EMGT-5220 Engineering Project Management SEC 01

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Project Proposal

Optimizing Equipment Procurement and Maintenance in the Mining Industry

Team 3

Mrunal Payagude

Vibin Roy

Madhav Sirsat

Ujjwal Srivastava

Mohammed Rehan Shaik

Bhavana Tadiboina

Saurya Vadlamudi

Point of Contact

Vibin Roy

(roy.v@northeastern.edu)

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Letter of Transmittal

Date:04/28/2022

Dr., Himlona Phalikhe
Northeastern Graduate School of Engineering
130 Snell Engineering
360 Huntington Avenue
Boston, MA 02115

Dear Dr., Himlona Phalikhe,

Please find enclosed the submittal of the project proposal for the Optimizing Equipment Procurement and Maintenance in the Mining Industry. Our application design and produce a globalized platform for miners and sellers to procure and maintain industrial equipment.

We propose to develop a web application that we integrated with a machine learning predictive tool to increase scalability and vision in terms of future trends in purchase and maintenance. The technical implementation of the project includes gathering historical data from customers and current data using DAQ Systems and training a supervised ML model to predict breakdowns and failures, and suggesting technicians and required spare parts. The proposal will be implemented using a Scaled Agile-Lean methodology with a structured schedule and resource allocation that serves the customers, Just-In-Time.

We thank you for an amazing course experience, continued mentoring, and support throughout the course and project. We are confident about various project management practices and are eager to put them to practice as project managers.

Thank you for your time and efforts

Sincerely,

Mrunal Payagude
Vibin Roy
Madhav Sirsat
Ujjwal Srivastava
Mohammed Rehan Shaik
Bhavana Tadiboina
Saurya Vadlamudi

1. Introduction

1.1. Problem

The mining equipment market is projected to grow to a valuation of USD 135 billion by 2025 driven by the introduction of innovative technology like electric machinery and the internet of things. Additionally, government support and growing investments in the sector further encourage this growth.[1] However, a majority of completed industrial machinery trades are severely dependent on well-established trust networks between different buyer and seller groups prevalent in the industry. This has posed a challenge in acquiring essential equipment for the operation to keep up with the industry growth, especially for new players in the market who aren't influential in these trusted trade networks.

The impact of this problem is further exacerbated when mining companies experience downtime due to equipment failure. Delays incurred while procuring new equipment, critical spare parts, or unavailability of service technicians can quickly add up to a significant loss that could be detrimental to the existence of the business.

1.2. Solution

The solution to this problem proposed here is to build a platform that enables the transparent trade of mining equipment and spare parts. An AI-powered predictive maintenance feature will also be integrated into this platform to assess the operating condition of the equipment in use to schedule necessary preventive maintenance with technicians and avoid any costly unplanned equipment failure. Additionally, it would also suggest authorized technicians available in the vicinity of the mining operation along with the services available and the cost. The result of this project would be a digital web platform that is accessible to all members in the market regardless of their size or geographical location. While this solution focuses predominantly on the firms based in Hyderabad or its initial rollout, provisions to expand it globally would be considered during the development. Our team has engineers with good relations in the mining industry, and experience building a startup and managing medium to large scale global projects in different technical areas. Existing, as well as upcoming mining companies, will benefit from this solution by getting access to the latest technology in the sector that is forecasted to grow in the next five years and optimizing their equipment maintenance operations.

[1] Global Mining Equipment Market, 2021-2030: Increase in Demand for Underground and Technologically Advanced Mining Equipment

2. Purpose & Objective

2.1. Purpose

The purpose of this project is to build a digital solution that unites multiple segments of the mining equipment industry such as mining companies, sellers, manufacturers, and technical service agencies to promote seamless procurement and maintenance of industrial mining equipment. This product will transform data into actionable insights for the customers to predict equipment failure, diagnose a technical issue without having a technician visually inspect the equipment, and gives access to trade networks for equipment and spare part procurement.

2.2. Objective

Incorporating different industry segments in this project demands separate diverse objectives for each of them. The primary objective of this project is to design an AI-powered platform that optimizes the procurement and maintenance of industrial mining equipment using data from different components of the market. This can be further streamlined into sub-objectives:

1. Consolidate information about the region and cost of industry equipment sellers and manufacturers as well as if they are affiliated with any trade networks
2. Develop a system to collect accurate operational data from equipment in use
3. Design a web application and machine learning model to effectively predict equipment failure and suggest authorized technicians in the vicinity

3. Technical Overview

The technical overview offers insights into how large datasets collected from the market can be used to create a predictive maintenance machine learning model and optimize the procurement process. This section is made more comprehensible by dividing it based on the digital solutions used in the project.

3.1. Machine Learning Model

The data gathered from mining engineers through customer research will be the backbone for creating a machine learning model to predict failure and suggest technicians and spare part sellers. Information such as loading time, payload, cycle time, change time, utilization, and maintenance logs will be collected and aligned to the database architecture employed in this project. It is also ensured that this data is fairly accurate and renders the actual operating condition of the equipment. An algorithm for the model would be selected based on the exploratory analysis of the different kinds of data available. This algorithm is then trained using the dataset using a time series analysis. Finally, the model will be deployed if the performance meets the targets set in the initial phase of the project.

3.2. Data Storage

Data servers are required to store the large amount of data collected from suppliers and mining companies. Configuring and maintaining data servers requires a significant amount of skilled effort and infrastructure. Cloud storage solutions available in the market today alleviate this concern and make it possible to stock data on servers that are not owned by the users. Considering the scalability of this project, cloud storage is used during the initial development. Provision for migrating large datasets to dedicated data management infrastructure during the expansion phase would be a key focus during the software development.

Among many cloud solutions available in the market today, Azure is selected for managing this database based on project research. It provides the development environment and tools required for designing a new cloud service. While there is a learning curve, Azure is built and optimized to perform consistently with .NET frameworks which would be crucial while migrating to a company-managed data server during the expansion phase. Additionally, it is the most cost-effective solution that is appropriate for this project.

3.3. Web Application

Clients will interact with this platform using a web application to procure components, monitor equipment performance, and schedule maintenance. Several operating systems can host this interface, but a web application was chosen for the initial phase over a mobile application because it can be launched into the market without app store approvals and is easy to update. Another key advantage is that it can be accessed from a browser on any device and does not require any downloads.

4. Implementation Plan

4.1. Work Breakdown Structure (WBS)

WBS is a hierarchical breakdown of the project deliverables that are developed according to the execution strategy decided by the management to achieve the project objectives. It encompasses both internal and external deliverables. Each successive level denotes a more detailed task breakdown of the predecessor. It is based on the 4/40 rule where the duration of each work package should be over 4 hours but less than 40 hours.

This WBS is organized according to the project phases which are project initiation, project planning, project execution, and project closing.

1. **The Project Initiation Phase**
   Contains all pre-planning tasks such as defining the project scope, execution strategy, and milestones. The project manager collaborates with the project sponsor to collect required documents from mining companies and stakeholders as well as decide leadership roles for the project based on the team's experience.

2. **The Project Planning Phase**
   Involves all the activities required to create a detailed schedule, budget, and resource allocation that would be fundamental to the smooth functioning of the execution phase. Market research will also be carried out during this phase to obtain the inputs to commence the execution phase by conducting an exploratory analysis of the machine learning model.

3. **The Project Execution Phase**
   This, being the longest and the most task incentive phase, focuses on software development including wireframe design, testing, debugging, and launching the initial beta version to identified focus groups. Agile methods will be employed for collaborative software development. Additionally, this phase involves configuring data servers with the most efficient database architecture and improving the beta version based on the feedback received. Once the data storage is set up and software development is in its final stage, tasks for obtaining legal permits and developing a marketing plan are also executed.

4. **The Project Closing Phase**
   Includes designing the monitoring and control measures for the project and tracking customer feedback to assess the application performance. Test case and process reports are also generated and documented for future use. Future expansion activities and business goals are also prioritized and planned for using strategic and tactical projects in this phase. Lastly, a final project report encompassing inputs from the stakeholders and project sponsor about the tasks in this project is created and documented.

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

4.2. Schedule

A detailed schedule including task start and finish dates is prepared during the project planning phase. It is developed using the WBS structure and serves as an important tool for monitoring and controlling the project's progress. The duration for each activity in the schedule was estimated based on similar previous projects and verified by experienced team members. An additional allowance of 15% for personal time is included in the estimated hours for each task.

The major milestones and budget prepared in the project planning phase are used as the reference for deciding the resource allocation for each task. For tracking the performance of the project and accounting for the changes in the schedule, the schedule is prepared on MS Project. Gantt charts, activity network diagrams, and resource loading can easily be monitored on this software.

Refer to appendix B for the Gantt chart of the project based on initial planning.

4.3. Responsibility Chart

The responsibility chart, also known as RACI Matrix, provides insights about the responsible, accountable, consulted, and informed team members for each task in the project. Once again, this is created using the WBS structure which gives sufficient details about the tasks involved in the project. Responsible members of the task would invest most of the efforts required to complete the task in consultation with the designated members. The task would then be approved by a member who is held accountable for it and the team's work. The final work and the proceedings will be forwarded to the informed member of the RACI matrix. While there might be multiple members for each designation, there should only be one accountable member to avoid conflicts or confusion.

Refer to appendix C for the RACI matrix.

4.4. Resource Allocation

Resource allocation is created based on the schedule and RACI matrix to determine the contribution required for each task. It serves as the input along with the schedule for creating the project budget. The resource allocation is divided into two parts. Firstly, estimated hours for each project member, and secondly, the cost of the software and equipment required to support this project. Additionally, it includes each member's hourly rates and allocation of their total available hours to this project.

Refer to appendix D for the Resource Allocation.

4.5. Stakeholders

This section lists all the involved members during the tenure of this project.

- **Project team**
    - **Financial Manager**
      Mrunal Payagude
    - **Project Manager**
      Vibin Roy
    - **Head of Design**
      Madhav Sirsat
    - **Quality Manager**
      Ujjwal Srivastava
    - **Marketing Manager**
      Mohammed Rehan Shaik
    - **Software Development Manager**
      Bhavana Tadiboina
    - **Data Manager**
      Saurya Vadlamudi

See section 8 for team member credentials.

- **Project Sponsor**

The project sponsor owns the project and provides resources and support for the project.

- **Resource Management Team**

The Resource management team is composed of:

    - Resource allocation specialist
    - Financial Analysts

- **Customer**

Our target customers are mining companies based in Hyderabad.

5. Execution Plan

5.1. Project Monitoring

Project monitoring guarantees that the milestones set in the project planning phase are met within the specified timeline by collecting and reporting information concerning all aspects of the project performance. All project objectives derived in the project planning stage must be examined and measures for each should be included in the monitoring system. Similarly, all risks that were identified in the risk management plan should be monitored based on their risk priority number.

Data Security

One of the major risks that are imminent in this project is the security of the data shared by manufacturers, sellers, and mining companies. Potential data leakage can result in the termination of the entire project. The data manager is responsible for designing databases on secure servers and evaluating security threats every week.

Customer Feedback

The disruptive nature of this project in the mining equipment industry demands the approval of as many members of the mining market as possible, even while the platform is being built. Customer feedback (especially during data collection and beta testing) is key to evaluating the acceptance of the project after deployment and bridging the gap between stakeholders, customers, and project objectives. Several means for collecting feedback are planned in this project by the marketing team. This includes online portals, phone surveys, relationship surveys, transactional surveys, etc.

Schedule

The project schedule is monitored and reported regularly to ensure the project milestones are met with the resources allocated in the project planning stage. Monitoring the project schedule also helps in managing the timeline, resources needed, and timely delivery of the project. The overall project performance is also analyzed by measuring each task's aggregated earned value (EV).

Changes

Changes made by the project team, client, or management must be closely monitored for their impact on project scope, time, and cost. Change orders should include the scope of change in detail and the additional resources that would be needed. This would make it easier for the project manager to update the project timeline and resource allocation to accommodate the changes such that the original project plan is least affected. Implementation of approved changes and schedule amendments should also be carefully monitored to ensure that project objectives are fulfilled.

Cost

Expense monitoring indicates the efforts that have been devoted to each task or additional resources allocated to complete each activity. This also keeps track of actual versus planned expenditure for the entire project which helps the guide project manager to stay within budget. If there was a cost overrun in one of the deliverables, plans can be made to reduce expenses in another future deliverable.

Stakeholder

Monitoring stakeholder relationships and their influence on the finances, legal matters, and efficiency of operations are central to running the project smoothly. It not only leads to an increase in stakeholder engagement but also helps in conflict resolution. The RACI matrix prepared in the initial stages determines the extent of involvement permitted to each stakeholder for every major activity in the WBS.

Quality Assurance

A major responsibility of the quality manager is to ensure that the data collected for training the machine learning model for predictive maintenance is not biased and gives a reasonable estimation of the equipment operations in the market today as well as prevalent trade networks. Apart from data, the quality of project deliverables and performance of the project team is also monitored using KPIs derived specifically for this project. The implementation of recommendations from audits is also monitored and at the same time, findings from this quality assurance monitoring that are beyond the threshold can trigger audits.

5.2. Project Controlling

This application enables transparent trade and seamless procurement of mining equipment. During the application development phase, there is a need for continuous control that works with monitoring. A mixed project control mechanism is used in this project- Cybernetic and Go/No-Go Control. Weekly meetings are conducted to discuss the progress and bottlenecks in the development or testing. These meetings will summarize the control mechanism, frequency, and who is responsible for the process completion.

All the software development processes use standardized Go/No-Go project control mechanisms and the requirement gathering, marketing, and budgeting processes would be based on the Cybernetic project control mechanic.

Control Category	Control Description	Frequency	Record/Output	Responsibility
Go/No-Go	Data sets for the Machine learning Model	Weekly	Data pattern and sanitization	Software Development Manager Data Manager
Go/No-Go	Data management infrastructure	Weekly	Configuration and maintaining data servers	Data Manager Software Development Manager
Go/No-Go	Web application	Weekly	Web application	Software Development Manager
Cybernetics	Marketing	Post Mobile app development	Marketing strategy	Marketing Manager Quality Manager
Cybernetics	Budget Justification	Weekly	Detailed financial reports	Financial Manager Project Manager
Go/No-Go	Quality assurance team	Daily	All activities in the project	Quality Manager Project Manager

5.3. Project Auditing

Auditing is a systematic and transparent quality management tool that determines whether project activities comply with organizational policies and project procedures. These audits also ensure that projects contribute to the organization's growth and return on investment by complying to project policies and procedures. Several audits are recommended for this project which is to be conducted by independent auditors with no conflict of interest.

The auditing team should consist of a combination of functional and subject matter experts. Project auditing has different types of audits with each having distinct objectives. When an audit is scheduled, the project manager and the project sponsor would be sent a formal notification which includes the scope, objective, and the audit team details. Auditors would carry out fieldwork in the form of interviews and document reviews to evaluate the project and find any deviations. These findings supported by clear evidence as well as recommendations to avoid recurrence in the future are included in an audit report which is submitted to the Project Manager and the management.

The final report will contain the audit results, management's response to the findings, and an account of the implementation of the recommendations provided by the auditors. Response from management would help in identifying any special circumstances that prompted the deviation and monitoring incorporation of recommendations would ensure that these are followed as intended.

The audits required in this project to ensure that the objectives are met are listed below:

- **Process Quality Audit**
    - **Risk Management**

The risk management plan's comprehensiveness and accuracy in gauging the impact and occurrence of the financial, legal, and operational risks identified in the management plan. It also evaluates the effectiveness of the risk mitigation plans and how it's communicated to the concerned stakeholders. How often updating and monitoring the project risk register is done is another key objective of this audit.

- **Project Management Practices**

This section of the audit investigates the compliance with project management procedures and documentation defined in the PMBOK. The project manager is responsible for handing over documents such as the business case, project charter, work breakdown structure, and risk management plan to the auditors when formally notified of the audit. Additionally, Control Objectives for Information and Related Technology (COBIT) framework is used as the benchmark for IT systems management practices. Any deviations from the standards such as missing documentation, absence of clearly defined procedures for dealing with project events, poor control, or ineffective communication within the project will be flagged and reported along with necessary recommendations to prevent the mistake and mitigate the impact of the damage.

- **Change Management**

Changes in the project plan, resources, or processes are inevitable in any project. The response to these changes by planning, managing, and reinforcing to incorporate this alteration is analyzed in this section. The outcomes and effectiveness of the action plans developed are utilized for this. Scope creep is another concern that is of major interest here. How a project avoids or lessens the impact of scope creep is also audited and included in the final report.

- **Project Gate Review**

Project gate audits are usually done before commencing the next phase of a project. This project is split into 4 major stages: Project Initiation, Project Planning, Project Execution, and Project Termination. The audit objectives for each of these are decided in the project initiation stage and would systematically cover strategic alignment to the organization's goals, plans and risks for the next stage, and preparedness for service.

- **Post-Implementation Audit**

This audit is a special type of gateway audit that is done 6 months after the end of the project termination stage. While the objectives might be similar to the other gateway audits, this one investigates the project proceedings from start to finish as well as its operational excellence and benefits realization. It takes into value the completion of objectives from the project charter, stakeholder satisfaction, budget compliance, lessons learned, and data security. Considering all the project events during the 4 stages, the accuracy of various financial, risk, and management reports generated during the project lifecycle is also investigated. This is essential for answering whether the project answered the problems addressed in the business case and for increasing the success probability of future projects.

5.4. Project Termination

The project termination phase includes implementing the monitoring and control measures for the project operation post-release and tracking customer feedback to assess the application performance. Test cases and process reports are also generated and documented for future reference. Measures taken for continuous integration and development process permits receiving continuous feedback from the stakeholders about the application's adaptability. To gain traction and popularity for the project, promotional offers planned by marketing and financial managers would be used to provide discounts and free trials to selected customers to try all the features. This will enable bug detection in the software and expand the customer database. Another major activity that is considered in this phase is the future expansion that is prioritized and planned using strategic and tactical projects. Marking the end of the project, a final project report encompassing inputs from the stakeholders and project sponsor about all the tasks and experiences in this project is submitted to the management and documented.

6. Risk Assessment Management Plan

As mentioned, and explained extensively in previous sections of this report, the disruptive nature of this project that aims to dismantle trade networks and facilitate transparent transactions incur several risks that are detrimental to the execution of this project. These risks are not only applicable after the deployment of the platform but also during the project execution phase. It is therefore evident that risk management must be taken into consideration while planning this project. The first step is to identify all the potential risks and then categorize them based on quantitative analysis. Following this, a risk matrix will be developed by placing all risks associated on a heat map and followed up throughout the project based on the risk management strategy for each category of risks.

6.1. Identification and Analysis of Risks

The quality manager is responsible and accountable for identifying the risks associated with each phase of the project and performing quantitative analysis to assess its influence on the operations. The identified risks are mentioned below:

- **Internal Risks**
  - Insufficient funding
  - Lack of collaboration and negative influence from external stakeholders
  - Unforeseeable circumstances amongst management

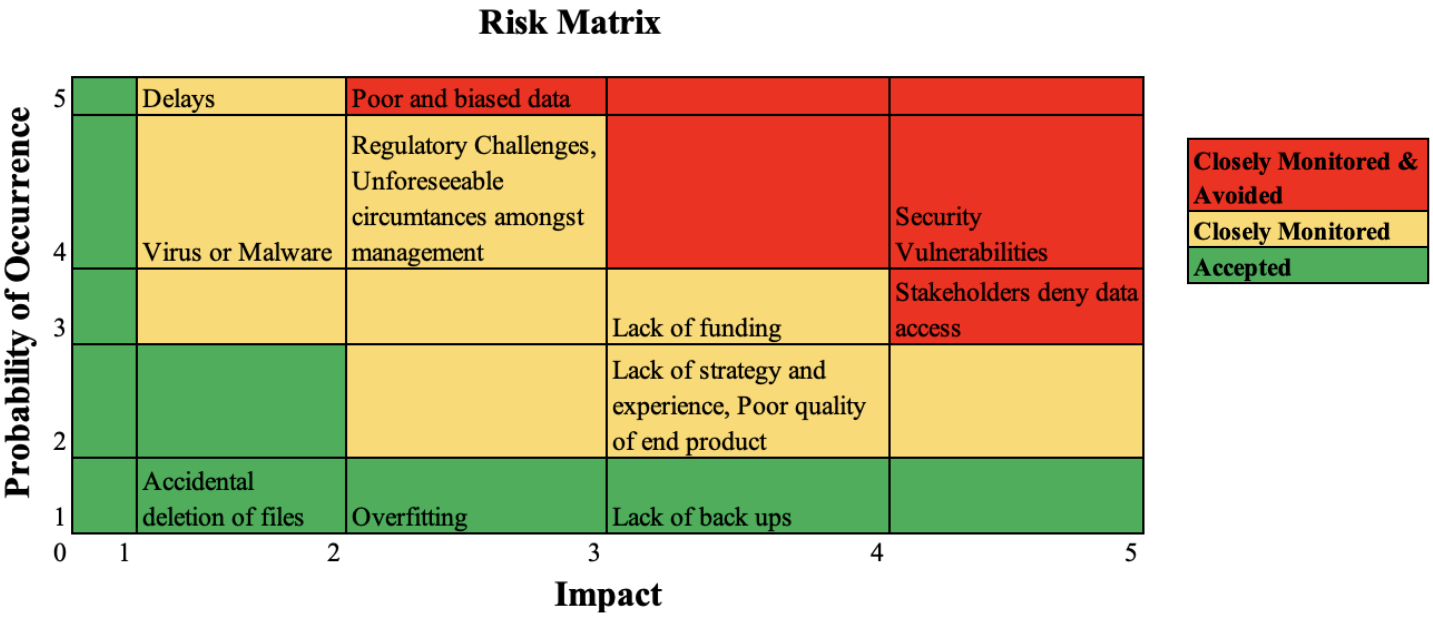
- **Data Risks**
  - Poor and biased data
  - Overfitting
  - Lack of backups
  - Virus or malware
  - Accidental deletion of files

- **Execution Risks**
  - Lack of strategy and experience
  - Security Vulnerabilities
  - Regulatory Challenges
  - Stakeholders deny data access
  - Poor quality of product
  - Delays

6.2. Risk Management Plan

Once potential risks have been acknowledged and categorized, a risk analysis is performed to develop a risk management plan. This analysis will be done using the logic below.

1. Scores ranging from 1 to 5 are defined for two parameters - Probability of Occurrence and Risk Impact. Each score also has defined criteria that are used to attribute every identified risk to these parameters.
2. Each risk is assigned a risk impact and probability of occurrence score based on the criteria defined in step 1, along with the reasoning for consigning the score
3. A Risk Priority Number (RPN) is calculated by multiplying the two scores for every risk listed in the plan
4. A risk matrix with a heat map is populated based on the RPN. Low risks are accepted, medium risks are monitored regularly but high risks identified are considered critical threats to the execution of the project and will be closely monitored frequently by the quality management team



Given the external influence nature of high risks identified in this project, the quality manager works closely with the data management, marketing department, and the project sponsor to monitor its impact. The cooperation with external stakeholders is monitored using surveys, focus groups, and in-person meetings to analyze the political attitude towards the project. These high risks are avoided as much as possible and control measures are devised by the management to mitigate any serious damage to the overall project health.

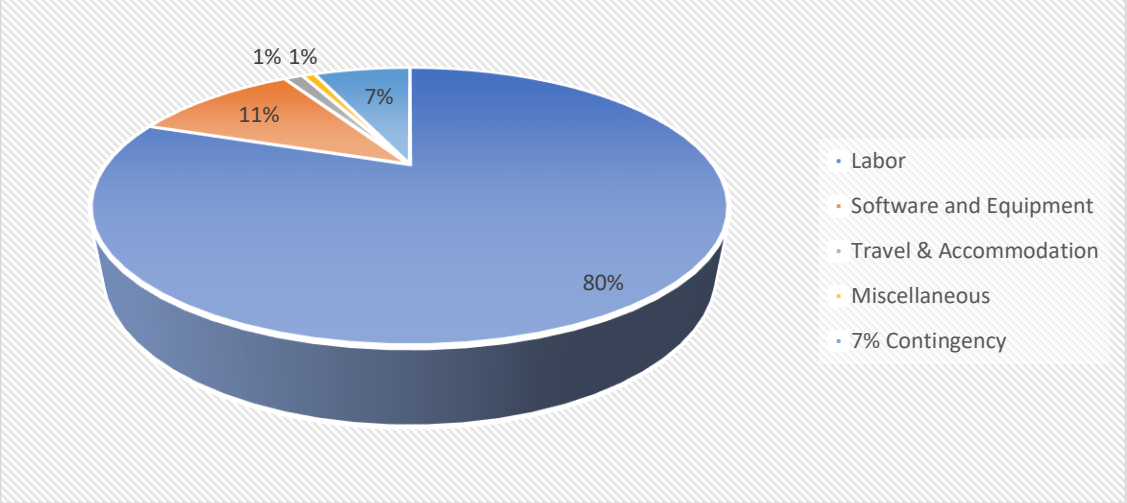
Data vulnerabilities, another critical high risk, are monitored by the quality manager in collaboration with the data manager. It is to be noted that this risk is considered in the very early database design process and measures are taken to ensure that the servers and protocols used will comply with these security requirements. These steps taken are expected to diminish any concerns that might compromise the good faith in this project.

7. Financial Plan with Budget

7.1. High-Level Details

The objective of this project is to design an AI-powered platform that optimizes the procurement and maintenance of industrial mining equipment using data collected from different segments of the market. A budget directly influences the complexity of the technical equipment used, risk tolerance, and how many resources can be allocated to meet the deadline.

Budget Summary	
Resources	**Total Cost**
Labor	$315,825.40
Software and Equipment	$43,000.00
Travel & Accommodation	$5,000.00
Miscellaneous	$3,360.00
7% Contingency	$25,702.98
Total Cost	**$392,888.38**



Refer to Appendix E for the detailed budget.

7.2. Budget Justification

The labor cost is derived from the budget that was created using the hourly rate for each task and the estimated hours. The hourly rate was set using the US labor data as well as current market trends[2]. Implementing this project requires minimal equipment, and the cost of setting up the infrastructure is set based on project research. Major components of this cost include different project management and software development applications as well as the cost of setting up a data server on the Azure platform. The cost of the marketing team visiting client sites to gather data as

well as for promoting the product constitutes travel and accommodation expense. This is considered as a separate expense rather than being included in miscellaneous because meeting customers in person and acquiring data is critical and has to be supervised closely to avoid any over expenditure. Apart from the labor and equipment cost, a 7% contingency allowance is also added to meet unprecedented needs in the project.

Assuming an annual cash flow of $90000 ($1500/month for each subscription), we have a payback period of approximately 4.5 years. This calculation is derived by estimating 5 customers to be onboarded upon deployment of the platform.

[2]Software Development Price Guide & Hourly Rate Comparison

8. Team Credentials

Mrunal Payagude

An Impact-driven and innovative technical individual pursuing MS in Engineering Management who loves to create a good product-market fit strategy and transform businesses. She is peculiar in identifying the customer's underserved needs and creating a value proposition. Having led projects from scratch in FinIQ Pvt Ltd, she has experience in agile methodologies, life-cycle management, data resource planning, budgeting, and is fluent with cross-functional teams. Working as a financial manager, she is utilizing her professional experience and skills in handling project budgets and overseeing the project lifecycle.

Vibin Roy

A problem-oriented and analytical graduate student pursuing an MS in Engineering Management at Northeastern University. He has solid professional experience working in the project management department as an Associate Project Engineer at Hitachi Energy. MS project, advanced Microsoft Excel, JIRA, and AutoCAD are some of the software in his expertise. In addition to the several leadership roles and student organizations that he has been part of, he also has experience leading initiatives in a corporate setting. Passion for sustainability and renewable energy drives him, and he aspires to become a competent project manager who brings challenging and complex projects to life. Combining passion and professional experience, he manages this project by coordinating members and organizing the tasks.

Madhav Sirsat

A highly analytical and process-oriented individual pursuing an MS in Engineering Management at Northeastern University with Data Engineering as a concentration and over almost two years of professional experience as a Data Analyst at ASK Industries, India. His experience in several projects with stringent budgets, tight deadlines, and ever-evolving requirements during both his professional run and while pursuing a bachelor's has given him the acute skills necessary to be a successful designer. Currently, he aspires to solve convoluted problems in the data engineering world by enhancing his design skills.

Ujjwal Srivastava

A graduate student pursuing an MS in Engineering Management at Northeastern University. He has an undergraduate degree in Electrical and Electronics Engineering, with an elective focus on business analytics and organizational behavior. He is extensively involved in data visualization and quality tools, as well as has held numerous management and leadership positions in student organizations. He is now delving into project quality management and strives to handle projects and deliver results with the best quality by creating KPIs and dashboards for monitoring.

Mohammed Rehan Shaik

A graduate student pursuing an MS in Engineering Management at Northeastern University aiming to be a Marketing Manager and lead his startup to change the trends in the Mining Industry. At the

outset, his long-term goal was to transform his father's business into an enduring institution that may seem like a story of inheritance. Yet, his family business is a story of moving an entire community of 200 forward with an entrepreneurial spirit. The idea was to use artificial intelligence to completely replace or enhance the current procedure and protocols in the unorganized mining sector. He is leveraging his contacts in the industry and his experience setting up similar startups to tackle marketing for the project and deliver the best results.

Bhavana Tadiboina

A graduate student pursuing her master's degree in Engineering Management at Northeastern University aims to be a Project Manager. Having gained experience in programming with Java, and Python she ventured out to develop a project on Acoustic Event Detection using AI and Deep Learning. Later she worked with Value Momentum as a Quality Analyst-automated design and test scenarios, project life cycle implementation, and has been a part of the agile implementation team. She is preparing to clear CAPM and CSM to master Project Management skills.

Saurya Vadlamudi

A graduate student pursuing his master's degree in Engineering Management at Northeastern University. He has an undergraduate degree in Mechanical Engineering, with a specialization in automotive engineering. He gained exposure to powertrain systems, supplier & team relations, project management, and team building by being part of the Formula team. He loves to work with data and its applications to make informed decisions. Currently, he is working to extend his reach into the supply chain and project management along with exploring leveraging data analytics to make supply chain processes more efficient.

APPENDICES

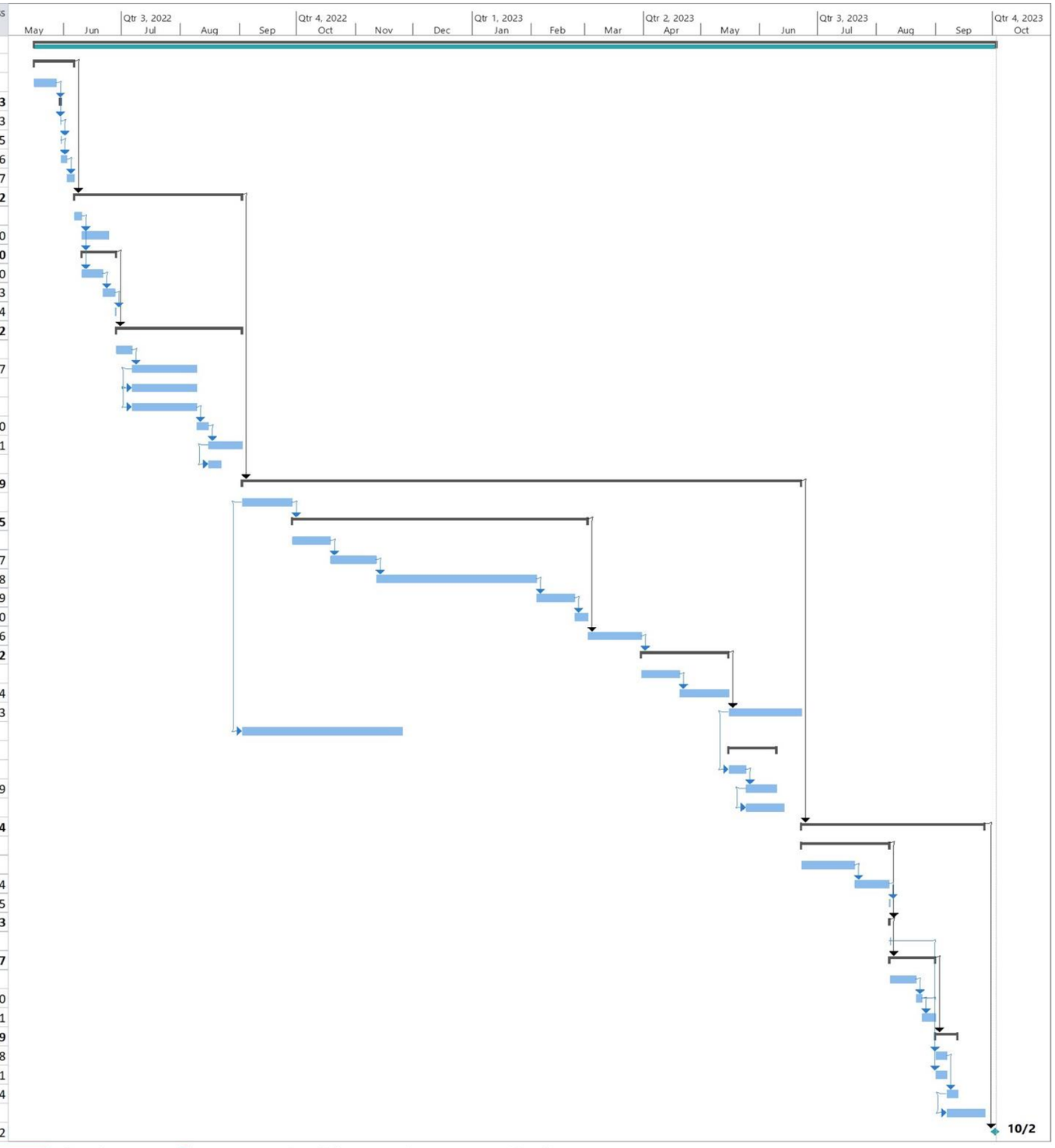
Appendix A: Work Break-down Structure

ID	Task
1	**1.0 Project Initiation Phase**
2	**1.1 Hold Project Initiation Meeting**
3	1.1.1 Define Scope and execution strategy
4	1.1.2 Set schedules for major milestones
5	1.1.3 Assign leadership roles
6	1.1.4 Gather required documents from clients and stakeholders
7	**1.2 Prepare RACI matrix**
8	**2.0 Project Planning Phase**
9	**2.1 Detailed Schedule and task dependencies**
10	**2.2 Risk Management**
11	**2.3 Budgeting and Resource Allocation**
12	2.3.1 Allocate resources based on schedule and project milestones
13	2.3.2 Estimate the cost of software & equipment by forecasting application traffic
14	2.3.3 Estimate overhead costs and prepare final budget
15	**2.4 Market Research**
16	2.4.1 Collect equipment inventory list and maintenance logs from mining companies
17	2.4.2 Seller Agencies: Interview to validate needs and gather information
18	2.4.2.1 Information on trade networks and equipment sale trends
19	2.4.2.2 Information on spare part sellers
20	2.4.2.3 Cost and location information about authorized technicians
21	2.4.3 Identify industry focus groups for beta testing and customer feedback
22	**3.0 Project Execution Phase**
23	3.1 Testing Machine Learning Model feasibility for predictive maintenance
24	**3.2 Product /software Development**
25	3.2.1 Define UI/UX design strategy
26	3.2.2 Wireframe design
27	3.2.3 Application development with selected machine model
28	3.2.4 User interface testing
29	3.2.5 Launching Beta version of the application
30	**3.3 Configure data servers and develop database management process**
31	**3.4 Beta version customer feedback**
32	3.4.1 Promote beta version to companies and seller agencies for customer feedback
33	3.4.2 Compile user pain-points and bug reports for troubleshooting
34	**3.5 Full version application deployment with predictive maintenance and database**

35	**3.6 Obtain legal permits and IP for application**
36	**3.7 Marketing and Outreach**
37	3.7.1 Develop promotional plan for free trial and premium membership opportunity
38	3.7.2 Application demo for potential clients identified
39	**4.0 Project Closing Phase**
40	**4.1 Customer Feedback**
41	4.1.1 Monitor customer experience
42	4.1.2 Resolve issues and release updates
43	4.1.3 Quality assurance updates meeting
44	**4.2 Documentation**
45	4.2.1 Meeting with stakeholders to document the process
46	4.2.2 Create a visualization map of the process
47	4.2.3 Documentation of test cases
48	**4.3 Monitoring & Updates**
49	4.3.1 Develop a new process to monitor application usage and track complaints
50	4.3.2 Define KPIs for performance tracking from transactions made on the application
51	4.3.3 Continuous improvement plans for quality assurance
52	**4.4 Prioritize, plan and budget for future targets**
53	4.4.1 Expansion to other locations in US
54	4.4.2 Analytics team expansion based on userbase growth
55	4.4.3 Expansion into global markets
56	**4.5 Audits**
57	**4.6 Final Project Report**

Appendix B: Project Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	**OPTIMIZATION OF EQUIPMENT PROCUREMENT AND MAINTENANCE IN THE MINING INDUSTRY**	**361 days**	**5/16/2022**	**10/2/2023**	
2	**Project Initiation Phase**	**15.19 days**	**5/16/2022**	**6/6/2022**	
3	**Define Scope and execution strategy**	10 days	5/16/2022	5/27/2022	
4	**Hold Project Initiation Meeting**	**0.19 days**	**5/30/2022**	**5/30/2022**	**3**
5	Set schedules for major milestones	0.13 days	5/30/2022	5/30/2022	3
6	Assign leadership roles	0.06 days	5/30/2022	5/30/2022	5
7	Gather required documents from clients and stakeholders	3 days	5/30/2022	6/2/2022	6
8	**Prepare RACI matrix**	2 days	6/2/2022	6/6/2022	7
9	**Project Planning Phase**	**64.25 days**	**6/6/2022**	**9/2/2022**	**2**
10	**Detailed Schedule and task dependencies**	4 days	6/6/2022	6/10/2022	
11	**Risk Management**	10 days	6/10/2022	6/24/2022	10
12	**Budgeting and Resource Allocation**	**12.25 days**	**6/10/2022**	**6/28/2022**	**10**
13	Allocate resources based on schedule and project milestones	7 days	6/10/2022	6/21/2022	10
14	Estimate the cost of software & equipment by forecasting application traffic	4 days	6/21/2022	6/27/2022	13
15	Estimate overhead costs	1.25 days	6/27/2022	6/28/2022	14
16	**Market Research**	**48 days**	**6/28/2022**	**9/2/2022**	**12**
17	Collect equipment inventory list and maintenance logs from mining companies	6 days	6/28/2022	7/6/2022	
18	Seller Agencies: Interview to validate needs and gather information	24 days	7/6/2022	8/9/2022	17
19	Information on trade networks and equipment sale trends	24 days	7/6/2022	8/9/2022	18SS
20	Information on spare part sellers	24 days	7/6/2022	8/9/2022	19SS
21	Cost and location information about authorized technicians	4 days	8/9/2022	8/15/2022	20
22	Identify findustry focus groups for beta testing and customer feedback	14 days	8/15/2022	9/2/2022	21
23	Auditing	5 days	8/15/2022	8/22/2022	22SS
24	**Project Execution Phase**	**209 days**	**9/2/2022**	**6/22/2023**	**9**
25	**Testing Machine Learning Model feasibility for predictive maintenance**	18 days	9/2/2022	9/28/2022	
26	**Product /software Development**	**111 days**	**9/28/2022**	**3/2/2023**	**25**
27	Define UI/UX design strategy	14 days	9/28/2022	10/18/2022	
28	Wireframe design	18 days	10/18/2022	11/11/2022	27
29	Application development with selected machine model	60 days	11/11/2022	2/3/2023	28
30	User interface testing	14 days	2/3/2023	2/23/2023	29
31	Launching Beta version of the application	5 days	2/23/2023	3/2/2023	30
32	**Configure data servers and develop database management process**	20 days	3/2/2023	3/30/2023	26
33	**Beta version customer feedback**	**32 days**	**3/30/2023**	**5/15/2023**	**32**
34	Promote beta version to companies and seller agencies for customer feedback	14 days	3/30/2023	4/19/2023	
35	Compile user pain-points and bug reports for troubleshooting	18 days	4/19/2023	5/15/2023	34
36	**Full version application deployment with predictive maintenance and database**	28 days	5/15/2023	6/22/2023	33
37	**Obtain legal permits and IP for application**	60 days	9/2/2022	11/25/2022	25SS
38	**Marketing and Outreach**	**19 days**	**5/15/2023**	**6/9/2023**	
39	Develop promotional plan for free trial and premium membership opportunity	7 days	5/15/2023	5/24/2023	36SS
40	Application demo for potential clients identified	12 days	5/24/2023	6/9/2023	39
41	Auditing	14 days	5/24/2023	6/13/2023	40SS
42	**Project Closing Phase**	**68.5 days**	**6/22/2023**	**9/26/2023**	**24**
43	**Customer Feedback**	**32.25 days**	**6/22/2023**	**8/7/2023**	
44	Monitor customer experience	20 days	6/22/2023	7/20/2023	
45	Resolve issues and release updates	12 days	7/20/2023	8/7/2023	44
46	Quality assurance updates meeting	0.25 days	8/7/2023	8/7/2023	45
47	**Documentation**	**0.25 days**	**8/7/2023**	**8/7/2023**	**43**
48	Meeting with stakeholders to document the process	0.25 days	8/7/2023	8/7/2023	
49	**Monitoring & Updates**	**18 days**	**8/7/2023**	**8/31/2023**	**47**
50	Develop a new process to monitor application usage and track complaints	10 days	8/7/2023	8/21/2023	
51	Define KPIs for performance tracking from transactions made on the application	3 days	8/21/2023	8/24/2023	50
52	Continuous improvement plans for quality assurance	5 days	8/24/2023	8/31/2023	51
53	**Prioritize, plan and budget for future targets**	**8 days**	**8/31/2023**	**9/12/2023**	**49**
54	Expansion plan to other locations in US	4 days	8/31/2023	9/6/2023	48
55	Analytics team expansion plan based on userbase growth	4 days	8/31/2023	9/6/2023	51
56	Expansion plan into global markets	4 days	9/6/2023	9/12/2023	54
57	Post-Implementation Audit	14 days	9/6/2023	9/26/2023	56SS
58	**Final Project Report**	0 days	10/2/2023	10/2/2023	42



Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

Appendix C: RACI Matrix

ID	Task	Project Sponsor	Project Manager	Financial Manager	Head of Design	Marketing Manager	Resource Manager	Data Manager	Software Development Manager	Quality Manager
1	**1.0 Project Initiation Phase**									
2	**1.1 Hold Project Initiation Meeting**									
3	1.1.1 Define Scope and execution strategy	C	R	R						
4	1.1.2 Set schedules for major milestones	C	R	R						
5	1.1.3 Assign leadership roles	A	R	I	I	I	I	I	I	I
6	1.1.4 Gather required documents from clients and stakeholders		A	C		C	R			
7	**1.2 Prepare RACI matrix**		R	I	I	I	I	I	I	I
8	**2.0 Project Planning Phase**									
9	**2.1 Detailed Schedule and task dependencies**		R,A		C	C	R	C	C	
10	**2.2 Risk Management**	I	R	A						C
11	**2.3 Budgeting and Resource Allocation**									
12	2.3.1 Allocate resources based on schedule and project milestones		R	I	I	I	A	I	I	I
13	2.3.2 Estimate the cost of software & equipment by forecasting application traffic		A				R	C	C	
14	2.3.3 Estimate overhead costs and prepare final budget	I	A	R						
15	**2.4 Market Research**									
16	2.4.1 Collect equipment inventory list and maintenance logs from mining companies					R	A	C		
17	2.4.2 Seller Agencies: Interview to validate needs and gather information									
18	2.4.2.1 Information on trade networks and equipment sale trends	C	A			R	R	C		
19	2.4.2.2 Information on spare part sellers	C	A			R	R	C		
20	2.4.2.3 Cost and location information about authorized technicians	C	A			R	R	C		
21	2.4.3 Identify industry focus groups for beta testing and customer feedback	C	A			R	R			
22	**3.0 Project Execution Phase**									
23	3.1 Testing Machine Learning Model feasibility for predictive maintenance		I					R,A	R	C
24	**3.2 Product /software Development**									
25	3.2.1 Define UI/UX design strategy	C	C		R,A	C			C	
26	3.2.2 Wireframe design	C	C		A			C	R	
27	3.2.3 Application development with selected machine model		A					R	R	C
28	3.2.4 User interface testing		I		A				R	C
29	3.2.5 Launching Beta version of the application	C	A	I		R			R	I
30	**3.3 Configure data servers and develop database management process**		A	C				R	R	C
31	**3.4 Beta version customer feedback**									
32	3.4.1 Promote beta version to companies and seller agencies for customer feedback	I	A	C		R				C
33	3.4.2 Compile user pain-points and bug reports for troubleshooting		A				R	I	I	R
34	**3.5 Full version application deployment with predictive maintenance and database**	I	A		R			R	R	C
35	**3.6 Obtain legal permits and IP for application**	I	A	R			R			R
36	**3.7 Marketing and Outreach**									

ID	Task	Project Sponsor	Project Manager	Financial Manager	Head of Design	Marketing Manager	Resource Manager	Data Manager	Software Development Manager	Quality Manager
37	3.7.1 Develop promotional plan for free trial and premium membership oppurtunity	C	I	R		R,A				
38	3.7.2 Application demo for potential clients identified	C				A		R	R	I
39	**4.0 Project Closing Phase**									
40	**4.1 Customer Feedback**									
41	4.1.1 Monitor customer experience		R		R	A			C	R
42	4.1.2 Resolve issues and release updates	I	A		R			R	R	C
43	4.1.3 Quality assurance updates meeting		A			C				R
44	**4.2 Documentation**									
45	4.2.1 Meeting with stakeholders to document the process	C	R,A							
46	4.2.2 Create a visualization map of the process				R		R	C	C	A
47	4.2.3 Documentation of test cases				C	C	R		C	A
48	**4.3 Monitoring & Updates**									
49	4.3.1 Develop a new process to monitor application usage and track complaints		A					C	C	R
50	4.3.2 Define KPIs for performance tracking from transactions made on the application							C		R,A
51	4.3.3 Continuous improvement plans for quality assurance		C	C						R,A
52	**4.4 Prioritize, plan and budget for future targets**									
53	4.4.1 Expansion to other locations in US	A	C			R				
54	4.4.2 Analytics team expansion based on userbase growth	A		C				R		
55	4.4.3 Expansion into global markets	A				R				
56	**4.5 Audits**		R	R	C	C	R	C	C	R,A
57	**4.6 Final Project Report**		R	C	C	C	R	C	C	C

Appendix D: Budget Justification

ID	Task	Labor			Estimated Material Cost	Miscellaneous	Total Cost
		Estimated hours	Hourly Rate	Estimated Labor Cost			
1	**1.0 Project Initiation Phase**						
2	**1.1 Hold Project Initiation Meeting**						
3	1.1.1 Define Scope and execution strategy	80	$85.00	$6,800.00	$1,500.00	$840.00	$9,140.00
4	1.1.2 Set schedules for major milestones	1.04	$85.00	$88.40	$0.00	$0.00	$88.40
5	1.1.3 Assign leadership roles	0.48	$87.50	$42.00	$0.00	$0.00	$42.00
6	1.1.4 Gather required documents from clients and stakeholders	24	$67.50	$1,620.00	$0.00	$0.00	$1,620.00
7	**1.2 Prepare RACI matrix**	16	$90.00	$1,440.00	$0.00	$0.00	$1,440.00
8	**2.0 Project Planning Phase**						
9	**2.1 Detailed Schedule and task dependencies**	32	$67.50	$2,160.00	$1,500.00	$840.00	$4,500.00
10	**2.2 Risk Management**	80	$85.00	$6,800.00	$0.00	$0.00	$6,800.00
11	**2.3 Budgeting and Resource Allocation**						
12	2.3.1 Allocate resources based on schedule and project milestones	56	$67.50	$3,780.00	$0.00	$0.00	$3,780.00
13	2.3.2 Estimate the cost of software & equipment by forecasting application traffic	32	$67.50	$2,160.00	$0.00	$0.00	$2,160.00
14	2.3.3 Estimate overhead costs and prepare final budget	10	$85.00	$850.00	$0.00	$0.00	$850.00
15	**2.4 Market Research**						
16	2.4.1 Collect equipment inventory list and maintenance logs from mining companies	48	$60.00	$2,880.00	$0.00	$0.00	$2,880.00
17	**2.4.2 Seller Agencies: Interview to validate needs and gather information**						
18	2.4.2.1 Information on trade networks and equipment sale trends	192	$70.00	$13,440.00	$0.00	$0.00	$13,440.00
19	2.4.2.2 Information on spare part sellers	192	$70.00	$13,440.00	$0.00	$0.00	$13,440.00
20	2.4.2.3 Cost and location information about authorized technicians	32	$70.00	$2,240.00	$0.00	$0.00	$2,240.00
21	2.4.3 Identify industry focus groups for beta testing and customer feedback	112	$70.00	$7,840.00	$0.00	$0.00	$7,840.00
22	**3.0 Project Execution Phase**						
23	**3.1 Testing Machine Learning Model feasibility for predictive maintenance**	144	$80.00	$11,520.00	$0.00	$840.00	$12,360.00
24	**3.2 Product /software Development**						
25	3.2.1 Define UI/UX design strategy	112	$80.00	$8,960.00	$3,000.00	$0.00	$11,960.00
26	3.2.2 Wireframe design	144	$80.00	$11,520.00	$0.00	$0.00	$11,520.00
27	3.2.3 Application development with selected machine model	480	$83.33	$40,000.00	$20,000.00	$0.00	$60,000.00
28	3.2.4 User interface testing	112	$80.00	$8,960.00	$0.00	$0.00	$8,960.00
29	3.2.5 Launching Beta version of the application	40	$81.67	$3,266.67	$0.00	$0.00	$3,266.67
30	**3.3 Configure data servers and develop database management process**	160	$83.33	$13,333.33	$17,000.00	$0.00	$30,333.33
31	**3.4 Beta version customer feedback**						
32	3.4.1 Promote beta version to companies and seller agencies for customer feedback	112	$82.50	$9,240.00	$0.00	$0.00	$9,240.00
33	3.4.2 Compile user pain-points and bug reports for troubleshooting	144	$70.00	$10,080.00	$0.00	$0.00	$10,080.00
34	**3.5 Full version application deployment with predictive maintenance and database**	224	$82.50	$18,480.00	$0.00	$0.00	$18,480.00
35	**3.6 Obtain legal permits and IP for application**	480	$72.50	$34,800.00	$0.00	$0.00	$34,800.00
36	**3.7 Marketing and Outreach**						
37	3.7.1 Develop promotional plan for free trial and premium membership oppurtunity	56	$77.50	$4,340.00	$0.00	$0.00	$4,340.00
38	3.7.2 Application demo for potential clients identified	96	$78.33	$7,520.00	$5,000.00	$0.00	$12,520.00

39	**4.0 Project Closing Phase**						
40	**4.1 Customer Feedback**						
41	4.1.1 Monitor customer experience	160	$80.00	$12,800.00	$0.00	$840.00	$13,640.00
42	4.1.2 Resolve issues and release updates	96	$82.50	$7,920.00	$0.00	$0.00	$7,920.00
43	4.1.3 Quality assurance updates meeting	2	$82.50	$165.00	$0.00	$0.00	$165.00
44	**4.2 Documentation**						
45	4.2.1 Meeting with stakeholders to document the process	2	$90.00	$180.00	$0.00	$0.00	$180.00
46	4.2.2 Create a visualization map of the process	144	$66.67	$9,600.00	$0.00	$0.00	$9,600.00
47	4.2.3 Documentation of test cases	80	$60.00	$4,800.00	$0.00	$0.00	$4,800.00
48	**4.3 Monitoring & Updates**						
49	4.3.1 Develop a new process to monitor application usage and track complaints	40	$82.50	$3,300.00	$0.00	$0.00	$3,300.00
50	4.3.2 Define KPIs for performance tracking from transactions made on the application	64	$75.00	$4,800.00	$0.00	$0.00	$4,800.00
51	4.3.3 Continuous improvement plans for quality assurance	32	$75.00	$2,400.00	$0.00	$0.00	$2,400.00
52	**4.4 Prioritize, plan and budget for future targets**						
53	4.4.1 Expansion to other locations in US	32	$80.00	$2,560.00	$0.00	$0.00	$2,560.00
54	4.4.2 Analytics team expansion based on userbase growth	32	$82.50	$2,640.00	$0.00	$0.00	$2,640.00
55	4.4.3 Expansion into global markets	32	$80.00	$2,560.00	$0.00	$0.00	$2,560.00
56	**4.5 Audits**	200	$72.50	$14,500.00	$0.00	$0.00	$14,500.00
57	**4.6 Final Project Report**	0	$0.00	$0.00	$0.00	$0.00	$0.00
	Total	**4127.52**	**-**	**$315,825.40**	**$48,000.00**	**$3,360.00**	**$367,185.40**

Appendix E: Resource Allocation Plan

Project Name: Optimizing Equipment Procurement and Maintenance in the Mining Industry Project Start Date: 05/16/2022	Total Days	361	Total Budget	$367,185.40

Labor				
Resource	**Role**	**Hours**	**Rate/Hour**	**% Allocation**
Mrunal Payagude	Financial Manager	284	$80.00	50%
Vibin Roy	Project Manager	994	$90.00	100%
Madhav Sirsat	Head of Design	408	$80.00	75%
Ujjwal Srivastava	Quality Manager	463	$75.00	75%
Mohammed Rehan Shaik	Marketing Manager	402	$75.00	75%
Bhavana Tadiboina	Software Development Manager	539	$80.00	100%
Saurya Vadlamudi	Data Manager	414	$80.00	75%
Team Member 8	Resource Manager	578	$45.00	100%
Team Member 9	Project Sponsor	49	$85.00	10%

Software, Equipment & Miscellaneous			
Resource	**Type**	**Team**	**Total Cost**
Development Software	Software	Software Development	$20,000.00
Project Management Software	Software	Project Management, Resource Management	$3,000.00
Data Servers	Equipment	Data Management	$17,000.00
Design Software	Software	UI/UX Design	$3,000.00
Travel & Accommodation	Miscellaneous	Marketing Team	$5,000.00
General and Administrative	Miscellaneous	General & Administrative	$3,360.00