Case Study

AT A GLANCE INDUSTRY:
Project Management Case Study

COMMODITY:
Iron Ore

CLIENT:
Confidential

LOCATION:
South Africa

PROBLEM SUMMARY:
Review of PMBOK Knowledge Areas addressed within a technology project.

SERVICE:
Case Study

AUTHOR:
Tiffany Verwey –
Project Management & Support

PROJECT MANAGEMENT KNOWLEDGE AREAS

CASE STUDY

Review of how the PMBOK 6th edition PM knowledge areas were addressed during the implementation of a Berm Monitoring System project for an Iron Ore Mine in South Africa

Abstract:

VBKOM was part of a team that implemented a Berm Monitoring System for active waste dumps on an open pit Iron Ore mine and conducted a case study to determine how effectively the PMBOK knowledge areas were covered during the implementation of the project.

Keywords:

Berm Monitoring System (BMS), Project Management Body of Knowledge (PMBOK), Proof of Concept (POC), Project Manager (PM), Electronic Document Management System (EDMS), Work Breakdown Structure (WBS), Factory Acceptance Test (FAT), Site Acceptance Test (SAT), Basis of Schedule (BoS), Basis of Estimate (BoE), Procurement Operating Plan (POP), RAIID (Risks, Actions, Issues, Incidents & Decisions)

Project Background

VBKOM (Pty) Ltd works on various mining projects, providing a multitude of services, including Project Management and Support, to technology development projects for surface mining operations.

In 2020, VBKOM was requested to assist with various project management and support tasks for a client that was in the process of developing a technology solution to physically measure edge tipping safety berm heights for active waste dumps.

Figure 1: Aerial view of a waste dump on an open pit mine with the compliant edge tipping safety berm shown in green (Reutech, 2022)

The client partnered with Horts Geo-Solutions (https://horts-solutions.com/) and Reutech Mining (https://www.reutechmining.com/) to develop an innovative Berm Monitoring System (BMS) that consists of a Riegl VZ 400i laser scanner (LiDAR) fitted on a ruggedised trailer.

The scanner has a range of approximately 400 metres. The trailer is placed on any active waste dump where haul trucks are tipping material. The scanner is configured to scan the area every three minutes. The trailer is also equipped with an onboard computer that processes point cloud data from the laser scanner.

Software then analyses and interprets the data. The processed information is sent over the Wi-Fi network, via the Rajant Wi-Fi radio, to the mine's control room, where staff have a webpage view of the berm height compliance per active waste dump. Each BMS trailer also has a tablet mounted on the side of the trailer which can be used by staff in the field to view berm height compliance.

The project kicked off in 2019 with a Proof of Concept (POC) where the initial designs and development took place, and the solution was tested and upgraded to effectively work in the environment that it was placed.

Figure 2: BMS Trailer Evolution (2019-2022)

In 2020, VBKOM, together with the client Project Manager (PM), developed assurance documentation to take the project through capital approval for execution on two mines. Project execution for the fabrication, set-up and roll-out of 21 BMS trailers took place between 2020 and 2022.

For more technical insights please visit https://www.reutechmining.com/berm-monitoring-system/.

Case Study

The Project Management Body of Knowledge (PMBOK) 6th edition stipulates 10 knowledge areas with 5 process groups (Project Management Institute, 2017, page 23-25). Using these knowledge areas and process groups, a case study was done to determine how the guidelines from the PMBOK were followed during the life cycle of the BMS project.

Table 1 has been adapted from the PMBOK to indicate which knowledge areas and process groups were covered during the execution of the project.

A detailed discussion on what inputs, tools & techniques and outputs were used/completed for each knowledge area and process group can be seen after Table 1.

Table 1: BMS Project(s) Knowledge Areas and Process Groups (Project Management Institute, 2017, page 25)

Knowledge Areas	Project Management Process Group									
	Initiating Process Group		Planning Process Group		Executing Process Group		Monitoring and Controlling Process Group		Closing Process Group	
1. Project Integration Management	1.1 Develop Project Charter	✓	1.2 Develop Project Management Plan	✓	1.3 Direct and Manage Project Work 1.4 Manage Project Knowledge	✓ ✓	1.5 Monitor and Control Project Work 1.6 Perform Integrated Change Control	✓ ✓	1.7 Close Project	✓
2. Project Scope Management			2.1 Plan Scope Management 2.2 Collect Requirements 2.3 Define Scope 2.4 Create WBS	✓ ✓ ✓ ✓			2.5 Validate Scope 2.6 Control Scope	✓ ✓		

Knowledge Areas	Project Management Process Group									
	Initiating Process Group		Planning Process Group		Executing Process Group		Monitoring and Controlling Process Group		Closing Process Group	
3. Project Schedule Management			3.1 Plan Schedule Management 3.2 Define Activities 3.3 Sequence Activities 3.4 Estimate Activity Durations 3.5 Develop Schedule	✓ ✓ ✓ ✓ ✓			3.6 Control Schedule	✓		
4. Project Cost Management			4.1 Plan Cost Management 4.2 Estimate Costs 4.3 Determine Budget	✓ ✓ ✓			4.4 Control Costs	✓		
5. Project Quality Management			5.1 Plan Quality Management	✓	5.2 Manage Quality	✓	5.3 Control Quality	✓		
6. Project Resource Management			6.1 Plan Resource Management 6.2 Estimate Activity Resources	✓ ✓	6.3 Acquire Resources 6.4 Develop Team 6.5 Manage Team	✓ ✓ ✓	6.6 Control Resources	✓		
7. Project Communications Management			7.1 Plan Communications Management	✓	7.2 Manage Communications	✓	7.3 Monitor Communications	✓		
8. Project Risk Management			8.1 Plan Risk Management 8.2 Identify Risks 8.3 Perform Qualitative Risk Analysis 8.4 Perform Quantitative Risk Analysis 8.5 Plan Risk Responses	✓ ✓ ✓ × ✓	8.6 Implement Risk Reponses	✓	8.7 Monitor Risks	✓		
9. Project Procurement Management			9.1 Plan Procurement Management	✓	9.2 Conduct Procurements	✓	9.3 Control Procurements	✓		
10. Project Stakeholder Management	10.1 Identify Stakeholders	✓	10.2 Plan Stakeholder Engagement	✓	10.3 Manage Stakeholder Engagement	✓	10.4 Monitor Stakeholder Engagement	✓		

1 PROJECT INTEGRATION MANAGEMENT

1.1 Develop Project Charter

A project charter was developed for the implementation of the BMS system at two mines (i.e., two charters had to be developed) that consisted of a motivation for the project, background on the system and project proof of concept, high-level timelines, and costs for implementation (assumptions provided by stakeholders and project team) as well as the planned project organisation using MS Visio organograms.

The documents were reviewed by key stakeholders of the project as well as an assurance specialist and signed off and stored on the client's Electronic Document Management System (EDMS).

1.2 Develop Project Management Plan

For the Project Management Plan (also called the Project Execution Plan), the charter was used as the base document and was further developed to include each knowledge area of the PMBOK. Stakeholder engagements and lessons learned from the POC were used as inputs for the document as well. As part of the Project Management Plan, the following was discussed/planned for:

- Project scope definition, inclusions, and exclusions
- Project study options evaluated for implementation
- Project Work Breakdown Structure
- Project assumptions and constraints
- Headline risks and mitigations
- Project impact on operations
- Project execution strategy in line with schedule
- Project governance, organisation, and staffing
- Schedule management
- Scope management
- System overview and Hardware description
- Project reporting and technical & steering committee
- Financial parameters including cost budget estimate and cashflow
- Project integration management (this includes management planning for design engineering, procurement, cost, documents, change management, operational readiness, quality and standards, risk, health and safety, material handling, commissioning and configuration, maintenance and technical support, and project close out).

1.3 Direct and Manage Project Work

The signed off Project Management Plan was distributed to all stakeholders and was used as a guideline for managing the project. All changes and updates were discussed in monthly feedback meetings to the project technical committee. A RAIID log (Risks, Actions, Issues, Incidents and Decisions log) was created to note, allocate and manage the project work on a weekly basis.

1.4 Manage Project Knowledge

The project knowledge was managed by making use of a Microsoft Teams space where all project documentation was shared with the stakeholders. This included the project documentation, schedule, RAIID log, lessons learned log, risk register and weekly presentations.

1.5 Monitor and Control Project Work

Prior to implementation, the client and suppliers agreed on how the project would be implemented and managed, and how feedback should be given. VBKOM worked closely with Horts-Geo Solutions to update the schedule and RAIID log weekly prior to developing the progress feedback meeting presentation that was then presented to the client every Friday. All changes were noted and accepted or rejected during the meeting. The client would then present these changes in their monthly technical feedback meetings.

The weekly progress meetings also indicated the progress of all major milestones, activities completed for the week, activities planned for the next week, risks and challenges as well as decisions or inputs required from the client.

1.6 Perform Integrated Change Control

As stated above, the management and control of change on the project was stipulated in the project management plan, discussed during weekly progress meetings between all relevant project stakeholders, and presented to the project technical committee once a month.

It must be noted that no major changes to the system took place, however, some additional scope recommendations were made by the client and investigated by the suppliers as well as timeline changes that were caused by COVID-19 lockdowns. Schedule updates and re-baselines had to be made.

1.7 Close Project

The project charter and project management plan with all other project documents that were populated prior to and during execution were used to develop a comprehensive project close out report. The report highlighted how the project was actually executed based on the planning that was done and captured in the process groups prior to close out. The document was reviewed and signed off then uploaded to the client EDMS.

The trailers, with their owner user manuals, were handed over to the client and the service level agreement for 12 months kicked-off with the suppliers.

2 PROJECT SCOPE MANAGEMENT

2.1 Plan Scope Management

The POC close out report, project charter and project management plan were developed with inputs from all relevant stakeholders and suppliers and assisted with the planning and clarification of the scope of the project.

2.2 Collect Requirements

The expert judgement of the project team and key stakeholders was used to populate the requirements and used as inputs to the charter and project management. The original POC close out document was used as the basis for project requirements which were further built on for the project planning and execution. If such documentation were not

available, the team would have developed a specific requirements document called an end-state operational requirements (ESOR) document.

2.3 Define Scope

The scope definition was clarified and agreed on during the project charter and project management plan development. This is a fit for purpose, first of its kind solution, and therefore the suppliers were part of the scope definition process.

2.4 Create WBS

The project scope and work packages were defined by each supplier. VBKOM and the client PM then used various tools and techniques, such as mind-mapping, brainstorming and task assignments, to plan and coordinate the work and then used MindManager to develop a 4-level project Work Breakdown Structure (WBS).

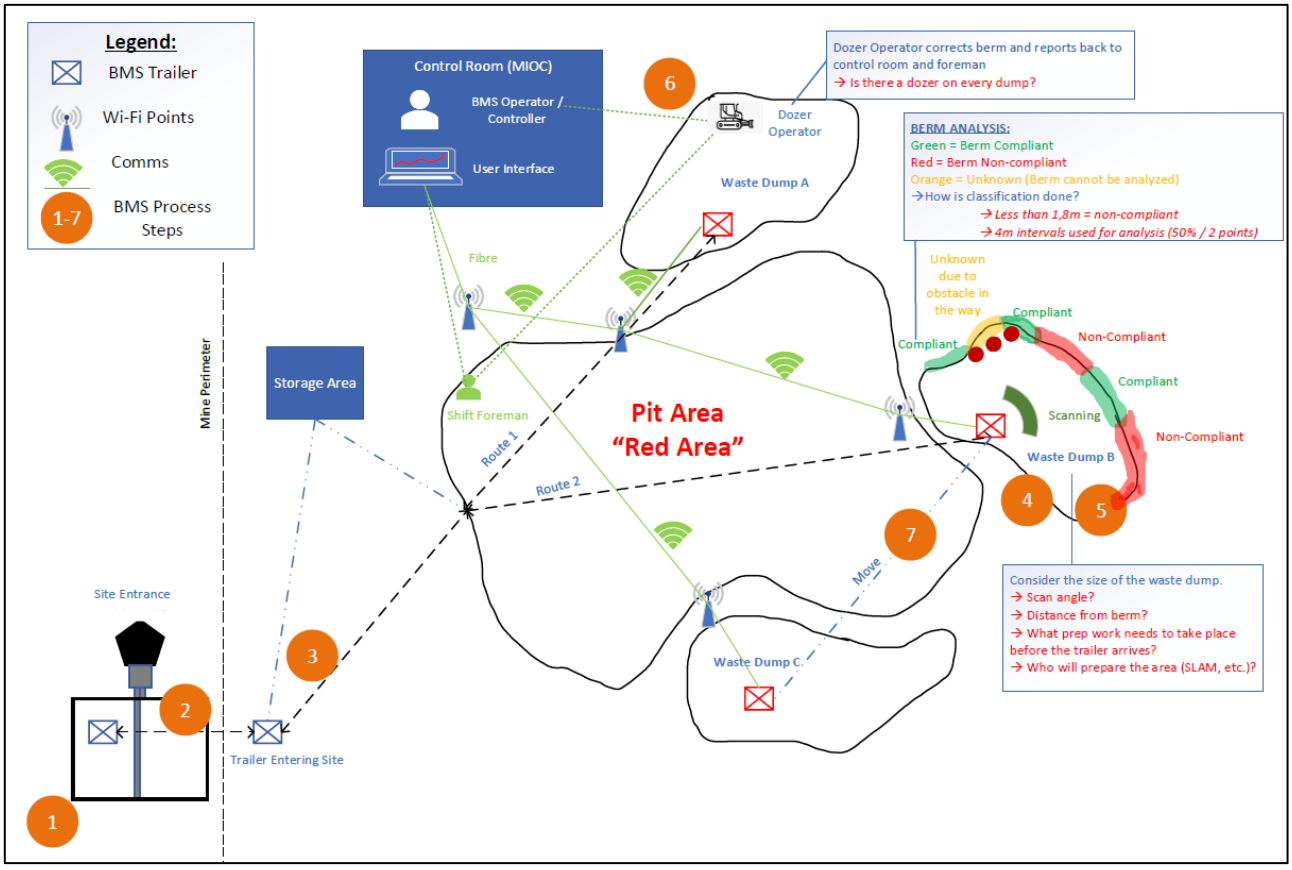

Figure 3: Example of Brainstorming Inputs to Project WBS

2.5 Validate Scope

All trailers and the BMS system were inspected, tested, and checked at various stages in the fabrication and implementation process. Various Factory Acceptance Tests (FATs) and Site Acceptance Tests (SATs) were done by important stakeholders of the project and were signed off prior to go-live and being moved to an active waste dump.

2.6 Control Scope

The project scope was managed based on what was stipulated in the project management plan. All additional work requested by the client was managed as additional scope and was planned for by the project to not delay the close out of the project.

3 PROJECT SCHEDULE MANAGEMENT

3.1 Plan Schedule Management

VBKOM and the client worked together to put together a Basis of Schedule (BoS) that stipulates exactly how the project schedule should be developed and managed on Microsoft Project.

3.2 Define Activities

The client and suppliers provided all the activities that were required for the implementation of the system. VBKOM drafted a schedule and various scheduling meetings were held in order to ensure that all the work packages and activities were included in the schedule.

3.3 Sequence Activities

The expert knowledge of the suppliers and requirements for implementation by the client were considered when the activity sequence was done on the schedule.

3.4 Estimate Activity Durations

The expert knowledge and lead times of the suppliers and timeline requirements for implementation by the client were considered when the durations were assigned to each activity on the schedule.

3.5 Develop Schedule

The draft schedule was developed and presented to the project team, updates were made, and the schedule was baselined. The schedule calendar was set to accommodate South African public holidays as well as working days from Monday to Friday. The baselined schedule was then used as an input document to the execution strategy and project management plan.

3.6 Control Schedule

The schedule was updated once a week with inputs from project stakeholders and was baselined twice. Once to accommodate the COVID-19 delays, and again to add tracking of the mine's updates to their Standard Operating Procedures (SOPs).

The project team worked hard to expedite certain activities and even though the work was behind schedule during execution, time was made up during roll-out, and the team completed the work within schedule at the end of the project.

4 PROJECT COST MANAGEMENT

4.1 Plan Cost Management

Using the standard cost management procedures for projects by the client, a cost management plan was developed as part of the project management plan and indicated that the cashflow would be managed by the client-allocated cost controller and PM.

4.2 Estimate Costs

The scope set in the project management plan was used to request quotes from the suppliers for hardware, software, resources, travel, accommodation, etc. as well as averages of owner's costs to get the estimates in preparation of a project estimate document that was developed by VBKOM and reviewed by the client. It was also aligned with the payment schedules provided by the suppliers and project schedule. The estimate was captured on an MS Excel document.

4.3 Determine Budget

Based on the average costs of implementing the POC, a budget amount was decided on based on the number of systems to be rolled out. The estimate and cashflow were then aligned with these costs and the project funding amount was presented and approved at a capital steering committee before the funds were released by supply chain management.

4.4 Control Costs

The client PM and Supply Chain Management Specialist as well as the cost controller for the project worked together to ensure that all work packages were planned and managed in a Procurement Operating Plan (POP) that made it easy to see all details of each package, including any modifications to orders placed for all suppliers.

5 PROJECT QUALITY MANAGEMENT

5.1 Plan Quality Management

The quality management plan was developed as part of the project management plan and incorporated basic and client specific requirements for managing quality on projects.

5.2 Manage Quality

The project team worked closely with the Section Engineering Managers (SEMs) and Safety Officer assigned to the project to ensure that all quality requirements in terms of documentation, reports, FAT's, SAT's, etc. were adhered to and completed correctly.

5.3 Control Quality

All changes and updates had to be reviewed and signed off by the project stakeholders before commencement of a next step.

6 PROJECT RESOURCE MANAGEMENT

6.1 Plan Resource Management

The project charter, together with a number of planning meetings, assisted the team to plan for the resources on the project. The resources included people, estimates of costs, equipment, and software to be used to execute the project. The management of the resources for the project was captured in the project management plan.

6.2 Estimate Activity Resources

As part of the project management plan, the project was organised to include all stakeholders in the project as well as the cashflow for the project. A Basis of Estimate (BoE) was also developed in order to explain how the estimate was built and included information on exchange rates. The estimate was also reviewed and signed off as part of the project management plan.

6.3 Acquire Resources

The client and suppliers were all clear on their scope and project resource requirements prior to execution. The requirements of when which resources had to be on site was planned prior to execution and incorporated into the project schedule to manage them. Each resource was assigned specific tasks that they were responsible for and had to provide weekly feedback on their progress. Due to the suppliers and client developing the solution, direct orders were placed on the suppliers as they were the sole source suppliers of the solution. Additional VBKOM resources were appointed to assist with Risk Assessment development as well as the development of a BMS specific SOP.

6.4 Develop Team

Weekly virtual meetings took place on Fridays and ad hoc site meetings also took place. The team made a real effort to spend as much time as possible on the project. The PM also regularly followed up on actions with the project team.

6.5 Manage Team

Key stakeholders from both the client and suppliers were part of the progress feedback meetings and all issues were addressed and resolved during these meetings.

6.6 Control Resources

As with all projects, interpersonal skills and project information management were key components for controlling the resources on the project. VBKOM assisted the client PM with management of people and situations and problem-solving techniques.

7 PROJECT COMMUNICATIONS MANAGEMENT

7.1 Plan Communications Management

Prior to implementation, VBKOM assisted the client with the set-up of project feedback meeting presentation templates, and set-up and agenda for weekly progress meetings and prep sessions with the suppliers prior to the

weekly meetings. The frequency of the meetings as well as who should attend and the outcomes/documents to manage communications were also stipulated as part of the project management plan.

7.2 Manage Communications

The project communications management plan that formed part of the project management plan was adhered to by all project stakeholders and closely managed by the client PM and VBKOM. Other tools were also used to manage communications, which included MS Teams and WhatsApp.

7.3 Monitor Communications

The client PM and VBKOM monitored the project communications and intervened if/when necessary. The team worked really hard to stay professional and within the scope of their work when communicating with each other.

8 PROJECT RISK MANAGEMENT

8.1 Plan Risk Management

In the project charter, headline risks were identified and used as the basis for planning the management of risks for the project. As part of risk management for the project, a two-day risk assessment workshop was facilitated by VBKOM and all the relevant project stakeholders attended.

8.2 Identify Risks

For each aspect of the project and the project environment, risks were identified by VBKOM and the client PM, and were discussed and added to during the risk assessment workshop.

8.3 Perform Qualitative Risk Analysis

The client's qualitative risk analysis tool is a 5x5 risk matrix that uses likelihood of occurrence and impact of the risk, and was used to populate the risk register and mitigating actions. The responsible person for each risk was identified as well as the person responsible for the mitigating actions.

8.4 Perform Quantitative Risk Analysis

An initial evaluation was done and it was determined that the size of the project did not justify a quantitative risk analysis as this is a costly exercise and the client preferred for the team to focus on roll-out and saving costs.

8.5 Plan Risk Responses

The qualitative risk analysis and RAIID log were used to allocate due dates for each risk to be addressed.

8.6 Implement Risk Reponses

The management of risks was discussed in the workshop, and the risk mitigating actions were added to the project RAIID log and monitored and updated weekly.

8.7 Monitor Risks

The management of risks was discussed in the workshop, and the risk mitigating actions were added to the project RAIID log and monitored and updated weekly.

9 PROJECT PROCUREMENT MANAGEMENT

9.1 Plan Procurement Management

Procurement management planning was done as part of the project management plan development together with the client Supply Chain Management (SCM) Specialist.

This was a sole source selection and the procurement strategy for the various packages was done through a Request for Proposal (RFP) process. The Procurement Operating Plan (POP) was developed and managed by the client PM and SCM Specialist.

9.2 Conduct Procurements

Once the project received capital approval, the funds were released, and contracts were placed with the suppliers through SCM. The service level agreements (SLAs) were also put in place for one year after project close out.

9.3 Control Procurements

The POP was managed, and between SCM, the client PM and cost controller, the contracts were managed.

10 PROJECT STAKEHOLDER MANAGEMENT

10.1 Identify Stakeholders

During the development of the project charter, the most important stakeholders were identified and captured in the document. A list of stakeholders was put together with the stakeholder names and roles and was added to during the process of developing and signing off the project management plan.

10.2 Plan Stakeholder Engagement

During the project kick-off meeting, the project team planned and finalised the channels to be used as well as the frequency of engagements that should take place. As part of the project communication management planning the rules of engagement were also discussed and agreed on by all stakeholders.

10.3 Manage Stakeholder Engagement

The client PM took responsibility for managing the stakeholder engagements and the team was also committed to ensure that everyone was aligned on each task that should take place and who the responsible person was. Having weekly progress meetings assisted with this as well.

It should be noted that there were no major changes to stakeholders on the project and this made it considerably easier to manage and maintain proper engagement with stakeholders.

10.4 Monitor Stakeholder Engagement

The team provided regular feedback on any issues faced with stakeholders to the client PM, who assisted with resolving the issues. All changes and issues faced were captured and monitored on the project RAIID log and were also discussed during the weekly progress meetings. When the client felt that the team was not performing as desired, it was addressed, and the team made adjustments to be more efficient and perform better. The key was open and honest communication between all the parties involved and this ensured that the stakeholders were aligned with each other.

Project Results

There is inherent risk associated with a haul truck that is required to reverse and tip material over the edge of an active waste dump. The primary control to prevent a truck over-the-edge incident is the waste dump safety berm. The challenge comes in attempting to ensure, on a continuous basis, that the safety berm height in the field is compliant with the design (planned) height. At mines, this height varies from 1.2m to 1.9m depending on the tyre diameter of tipping trucks.

Traditional methods that were used were subjective and potentially ineffective due to being reliant on people and not technology. In other words, berm heights were estimated and not physically measured. Traditional methods included height poles and colour coded cones that were placed at certain points on waste dumps and were used as a rough indicator of berm height compliance.

The objective of the project was to deploy a technology, in the form of a Berm Monitoring System (BMS) that will allow active monitoring of height compliance of dynamic waste dump safety berms. This will contribute towards preventing haul trucks from breaching inadequate waste dump safety berms when reversing to tip.

The implementation of the Berm Monitoring System project has yielded several benefits including:

- Replacing old and rudimentary methods such as cones and height poles with a quantitative measuring tool.
- Monitoring of dumps can take place 24 hours a day as the technology can work both day and night.
- All components are IP67 rated and can withstand dust, rain and heat.
- The system requires minimal movement due to the range of the laser scanner being in the order of 400 metres.
- Near real-time information is available in the mining control room where the BMS Dispatcher has a view of the waste dump safety berm status for each active waste dump.
- The BMS Dispatchers are in a position to alert foremen and dozer operators about any sub-standard berms which can then be repaired.
- Substandard waste dump safety berms can be identified and attended to significantly faster than in the past.
- Mining staff who operate in the field now have an accurate and reliable tool to assist them in managing waste dump safety berms.
- Mine management has the ability to know the status of waste dump safety berms without physically having to travel to the field to visually inspect and validate reports from field staff.
- The benefit for truck operators is that they can know that the waste dump safety berms, that they rely on every day, are being actively managed to ensure a safe tipping environment.

Overall, the system is contributing to a reduced risk associated with haul trucks tipping on waste dumps.

Customer Value

The project set-up was done properly, and this ensured that the team was equipped with the necessary project management tools and documentation to successfully implement and complete the project.

References

Project Management Institute, 2017. A guide to the project management body of knowledge (PMBOK® guide)

Reutech. (2022). Berm Monitoring System. Retrieved from https://www.reutechmining.com/berm-monitoring-system/