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Project Proposal Final Draft

TapFare: MBTA on Your Mobile

EMGT 5220 Engineering Project Management Fall 2023

Team 7: PM Powerhouse

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# Letter of Transmittal

Date: 12/10/2023

Prof. Sharad Bajracharya

Northeastern Graduate School of Engineering

Snell Engineering

360 Huntington Avenue

Boston, MA 02115

Dear Prof. Sharad Bajracharya,

Enclosed is the project proposal for "Tap Fare: MBTA on Your Mobile," developed by Team 7, PM Powerhouse from the EMGT 5220 Engineering Project Management class, Fall 2023 at Northeastern University.

This proposal outlines a groundbreaking initiative to enhance the MBTA commuting experience through a state-of-the-art mobile application. "Tap Fare" is designed to revolutionize fare payments and provide commuters with real-time transit updates, addressing key challenges in public transportation.

The enclosed documents detail the technical specifications, implementation plan, risk analysis, and budget justification for "Tap Fare." Our multidisciplinary team has worked diligently to ensure that every aspect of this project aligns with the highest standards of innovation, efficiency, and user experience.

We are confident that this proposal will demonstrate the potential impact and feasibility of "Tap Fare." We are grateful for your guidance and look forward to any feedback or suggestions you may have to further refine our project.

Thank you for considering our proposal. Should you have any questions or require additional information, please do not hesitate to contact us.

Sincerely,

Team Members

Menon Vignesh

Nagap Vinit Shankar

Nivedita Nivedita

Ramireddy Vivek Reddy

Ravi Nithyasri

Shetty Eshaan Ratnaraj

Sudhamani Prakash Dhivith Vaibhav

# Executive Summary

The team at Northeastern University's PM Powerhouse has conceptualized an innovative solution to transform the Massachusetts Bay Transportation Authority (MBTA) commuting experience. The proposal is to develop "TapFare: MBTA on Your Mobile," a dynamic mobile application designed to simplify fare payments and provide real-time transit updates. This application addresses the growing need for digital and efficient public transport solutions.

"TapFare" sets itself apart by offering advanced features not currently available in existing systems. Its primary goal is to enhance commuter convenience through seamless digital fare transactions and up-to-date transit information. Key benefits include reducing the need for physical payment methods and equipping commuters with accurate travel information, thereby improving the overall efficiency and experience of using MBTA services. The application will leverage cutting-edge technology, including NFC for contactless payments, robust payment gateways (Stripe, PayPal), and real-time data analytics. A strong focus is placed on security, employing tokenization to protect user data. Additionally, the user interface will be designed for optimal usability and accessibility.

The implementation plan is structured in four phases: Initiation, Planning, Execution, and Closing. These phases encompass defining the project scope, detailed planning, application development and testing, and final deployment and performance monitoring. A multidisciplinary team, proficient in software development, project management, and user experience design, will lead these efforts. The projected budget for "TapFare" is $1,528,813, which includes development, operational costs, and a contingency reserve. This investment is expected to yield significant operational savings for MBTA and enhance customer satisfaction.

Ultimately, "TapFare" is not just a technological advancement; it's a step towards redefining public transportation in Massachusetts, offering a more efficient, user-friendly, and cost-effective solution for the MBTA and its commuters.

# Introduction

Public transport is a fundamental foundation of modern civilization, but it nevertheless faces long-standing problems that impede the everyday travel of many people. This calls for a transit experience that is not only more effective but also more user-friendly and sustainable. These difficulties range from reliance on physical Charlie cards, paper tickets, and cash transactions, to painful waits.

## The Big Problem

The fundamental issue is the outmoded and cumbersome state of the public transport infrastructure. This outdated method gives rise to several problems, such as:

Limitations with payments: The use of cash payments, paper tickets, and physical Charlie cards adds friction to the commuter experience.

Lack of Information: Passengers continue to lack access to reliable, up-to-date information about schedules, delays, and alternate routes.

## The Project Problem/Solutions/Goals

Our project, "TapFare," arises as the solution to this multifaceted problem. We embark on a mission to:

Problem 1: Inefficient Payment Processes:

Current Scenario: Commuters grapple with physical Charlie cards, paper tickets, and a perplexing fare system, while the production of plastic Charlie cards and tickets.

TapFare Solution: The TapFare app leverages technology concepts, including online payment gateway integrations such as PayPal and Stripe using APIs for secure transactions, to allow users to conveniently purchase and receive new cards digitally, and for adding old physical cards, the use of Card Scanning and Data Extraction concepts are used.

Problem 2: Lack of Real-Time Updates on transportation schedules and service disruptions

Current Scenario: Public transport often faces challenges such as inconsistent schedules, service disruptions, and a lack of real-time updates, resulting in an unreliable and frustrating travel experience. Passengers lack access to reliable, real-time information about schedules, delays, and alternative routes, leading to discomfort and uncertainty during their journeys.

TapFare Solution: We leverage advanced Data analytics tools like Tableau and Python, and AI-driven algorithms are developed using APIs from Google maps and Twitter API for real-time updates to optimize schedules, predict potential disruptions, and provide real-time updates to commuters. The TapFare app becomes your real-time travel companion, ensuring that passengers are always informed and can plan their journeys with confidence. This results in a highly efficient and dependable transit system that minimizes delays and improves the overall travel experience, reducing the stress associated with public transportation.

# Purpose & Objectives

## Purpose

The TapFare app's goal is to revolutionize public transportation by acting as a unified platform that includes both the "Streamline Payments" and "Provide Real-Time Information" components. This multi-dimensional program strives to improve commuter convenience, efficiency, and satisfaction. Our primary goal in developing the app is to create a comprehensive digital payment ecosystem that eliminates the usage of cash, encourages contactless transactions, and streamlines fare payments for commuters. This comprises integrating E-Charlie and E-Commuter cards into commuters' digital wallets, allowing for more efficient tracking and administration of transportation expenses. Simultaneously, by integrating powerful data analytics and AI-driven algorithms, the app provides commuters with real-time transportation data, guaranteeing that riders have access to accurate and up-to-date information about timetables, delays, and alternate routes. The app's real-time information component is intended to reduce the uncertainty and stress often associated with commuting by allowing passengers to adapt quickly to changing transit conditions, make informed decisions, and confidently plan their journeys, all within the TapFare app's user-friendly interface.

## Objective

The objective of this project is to develop a comprehensive mobile application that supports digital payments for all forms of transportation (Bus, T-Line, Ferry, Commuter Rail) operated by the Massachusetts Bay Transportation Authority (MBTA) while also providing real-time updates on public transportation services.

This application aims to:

1. Streamline Payment Processes: Create an easy-to-use platform that allows commuters to easily make digital payments for MBTA transit modes such as buses, subways, commuter trains, and ferries. This app will try to eliminate maximum the use of physical cards by integrating payment gateways that support various payment methods, including credit/debit cards, and mobile wallets (e.g., Apple Pay, Google Pay) which would deposit the money directly to the MBTA account. The current fare collection system would remain the same however we would be integrating with payment gateways to support transactions on our app.
2. Ensure Real-Time Updates on transportation schedules and service disruptions: The application would also have a real-time information system that would provide reliable, up-to-date updates on public transportation services. Passengers will get real-time access to schedules, service alerts, route modifications, and any disruptions, allowing them to make informed decisions and reduce wait times.

With this transition, the project aims to benefit both commuters and the Massachusetts Bay Transportation Authority (MBTA).

Benefits for MBTA:

1. Operational Efficiency: The MBTA can dramatically increase operating efficiency by lowering or eliminating cash transactions. Cash handling, counting, and reconciliation processes can be time-consuming and error-prone. A digital payment platform automates fare collecting, which reduces administrative effort and the need for manual intervention.
2. Cost Reduction: Handling and processing cash transactions incur physical costs such as labour, security, and currency transportation. The MBTA can reduce these costs by moving to digital payments, resulting in possible budget savings that can be put toward improving transit services.
3. Data Insights: Digital payment systems collect useful information on commuter behaviour, travel patterns, and payment preferences. This information can be used by the MBTA to improve route planning, service optimization, and targeted marketing campaigns. These insights can lead to more efficient resource utilization and increased commuter happiness.

Benefits for Commuters:

1. Convenience: Commuters benefit from a simple and convenient payment process. They may pay for rides swiftly and conveniently with a user-friendly mobile app or contactless card, eliminating the need for cash, exact change, or standing in line at ticket vending machines.
2. Flexible Payment Option: Mobile wallets, credit/debit cards, and preloaded smart cards are common payment methods offered by digital payment providers. Commuters can select the mode of transportation that best meets their tastes and financial position.
3. Cost Transparency: Commuters have quick access to transaction histories and receipts with digital payments, encouraging transparency in fare prices and making it easier to monitor transportation spending.
4. Real-Time Information: This can help commuters to better plan their routes and respond to unforeseen changes in service.

# Technical Overview

The TapFare project is poised to transform the public transportation experience by harnessing cutting-edge technologies to address long-standing issues. The following in-depth technical overview elaborates on the key components and technologies employed, drawing parallels to established examples for clarity and reference.

**Payment Gateway Integration**

To ensure secure and efficient payment transactions within the app, TapFare integrates well-established payment gateways. Prominent options include Stripe, renowned for its seamless online transactions, PayPal, a global leader in digital payments, and Square, which provides versatile payment solutions. These gateways employ robust APIs to facilitate connections with banks, credit card companies, and financial institutions, ensuring the secure transfer of funds.

**Card Readers and NFC Technology**

To enable a seamless transition from physical to digital cards, TapFare employs advanced Data Extraction and Card Scanning technologies. These tools capture data from physical cards and seamlessly integrate it into the digital system, providing users with a straightforward shift from traditional physical cards to digital alternatives. Enabling contactless card payments for physical transactions, TapFare harnesses Near Field Communication (NFC) technology. This technology allows quick, secure, and contactless communication between e-payment cards and card readers, creating a streamlined payment process. These card readers may interface with point-of-sale (POS) systems or mobile devices through Bluetooth or USB connectivity, guaranteeing a seamless payment experience for users.

**Mobile Wallet Integration**

To offer users a secure means of storing payment information on their mobile devices, TapFare integrates with mobile wallet platforms such as Apple Pay and Google Pay. Through Software Development Kits (SDKs), these mobile wallets provide secure and convenient payment options. Users can make payments by merely tapping their smartphones on compatible terminals, like existing implementations in the e-commerce realm.

**Tokenization**

To fortify security, TapFare adopts tokenization technology. This technology replaces sensitive card data with unique tokens during transactions, ensuring that actual card information remains confidential. Much like how secure, unique tokens protect your social media login information, tokenization safeguards sensitive payment details from potential breaches.

**Security Measures**

Prioritizing user data protection, TapFare implements stringent security measures. This includes the use of encryption protocols like SSL/TLS for secure data transmission, adherence to the Payment Card Industry Data Security Standard (PCI DSS), and comprehensive security best practices. These measures are akin to the use of HTTPS to secure online transactions on e-commerce websites, safeguarding cardholder data.

**APIs and Web Services**

To facilitate seamless communication with financial systems, TapFare relies on Application Programming Interfaces (APIs) and web services provided by card issuers, payment gateways, and financial institutions. These APIs establish the crucial link between the app and the broader financial ecosystem. This approach is analogous to the use of social media platform APIs by applications to access user data and streamline interactions. Languages used will include JavaScript and Python for developing API communication and integration.

**Real-time updates on transportation schedules and service disruptions**

TapFare leverages data analytics like tools like Tableau and Python, and TensorFlow or PyTorch for AI implementation. Programming languages include Python, JavaScript, and Java for building the real-time updating system to manage the transportation system effectively. These technologies analyze both historical and real-time data, predict potential disruptions, and optimize travel schedules. This guarantees that travellers are continuously informed during their journeys. Some sample APIs are Google Maps for route and mapping information, transportation data feeds from relevant transit authorities, and Twitter API for real-time updates on service disruptions. TapFare employs advanced data analytics and AI-driven algorithms to optimize schedules, predict potential disruptions, and provide real-time updates. This results in a more reliable and efficient transit system.

**Physical Infrastructure Changes**

1. Contactless Payment Infrastructure:

* Install contactless payment terminals at subway stations, bus stops, and commuter rail stations.
* Upgrade or replace existing ticket vending machines and card readers with contactless-enabled devices.
* Provide the necessary power and network connectivity for these terminals.
* NFC Technology Implementation: Equip vehicles (buses, trains, ferries) with NFC-enabled card readers to facilitate contactless payments and card scanning. Ensure that the physical hardware on vehicles supports Near Field Communication (NFC) technology.

1. Network Connectivity:

* Enhance network connectivity at transportation hubs to support real-time data transmission between the TapFare app, payment gateways, and the MBTA's back-end systems.
* Ensure robust cellular and Wi-Fi coverage in subway tunnels and other areas with limited connectivity.

1. User Information Kiosks:

* Install information kiosks at major transportation hubs, which can be interactive touchscreens for assisting passengers with trip planning, card management, and app downloads.

1. Ticket Inspectors and Fare Enforcers:

* Train personnel to inspect digital tickets and assist passengers in using the app and contactless payments.
* Ensure they have mobile devices or hardware capable of validating digital tickets.

1. Environmental Considerations:

* Implement environmentally friendly solutions, such as solar-powered kiosks or devices, to reduce the ecological impact.

**Current MBTA Systems**

1. Digital Solutions:

* Primarily through the mTicket app for commuter rail and ferry services.
* Lacks a unified app for all transit modes.

1. Digital Offerings Constraints:

* Recent discontinuation of online CharlieCard reloads.
* Reliance on physical ticketing systems and in-person reloads.

1. Fare Collection Infrastructure:

* Existing infrastructure but without comprehensive digital integration.
* Dependence on third-party apps for some services.

1. Real-Time Information Gap:

* Limited real-time updates, especially for bus services.
* Trams have digital boards, but this is not uniformly available across all modes.

**Integration of TapFare with Existing MBTA Systems**

* + - 1. Unified Digital Platform:
* Creating a single app for all MBTA transit modes.
* Integrating payment and real-time transit updates.
  + - 1. Enhanced Digital Payment Options:
* Implementing advanced online payment systems.
* Eliminating the need for physical ticketing and in-person reloads.
  + - 1. Comprehensive Real-Time Data:
* Providing live updates for all transit modes, including buses.
* Leveraging data from APIs like Google Maps and Twitter.
  + - 1. Collaboration with MBTA:
* Working with MBTA to complement and enhance the existing fare system.
* Ensuring seamless integration with current MBTA infrastructure.

The current MBTA systems, while offering some digital solutions like the mTicket app for commuter rail and ferry services, face limitations due to the recent discontinuation of online CharlieCard reloads and an over-reliance on physical ticketing. This situation highlights a lack of comprehensive digital integration and a notable gap in real-time updates, especially for bus services. In contrast, TapFare's integration with MBTA systems is poised to address these deficiencies through a unified digital platform. This platform, encompassing all MBTA transit modes, will integrate advanced online payment systems and provide comprehensive real-time data, leveraging APIs from Google Maps and Twitter. TapFare's user-centric development, achieved through close collaboration with MBTA, aims to enhance the existing fare system and infrastructure, offering a seamless and improved experience for commuters.

**Accessibility considerations for individuals with disabilities.**

On the App:

1. Screen Reader Friendly: We're making TapFare easy to use for visually impaired people. The app will talk out loud, describing what's on the screen.
2. Voice Commands: Users can talk to the app to get around and find what they need, helping those who find it tough to use their hands.
3. Customizable Look: The app lets users change how it looks – like making text bigger, using colors that are easy to see, and simplifying menus – to help those with trouble seeing or understanding complex layouts.
4. Help on Demand: If someone's stuck, they can get instant help or chat with someone right in the app.
5. Easy Trip Planning for All: The app gives clear info on which buses and trains are wheelchair-friendly, and which stations have working elevators.

Changes at Stations and in Buses/Trains:

1. Easy-to-Use Payment Terminals: All new machines for paying fares will be set at heights that work for everyone, including those in wheelchairs.
2. Safe Paths: We're putting special floor markings at stations to guide people with visual impairments safely around, especially near payment areas and platform edges.
3. Hearing Announcements: Important info about stops and any service changes will be announced out loud in buses, trains, and at stations.
4. Helpful Kiosks: Big stations will have special kiosks where information can be read in Braille, heard, or adjusted to a comfortable height.

# Implementation Plan

## WBS

The Work Breakdown Structure (WBS) defines the complete set of activities to successfully complete the project. The phases highlighted in the WBS are:

1. **Project Initiation:** Getting the project started by identifying stakeholders, authorizing it, and setting an initial budget.
2. **Project Planning:** Detailed planning of project activities, schedules, budgets, resources, risks, and communication.
3. **Requirement Analysis:** Defining system and functional requirements, prioritizing them, and creating a traceability matrix.
4. **Software Development:** Building software features, conducting thorough testing, and ensuring integration with external systems.
5. **Testing and Quality Assurance:** Assessing software integration, conducting user acceptance testing, and evaluating performance.
6. **Deployment:** Configuring infrastructure and servers for the software's operation.
7. **User Training and Support:** Creating user support materials like FAQs and chatbots.
8. **Project Closure:** Reviewing project success, obtaining client approvals, and transitioning project assets.
9. **Handover to MBTA:** Training the client's team and ensuring a smooth transition of ownership.
10. **Monitoring and Maintenance:** Ongoing support for addressing bugs, applying updates, and improving the software.

Refer to Appendix A for the complete Work Breakdown Structure (WBS).

## Schedule

The project schedule specifies a thorough and well-structured project with distinct phases and dates. It starts with Project Initiation, which defines the project's scope and stakeholders, laying the groundwork for the entire endeavor. Following that are the phases of Project Planning, Requirement Analysis, and Software Development, each of which plays an important part in influencing the project's direction and the creation of the intended software or product. Testing and Quality Assurance ensure that the ultimate product is of good quality, while Deployment marks the point at which it is made available to end customers. User training and support aid in the transition, and the Project Closure phase completes all project operations. The project finishes with the Handover to MBTA, which officially transfers the project to the Massachusetts Bay Transportation Authority and transforms the system into an ongoing Monitoring and Maintenance procedure to ensure its long-term effectiveness and adaptability. This timetable provides a clear roadmap for effective project management and project completion. The baseline project Gantt  
Chart can be found in Appendix B

## Responsibility Chart

The duties of each stakeholder in relation to each job in the work breakdown structure are arranged in a responsibility chart. The work breakdown structure format is used by the chart, sometimes called a RACI matrix, to identify who is responsible, accountable, consulted, and informed about each job. For the matrix, go to Appendix C. It is essential to ascertain the responsibilities of various stakeholders to picture the relationships between various roles and the project deliverables. The RACI Matrix also establishes who oversees each job that has been specified, preventing one person from taking on too much responsibility.

## Resource Allocation

In this project for the Massachusetts Bay Transportation Authority (MBTA), the "TapFare: MBTA on Your Mobile" initiative aims to enhance the customer experience by bringing MBTA services to mobile platforms. The project is budgeted at 24,000 hours with a contract value of $1,528,813. Key resources include a dedicated Project Manager, Developer Lead, Lead tester, Product Manager, Financial Manager, UI/UX designer, and Content Lead. The allocation of resources is meticulously planned, with roles ranging from 60% to 100% allocation, ensuring that each team member contributes effectively to the project's success. Additionally, external companies are engaged for specific platform and design requirements. A contingency of 15.83% is included in the resource allocation to account for unforeseen changes or challenges. The project is set to commence on 01/08/2023 and is scheduled for completion by 04/10/2024. Refer to Appendix D for a detailed resource allocation plan.

## Stakeholders

The following list is a short overview of those interested parties that are mentioned throughout this report:

**Project Team**

* **Project Manager**

Sudhamani Prakash Dhivith Vaibhav

* **Financial Manager**

Ramireddy Vivek Reddy

* **UI/UX Designer**

Menon Vignesh

* **Product Manager**

Shetty Eshaan Ratnaraj

* **Lead Tester**

Ravi Nithyasri

* **Developer Lead**

Nivedita Nivedita

* **Content Lead**

Nagap Vinit Shankar

See section 8.0 for team members’ credentials.

**Principle Engineers**

* Software developers: The team responsible for designing and building the app's software, including the user interface, backend systems, and database.
* Quality assurance (QA) engineers: The team responsible for testing the app's functionality, ensuring that it works as expected, and identifying any bugs or issues.
* Technical architects: The team responsible for designing the overall technical architecture of the app, including how different components will interact and how data will be stored and processed.
* User experience (UX) designers: The team responsible for designing the app's interface and ensuring that it is intuitive and easy to use.
* Analytics and Data Teams: Data analytics are crucial to understanding user behavior and improving the app over time.

**Vendors**

* Payment Gateway Providers:

Stripe

PayPal

* Mobile Wallet Platforms:

Apple Pay

Google Pay

* NFC Technology and Hardware:

NXP Semiconductors

Gemalto (Thales Group)

**Customers**

MBTA (Massachusetts Bay Transportation Authority) is our customer.

**Inspection Team**

* Project Manager: The project manager is often responsible for coordinating and overseeing the inspection process. They ensure that the inspection aligns with the project objectives and goals.
* Subject Matter Experts (SMEs): Depending on the area being inspected, SMEs are individuals with specialized knowledge or expertise related to the project. They provide in-depth insights and assessments.
* Quality Assurance (QA) or Quality Control (QC) Team: These professionals are responsible for ensuring that project deliverables meet the required quality standards. They may conduct inspections at various stages of the project to identify and address issues.
* Internal Auditors: In some organizations, internal auditors are responsible for conducting reviews and inspections to ensure compliance with organizational policies and procedures.
* External Auditors: If the project is subject to external regulations or compliance requirements, external auditors may be involved to ensure adherence to these standards.
* Client or Stakeholder Representatives: The client or relevant stakeholders may be part of the inspection team to assess whether project deliverables meet their requirements and expectations.

# Execution Plan

## Project Monitoring

Key Monitoring Factors

* Time: Time monitoring is critical for TapFare to ensure the timely completion of the project, reflecting the need for efficient public transportation solutions.
* Cost: Cost monitoring is directly related to managing project costs within the allocated budget for developing the TapFare application.
* Scope: Scope monitoring ensures that the project objectives align with data security and privacy standards, specifically referring to PCI DSS certification, which is crucial for an application handling financial transactions.
* Quality: Quality monitoring focuses on maintaining high standards in payment transactions and user data protection, aligning with the security and quality measures required for a payment-focused application.
* Staff: Staff monitoring is crucial for roles like the Project Manager, Developer Lead, Lead Tester, and others mentioned in the TapFare project team, ensuring effective coordination and task completion.
* Changes: Change monitoring is essential for TapFare to handle modifications that may impact scope, cost, or time, ensuring the project aligns with goals and objectives.

Technical Monitoring Overview: The technical monitoring aspects are directly related to the TapFare application, covering payment gateway integration, card readers, NFC technology, mobile wallet integration, tokenization, and security measures.

Implementation Plan Monitoring: The implementation plan monitoring involves aspects like the WBS, schedule, responsibility chart, and resource allocation, all of which are critical for successfully developing and deploying the TapFare application.

Benefits Monitoring: Benefits monitoring focuses on operational efficiency improvements for MBTA and user-centric benefits, directly aligning with the goals of the TapFare application.

Physical Infrastructure Changes Monitoring: Monitoring physical infrastructure changes is essential for TapFare, especially in terms of contactless payment infrastructure, network connectivity, user information kiosks, and changes for ticket inspectors and fare enforcers.

Monitoring and Maintenance: Monitoring and maintenance ensure the ongoing success of TapFare by addressing bugs, applying updates, and improving the app's functionality.

Conclusion: The conclusion emphasizes the importance of project monitoring for the success of TapFare, reinforcing the need for regular assessment and communication with stakeholders.

In summary, each point in the project monitoring section is related to and focused on the development and success of the TapFare application. The aspects cover the entire project lifecycle, from planning to implementation and ongoing maintenance, ensuring that TapFare aligns with its objectives and the needs of MBTA commuters.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Control Category** | **Control Description** | **Frequency** | **Record/Output** | **Responsibility** |
| Phase-Gated Control | Reviews at project milestones to assess progress | 4 times; at weeks 4, 8, 12, and 16 | Milestone Approval | Project Council, Project Manager |
| Monitoring Control - Status Monitoring | Monitoring of project activities and tasks | Weekly | Status Report | Project Manager |
| Monitoring Control - Cost | Monitoring and calculating Cost Variance (CV), Cost Performance Index (CPI) | Weekly | Cost Status Report | Project Controller |
| Monitoring Control - Schedule | Monitoring Schedule Variance (SV), Schedule Performance Index (SPI) | Weekly | Schedule Status Report | Project Controller |
| Monitoring Control - Validation of Charged Hours | Validation of charged hours against planned hours | Weekly | Billable Hours Status Report | Project Controller |
| Monitoring Control - Team Updates Meetings | Weekly meetings to discuss progress and challenges | Weekly | Minutes of Meetings | Project Manager |
| Monitoring Control - Leadership Updates Meeting | Meeting every 2-3 weeks for high-level updates | Every 2-3 weeks | Minutes of Meetings | Project Manager |

## Project Control

The project will have a control strategy that ensures each aspect of the development process is monitored, allowing for timely identification of deviations and prompt corrective actions. A feedback control loop will be set up to monitor the progress. There will be weekly meetings in which each management sector will report on the various factors being monitored. The table below summarizes which management sector is responsible for each key factor.

|  |  |
| --- | --- |
| **Key Factor** | **Sector Responsible** |
| Cost | Financial Management |
| Schedule | Project Management |
| Staff | Program Management |
| Product Quality & Changes | Product Management |

The regular meetings serve as a mechanism to gauge the project's ongoing activities. Should any segment of the project show signs of deviation from the established control, the management team engages in discussions to determine and implement corrective measures within the respective responsible sector.

## Project Auditing

To ensure the quality of the app, certain audits shall be undertaken at key stages of the development cycle. These audits include:

**Technical Audits**

Code review audit: This audit involves a thorough review of the application's source code to identify any coding errors or vulnerabilities that may affect the application's performance or security.

Design review audit: This audit examines the application's design to ensure that it is user-friendly, efficient, and effective.

Quality assurance audit: This audit evaluates the application's adherence to quality assurance standards, such as the use of testing methodologies, documentation, and defect management processes.

Performance audit: This audit measures the application's performance and responsiveness to identify any bottlenecks or performance issues.

Security audit: This audit assesses the application's security features and vulnerabilities, such as authentication, authorization, and encryption.

Compliance audit: This audit examines the application's compliance with industry regulations and standards, such as the General Data Protection Regulation (GDPR) or the Payment Card Industry Data Security Standard (PCI DSS).

Operational audit: This audit evaluates the application's operational effectiveness, including its scalability, reliability, and availability.

By conducting these audits potential issues can be identified earlier on and corrective actions can be taken to ensure that the final product is of high quality, meets the needs of the end-users and ensures that there are no delays.

**Non-Technical Audits**

Project management audit: This audit examines the project management process to ensure that it is effective and efficient. This may include evaluating project planning, resource allocation, risk management and communication processes.

Stakeholder audit: This audit assesses stakeholder engagement and satisfaction with the project. This may involve collecting feedback from stakeholders, identifying areas for improvement and implementing changes to improve stakeholder satisfaction.

Financial audit: This audit examines the project's financial performance to ensure that it is within budget and that resources are being allocated appropriately. This may include reviewing expense reports, invoices and financial statements.

Legal audit: This audit assesses the project's compliance with legal and regulatory requirements, such as data privacy laws or intellectual property rights. This may involve reviewing contracts, licenses and other legal agreements.

User experience (UX) audit: This audit evaluates the application's user experience to ensure that it is intuitive, user-friendly, and meets the needs of the target audience. This may involve conducting user testing, analyzing user feedback and making changes to improve the user experience.

By conducting these non-technical audits during the development of the application, project stakeholders can gain a more comprehensive understanding of the project's overall health and success. These audits can help identify potential issues and provide insights into areas for improvement, leading to a better final product and a more successful project.

## Project Closure

As we bring the TapFare project to its conclusion, it is imperative to reflect on the journey from inception to termination. This phase marks not only the completion of the development cycle but also a critical juncture for evaluating the project's overall success and alignment with its intended objectives. One of the primary considerations during project termination is the assessment of whether the project adhered to its initial scope, stayed within the allocated budget, and followed the established schedule. Any deviations from these parameters will be analyzed to understand the underlying factors and lessons learned for future endeavors. A crucial aspect to evaluate is whether the TapFare application was developed by the defined scope requirements. Additionally, assessing its market performance against projected expectations is essential. This analysis aims to determine the project's contribution to the company's goals.

# Risk Assessment Management Plan

## Identification and Analysis of Risk

Creating a risk register and evaluating the possibility and impact of the project's risks (High, Medium, Low) are the first steps in the risk assessment process. Next, a response is assigned to each risk that has been assessed, and an action plan is created to control the risk.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Risk Area** | **Risk Description** | **Action Plan** | **Likelihood** | **Impact** | **Response** |
| 1 | Payment Gateway Integration | Transaction Security | Implement end-to-end encryption, regularly update security protocols, and  conduct periodic security audits. | High | High | Mitigate |
| 2 | Payment Gateway Integration | Gateway Downtime | Use multiple payment gateways simultaneously to ensure redundancy.  Implement fallback mechanisms for seamless transitions. | Medium | High | Mitigate |
| 3 | Card Readers and NFC Technology | Compatibility Issues | Thorough testing with a variety of devices and card types during development. | Medium | Medium | Avoid |
| 4 | Card Readers and NFC Technology | Data Extraction Errors | Implement validation checks and regular updates to improve extraction accuracy. | Medium | Medium | Avoid |
| 5 | Mobile Wallet Integration | Mobile Wallet Vulnerabilities | Stay updated with security patches and collaborate with mobile wallet providers  for enhanced security measures. | Medium | Medium | Avoid |
| 6 | Mobile Wallet Integration | User Adoption | Conduct user awareness campaigns, provide incentives for early adopters,  and ensure a user-friendly experience. | Medium | Medium | Avoid |
| 7 | Real-Time Updates and Data Accuracy | Reliance on External APIs | Monitor the performance and reliability of external APIs, have contingency plans  in place, and consider alternative data sources. | Medium | High | Mitigate |
| 8 | Real-Time Updates and Data Accuracy | Data Inaccuracy | Implement rigorous testing of the real-time information system, use reliable data  sources, and establish a feedback loop for users to report discrepancies. | Medium | High | Mitigate |
| 9 | User Resistance to Digital Transition | Lack of Awareness | Implement an extensive user education and onboarding program, provide clear  instructions and support, and address concerns through customer support channels. | High | Medium | Mitigate |
| 10 | User Resistance to Digital Transition | Preference for Physical Cards | Highlight the benefits of TapFare, offer incentives for early adopters, and provide a user-friendly experience. | Medium | Medium | Mitigate |
| 11 | Limited Internet Connectivity | Unavailability of Real-Time Updates | Implement offline functionality in the app to store essential information locally,  provide clear guidelines on when and how users can access and update information  offline, and work towards enhancing internet connectivity in public transport areas. | Medium | Medium | Avoid |
| 12 | Privacy Concerns with Data Analytics | Data Misuse | Clearly communicate the anonymization and security measures in place to protect  user data, comply with relevant data protection regulations, and allow users to control and manage their data preferences within the app. | High | High | Mitigate |
| 13 | Resistance from Traditional Transit System | Concerns about Impact on Existing System | Collaborate with transit authorities and involve them in the project planning,  demonstrate the benefits of TapFare in terms of efficiency and user experience,  and address concerns and work towards a smooth transition with the support of  key stakeholders. | Medium | High | Mitigate |
| 14 | Technical Execution and App Development | Technical Glitches | Conduct extensive testing phases, implement continuous monitoring, and have a rapid response plan for addressing technical issues. | High | High | Mitigate |
| 15 | Technical Execution and App Development | Data Breach | Implement robust data encryption, conduct regular security audits, and comply with  industry security standards (e.g., PCI DSS for payment transactions). | High | High | Mitigate |
| 16 | Technical Execution and App Development | Service Disruptions | Establish redundancy measures, conduct regular maintenance during non-peak hours,  and have a communication plan for informing users about disruptions. | High | High | Mitigate |

To see the overall project risks, a risk matrix for the likelihood vs. impact is then created.

A screen shot of a chart

Description automatically generated

## Risk Management Plan

A specialized management team has been developed to implement corrective measures against identified risks, and the Borda approach has been utilized to methodically characterize risks for level determination. Low impact and low likelihood risks will be tolerated in risk management, freeing up resources for other important uses. We will keep a close eye on risks with medium impact or probability in order to stop their possibility from rising. The management team will make a concerted effort to prevent risks one step above by keeping a close eye on these variables and giving frequent updates on handling and backup plans. Risks classified as "high" both in impact and likelihood shall be tackled with a dedication to mitigation at all reasonable expenses, with the ultimate objective of averting more project damage.

## Continuous Risk Assessment

To anticipate possible problems and keep control, NUS is dedicated to an ongoing effort in risk identification and management throughout the project lifecycle. This process will be performed numerous times. NUS is committed to keeping on schedule and within budget by being organized and actively participating in project tasks, highlighting the need to uphold project control. This proactive strategy complements NUS's dedication to project management by foreseeing and resolving possible problems in advance of project completion. Effective resource distribution will be made sure of, and risk management measures will be commensurate with the possible impact on the project. All parties involved in the risk management process will receive fast updates regularly, promoting openness and enabling timely modifications to risk reduction tactics. NUS endeavors to handle possible obstacles by implementing a thorough risk management plan and ongoing risk assessment, guaranteeing favorable project results and compliance with predetermined schedules and financial constraints.

# Financial Plan with Budget

## High-Level Details

Within the financial planning segment of the project report, it is essential to detail the project's budget, serving as the fundamental building block for resource and expenditure management. This stage commences with the definition of the project's scope, meticulously delineating its boundaries and objectives, while judiciously deciding which features to include and exclude. To ensure the budget is meticulously managed, the deployment of project management software becomes indispensable, as it proficiently streamlines financial resource organization and bolsters cost-effectiveness. Moreover, a critical facet within this financial realm is the identification of stakeholders. Their viewpoints and expectations play a pivotal role in financial planning, thus necessitating the development of a stakeholder register, supported by apt communication tools to facilitate unobstructed stakeholder engagement.

Meanwhile, the creation of a project charter is a crucial component that grants official approval to the project and gives the project manager the necessary power to assign resources. This involves using legal documents to formally approve the start of the project, leading to the formal Project Charter document being created. The creation of a preliminary budget, which offers a high-level financial summary of the project's expected costs, is also included in the larger financial plan. This phase involves gathering relevant financial information and using project management tools to precisely estimate the amount of money needed. Following this strict budgeting framework guarantees informed financial decision-making, which supports the project's successful completion.

The "TapFare" app's financial plan lists all the costs and sources of income. Salaries, equipment, and licenses are included in development costs, whereas server hosting and upkeep are included in operating costs. Promotional efforts will be funded by marketing expenses, while overhead is covered by administrative charges. Regarding revenues, we expect to receive money from in-app advertising, transaction fees, membership fees, and other possible sources of income.

1. Development Costs:

* Salaries for development team: $948,100
* Tools and licenses, Servers & Maintenance: $200,713
* Machinery cost: $50,000
* Total Development Costs: $1,198,813

2. Operational Costs (Annual):

* Administrative costs & Total Operational Costs: $330,000

3. Contingency Cost: $210,000

4. Revenue Sources (Annual):

* Subscription fees (estimated 500,000 users at $5/month): $2,500,000.
* Transaction fees: $300,000
* In-app advertising: $300,000
* Other potential revenue: $300,000
* Total Revenue: $3,400,000

## Budget Justification

The budget for the "TapFare" app project is supported by a thorough Net Present Value (NPV) analysis, which justifies resource allocation. The expense breakdown covers development and operational costs, with investments in salaries and tools to ensure app quality. Subscription fees, transaction income, and advertising align with the goal of maintaining cash flow. The NPV figure of $179,350.05 over five years highlights the project's ability to generate value. This financial feasibility demonstrates a commitment to sound financial decision-making and supports the case for additional development and funding. Refer to Appendix E for detailed justification.

Using the Net Present Value (NPV) method, we can assess the project's financial viability by considering future cash flows and accounting for the time value of money. A positive NPV indicates that the project is expected to generate more revenue than it costs to develop and operate, making a strong case for additional funding. The NPV analysis helps us evaluate the project's long-term financial sustainability and its alignment with the organization's financial objectives. It underscores the TapFare app's potential to address challenges in the public transportation sector while being a commercially viable and worthwhile endeavor.

Net Present Value (NPV) Analysis:

Calculating the Net Present Value (NPV) using a discount rate of 10% over five years.

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Cash Flow (CFt)** | **Discount Rate (r)** | **Discounted Cash Flow (CFt / (1 + r)^t)** |
| 1 | -$1,408,813.00 | 10% | -$1,408,813.00 |
| 2 | $3,070,000.00 | 10% | $2,790,909.09 |
| 3 | $3,070,000.00 | 10% | $2,537,190.08 |
| 4 | $3,070,000.00 | 10% | $2,306,536.44 |
| 5 | $3,070,000.00 | 10% | $2,096,851.31 |

NPV = DCF (Year 1) + DCF (Year 2) + DCF (Year 3) + DCF (Year 4) + DCF (Year 5)

NPV ≈ $ 8,322,673.92

The positive NPV of $8,322,673.92 indicates that the "TapFare" app is expected to generate substantial value and returns on investment over the five-year period, making it a financially viable project. This supports the budget justification and demonstrates the economic feasibility of further developing and investing in the app.

Engineering Economic Technique:

The financial assessment of the "TapFare" app illustrates the application of the engineering economic technique known as Net Present Value (NPV) and its foundational principles. NPV, a fundamental concept in engineering economics, considers the time value of money, recognizing that the worth of money decreases over time due to factors like inflation. In this case, a discount rate of 10% is employed to reflect the time value of money, enabling a comprehensive evaluation of the project's financial viability.

The NPV methodology entails a thorough examination of cash flows, where annual revenues are deducted from operational costs to ascertain the expected cash flows associated with the project. This cash flow analysis corresponds with principles in engineering economics by providing a clear understanding of cash inflows and outflows linked to the project. Moreover, NPV is fundamentally designed to facilitate informed investment decisions, aligning with the central tenet of engineering economics, which is to make rational choices that maximize returns. In the context of the "TapFare" app, a positive NPV of $8,322,673.92 signifies that the project is projected to generate more revenue than the expenses involved in its development and operation, thus providing a compelling financial rationale for further project development and financial backing.

Additionally, the NPV analysis extends over a five-year horizon, underscoring the importance of assessing the project's long-term financial sustainability. Principles in engineering economics emphasize the critical aspect of evaluating projects in terms of their ability to maintain economic viability and align with the financial objectives of the organization. The favorable NPV not only validates the project's feasibility but also underscores its potential to generate substantial returns, reinforcing the core tenet of engineering economics, which is to ensure that projects are not only economically viable but also contribute positively to the financial health of the organization.

# Team Credentials

**Menon Vignesh**

Vignesh is currently a graduate student pursuing an MS in Engineering Management with a specialization in Supply Chain at Northeastern University. Before his academic pursuits, he gained valuable experience working for two years as an Operations Analyst in the transportation and logistics domain. During this time, Vignesh played a pivotal role in leading an end-to-end project aimed at reducing empty trailer movement to minimize carbon emissions. This experience honed his skills in stakeholder communication, effective negotiation, and the successful execution of large-scale projects. Vignesh began an internship as a TPM (Technical Program Management) intern after coming to the United States. He gained a thorough understanding of the whole product development process, from conception to completion, in this job. Vignesh also gained significant insights into numerous reverse logistics factors, all of which are focused toward assuring customer satisfaction. Vignesh is confident that his hands-on expertise managing end-to-end projects, along with his adept negotiation abilities, will make him an invaluable contributor to the successful completion of the TapFare project. He is confident in his abilities to interact effectively with stakeholders and steer the project toward its goals.

**Nagap Vinit Shankar**

Vinit Nagap obtained a strong foundation in computer science from the University of Mumbai, he is currently pursuing a Master of Science in Engineering Management at Northeastern University. Vinit is an expert in product management, data analytics, and user experience design with an excellent GPA of 3.7. He has a track record of success as a software engineer at Aurionpro Solutions Limited, where he oversaw product strategy, market research, and ideation, leading to a significant increase in user happiness and income. As the Product Manager for the Aspiring Product Manager Club, Vinit demonstrated his leadership abilities by overseeing the expansion of the club's digital platform and encouraged 30% rise in user engagement as well as a 20% increase in membership of the club. His technical skills include web development, Python, and Java, and he also has qualifications in project management and leadership.

**Nivedita Nivedita**

Nivedita is a graduate student at Northeastern University pursuing an MS in Engineering Management with a solid background in software engineering and product management. Her previous expertise as a Programmer Analyst, where she optimized system efficiency and implemented sophisticated solutions, qualifies her as a great addition to TapFare application development. As a Product Manager, she demonstrated her ability to gather client requirements, produce proposals, and improve customer satisfaction, making her well-suited to contribute to TapeFare’s product management components. Her collaborative style and expertise in working with cross-functional teams are ideal for the project’s diverse objectives. Her expertise in software engineering and understanding of product management processes make her a valuable contribution to the TapFare project’s technical and strategic components, assuring the effective development and administration of this innovative transportation solution.

**Sudhamani Prakash Dhivith Vaibhav**

Dhivith is a dedicated graduate student specializing in Engineering Management with a strong emphasis on Product Development and Product Management. His academic journey began with an undergraduate degree in Mechanical Engineering, providing him with a robust technical foundation. Dhivith's professional journey extends into Operations and Program Management, where he has meticulously honed his skills and expertise. His practical experience has been predominantly within the domain of Automobile manufacturing firms. He has gained proficiency in critical tools and technologies such as SQL, MS Excel, Tableau, and Solidworks in these roles. Still, he has also excelled in applying process improvement methodologies to optimize manufacturing operations. In parallel with his procedures and program management achievements, Dhivith has a profound interest in the intricacies of manufacturing and product development. He actively engages in projects that optimize manufacturing processes and enhance product design. His hands-on experience in these areas positions him as a bridge between engineering and management, enabling him to effectively lead cross-functional teams in the dynamic process of bringing innovative products to market.

**Ramireddy Vivek Reddy**

Vivek is a dedicated student currently pursuing a Master of Science in Engineering Management at Northeastern University. With a background in biotechnology and extensive experience as a product and sales development manager, he is committed to mastering the intricacies of product and project lifecycle development. As a senior systems engineer, he honed his skills using tools like Oracle Fusion Middleware, Tableau, and SQL, while also gaining valuable insights through internships in biotechnology and UI/UX design. Vivek’s versatile skill set includes proficiency in Adobe Photoshop, C and Python coding languages, and expertise in Agile and Waterfall methodologies. Notably, his project “ADAPTOOL” highlights his aptitude in genetic analysis. His deep understanding of product and project development ensures he can effectively contribute to engineering and product development endeavors, fostering innovation and success.

**Ravi Nithyasri**

Nithyasri Ravi holds a bachelor's degree in computer science, which served as the launching pad for her impressive career. With over four years of valuable work experience, she began her journey as a software developer at Zoho Corporation, where she honed her technical skills and gained insights into software development processes. Her career then took an exciting turn as she transitioned into the role of a Product Manager, showcasing her adaptability and ability to explore diverse domains. Currently, Nithyasri is pursuing a graduate degree at Northeastern University, specializing in Engineering Management and minoring in Product Management. This academic pursuit reflects her commitment to continuous learning and her desire to expand her skill set in the world of product management. Nithyasri Ravi's educational background, coupled with her multifaceted work experience, positions her as a dynamic and forward-thinking professional ready to take on challenges in the technology and product management space.

**Shetty Eshaan Ratnaraj**

Eshaan is a graduate student pursuing his master's in engineering management at Northeastern University. He completed his undergraduate degree in Electronics and Communication Engineering after which he began working in working in Deloitte as a technical analyst, where he led the development of a Python-based automation project. This project resulted in a substantial reduction in material composition processing time for a prominent Malaysian Cement Company. In addition to his technical achievements, Eshaan has demonstrated a keen aptitude for project management. He led a team at one of India's leading non-profit organizations, where his project management skills came to the forefront. His ability to coordinate diverse tasks, align team members, and ensure projects were executed on time and within budget exemplified his dedication and leadership. Furthermore, Eshaan's proficiency in resource management and risk mitigation consistently led to successful project outcomes.

# Appendices

**Appendix A: Work Breakdown Structure (WBS)**

|  |  |
| --- | --- |
| **ID** | **Task** |
|  | **TapFare: MBTA on Your Mobile** |
| 1 | **1.0 Project Initiation** |
| 2 | 1.1 Identify Stakeholders |
| 3 | 1.2 Create Project Charter |
| 4 | 1.3 Develop Preliminary Budget |
| 5 | **2.0 Project Planning** |
| 6 | 2.1 Conduct Market Research |
| 7 | 2.2 Define Project Objectives |
| 8 | 2.3 Create a Risk Management Plan |
| 9 | 2.4 Establish a Project Schedule |
| 10 | 2.5 Define Resource Requirements |
| 11 | 2.6 Develop a Communication Plan |
| 12 | **3.0 Requirement Analysis** |
| 13 | 3.1 Define System Requirements |
| 14 | 3.2 Document Functional Requirements |
| 15 | 3.3 Prioritize Requirements |
| 16 | 3.4 Create a Requirement Traceability Matrix |
| 17 | **4.0 Software Development** |
| 18 | 4.1 Create the "Add a Card" Functionality |
| 19 | 4.2 Implement Secure Payment Gateways |
| 20 | 4.3 Develop the "Provide Real-Time Information" Component |
| 21 | 4.4 Create Real-Time Data Analytics and AI-Driven Algorithms |
| 22 | 4.5 Build User Management System |
| 23 | 4.6 Test the App Thoroughly |
| 24 | 4.7 Ensure Smooth Integration with MBTA |
| 25 | **5.0 Testing and Quality Assurance** |
| 26 | 5.1 Perform integration testing. |
| 27 | 5.2 Execute user acceptance testing. |
| 28 | 5.3 Evaluate performance and scalability. |
| 29 | **6.0 Deployment** |
| 30 | 6.1 Configure cloud infrastructure. |
| 31 | 6.2 Set up servers for app operation. |
| 32 | **7.0 User Training and Support** |
| 33 | 7.1 Create FAQs. |
| 34 | 7.2 Set up support chatbots. |
| 35 | **8.0 Project Closure** |
| 36 | 8.1 Conduct a project review. |
| 37 | 8.2 Obtain client approvals. |
| 38 | 8.3 Transition project assets and knowledge. |
| 39 | **9.0 Handover to MBTA** |
| 40 | 9.1 Provide training and knowledge transfer to MBTA team. |
| 41 | 9.2 Ensure smooth transition of project ownership. |
| 42 | **10.0 Monitoring and Maintenance** |
| 43 | 10.1 Address bug fixes. |
| 44 | 10.2 Apply regular updates and improvements. |

**Appendix B: Project Schedule**

**A screenshot of a calendar

Description automatically generated**

**A screenshot of a project

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Description automatically generatedA screenshot of a project

Description automatically generatedA screenshot of a computer

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**Appendix C: RACI Matrix**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Task | **Project Manager** | **Product Manager** | **UI/UX Designer** | **Developer Lead** | **Lead Tester** | **Financial Manager** | **Content Lead** | **MBTA Representative** |
|  | **TapFare: MBTA on Your Mobile** |  |  |  |  |  |  |  |  |
| 1 | **1.0 Project Initiation** |  |  |  |  |  |  |  |  |
| 2 | 1.1 Identify Stakeholders | R | A,C | I | I | - | C | I | C |
| 3 | 1.2 Create Project Charter | R | C | I | I | - | C | I | C |
| 4 | 1.3 Develop Preliminary Budget | C | C | I | I | - | R | I | C |
| 5 | **2.0 Project Planning** |  |  |  |  |  |  |  |  |
| 6 | 2.1 Conduct Market Research | A | R | I | I | - | I | C | C |
| 7 | 2.2 Define Project Objectives | A | R | C | C | I | C | I | C |
| 8 | 2.3 Create a Risk Management Plan | R | C | C | C | - | C | I | C |
| 9 | 2.4 Establish a Project Schedule | R | C | C | C | I | C | I | C |
| 10 | 2.5 Define Resource Requirements | R | C | C | C | - | I | I | C |
| 11 | 2.6 Develop a Communication Plan | R | A,C | C | C | I | I | I | C |
| 12 | **3.0 Requirement Analysis** |  |  |  |  |  |  |  |  |
| 13 | 3.1 Define System Requirements | A | R,C | R,C | R,C | - | C | I | C |
| 14 | 3.2 Document Functional Requirements | A | R | C | C | - | C | I | C |
| 15 | 3.3 Prioritize Requirements | R | R,A | C | C | - | C | I | C |
| 16 | 3.4 Create a Requirement Traceability Matrix | R | I | C | C | - | C | I | C |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Task | **Project Manager** | **Product Manager** | **UI/UX Designer** | **Developer Lead** | **Lead Tester** | **Financial Manager** | **Content Lead** | **MBTA Representative** |
| 17 | **4.0 Software Development** |  |  |  |  |  |  |  |  |
| 18 | 4.1 Create the "Add a Card" Functionality | C | A,C | R,A | R,A | I |  | I | C |
| 19 | 4.2 Implement Secure Payment Gateways | C | A,C | R,A | R,A | I |  | I | C |
| 20 | 4.3 Develop the "Provide Real-Time Information" Component | C | A,C | R,A | R,A | I |  | I | C |
| 21 | 4.4 Create Real-Time Data Analytics and AI-Driven Algorithms | C | A,C | R,A | R,A | I |  | I | C |
| 22 | 4.5 Build User Management System | C | A,C | R,A | R,A | I |  | I | C |
| 23 | 4.6 Test the App Thoroughly | C | A | A | A | R |  | I | C |
| 24 | 4.7 Ensure Smooth Integration with MBTA | C | R | C | R | C |  | I | C |
| 25 | **5.0 Testing and Quality Assurance** |  |  |  |  |  |  |  |  |
| 26 | 5.1 Perform integration testing | I | A,C | A,C | A,C | R |  | I | C |
| 27 | 5.2 Execute user acceptance testing | I | A,C | A,C | A,C | R |  | I | C |
| 28 | 5.3 Evaluate performance and scalability | I | A,C | A,C | A,C | R |  | I | C |
| 29 | **6.0 Deployment** |  |  |  |  |  |  |  |  |
| 30 | 6.1 Configure cloud infrastructure | C | C | C | R | - | C | I | C |
| 31 | 6.2 Set up servers for app operation | C | C | C | R | - | C | I | C |
| 32 | **7.0 User Training and Support** |  |  |  |  |  |  |  |  |
| 33 | 7.1 Create FAQs | C | C | I | I | - | I | R | A |
| 34 | 7.2 Set up support chatbots | C | C | I | I | - | I | R | A |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Task | **Project Manager** | **Product Manager** | **UI/UX Designer** | **Developer Lead** | **Lead Tester** | **Financial Manager** | **Content Lead** | **MBTA Representative** |
| 35 | **8.0 Project Closure** |  |  |  |  |  |  |  |  |
| 36 | 8.1 Conduct a project review | R | A,C | C | C | - | I | I | R,A |
| 37 | 8.2 Obtain client approvals | A | C | C | C | - | C | I | R |
| 38 | 8.3 Transition project assets and knowledge | A,C | A,C | C,I | C,I |  | C | R,C | R,A |
| 39 | **9.0 Handover to MBTA** |  |  |  |  |  |  |  |  |
| 40 | 9.1 Provide training and knowledge transfer to MBTA team | R,A | C | I | I | - | I | R | R,A |
| 41 | 9.2 Ensure smooth transition of project ownership | A | C | C | C | - | I | I | R |
| 42 | **10.0 Monitoring and Maintenance** |  |  |  |  |  |  |  |  |
| 43 | 10.1 Address bug fixes | C | C | A | A | R | I | I | C |
| 44 | 10.2 Apply regular updates and improvements | I | C | R,A | R,A | A |  | I | C |

**Appendix D: Resource Allocation Plan**

|  |  |
| --- | --- |
| Client | MBTA |
| Project | TapFare: MBTA on Your Mobile |
| Budget hours | 24000 hrs |
| Contract value | $1,528,813 |
| Project Start Date | 01/08/2023 |
| Project End Date | 04/10/2024 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Resources | Type | Role | Efforts (Hours) | Rate Per Hour | Total | Allocation |
| Dhivith | Labor | Project Manager | 2400 hrs | $41.66 | $100,000 | 100% |
| Nivedita | Labor | Developer Lead | 2400 hrs | $41.66 | $100,000 | 90% |
| Vignesh | Labor | UI/UX Designer | 2400 hrs | $41.66 | $100,000 | 60% |
| Eshaan | Labor | Product Manager | 2400 hrs | $41.66 | $100,000 | 100% |
| Nithyasri | Labor | Lead Tester | 2400 hrs | $41.66 | $100,000 | 90% |
| Vivek | Labor | Financial Manager | 2400 hrs | $41.66 | $100,000 | 60% |
| Vinit | Labor | Content Lead | 2400 hrs | $41.66 | $100,000 | 60% |
| Google/App Store | External Company | Application Deployment Platforms | - | - | - | - |
| Paypal, Apple Pay | External Company | Payment Integration Platforms | - | - | - | - |
| AWS, Google Cloud | External Company | Cloud Deployment Platform | - | - | - | - |
| Adobe/ Figma | External Company | Design Platforms | - | - | - | - |
| Saigon Technology, Science Soft | Labor | Software Developers/ UI Designers | 3400 hrs | - | $200,000 | 100% |
| EAC (Hours) | Contingency | Total (Hours) |  |  |  |  |
| 20200 | **15.83%** | **24000** |  |  |  |  |

**Appendix E: Budget Justification**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Project Name: TapFare: MBTA on Your Mobile** | | | | | | | | | **Total Budget** | **$1,528,813** |
| **ID** | **Task description** | **Resources** | | | | | | |  |  |
| **Labor** | | | | **Materials and Equipment** | | | **Miscellaneous** | **Task Total Cost** |
| **No. of People** | **Working Hours** | **Hourly Rate** | **Estimated Cost** | **Qty** | **Unit Price** | **Estimated Cost (Quantity \* Unit Price)** |
| 1 | Project Initiation | 5 | 140 | 95 | $66,500 | 10 | $1,500 | $15,000 | 4000 | $85,500 |
| 2 | Project Planning | 5 | 220 | 95 | $104,500 | 14 | $1,600 | $22,400 | 7250 | $134,150 |
| 3 | Requirement Analysis | 4 | 180 | 95 | $68,400 | 15 | $1,563 | $23,438 | 6750 | $98,588 |
| 4 | Software Development | 8 | 560 | 100 | $448,000 | 80 | $2,100 | $168,000 | 10500 | $626,500 |
| 5 | Testing and Quality Assurance | 4 | 200 | 80 | $64,000 | 15 | $1,875 | $28,125 | 7750 | $99,875 |
| 7 | User Training and Support | 1 | 140 | 100 | $14,000 | 5 | $1,300 | $6,500 | 6250 | $26,750 |
| 8 | Project Closure | 4 | 150 | 90 | $54,000 | 8 | $1,625 | $13,000 | 8000 | $75,000 |
| 9 | Handover to MBTA | 3 | 110 | 90 | $29,700 | 10 | $1,525 | $15,250 | 9500 | $54,450 |
| 10 | Monitoring and Maintenance | 2 | 150 | 80 | $24,000 | 20 | $2,000 | $40,000 | 5000 | $69,000 |
| 11 | Address bug fixes | 2 | 150 | 100 | $30,000 | 30 | $2,100 | $63,000 | 8500 | $101,500 |
| 12 | Apply regular updates and improvements | 3 | 150 | 100 | $45,000 | 50 | $2,100 | $1,05,000 | 7500 | $157,500 |
|  | **Cost without Contingency** | | | | | | | | | **$1,528,813** |
|  | **Contingency Costs** | | | | | | | | | **$210,000** |
|  | **Total Cost** | | | | | | | | | **$1,738,813** |

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