitha | 4+ years of experience, Proficient with manual and automated testing focused on performance, security and functional testing to achieve high quality deliverables. | FT |
| EID-064 | Ishinee Nayandi | Being a UI/UX Engineer with 4+ years of experience, I've designed user friendly interfaces, collaborated with development teams to create wireframes, performed frontend duties using ReactJS. | PT |
| EID-069 | Nishan Sandeepa | 6+ years of experience at the Business Analyst level in requirement analysis and stakeholder communication. Previously Have a domain expertise about travel and transport domain. | PT |

Table 4: Role and Responsibilities

| ID | Name | Role | Responsibility | Worktime hr (%)/day |
|---|---|---|---|---|
| EID-058 | Suresh Sameera | Project Manger | Management, Communication in the project and Write the Project Plan Report. | 4 (50%) |
| EID-021 | Harsha Indunil | Architect | Designs System Architecture, Write Design Documentation and Supports for Backend Developments, and Deployment Tasks. | 8 (100%) |
| EID-024 | Naveen Deneth | Full-Stack Engineer | Develop Backend and Frontend of the project and<br>Handle Deployment tasks | 8 (100%) |
| EID-030 | Pasindu Sasmitha | QA Engineer | Tests the System and Write Test Report | 8 (100%) |
| EID-064 | Ishinee Nayandi | UI/UX Engineer | Communicate with Client, Design User Interfaces and Support for minor Frontend Development tasks. | 4 (50%) |
| EID-069 | Nishan Sandeepa | Business Analyst | Analyzes Business domain, Identify the All requirements in the project and Writes SRS document. | 4 (50%) |

### 3.4 Role Alignments

As a City Taxi Project team, their assignment is well structured to help each member relate his role directly to team objectives, creating smooth coordination and speedy delivery. Below is a detailed explanation of how each role contributes to achieving the project's goals:

- **Project Manager**
  Overseeing a project and making sure it matches its goals are the responsibility of the Project Manager. Planning, resource allocation, communication and monitoring project milestones are taken care by Suresh. This role makes sure all activities are completed in time, on budget, and to design standards. The Project Manager focus

on ISO 12207 project processes uses them to facilitate effective team coordination and progress tracking.

- **Business Analyst**
  Nishan works as a part time team member whose responsibility is to gather and collect business requirements and then analyzing them to form the base of the system design and implementation. His work makes sure that the technical outputs meet the stakeholders' requirements and project objectives. Nishan's SRS document to developers and designers is very clear on what to do.

- **UI/UX Engineer**
  In line with the project goal of creating a simple platform for passengers as well as drivers, Ishinee aims to make the interface user friendly. She knows all too well ReactJS, so she shares in the frontend development and helps make sure the system isn't just performed functionally, but also aesthetically.

- **Software Architect**
  Harsha architects the system's architecture with an aim to achieve scalability, modularity, and content of the project technical goals. This role also makes sure the application is able to cover all application system functionality and system scale requirements. In addition to that, DevOps department work is also maintained together with backend development and technical support provided for infrastructure reliability and backend development.

- **Full-Stack Engineer**
  Naveen is in charge of implementing frontend and backend part for the City Taxi application. He supports stated project objectives directly, such as real time ride booking, easy interfaces and seamless system integration. Naveen also works with the DevOps team so that system will be deployable and maintainable.

- **QA Engineer**
  Thorough testing is done by Pasindu to make sure that the City Taxi system passes high quality standards. He plays the role as his purpose is to run functional, performance and security tests to ensure that a reliable and secure application is delivered. He makes sure the system will deploy, and if it won't, by identifying and solving problems, making the system stable again.

- **DevOps Team**
  Harsa and Naveen both take care of system deployment, scaling and maintenance together. Their efforts make sure they meet their technical objectives ,real time operations and reliability. Their role is constantly critical to make the system robust, scalable and deployable on a live environment.

## 4. Budget Management

City Taxi project will take 12 weeks (3 months) without Sunday. The entire project costs £100,000 and the only reason for this is to pay salaries for the team. There is no need to account for any other expenses.

### 4.1 Human Resources

Total day: 71
Working hours per full time employee: 71 * 8 = 568
Working hours per part time employee: 71 * 4 = 284

Table 5: Salary Estimation

| Employee ID | Name | FT/PT | Rate (£/hr) | Hours | Cost (£) |
|---|---|---|---:|---:|---:|
| EID-058 | Suresh Sameera | PT | 25.00 | 284 | 7100.00 |
| EID-021 | Harsha Indunil | FT | 50.00 | 568 | 28400.00 |
| EID-024 | Naveen Deneth | FT | 35.00 | 568 | 19880.00 |
| EID-030 | Pasindu Sasmitha | FT | 35.00 | 568 | 19880.00 |
| EID-064 | Ishinee Nayandi | PT | 50.00 | 284 | 14200.00 |
| EID-069 | Nishan Sandeepa | PT | 35.00 | 284 | 9940.00 |
| | | | Total | 2556 | **99400.00** |

### 4.2 Financial Summary

Budget for the City Taxi project of £100k is all team salaries over 12 weeks in total (excluding Sundays, that's 71 working days). There are 568 hours per person for full time employee and 284 hours per person for part time employee, making a total of 2566 hours. Architect costs £28,400; Full Stack & QA Engineers £19,880 each; UI/UX Engineer costs £14,200; Business Analyst £9,940; Project Manager £7,100. By using total cost as £99,400 and a contingency of £600 (a surplus), we can see whether the cash budget rises or falls every week.

# 5. Project Process

## 5.1 Work Breakdown Structure

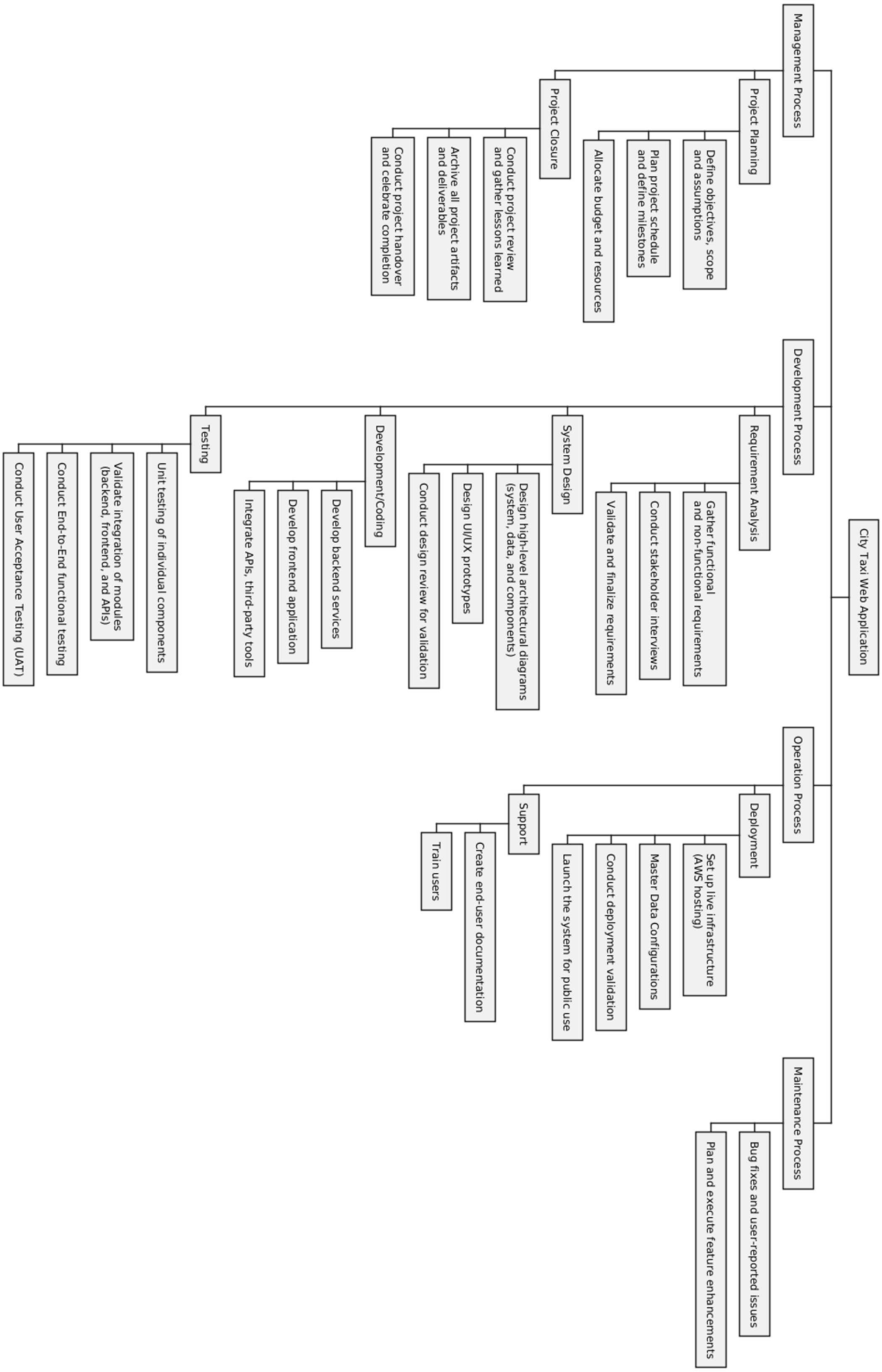

City Taxi Web Application
Management Process
Project Planning
Define objectives, scope and assumptions
Plan project schedule and define milestones
Allocate budget and resources
Project Closure
Conduct project review and gather lessons learned
Archive all project artifacts and deliverables
Conduct project handover and celebrate completion
Development Process
Requirement Analysis
Gather functional and non-functional requirements
Conduct stakeholder interviews
Validate and finalize requirements
System Design
Design high-level architectural diagrams (system, data, and components)
Design UI/UX prototypes
Conduct design review for validation
Development/Coding
Develop backend services
Develop frontend application
Integrate APIs, third-party tools
Testing
Unit testing of individual components
Validate integration of modules (backend, frontend, and APIs)
Conduct End-to-End functional testing
Conduct User Acceptance Testing (UAT)
Operation Process
Deployment
Set up live infrastructure (AWS hosting)
Master Data Configurations
Conduct deployment validation
Launch the system for public use
Support
Create end-user documentation
Train users
Maintenance Process
Bug fixes and user-reported issues
Plan and execute feature enhancements

Figure 3: WBS Diagram

**Management Process:** This includes Project Planning of objectives defining, scheduling milestones, and allocating materials. Includes Project Closure, which includes reviewing lessons learned, archiving deliverables and final hand over.

**Development Process**: This starts by Requirement Analysis where the functional and non functional requirements were gathered through stakeholder Interviews and Validation. Its now on to System Design and creates architectural diagrams, UI/UX prototypes, and the like and does design reviews. Integrating APIs, backend and frontend services, smooth moves to Development/Coding. It ends with Testing – unit tests, integration validation, functional testing and User Acceptance Testing (UAT).

**Operation Process:** It covers Deployment, Deploying AWS infrastructure, configuring master data, validating deployment, and launching the system. Supports include the creation of user documentation and training users.

**Maintenance Process:** These are focused on bug fixing, fixing user reported issues and planning the next round of feature enhancements to ensure your service continues to improve continuously.

## 5.2 Rationale for WBS

### 5.2.1 Rationale of Management Process

The City Taxi Project is planned, properly resources allocated, and controlled for by the Management Process. It simplifies, in the process of executing and closing it documents lessons learned and makes it formal to handover.

- **Project Planning Rationale:** The City Taxi Project can experience the delays, resource mismanagement, scope creep, and without appropriate planning. This process is included so a structured process can be followed at the beginning and during the project execution being completed efficiently in order to meet the stakeholders objectives and the taxi application unique needs.

- **Project Closure Rationale:** Formal closure of the City Taxi Project is needed for documentation, knowledge transfer and that the project is closed off to stakeholder expectations. This is just a further step to ensure a proper handover and retain key insight for future improvements.

### 5.2.2 Rationale of Development Process

Throughout its Design, Coding, and Testing stages the Development Process converts the City Taxi Project's requirements into a functional system. It makes sure the application fulfills the user needs (passengers, drivers, and operators) as well as maintaining standards of highest quality.

- **Requirement Analysis Rationale:** Success of the City Taxi Project depends on clear requirements. Requirements not well defined or misunderstand can cause rework, failure to accomplish stated objectives, and dissatisfied stakeholders. With a robust requirements phase, we make sure we've got all the major features: booking, payment, tracking.

- **System Design Rationale:** The technical structure guidance during the design phase is based on the City Taxi Project requirements. Basically it entails helping the development go as smoothly and efficiently as possible through architectural diagrams for the backend, frontend and integrations.

- **Development/Coding Rationale:** The actual development phase is building the City Taxi system. This proper execution is the application works as it is supposed to do, backend services, frontend interfaces, 3rd party integrations (for example Google Maps and payment gateways) work united to make this experience seamless.

- **Testing Rationale:** Risks of failures and bugs post deployment are mitigated by testing. It guarantees the City Taxi Project's system is both robust, reliable and highly user friendly so that maintenance overhead is reduced and stakeholders are satisfied.

### 5.2.3 Rationale of Operation Process

The Operation Process describe the deployment of the City Taxi Project system as well as supporting users with documentation and training. It facilitates a low risk transition to live operations and ensures high user adoption.

- **Deployment Rationale:** The City Taxi system must be deployed properly to start out functional, available, in line with user criteria. The shortage of this phase could have detrimental impacts on the rollout with road blockers such as drivers and passengers.

- **Support Rationale:** Clear documentation and training provide end users and stakeholders with the complete capacity to make use of the features offered by City Taxi system. If they don't support it, this could result in a poor experience for users, and perhaps result in less adoption.

### 5.2.4 Rationale of Maintenance Process

The Maintenance Process makes sure that City Taxi Project system keeps running reliably and responds to user flows of the day, lets bugs and fixes any issues appear and merge new updates to it to adapt it to user needs and change expectations.

- **Bug Fixes and Enhancements Rationale:** The bugs and the maintenance are responsible for maintaining the City taxi application in shape and provides it stability, security and adjusts to the changing needs. Commitment to quality, high quality throughout lifecycle manifested in regular updates and enhancements that are indicative of the trust and satisfaction of users long term.

## 5.3 Project Schedule

Table 6: Task Assignees

| Task | Assignees |
|---|---|
| T101. Define objectives, scope, and assumptions | Suresh Sameera |
| T102. Plan project schedule and define milestones | Suresh Sameera |
| T103. Allocate budget and resources | Suresh Sameera |
| T104. Conduct project review and gather lessons learned | Suresh Sameera, Harsha Indunil, Pasindu Samitha, Naveen Deneth |
| T105. Archive all project artifacts and deliverables | Harsha Indunil, Naveen Deneth |
| T106. Conduct project handover and celebrate completion | Suresh Sameera, Nishan Sandeepa |
| T201. Conduct stakeholder workshops and interviews | Nishan Sandeepa |
| T202. Gather functional and non-functional requirements | Nishan Sandeepa |
| T203. Validate and finalize requirements | Nishan Sandeepa |
| T204. Design high-level architectural diagrams | Harsha Indunil |
| T205. Design UI/UX prototypes | Ishinee Nayandi |
| T206. Conduct design review for validation | Ishinee Nayandi, Harsha Indunil |
| T207. Implement backend services | Naveen Deneth, Harsha Indunil |
| T208. Develop frontend Application | Naveen Deneth, Ishinee Nayandi |
| T209. Integrate APIs, third-party tools | Naveen Deneth |
| T210. Unit testing of individual components | Naveen Deneth, Harsha Indunil |

| | |
|---|---|
| T211. Validate integration of modules | Pasindu Sasmitha |
| T212. Conduct End to End functional testing | Pasindu Sasmitha |
| T213. Conduct UAT | Pasindu Sasmitha, Nishan Sandeepa |
| T301. Set up live infrastructure | Naveen Deneth, Harsha Indunil |
| T302. Master Date Configurations | Naveen Deneth, Harsha Indunil |
| T303. Conduct deployment validation | Harsha Indunil |
| T304. Launch the system for public use | Naveen Deneth, Harsha Indunil |
| T305. Create end-user documents | Suresh Sameera, Harsha Indunil, Naveen Deneth, Pasindu Sasmitha, Ishinee Nayandi, Nishan Sandeepa |
| T306. Train Users | Nishan Sandeepa, Naveen Deneth |
| T401. Handle bug fixes and user-reported issues | N/A |
| T402. Plan and execute feature enhancements | N/A |

Table 7: Task Schedule

| Task | Start Date | End Date | Duration (Days) | Dependencies / Milestone |
|---|---|---|---|---|
| **1. Management Process** | | | | |
| **1.1 Project Planning** | | | | |
| T101. Define objectives, scope, and assumptions | 27/11/2024 | 27/11/2024 | 1 | |
| T102. Plan project schedule and define milestones | 28/11/2024 | 29/11/2024 | 2 | T101 |
| T103. Allocate budget and resources | 30/11/2024 | 30/11/2024 | 1 | T102 (M01) |
| **1.2 Project Closure** | | | | |
| T104. Conduct project review and gather lessons learned | 17/02/2025 | 17/02/2025 | 1 | T305, T306 |
| T105. Archive all project artifacts and deliverables | 17/02/2025 | 17/02/2025 | 1 | T305, T306 |

| | | | | |
|---|---|---|---|---|
| T106. Conduct project handover and celebrate completion | 18/02/2025 | 18/02/2025 | 1 | T104, T105 (M09) |
| **2. Development Process** | | | | |
| **2.1 Requirement Analysis** | | | | |
| T201. Conduct stakeholder workshops and interviews | 02/12/2024 | 03/12/2024 | 2 | T103 |
| T202. Gather functional and non-functional requirements | 02/12/2024 | 06/12/2024 | 5 | T103 |
| T203. Validate and finalize requirements | 07/12/2024 | 07/12/2024 | 1 | T201, T202 (M02) |
| **2.2 System Design** | | | | |
| T204. Design high-level architectural diagrams | 09/12/2024 | 17/12/2024 | 8 | T203 |
| T205. Design UI/UX prototypes | 09/12/2024 | 18/12/2024 | 9 | T203 |
| T206. Conduct design review for validation | 19/12/2024 | 19/12/2024 | 1 | T204, T205 (M03) |
| **2.3 Development/Coding** | | | | |
| T207. Implement backend services | 20/12/2024 | 16/01/2025 | 24 | T206 |
| T208. Develop frontend Application | 20/12/2024 | 23/01/2025 | 30 | T206 |
| T209. Integrate APIs, third-party tools | 17/01/2025 | 23/01/2025 | 6 | T207 (M04) |
| **2.4 Testing** | | | | |
| T210. Unit testing of individual components | 20/12/2024 | 23/01/2025 | 30 | T206 |
| T211. Validate integration of modules | 24/01/2025 | 29/01/2025 | 5 | T208, T209, T210 |
| T212. Conduct End to End functional testing | 30/01/2025 | 03/02/2025 | 4 | T211 |
| T213. Conduct UAT | 10/02/2025 | 10/02/2025 | 1 | T303 (M05) |
| **3. Operation Process** | | | | |
| **3.1 Deployment** | | | | |
| T301. Set up live infrastructure | 04/02/2025 | 07/02/2025 | 4 | T212 |
| T302. Master Date Configurations | 08/02/2025 | 08/02/2025 | 0.5 | T301 |

| | | | | |
|---|---|---|---|---|
| T303. Conduct deployment validation | 08/02/2025 | 08/02/2025 | 0.25 | T302 (M06) |
| T304. Launch the system for public use | 11/02/2025 | 11/02/2025 | 0.25 | T213 (M07) |
| **3.2 Support** | | | | |
| T305. Create end-user documents | 24/01/2025 | 12/02/2025 | 17 | T210 |
| T306. Train Users | 12/02/2025 | 15/02/2025 | 4 | T304 (M08) |
| **4. Maintenance Process** | | | | |
| T401. Handle bug fixes and user-reported issues | N/A | N/A | 0 | T106 |
| T402. Plan and execute feature enhancements | N/A | N/A | 0 | T106 |

- M01: Project Plan Complete Date - 30/11/2024
- M02: Requirements Finalized - 07/12/2024
- M03: System Design Complete - 19/12/2024
- M04: Development Complete23/01/2025
- M05: Testing Phase Complete - 10/02/2025
- M06: Deployment Preparation Complete - 08/02/2025
- M07: Go Live - 11/02/2025
- M08: Operational support end - 15/02/2025
- M09: Project Closure - 08/02/2025

## 5.4 Gantt Chart

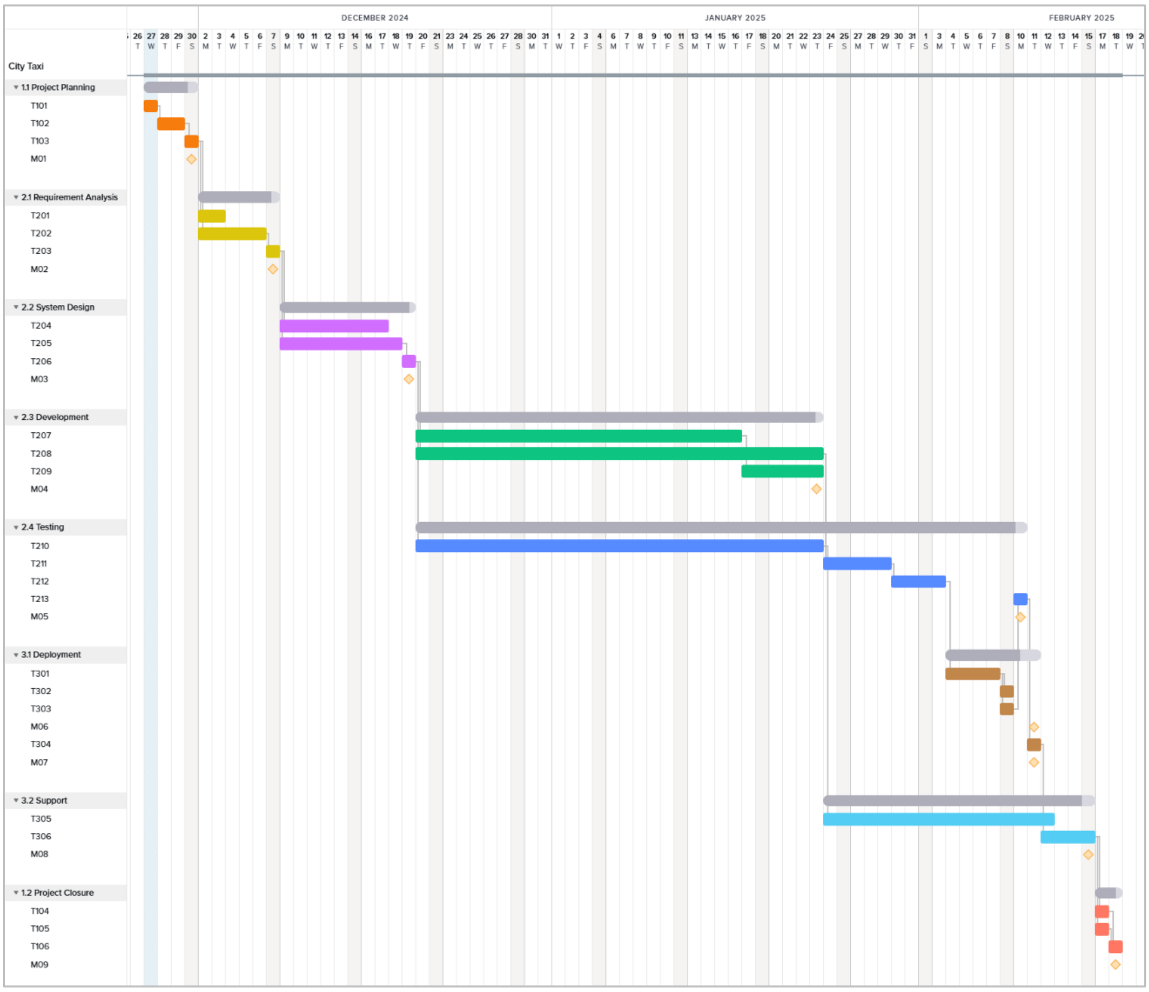


Figure 4: Gantt Chart

Gantt chart shows us a clear timeline for tasks across the project life cycle of Management, Development, Operation and Maintenance. From 27th to 30th November 2024, the Management Process begins by defining the project scope, schedule and resource. The Project Closure tasks on 17th - 18th February 2025, converge the project. The Development Process time duration is between 2nd December 2024 and 10th February 2025 starting with the Requirement Analysis, ending with Testing phase. Deployment and Support tasks of the Operation Process run from 4th to 15th February, 2025 and Maintenance Process (bug fixes and feature enhancements) will finish later after 18th February, 2025.

Order of execution is defined by the tasks dependencies. T102 (Plan project schedule) is depended T101, (Define objectives) first to have a structured plan for the project. Similar to that, T207 (Implement backend services) cannot be started until T206 (Design review) is complete, which confirms the validation of the design phase before the development is started. Critical tasks (T211) like Validate integration of modules are dependent on their preceding tasks unit testing (T210) and API integration(T209).

The Gantt chart milestones show completion of major phases. Project Plan completed (M01) 30th November 2024, Requirements finalized (M02) 7th December 2024, Development completed (M04) 23rd January 2025. Between these milestones, testing phase is complete (M05), go live (M07) and conclude with project closure (M09) on 18th February 2025.

Assigning time to a project on the Gantt chart is visualized with the horizontal bars, each one representing the task duration. Arrows point out dependencies between tasks and the two key points in time are milestones. Both the development and test phases that are largely concurrent enabling testing and early detection of defects, exhibit considerable task scheduling overlaps. The system compacts the deployment phase into 4th and 11th February 2025, followed by a quick but intense preparation for the system rollout.

### 5.5 Milestones

Here are the Milestones of City Taxi Project with their justification and their evaluation based on measurable performance.

1. **M01: Project Plan Complete**
   This milestone concludes the first phase of the project planning where the planning process involves, the project scope and goals, the project milestones and targets, the required resources and the time table.

   **Rationale:** With this particular achievement, the actual project pathway is articulated, as is the problem's extent and duration. In general, this step is important to achieve clear, several objectives for the successive phases in the project. It is evaluated depending on the status of the project plan document that contains all the major project requirements, the schedule, and costs.

   **Indicators:**
   - Approved project plan document
   - Defined scope and objectives
   - Finalized project schedule and milestones
   - Resource allocation approved

2. **M02: Requirements Finalized**
   This also marks the end of requirements gather phase where all functional and non-functional requirements have been identified and validated from stakeholders and finalized for the City Taxi system.

   **Rationale:** When achieved, it means the project has collected enough information on users and the business to inform the design and implementation process.

**Indicators:**

- List of features and functionalities finalized.
- All requirements gathered and validated by stakeholders.
- Approved Systems Requirements Specification Document (SRS)

3. **M03: System Design Complete**

All that remains is the delivery of high level architect diagrams and detailed UI/UX prototypes, which brings us to this milestone. This suggests that the project requirements are met, and the architecture is built to be implemented.

**Rationale:** This milestone is successful completion that the system has been designed with a clear architecture and user interface, which meet the predefined requirements. The system design documents are reviewed (architecture and design) and approved.

**Indicators:**

- Architectural design diagrams approved
- UI/UX prototype reviews and finished UI/UX prototypes.
- Completed design review meeting with stakeholders

4. **M04: Development Complete**

It reflects the end of all core development tasks – backend services, frontend interfaces and API integrations. This system is now ready for the testing.

**Rationale:** Rationale: The fact that the system's most important features have been implemented and that the system is technologically prepared for quality assurance and testing means that this is a milestone. The completion of all development tasks and a transition of the codebase to the testing phase is the assessment.

**Indicators:**

- Both backend and frontend codebase completed.
- All features integrated
- Testing handed over codebase

5. **M05: Testing Phase Complete**

This is the finishing line to testing, from unit to UAT (User Acceptance Testing). The bug and performance testing on the system is completed.

**Rationale:** This is a milestone that decides to complete the City Taxi system fully validated and all functional as well as non-functional requirements are met. The completion of all planned tests, including UAT feedback, is the assessment.

**Indicators:**

- (unit, integration, functional, UAT) executed all test cases.
- Critical bugs not remaining as well as major defects
- Stakeholders UAT approval.

6. **M06: Deployment Preparation Complete**

   Description: This milestone indicates that the system is fully setup for deployment with live infrastructure with data configured and with deployment validation.

   **Rationale:** This milestone means that the system is ready to be placed in the production system. The setup of live infrastructure and the validation of deployment is assessed.

   **Indicators:**

   - (AWS hosting) live infrastructure configured
   - Data configurations completed
   - Deployment a validation tests have passed.

7. **M07: Go Live**

   This is the official launch of the City Taxi system, that the system is served to the public.

   **Rationale:** This milestone means the City Taxi application is live and is running for end users i.e. passengers, drivers, and operators. The successful public launch determines if the components all function as expected.

   **Indicators:**

   - Live on the actual production servers
   - The City Taxi application is available to the public.
   - Operational functionalities confirmed.

8. **M08: Operational support end**

   It now represents the end of the support phase, where documentation and training for end users is finished and the support transition is completed.

   **Rationale:** This milestone reassures users that they have been trained and gotten the necessary support materials to continue operation. The completion of user documentation and training sessions is what is assessed.

**Indicators:**

- Finalized and distributed user documentation
- The system was trained on all users.
- Support transition complete

9. **M09: Project Closure**

This is the formal closing of the City Taxi project and all deliverables have been handed over and project artifacts archived.

**Rationale:** Formal closing of the project provides a formality that everything is delivered and a finality that all the remaining project reviews are handed over, all lessons learned are noted, and the project is closed. The completion of final project reports and handover documentation is assessed.

**Indicators:**

- Approval of final project
- Archives all project artifacts.
- Deliverables hand over to a client or stakeholders

## 5.6 Network Diagram

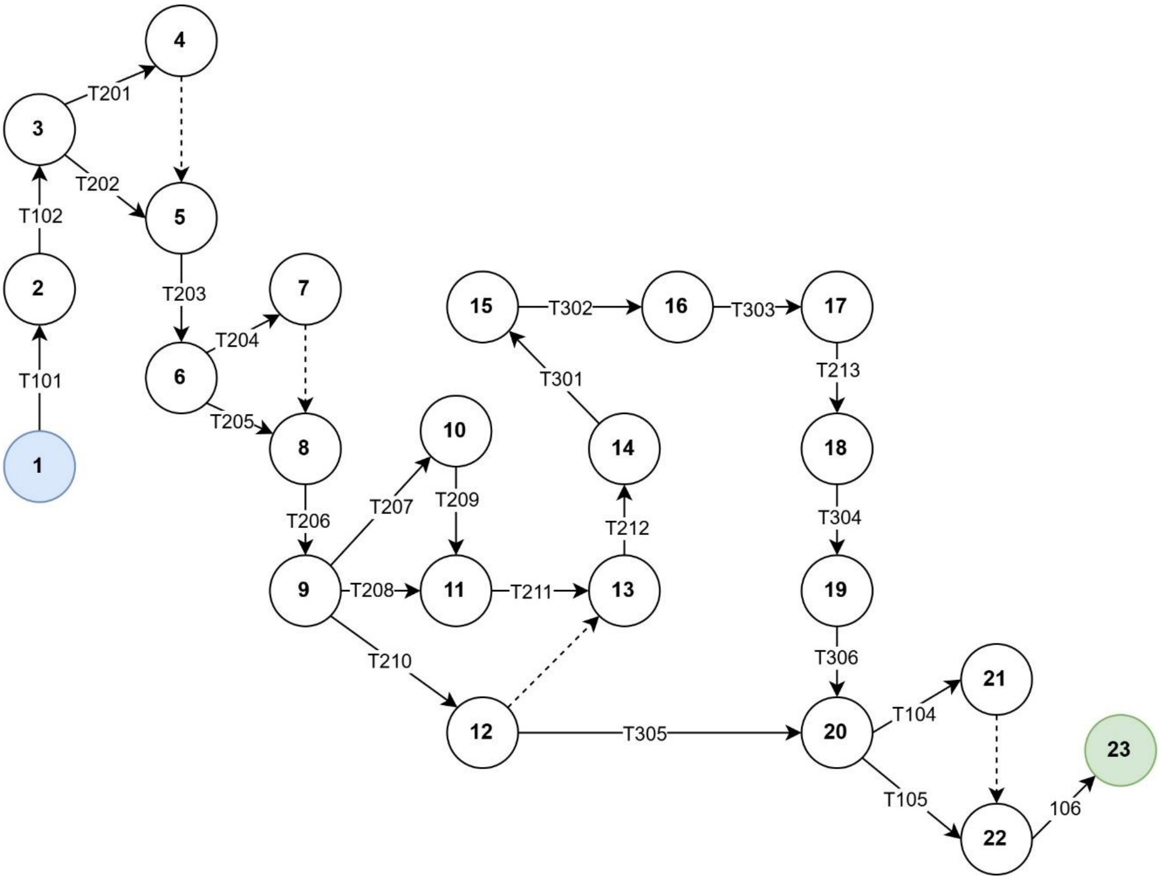


Figure 5: AOA Network Diagram

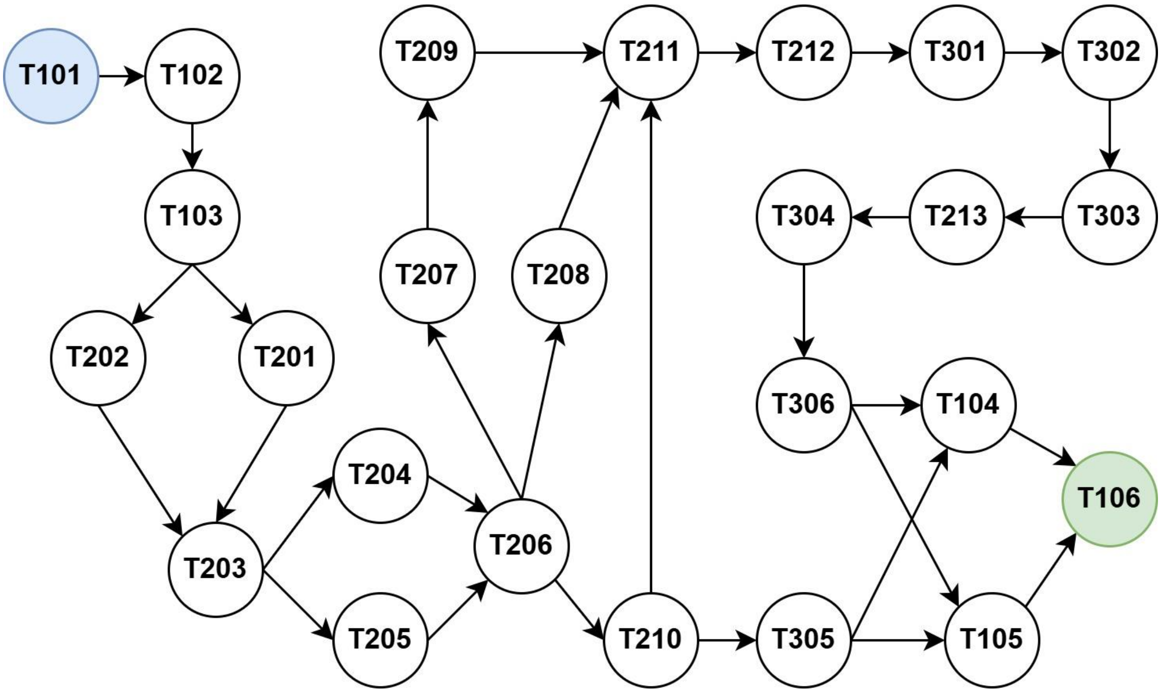


Figure 6: AON Network Diagram

The following diagram presents the critical path and activities for the AON network diagram.

Critical paths :

1. **T101, T102, T103, T202, T203, T205, T206, T207, T209, T211, T212, T301, T302, T303, T213, T304, T306, T105, T106**

2. **T101, T102, T103, T202, T203, T205, T206, T208, T211, T212, T301, T302, T303, T213, T304, T306, T104, T106**

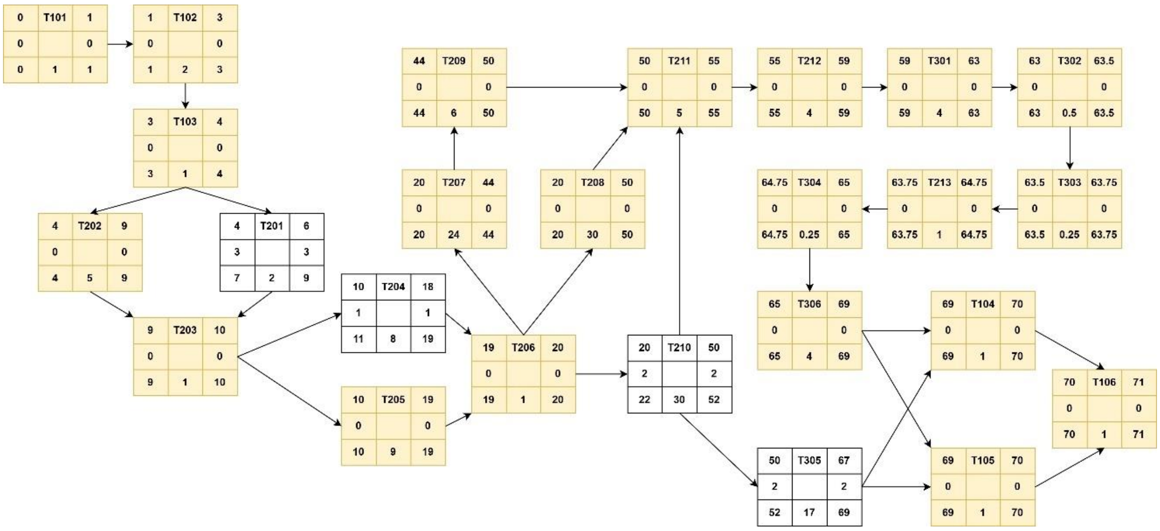
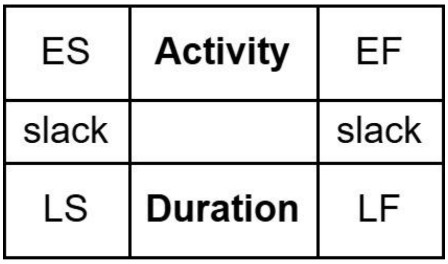


Figure 7: Critical path



| ES | **Activity** | EF |
|---|---|---|
| slack | | slack |
| LS | **Duration** | LF |

ES – Early Start

EF – Early Finish

LS – Latest Start

LF – Latest Finish

## 6. Tools and Technologies

Table 8: Tools and Technologies

| Type | Tool | Description |
|---|---|---|
| Software tools | Spring Boot | A Java-based framework for building backend services. |
| | ReactJS | A JavaScript library for building user interfaces. |
| | Postgres | A powerful open-source relational database. |
| | VS Code | A code editor for development, supporting various languages. |
| | IntelliJ IDEA | A Java IDE for backend and full-stack development. |
| | Postman | A tool for API testing and development. |
| | PgAdmin | A management tool for PostgreSQL databases. |
| Project management tools | GitHub Project | A platform for version control and project management. |
| | Microsoft Excel | A spreadsheet tool for tracking tasks, schedules, and budgets. |
| Collaborative tools | Google Meet | A video conferencing tool for team meetings. |
| | GitHub | A version control platform for collaborative coding. |
| | Figma | A collaborative design tool for UI/UX and prototyping. |

# 7. Project Monitoring and Control

## 7.1 Risk Management

The City Taxi project needs to be proactive in finding and solving risks. A risk register will be recorded in which risks will be assessed by likelihood and impact. Mitigation strategies for high priority risks, such as API dependencies and tight timelines will have backup plans for services with criticality, and additional buffer time for testing and debugging, so project execution continues to flow smoothly.

Table 9: Risk Analysis

| Risk ID | Description | Likelihood | Impact | Risk Level | Mitigation Strategy |
|---|---|---|---|---|---|
| R01 | API Service Outages - Google Maps API or AWS services experience downtime. | Medium | High | High | Work around this situation by providing alternative mapping APIs or such. Proactively, also Monitor third party service status. |
| R02 | Schedule Delays: Tight three-month schedule might cause delays in design, development, or testing. | High | High | High | Dynamically track progress and reprioritize tasks. Add buffer time for critical phases. |
| R03 | Budget Overrun: There are unforeseen expenses, or scope creep, beyond £100,000 allocated to the budget. | Medium | High | Medium-High | Draw a very strict line for expenses and Reserve contingency funds for unforeseen costs. |
| R4 | Resource Unavailability: During critical project phases key personnel become unavailable. | Low | High | Medium | Allocate multiple persons for critical phases. Cross train team members then so they can cover the critical roles. |
| R5 | Inadequate Testing: Because of limited time for | High | High | High | Make a list of most critical features, and run |

| | | | | | |
|---|---|---|---|---|---|
| | testing, bugs in the system will go undetected. | | | | parallel testing tasks such as unit, integration, and UAT. |
| R6 | Third-Party Cost Increases: Unforeseen increases in the cost of third-party services, e.g. Google Maps API or AWS services | Medium | Medium | Medium | Monitor and optimize query costs by reducing costs on third party services. |

### 7.2 Requirements Management

Requirements management has an effective importance for the City Taxi project, because of the needs to succeed in meeting user and stakeholder expectations. All functional and non functional requirements will be reviewed regularly with all project stakeholders to verify that all requirements fit within the project objectives stated in the System Requirements Specification (SRS). Formal approval is required for any proposed changes to requirements to be reviewed for impact to the scope, schedule and budget, with changes approved tracked and documented. In order to avoid any chance for scope creep, a requirements traceability matrix will be kept to associate requirements to deliverables.

### 7.3 Schedule and Budget Control

Keeping the project schedule and budget are essential to the City Taxi project's success. Weekly review of the Gantt chart and task dependencies will let us see where we lagging, particularly with critical path activities so that we keep an eye to hit milestone such as M01 (Project Plan Complete) and M07 (Go Live). To maintain a £600 contingency fund for uncertainty, The £100,000 budget will be followed in Microsoft Excel to monitor actual costs against planned spend to avoid over expenditure. Delays or overspending will cause resources to be reallocated or non-critical activities to be adjusted so as not to throw the project off the rails.

### 7.4 Quality Control

The City Taxi project was put in place to guarantee the delivery of a high quality system. All features will be rigorously tested in the form of unit, integration and user acceptance testing (UAT), and as such, real-time tracking and payment systems will be validated. They will be logged, prioritized and solved, and retested to make sure the fixes are work before deploying. While a multitude of quality metrics will be tracked to quantify the quality of the system as a whole (i.e. defect density, test coverage, stakeholder satisfaction), it will be maintained based on these measures.

### 7.5 Reporting and Measurement

For City Taxi project to stay transparent in its reporting and measure, regular reporting is necessary. Tasks will be completed bi-weekly, progress will be reported via those bi-weekly progress reports defining milestone achievements and risk and issues encountered. We will assess project health with key performance indicators (KPIs) on task completion rates, budget adherence and defect resolution times. For that reason, project status updates and milestone reviews will be shared at regular stakeholder meetings to align and facilitate decision making.

### 7.6 Configuration Management

For the City Taxi project, the system stability and version control needs require effective configuration management. As we will manage all the source code and documentation using GitHub, we will have a very thorough track of changes  and all changes are reversible. Formal approval will be made of key project baselines, including requirements, design documents, and the codebase; and they will be maintained consistently. We will carefully document and then test the deployment configuration in staging environments so that the Go Live phase is as risk free as possible.

## 8. Conclusion

The City Taxi project will develop a taxi reservation system and optimize this as an efficient, reliable, and affordable taxi reservation system for urban residents especially of low- and middle-income groups. The project is divided into small manageable phases, to be completed within 12 weeks, concentrating on solving traditional taxi services common challenges such as lack of real time tracking and secure payments, as well as user friendly interfaces using modern technologies.

The project scope is well defined meeting the needs of passengers, drivers and operators. The funding of £100,000 is totally spent on team salaries and is allotted with a definite timeline based on team members' skills. Some £600 is kept over as a contingency to leave a small surplus in case anything goes wrong.

There are specific milestones in the project schedule to use as a measure of progress and to guarantee on time deliverables. Within the selected tools, Spring Boot, ReactJS, PostgreSQL and AWS services, will help to reach these goals considering scalability, security, and user satisfaction . To support communication we use collaborative tools like GitHub and Google Meet, and to facilitate user interface design we use Figma.

Finally, the City Taxi project is well designed and set to start with well planned and structured approach and usage of modern technologies to achieve its goals. Its aim is to deliver a high quality and scalable solution to elevate the urban taxi booking experience.

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