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Project Proposal Draft 2

TapFare: MBTA on Your Mobile

EMGT 5220 Engineering Project Management Fall 2023

Team 7: PM Powerhouse

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# Letter of Transmittal

# Executive Summary

# 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 This outdated method gives rise to several problems, such as: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 travelers 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.

# 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 $1,738,813. 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’s (Massachusetts Bay Transportation Authority) day-to-day commuters are the primary users of our app and hence they are our customers.

**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

# Risk Assessment Management Plan

# 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 & Maintainence: $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 a five-year period.

|  |  |  |  |
| --- | --- | --- | --- |
| **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. Prior to 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 graph

Description automatically generated

A screenshot of a graph

Description automatically generated

**Appendix C: RACI Matrix**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Task | **Dhivith - Project Manager** | **Eshaan - Product Manager** | **Vignesh - UI/UX Designer** | **Nivedita - Developer Lead** | **Nithyasri Ravi - Lead Tester** | **Vivek -Financial Manager** | **Vinit - 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 | A |
| 3 | 1.2 Create Project Charter | R | C | I | I | - | C | I | A |
| 4 | 1.3 Develop Preliminary Budget | C | C | I | I | - | R | I | A |
| 5 | **2.0 Project Planning** |  |  |  |  |  |  |  |  |
| 6 | 2.1 Conduct Market Research | A | R | I | I | - | I | C | A |
| 7 | 2.2 Define Project Objectives | A | R | C | C | I | C | I | A |
| 8 | 2.3 Create a Risk Management Plan | R | C | C | C | - | C | I | A |
| 9 | 2.4 Establish a Project Schedule | R | C | C | C | I | C | I | A |
| 10 | 2.5 Define Resource Requirements | R | C | C | C | - | I | I | A |
| 11 | 2.6 Develop a Communication Plan | R | A,C | C | C | I | I | I | A |
| 12 | **3.0 Requirement Analysis** |  |  |  |  |  |  |  |  |
| 13 | 3.1 Define System Requirements | A | R,C | R,C | R,C | - | C | I | A |
| 14 | 3.2 Document Functional Requirements | A | R | C | C | - | C | I | A |
| 15 | 3.3 Prioritize Requirements | R | R,A | C | C | - | C | I | A |
| 16 | 3.4 Create a Requirement Traceability Matrix | R | I | C | C | - | C | I | A |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Task | **Dhivith - Project Manager** | **Eshaan - Product Manager** | **Vignesh - UI/UX Designer** | **Nivedita - Developer Lead** | **Nithyasri Ravi - Lead Tester** | **Vivek -Financial Manager** | **Vinit - 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 | A |
| 19 | 4.2 Implement Secure Payment Gateways | C | A,C | R,A | R,A | I |  | I | A |
| 20 | 4.3 Develop the "Provide Real-Time Information" Component | C | A,C | R,A | R,A | I |  | I | A |
| 21 | 4.4 Create Real-Time Data Analytics and AI-Driven Algorithms | C | A,C | R,A | R,A | I |  | I | A |
| 22 | 4.5 Build User Management System | C | A,C | R,A | R,A | I |  | I | A |
| 23 | 4.6 Test the App Thoroughly | C | A | A | A | R |  | I | A |
| 24 | 4.7 Ensure Smooth Integration with MBTA | C | R | C | R | C |  | I | A |
| 25 | **5.0 Testing and Quality Assurance** |  |  |  |  |  |  |  |  |
| 26 | 5.1 Perform integration testing | I | A,C | A,C | A,C | R |  | I | A |
| 27 | 5.2 Execute user acceptance testing | I | A,C | A,C | A,C | R |  | I | A |
| 28 | 5.3 Evaluate performance and scalability | I | A,C | A,C | A,C | R |  | I | A |
| 29 | **6.0 Deployment** |  |  |  |  |  |  |  |  |
| 30 | 6.1 Configure cloud infrastructure | C | C | C | R | - | C | I | A |
| 31 | 6.2 Set up servers for app operation | C | C | C | R | - | C | I | A |
| 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 | **Dhivith - Project Manager** | **Eshaan - Product Manager** | **Vignesh - UI/UX Designer** | **Nivedita - Developer Lead** | **Nithyasri Ravi - Lead Tester** | **Vivek -Financial Manager** | **Vinit - 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 | A |
| 44 | 10.2 Apply regular updates and improvements | I | C | R,A | R,A | A |  | I | A |

**Appendix D: Resource Allocation Plan**

|  |  |
| --- | --- |
| Client | MBTA |
| Project | TapFare: MBTA on Your Mobile |
| Budget hours | 24000 hrs |
| Contract value | $1,738,813 |
| 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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