BAHRAIN POLYTECHNIC بوليتكنك البحرين

Assessment Cover Sheet

Assessment Title	Assessment_II Project Planning		
Assessment Type	Uncontrolled	Individual	Not must-pass
Due Date	28th November-2024	**Course Code**	EN8923
Course Title	Engineering Project Management		
Internal Moderator's			
External Examiner's			

Instructions:

1. The duration of the assessment is **15 days** from the date of commencement.
2. **Total of 100 marks, Worth 60% of course grade**
3. Leaning outcome assessed ***CILO 1*** - ***Formally initiate a project and develop project management plans, applying an international project management standard.*** ***CILO-2Execute, monitor and control project work and formally close a project, expanding on all knowledge areas of an international standard.***
4. Any assumptions to be clearly stated.
5. The assessment has a total of **05 pages.**
6. Follow the detailed rubrics given in the assessment section in Moodle.
7. Submit the **soft copy (pdf)** through the submission link given on Moodle.

Learner ID		**Date Submitted**	
Learner Name			
Programme	**ENT8020**		
Programme	**Bachelor of Engineering Technology (Mechanical)**		
Lecturer's	**Dr Shabbir Ahmed Muneer**		

By submitting this assessment for marking, I affirm that this assessment is my own work.

Learner

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Assessor's Name			
Marking Date		**Maks Obtained**	

Comments:

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1. INTRODUCTION

1.1 Project Overview

The **Solar-Powered LED Street Lighting System** in **Bahrain** is expected to solve the problems of energy wastage; high cost of operations; and the use of fossil fuels in street lighting. Because of Bahrain's favorable location where the country gets most sunlight throughout the year, utilization of solar energy in the nation for public facilities is advisable and sustainable. This project is therefore seeking to remove conventional street lighting and install new LED systems which are to be powered by solar systems. As the proposed solution will help in cutting the dependence on the national power grid, and will help in lowering the carbon print, it will thus align with Bahrain's Vision 2030 driven by green energy solutions and sustainability.

The system will use solar panels to harness solar energy during the day, store the energy in high-performance batteries, and power the LEDs at night. In addition to reducing energy consumption and carbon emissions, the system will be more cost-effective in the long term due to low operational and maintenance costs.

1.2 Objectives and Benefits

The project's objectives and anticipated benefits are as follows:

1.2.1 Objectives

1. Reduce energy costs for street lighting by 30% annually.
2. Enhance public safety through brighter and more reliable street lighting.
3. Contribute to Bahrain's environmental sustainability by utilizing solar energy.
4. Provide a low-maintenance lighting solution with a longer lifespan.

1.2.2 Benefits

- **Economic Benefits:** By reducing the dependency on the national electricity grid, the project will lower the operational costs associated with street lighting and reduce maintenance expenditures.

- **Environmental Benefits:** Solar power is a clean, renewable energy source that will reduce greenhouse gas emissions and contribute to Bahrain's goals for achieving net-zero emissions by 2050.
- **Social Benefits:** Improved street lighting enhances safety for pedestrians and drivers, thus reducing accidents and fostering a safer, more livable environment for all residents.

1.3 Assumptions and Constraints

1.3.1 Assumptions

- The availability of local suppliers for solar panels, LEDs, and batteries.
- The government will provide the necessary permits and support for the project.
- Weather conditions will generally be favorable for solar energy generation, with minimal disruptions due to dust storms or other extreme events.

1.3.2 Constraints

- **Budget:** The above project budget is limited to a maximum ceiling of BHD 50,000.
- **Regulatory Requirements:** The project has to conform to all required aspects of the local municipal provisions such as safety features and installation codes.
- **Weather Dependency:** Consequently, since Bahrain has a warm climate the amount of sunlight is adequate but problems such as occurrence of rains or dust storms may affect the electricity production from the solar panels.

2. SCOPE MANAGEMENT PLAN

2.1 Deliverable-Based Work Breakdown Structure (WBS)

The work breakdown structure (WBS) is one of the best ways of constructing work through decomposition of total project scope to achieve the project objectives. In this way, it is also guaranteed that all tasks that need to be done are clear, and all deliverables are divided into subtasks to make them easier to complete. A Deliverable-Based WBS targets the project’s output with one major deliverable being discernible from the lower constituent deliverables. It is one of the key tools used when creating a project schedule to plan project resources, costs and performance measurements.

The purpose of the Deliverable-Based WBS is to ensure clarity in task allocation and reduce ambiguity. This method also aids in managing scope creep by setting boundaries around what is included in the project. Below is a detailed Deliverable-Based WBS tailored for the **Solar-Powered LED Street Lighting System Project**, outlining the primary deliverables and their respective descriptions:

Table 1: Deliverable-Based Work Breakdown Structure (WBS)

Level	Task	Description
1	Solar-Powered LED Street Lighting System	The overall deliverable, representing the complete implementation of the project.
2.1	System Design	Development of technical blueprints, CAD layouts, and a detailed design strategy for installation.
2.2	Procurement	Sourcing of required materials such as solar panels, LED lights, batteries, and controllers.
2.3	Installation	On-site setup of the system, including mounting, wiring, and configuration of controllers.
2.4	Testing and Handover	Final functional testing, system validation, and official project transfer to stakeholders.

This WBS provides a structured view of the project's deliverables and ensures that all tasks are accounted for, improving project transparency and accountability.

2.2 Phase-Based Work Breakdown Structure (WBS)

However, in the **Phase-Based WBS**, the project activities are grouped in accordance with work's life cycle phases including initiation, planning, execution, controlling and closing phases. The method is more useful in ascertaining that all undertakings of the project under

different phases suit the project's goals and objectives. It also provides order on how to implement these phases so that there is no lapse on the progression made by the project.

Table 2: Phase-Based Work Breakdown Structure (WBS)

Phase	Activities	Deliverables
Initiation	Stakeholder identification, scope definition, and feasibility analysis.	Project Charter, Stakeholder List
Planning	Developing a comprehensive project plan, defining resources, estimating costs, and scheduling tasks.	Approved Project Plans
Execution	Procurement of materials, installation of solar panels and LEDs, and configuration of system components.	Installed Solar-Powered Lighting System
Monitoring & Control	Conducting system performance testing, ensuring compliance with quality standards, and implementing corrective measures as needed.	System Test Reports
Closure	Preparing final documentation, providing operational training, and transferring project deliverables.	Completed System and Handover Report

This WBS approach ensures a logical progression from project initiation to completion, allowing for better oversight and control.

2.3 Detailed Description of Deliverables

The project deliverables encompass every tangible outcome from the project activities, serving as milestones that collectively represent the successful completion of the project. Below is a comprehensive breakdown of each deliverable:

1. **System Design**

   - **Deliverables:** These are the form in terms of CAD drawing with high level of details, and delineation of interfaces as well as specifications.
   - **Explanation:** This stage is important to make sure all sub-components of solar lighting system, including the solar panel, LED light and battery components can be integrated effectively with the local environment and the urban fabric. This stage also includes choosing the right material, size and location in order to achieve the highest possible performance and service life. Idem, modifications need to be reviewed with respect to their ability to fit into a cohesive and sustained structure that supports program objectives.

2. **Procurement**

   - **Deliverables:** Purchase orders, supplier agreements and an inventory check list were common.
   - **Explanation:** Procurement phase guarantees appropriate quality such as high efficiency of solar panels and sturdiness of LED lights from rightful suppliers. Emphasis is placed on expenses control, goods' quality, and time efficiency. The planning phase is critical to reducing time-related risks or risks of incorporating below-standard products or substandard materials.

3. **Installation**

   - **Deliverables:** Indicated components such as photovoltaic solar panels, LED lightings, and circuits.
   - **Explanation:** Installation is the implementation phase whereby all elements are conveyed to the site of project delivery and connected correctly. This involves installation of solar panels on poles or rooftops, installation of LED wiring of the system controllers. Accuracy during installation is very important to maintain the style and standard of the required system and safety.

4. **Testing and Handover**

   - **Deliverables:** Performance reports, system manuals, and training sessions.

- **Explanation:** It encompasses a process of proving the system functionality with actual users and identifying problems as well as their solution. The last phase involves transferring physical possession of the project tangible deliverables to the end-users, plus relevant documented materials and user manuals, to support project sustainability.

3. TIME MANAGEMENT PLAN

3.1 Project Schedule (Activities, Durations, Dependencies)

A detailed **project schedule** is crucial for ensuring that the project progresses smoothly and stays on track. Below is an extended table, which outlines the tasks, durations, start dates, and dependencies:

Table 3: Project Schedule (Activities, Durations, Dependencies)

Task ID	Task	Start Date	End Date	Duration (Days)	Dependencies	Resources
1	Project Initiation	01-Jan-24	10-Jan-24	10	None	Project Manager
2	Define System Specifications	11-Jan-24	20-Jan-24	10	1 FS	Engineers, PM
3	Procurement Planning	21-Jan-24	31-Jan-24	10	2 FS	Procurement Team
4	Material Procurement	01-Feb-24	15-Feb-24	15	3 FS	Procurement Team
5	System Installation	16-Feb-24	16-Mar-24	30	4 FS	Installation Team

6	Testing and Validation	17-Mar-24	01-Apr-24	15	5 FS	QA Engineers
7	Project Handover	02-Apr-24	05-Apr-24	4	6 FS	Project Manager, Client

3.2 Gantt Chart

Here is the Gantt chart for the **Solar-Powered LED Street Lighting System in Bahrain** project. It visually represents the project schedule, with tasks aligned on a timeline. Each bar indicates the duration of a task, with color-coding for clarity:

- **Project Initiation**: January 1, 2024 – January 10, 2024
- **Define System Specifications**: January 11, 2024 – January 20, 2024
- **Procurement Planning**: January 21, 2024 – January 31, 2024
- **Material Procurement**: February 1, 2024 – February 15, 2024
- **System Installation**: February 16, 2024 – March 16, 2024
- **Testing and Validation**: March 17, 2024 – April 1, 2024
- **Project Handover**: April 2, 2024 – April 5, 2024

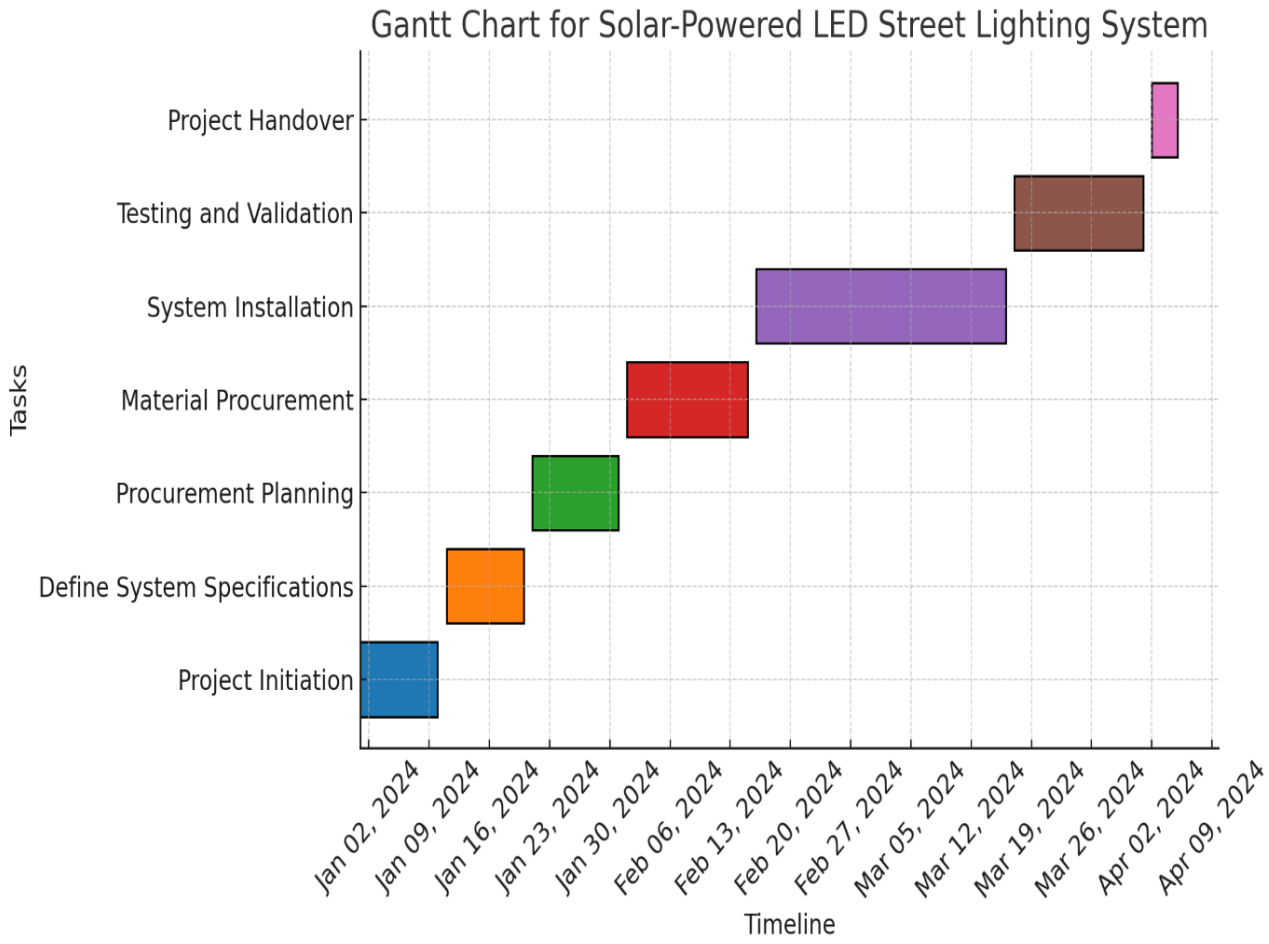

Figure 1:Gantt Chart

4. COST MANAGEMENT PLAN

A comprehensive **Cost Management Plan** is essential for controlling project expenses and ensuring the project remains within budget. The importance of designing a control plan for the cost of the project is evident in the necessity of having a Cost Management Plan. The table below shows all costs to be incurred in the implementation of the Solar-Powered LED Street Lighting Project under the different categories namely direct cost, indirect cost, and contingency cost. It's through comparison of total costs against the overall budget that the project team can be able to see differences and correct them.

4.1 Budget Breakdown

The table below presents a detailed budget breakdown for the project. Each line item specifies the quantity, unit cost, total cost, and cost type.

Table 4: Cost Analysis

Item	Quantity	Unit Cost (BHD)	Cost (BHD)	Cost Type
Solar Panels	100	200	20,000	Direct Cost
LED Lights	200	50	10,000	Direct Cost
Batteries	50	100	5,000	Direct Cost
Control System	20	250	5,000	Direct Cost
Installation Labor	N/A	N/A	8,000	Labor Cost
Miscellaneous	N/A	N/A	2,000	Contingency
TOTAL COST			**50,000**	

Figure 2: Cost Analysis Chart

The **Line Chart** helps visualize the relationship between **Costs** per **Item**.

5. QUALITY MANAGEMENT PLAN

The **Quality Management Plan** ensures that the project delivers outcomes that meet the required standards and satisfy stakeholder expectations. This plan guarantees that the result generated out of the project is acceptable and adequate in the quality level expected by the stakeholders. Another important feature of this plan is the use of a high level of quality assurance from the beginning to the end of the project. According to these standards the project will produce an efficient solar powered LED street lighting system to meet the reliability and performance needs of the end users.

5.1 Quality Assurance and Testing Standards

Quality Assurance (QA) is a critical component of the project, ensuring that all deliverables meet the defined requirements and specifications. By adhering to the ISO 9001:2015 standards for quality management, the project will implement a structured and systematic approach to maintain high standards throughout each phase.QA will be performed during the design phase alongside with procurement and installations phase and testing phase. The testing phase will, therefore, involve performance testing to check on the health of the system, the capability of the system to perform under normal environmental conditions such as temperature, sunlight and energy generation. These assessments will confirm the quality of the system in addition to addressing the need of its functionality and performance towards the expected expectations of various stakeholders.

Figure 3: Quality Assurance

Key quality assurance activities include:

- **Systematic Checks:** QA will entail examination at design, procurement, installation, and testing phases with a view of ascertaining whether the entire deliverables meet the technical specifications of the project.
- **Process Monitoring:** Measurements of the adherence to quality standards in works practices will be checked through audits and reviews of processes.
- **Documented Procedures:** Every procedure and specification will therefore be documented with reference to ISO requirements and standards as part of the formal record system.

The **Testing Phase** is basically where the project under development will be tested based on the real life like condition.

Testing will include:

- **Performance Evaluations:** Facilities will also be tested using conditions that are expected to be standard when the system is in operation, for instance fluctuations in temperature, light and the amount of energy produced.
- **Functional Testing:** Therefore, the inherent functionality of each of the four subsystems (solar panels, batteries, LEDs and controllers) will be challenged and compared against the design requirements.
- **Safety Standards Compliance:** All the equipment will have to undergo various tests to check compliance to safety requirements including electrical safety and the environment.

5.2 Test Case Form

Test Case Form must be developed to measure whether the system can perform successfully or not in the testing process. The form will make the running of all tests be orderly; observing the von Paris Triad and any arising problem will be well handled. Below is an example of the test cases that will be used to validate the solar-powered LED street lighting system:

Table 5: Test Case Form

Test ID	Test Description	Expected Outcome	Actual Outcome	Pass/Fail
TC001	Test solar panel output	Output ≥ 300 watts	TBD	TBD
TC002	Test LED brightness	Brightness ≥ 500 lumens	TBD	TBD
TC003	Test battery charge and discharge	≤ 5% loss per day	TBD	TBD
TC004	Test controller response time	≤ 1 second	TBD	TBD
TC005	Test system response to low sunlight	System continues operation with reduced output	TBD	TBD
TC006	Test system endurance under extreme temperatures	No performance degradation at 45°C	TBD	TBD

Test Case Description:

- **Test ID:** A unique identifier for each test case.
- **Test Description:** A brief description of the test, outlining what is being tested (e.g., solar panel output, LED brightness, etc.).
- **Expected Outcome:** The expected result based on design specifications. For example, the solar panel should produce an output of at least 300 watts under standard sunlight conditions.
- **Actual Outcome:** This column will be filled in during testing to record the real-world results.

- **Pass/Fail:** A final assessment to indicate whether the test passed or failed based on the comparison of the expected and actual outcomes.

6. HUMAN RESOURCE MANAGEMENT PLAN

A **Human Resource Management Plan** shows how the roles and responsibilities of the members of the project team are coordinated and every human resource is managed. It gives the framework for the curve out, distribution and coordination of resources to enhance project success.

6.1 Resource Breakdown Structure (RBS)

The **Resource Breakdown Structure (RBS)** identifies all the resources needed in a project and groups them precisely. Such categories are for example, labor, material, and equipment making it easier to plan and manage resources. Thus, the project team can guarantee proper staffing, equipment, and materials to complete each step of the project to meet the project requirements.

Table 6: Resource Breakdown Structure (RBS)

Category	Resource	Description
Labor	Project Manager	Oversees project execution, planning, and coordination.
Labor	Engineers	Responsible for designing, testing, and optimizing the system.
Labor	Installation Team	Handles the physical setup and installation of components.
Material	Solar Panels	Key energy source, converting sunlight into electricity.
Material	LED Lights	Provides high-efficiency illumination during nighttime.
Equipment	Batteries	Stores solar energy to ensure continuous operation at night.

Equipment	Controllers	Manages the system's operations, ensuring energy efficiency.

6.2 RACI Matrix

The **RACI Matrix** (Responsible, Accountable, Consulted, Informed) provides a clear framework for assigning roles and responsibilities within the project. This ensures effective collaboration and avoids confusion about who is responsible for or involved in specific tasks.

The **RACI** matrix includes four roles:

- **R = Responsible**: The person who performs the task.
- **A = Accountable**: The person who is ultimately accountable for the correct completion of the task. This is usually one person.
- **C = Consulted**: The people who are consulted and whose opinions are sought. This is typically a two-way communication.
- **I = Informed**: The people who are kept informed of progress, typically a one-way communication.

Table 7: RACI Matrix Table

Task	Project Manager (PM)	Procurement Team	Installation Team	Quality Assurance (QA)	Stakeholders (Client)	Engineers	Suppliers
Project Initiation	A	C	I	I	I	C	I
Define System Specifications	A	C	I	R	C	R	I
Procurement Planning	I	A	C	I	I	C	I
Material Procurement	I	R	C	I	I	I	A

System Installation	I	C	R	I	I	C	I
Testing and Validation	I	C	C	A	I	R	I
Project Handover	A	I	I	I	R	I	I

7. COMMUNICATION MANAGEMENT PLAN

The Communication Management Plan motivates the free exchange of information between all the project stakeholders, promoting teamwork, openness and responsibility. Businesspeople also need proper communication in executing projects in that; it facilitates effective decision-making where and when problems arise. The plan outlines how project information will be shared, the communication methods to be used, and the frequency of updates to keep everyone aligned.

7.1 Communication Matrix

The **Communication Matrix** identifies the key communication activities, methods, frequency, and intended audience for project updates. This structured approach ensures that the right information is delivered to the right stakeholders at the right time.

Table 8: Communication Matrix

Communication Type	Method	Frequency	Audience
Project Updates	Email	Weekly	Project Manager, Client
Budget Status	Meetings	Bi-weekly	Project Sponsor, Finance

Testing Results	Reports	End of Phase	Engineers, Client
Final Handover	Presentation	Once	Client, Project Team

Details of the Communication Plan:

- **Project Updates:** Weekly emails summarize progress, achievements, and risks, keeping stakeholders informed.
- **Budget Status:** Bi-weekly meetings review finances and address variances.
- **Testing Results:** Reports at each phase document performance and ensure transparency.
- **Final Handover:** A closing presentation highlights deliverables and success metrics.

8. RISK MANAGEMENT PLAN

The **Risk Management Plan** defines, analyses and minimizes risks that may be possible to achieve the project goals. Working risk identification and assessment with a clear focus on categorizing and monitoring said risks allows the project team to efficiently handle problematic situations or, at least, reduce the detrimental effect of those risks on further project completion and resultant costs.

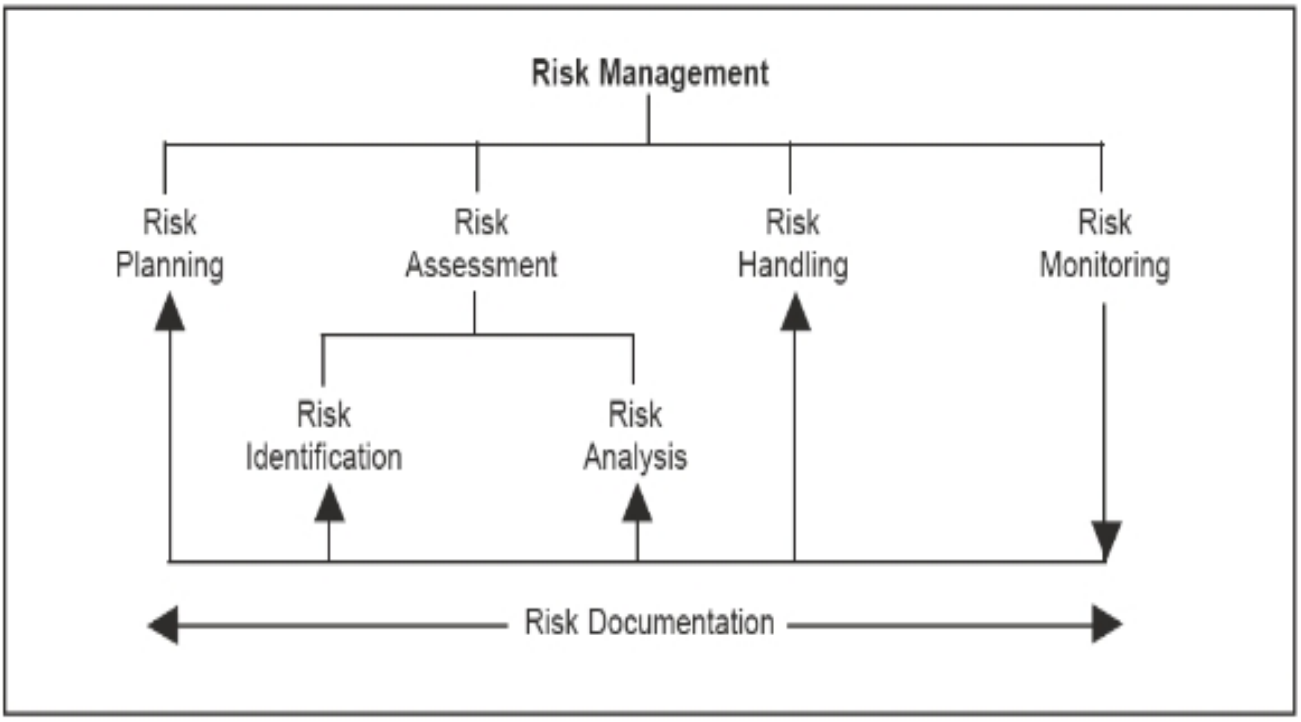

Figure 4: Risk Management Plan

8.1 Risk Breakdown Structure (RBS)

The **Risk Breakdown Structure** organizes potential risks into hierarchical levels for better identification and management.

Table 9: Risk Breakdown Structure (RBS)

Level 1	Level 2	Risk Description
Technical	System Failure	Potential malfunction due to design flaws, integration issues, or defects.
	Component Quality	Risk of substandard components affecting performance and durability.

Environmental	Weather	Impact of extreme weather conditions (e.g., dust storms, rain) on system performance and lifespan.
	Solar Variability	Fluctuations in sunlight reducing energy efficiency.
Operational	Supplier Delays	Risk of delayed material delivery due to unreliable suppliers or logistical issues.
	Installation Errors	Risk of improper installation leading to system inefficiencies or failures.

8.2 Risk Register

The **Risk Register** documents all identified risks, assesses their probability and impact, and outlines mitigation strategies.

Table 10: Risk Register

ID	Risk Description	Probability	Impact	Mitigation Plan
R01	Delay in solar panel delivery	High	High	Develop contracts with multiple suppliers to ensure redundancy.
R02	Performance issues in harsh weather	Medium	Medium	Use weather-resistant materials and conduct regular maintenance.

R03	Installation errors	Medium	High	Provide training to the installation team and conduct quality checks.
R04	System failure	Low	High	Perform rigorous system testing before deployment.
R05	Budget overrun	Medium	High	Allocate contingency funds and monitor expenses regularly.

9. PROCUREMENT MANAGEMENT PLAN

Procurement is defined as the act of acquiring goods and supplies required for the project. Procurement management encompasses the processes used to ensure that the project is successful. The **Procurement Management Plan** ensures that all materials and services required for the project are sourced efficiently, cost-effectively, and in compliance with quality and delivery standards. This plan outlines the procurement scope, selection criteria, and the approach for managing supplier relationships to achieve project objectives.

9.1 Procurement Statement of Work (SOW)

The **Statement of Work (SOW)** defines the scope, deliverables, and expectations for procurement activities to ensure clarity and alignment with project goals.

Table 11: Procurement Statement of Work (SOW)

Category	Details
Items to Procure	Solar panels, LED lights, batteries, controllers, mounting systems, cables, and protective casings.

Vendor Criteria	Vendors must provide certified, high-efficiency solar panels, durable LEDs, reliable batteries, and competitive pricing. They must also demonstrate a strong track record of on-time deliveries.
Expected Deliverables	Timely delivery of quality-assured components, including documentation such as warranties, certificates of compliance, and user manuals.
Compliance Standards	All procured items must meet ISO 9001:2015 quality management standards and relevant environmental compliance standards (e.g., RoHS).
Packaging Requirements	Components must be securely packaged to avoid damage during transportation and handling.
Lead Time	Delivery must occur within a maximum of 30 days from the order placement date.
Payment Terms	50% advance payment upon order placement, with the remaining balance due upon successful delivery and inspection.
Supplier Support	Vendors must provide after-sales support, including troubleshooting, component replacement, and technical assistance.
Inspection Protocols	All items will undergo rigorous quality checks upon arrival to ensure compliance with specifications and standards.

9.2 Vendor Selection Criteria

To identify the best supplier, vendors will be evaluated based on predefined selection criteria.

Weighted scoring ensures an objective and transparent selection process.

Table 12: Vendor Selection Criteria

Criterion	Weight	Vendor A	Vendor B	Vendor C
Cost	40%	35%	40%	30%
Quality	30%	35%	30%	35%
Delivery Timeline	20%	20%	25%	20%
Warranty	10%	10%	5%	15%
Total Weighted Score	**100%**	**30.50%**	**32.50%**	**29%**

10. CONCLUSION AND RECOMMENDATIONS

The **Solar-Powered LED Street Lighting System** is an efficient paving project that shows the country's adherence to the utilize sustainable development and renewable energy. As a cost effective, carbon neutral System, this underlines commitment to utilize solar power thereby fostering environmental responsibility. In addition, it improves safety by providing adequate lighting for the public, especially in areas which have not developed an adequate infrastructural base in this regard. They have not only solved the present energy issues but also have provided a reference point for other green projects in this area.

Recommendations:

- **Supplier Selection:** Select supplier with caution to offer the right service, capability, and affordable prices.

- **Pilot Testing:** First implement in test agencies to check the Systems efficiency before applying it to full scale agencies.
- **Stakeholder Involvement**: Make it possible to consult the stakeholders during the undertaking project to iron out any issue lest the project is affected.

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