

UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)

PROJECT MANAGEMENT PLAN TO DESIGN AND BUILD A 20KW SOLAR
SYSTEM FOR RESIDENTIAL USE

LEIBER YAH

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Carlos Brenes Vega

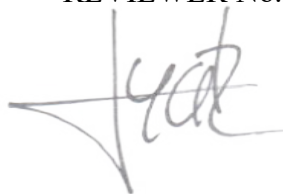
Full name must be written
TUTOR

Juan Camilo Delgado Acevedo

Full name must be written
REVIEWER No.1

Luis Diego Arguello

Full name must be written
REVIEWER No.2



Leiber Lorriel Amadeo Yah

Student full name
STUDENT

DEDICATION

In loving memory of my dear mother,

Though you are no longer with us in the physical realm, your presence continues to illuminate my path and warm my heart every day. Your unconditional love, strength, and wisdom have left an indelible mark on my soul, guiding me through life's trials and triumphs.

You were not only my mother but also my confidante, my mentor, and my greatest source of inspiration. Your unwavering belief in me fueled my dreams and instilled in me the courage to pursue them relentlessly.

This thesis is dedicated to you, my beloved mother, with boundless love, gratitude, and reverence. Your presence in my life has been a blessing beyond measure, and I carry your legacy with pride and honor.

Forever in my heart, forever my guiding light.

To my loving family, whose unwavering support, encouragement, and belief in my abilities have been the guiding light throughout this journey. Your sacrifices and endless love have fueled my determination to reach this milestone. This achievement is as much yours as it is mine.

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This thesis is dedicated to each of you, with heartfelt appreciation and love.

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ABSTRACT

This Project Management Plan outlines the comprehensive strategy for the design and installation of a 20-kilowatt (kW) hybrid solar solution tailored for residential applications in Belize. The project aims to address the growing energy demands of residential communities while promoting sustainable and eco-friendly practices. The plan encompasses key project management phases, initiation, planning, execution, monitoring and control and closure, as well as the ten knowledge areas established by the Project Management Institute.

Initiation involves defining the project scope, objectives, stakeholders, and initial feasibility analysis. The planning phase details the project schedule, resource allocation, risk management, and communication strategies. Execution involves the actual design and installation processes, ensuring adherence to quality standards and safety protocols. Monitoring and control mechanisms will be implemented to track project progress, address issues, and manage changes effectively.

The core focus is on delivering a 20-kW hybrid solar solution optimized for Belizean residential needs. The plan also considers local environmental conditions and regulatory requirements for a holistic sensitive implementation, as well as the regenerative aspect of project management and project execution as presented in the P5 analysis.

As Belize seeks to enhance its energy infrastructure, this project represents a significant step toward cleaner and more efficient residential energy solutions. The Project Management Plan provides a structured and adaptable framework to guide the successful execution of the project, contributing to the sustainable development goals of the region.

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ABBREVIATIONS AND ACRONYMS

BEL	Belize Electricity Limited
BZD	Belize Dollars
CBA	Central Building Authority
EVM	Earn Value Management
FGP	Final Graduation Project
KPI	Key Point Indicator
kW	Kilowatt
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMP	Project Management Plan
PUC	Public Utilities Commission
RBS	Risk Breakdown Structure
SOW	Scope of Works
TOR	Terms of Reference
WBS	Work Breakdown Structure

EXECUTIVE SUMMARY

This paper introduces a comprehensive Project Management Plan (PMP) for the design and installation of a 20-kW hybrid solar solution intended for residential use in Belize. The primary objective of this project is to address Belize's increasing need for cleaner and more affordable energy solutions. Belize, a small yet ecologically diverse nation, is heavily reliant on expensive energy imports, primarily from Mexico, which supplies 60 percent of the country's energy consumption. The remaining 40 percent is sourced from hydroelectric dams and micro-grids in certain regions. The prevailing environmental concerns and the high cost of energy imports underscore the need for innovative solutions.

Belize, like many countries globally, confronts a set of interrelated challenges in its energy sector that necessitate urgent attention and innovative solutions. These include the high cost of electricity, concerns regarding energy reliability, and a general lack of incentives or education regarding alternative and green energy sources. The high cost of electricity and the detrimental effects of global warming make it imperative to explore alternative energy sources, with solar technology emerging as the most promising and feasible solution.

The creation of this PMP aligns with the mission of Integrated Engineering Limited, which provides cost-effective and sustainable engineering solutions. Currently, Belize lacks specific guidelines and Project Management Plans for projects of this nature. This study aims to develop a comprehensive PMP for the design and installation of 20kW solar systems for residential use, filling a crucial void in the country's approach to renewable energy integration and the standards governing independent energy production. This project plan, developed in accordance with the Project Management Institute's Project Management Body of Knowledge (PMBOK), aims to establish mechanisms and standard operating procedures, promoting efficiency and sustainability in executing both current and future projects.

The overarching objective was to create a PMP aligned with PMBOK for the design and construction of a 20-kW solar solution intended for residential use in Belize, with the goal to provide an alternative power source and contribute to the promotion of green energy in the country.

The specific objectives, harmonizing with the general goal, include developing an Integration Management Plan, including a project charter, to coordinate all project elements essential for a successful outcome; establishing a Scope Management Plan to precisely define the necessary work for project success; creating a Schedule Management Plan to outline project deliverables and ensure timely completion; formulating a Cost Management Plan to budget and manage project finances efficiently; implementing a Quality and Safety Management Plan to guarantee that all deliverables meet stakeholders' expectations and

safety standards; crafting a Resource Management Plan to identify and manage essential resources; establishing a Communications Management Plan for effective stakeholder engagement and record-keeping; developing a Risk Management Plan to proactively manage potential risks; creating a Procurement Management Plan for product and service agreements; and formulating a Stakeholder Management Plan to identify and address stakeholder expectations and concerns throughout the project's lifecycle.

The successful execution of a project of this nature demands a comprehensive methodology that encompasses project initiation, planning, execution, monitoring and control, and closure phases. This methodology adheres to internationally recognized project management principles, including those outlined in the Project Management Institute's Project Management Body of Knowledge (PMBOK). This includes stakeholder identification and project charter for project initiation; scope definition, establishing standards, timelines, resources management, risk management, procurement assessment amongst others for project planning; quality checks, risk management, change management, resource management, stakeholder management etc. for project execution; progress tracking, quality management, risk management, change management for monitoring and control; and finally, the closeout documentation, project completion, handover, and final acceptance from stakeholders for the project closeout.

Integrated Engineering Services developed this project management plan as per the PMI standards, will the best project management practices. The methodology ensures that the plans' specific objectives and deliverables are met. All sub plans of the project management plan were successfully developed for consideration during the planning and execution of the project to ensure the successful completion of the project. This included a lot of new documentation that was not readily available. As well as making some changes to some of the already established processes. It is recommended that the project manager and the project team follow the subsidiary plans developed for the project using the relevant project management tools and techniques, proactively monitor the project execution ensuring standards are met, and conduct effective monitoring and evaluation of the project execution which will ensure successful completion

1 INTRODUCTION

1.1. Background

This paper introduces the Project Management Plan (PMP) for the design and installation of a 20-kW hybrid solar solution for residential applications in Belize. This Project Management Plan will integrate the project knowledge areas, which helps to synchronize and prioritize project management processes and project management phases to have a successful project execution.

Belize is a small country in the Caribbean. It is a picturesque and ecologically diverse nation. Belize has embraced the idea cleaner energy solutions. This endeavor is not only an environment imperative, but it also means reducing the country's reliance on expensive energy prices from the neighboring Mexico, which supplies a total of 60 percent of Belize's energy consumption, with the other 40 percent being provided by hydroelectric dams and a couple micro-grids installed in some parts of the country.

With this global mindset of finding alternative sources and renewable sources of energy and due to past studies done, it is confirmed that the most feasible solution is solar technology.

1.2. Statement of the problem

Belize, like many nations around the world, faces a series of interconnected challenges related to its energy sector that necessitate urgent attention and innovative

solutions. Some of these challenges include the high cost of energy, energy reliability, lack of incentives, or education on other green and alternative energy sources.

Due to the high cost of electricity and the effects of global warming in our environment, it is beneficial to find alternative way of energy sources, according to the Statistical Institute. Integrated Engineering saw the opportunity to capitalize on these needs to develop a product that satisfies these needs and for the betterment of the environment. In addition, creating a Project Management Plan in accordance with the guidelines proposed by Project Management Institute's Project Management Body of Knowledge can increase the company's chances of achieving this goal.

1.3. Purpose

Integrated Engineering Limited was created with a mission to provide cost effective and sustainable engineering solutions. Currently, there are no similar guidelines or project management plans for these types of projects. This study aims to develop a Project Management Plan to design and construct a 20kW solar system for residential use.

Since Belize currently has no standards for renewable energy integration into the grid and permissions for there to be independent energy producers, it also intended that through a collaboration between the relevant authorities and an analysis of green building standards, the Project Management Plan will develop minimum standards for green energy production in Belize.

Developing the Project Management Plan according to the principles and knowledge areas prescribed by the Project Management Body of Knowledge will enable the company to succeed in establishing mechanisms and standard operating procedures. These established practices will allow for efficiency and sustainable practices in successfully executing current and future projects.

1.4. Objective

The objective is to create a Project Management Plan in accordance with the Project Management Body of Knowledge. In addition to the guidance of the PMBOK, this project management plan will look at the green project management practices, by using the P5 Impact Analysis. This is for a project that entails the designing and construction of a 20-kW solar solution for residential purposes. This is to be done in the country of Belize to provide alternative power sources and to contribute to promoting green energy sources. This project has an estimated value of \$70,775 BZD. With this project it is expected customers to have a 35-40% reduction in their monthly electricity bill. In addition to the long-term cost savings it also will help in the global mission of producing green energy.

1.5. Specific objectives

The specific objectives which are aligned to the general objectives are as follows:

1. Develop an Integration Management Plan, inclusive of a project charter, defining key input elements to coordinate all the elements of the project needed to successfully complete the project.

2. Develop a Scope Management Plan to establish the work required, and only the work required, to complete the project successfully.
3. Develop a Schedule Management Plan to define the timeline for the project deliverables to ensure the project's timely completion.
4. Develop a Cost Management Plan to plan, estimate, and manage the budget for all project activities, deliverables, and resources.
5. Develop a Quality and Safety Management Plan to ensure that all project deliverables meet stakeholders' expectations.
6. Develop a Resource Management Plan to identify, acquire, and manage all physical and human resources needed to complete the project successfully.
7. Develop a Communications Management Plan to ensure effective communication with project stakeholders and to record all project communications.
8. Develop a Risk Management Plan to increase the probability/impact of positive risks and decrease the probability/impact of negative risks.
9. Develop a Procurement Management Plan to develop and administer agreements for products and/or services needed from outside the project team.
10. Develop a Stakeholder Management Plan to identify all groups and/or individuals potentially affected by the project and ensure that their expectations are understood, recorded, and considered throughout the project life cycle.

2 THEORETICAL FRAMEWORK

2.1 Company/Enterprise framework

A company or enterprise framework refers to the structure, policies, processes, and systems that an organization establishes to achieve its goals and objectives efficiently. It serves as a map for how the company operates, manages resources, and delivers value to its stakeholders.

2.1.1 Company/Enterprise background

Integrated Engineering Services is an engineering firm that has knowledge and supports a wide range of engineering projects. This includes electrical engineering, civil engineering etc. The engineering firm works on designing, implementing, commissioning, and closing projects. In addition to this, they do full turnkey projects.

2.1.2 Mission and vision statements

Mission- to provide cost effective and sustainable engineering solutions.

Vision- to guide the country in a greener and more sustainable path by providing cost effective and sustainable engineering solutions with this having a better world for all.

2.1.3 Organizational structure

Integrated Engineering Services is a small company with about 25 resources. This includes the director, financial advisor, and the rest of the team. Due to it being a small group, the projects that are worked on are not bigger than the team can manage. When the project is bigger than the team can manager, it is then outsourced but under the company's supervision.

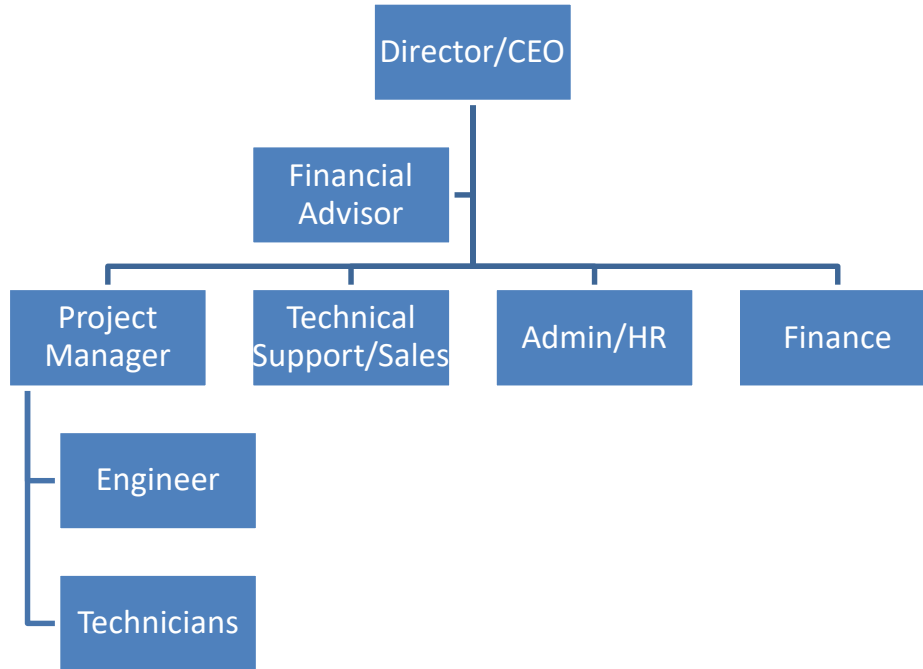


Figure 1 Organizational Structure. (L. Yah, 2023)

2.1.4 Products offered.

Integrated Engineering Services has a variety of portfolios. These include:

- **Electrical projects:** These include residential and industrial electrical designs, installation, supervision, and commissioning.
- **Solar energy projects:** This includes residential and industrial size projects, including pump stations with solar systems. This includes designs, installation, supervision, and commissioning.
- **Energy efficiency management:** This is for both residential and industrial projects. This is an analysis of power consumption, performance and recommendation on ways to better manage energy consumption and decrease the bill.

- **Engineering consultancy services:** These include civil engineering, electrical engineering, and project management services for the mentioned types of projects.

2.2 Project Management concepts

2.2.1 Project management principles

- **Value:** Focus on delivering value to stakeholders. Understand and prioritize their needs and expectations to ensure that the project aligns with the organization's strategic objectives.
- **Leadership:** Effective project management requires strong leadership. This will be accomplished by good project management practices and effective communication between all stakeholders.
- **Stakeholders:** Engage and manage project stakeholders proactively. Identify, analyze, and communicate with all relevant stakeholders to ensure their needs and concerns are addressed throughout the project lifecycle.
- **Processes:** Apply a structured approach to project management by using defined processes and methodologies. Understand and follow these processes to ensure consistency and reliability in project delivery from start to finish.

- **Risk:** Identify, assess, and manage risks proactively. Develop a Risk Management Plan and continuously monitor and respond to risks to reduce their impact on the project.
- **Quality:** Deliver a product or service that meets or exceeds stakeholder expectations. Implement quality management processes to ensure that project deliverables adhere to defined standards and requirements.

2.2.2 Project management domains

The project management domains follow.

- **Stakeholders** refers to building effective working relationships with them, with this proper integration to meet everyone's needs and priorities. In this instance, the key stakeholders will be the beneficiaries of the project, including the end users, the project execution, and the Government of Belize (GOB).
- **Team** is about developing and leading the teams so the project can succeed. In this project, team development will be fostered by having constructive meetings, getting feedback, and actioning the feedback received.
- **Development approach and life cycle** are the activities to address the development approach, cadence, and lifecycle phases of the project. In this case, the project is expected to use a hybrid approach of project development.
- **Planning domain** draws knowledge and process to setup success through the planned scope, activities, schedule, and resources. Planning in this project, like in

many others, is key. This includes making schedules, timelines, milestones, resources management etc.

- **Project work** considers the infrastructure that includes procurement, deployment of physical resources, and collation of capability, knowledge, and expertise. This is done by effectively communicating, engaging, and managing processes like procurement amongst others.
- **Delivery** is the knowledge and process used during the project execution from start to finish. This is observed and followed by monitoring of the project execution, conducting quality checks, and making improvements where necessary.

Measurement entails assessing performance and taking the necessary steps to bring your project back on track. This is part of the monitoring and control of the project, as well as checking delays, timelines, possible setbacks, and finding ways to address them.

- **Uncertainty** In a project, this means that any unforeseen issue needs to be kept in mind during project execution. This is done as part of the risk assessment and risk management, closely monitoring the execution of the project.

2.2.3 Predictive, adaptative and hybrid projects

The Predictive Project refers to when the scope of work and requirements for the project are clear and justify the detailed upfront planning. It is a form of project life cycle in which the project scope, time, and cost are determined in the early phases of the cycle (PMI, 2017).

Adaptive Project provides a more flexible plan to work with, rather than a project life cycle that is iterative and incremental (PMI, 2017). It can be used as an alternative to traditional projects, and customer involvement is more distinct.

Hybrid Projects are essentially taking two (or more) different project management methodologies and combining them to execute the project. It is a combination of two or more agile and non-agile projects, having a non-agile result. (PMI, 2016).

Therefore, the development of a Project Management Plan to design and install a 20-kW solar system for residential purposes adopts a hybrid style of project life cycle. In this case, it will be adaptive and incremental.

2.2.4 Project management

As defined in the PMBOK 6th Edition, project management can be defined as the use of knowledge, skills, and techniques to meet customer needs. Furthermore, it is accomplished through appropriate application and integration of the project management processes identified for the project. Benefits of project management include satisfying stakeholders, completing projects in a timely manner, avoiding cost over runs, managing any constraints like scope quality and resources. To understand more about project management, we need to define what is a project. A project can be defined as a temporary effort undertaken to create a unique service, product, or result (PMI, 2017, p.4). It is considered to have a beginning and an end, meaning it does not repeat itself, for example, operations.

2.2.5 Project management knowledge areas and processes

Number	Knowledge Areas	Examples
1	Integration Management	This engineering firm will be integrating all project management processes. This includes scope management, quality management, scope management, and the other processes for the project to be executed accordingly.
2	Scope Management	Scope management is the monitoring of the deliverables and the end goal to ensure that the customer requirements are achieved. This is to avoid any scope creep and ensure all parties are satisfied with the product.
3	Schedule Management	Schedule management includes the monitoring of the timelines with respect to the deliverable and ensure they are in line to address any set back or to speed up a process for the project to be finished.
4	Cost Management	Cost management is very important since the success of a project is highly dependent on the funds it has for it to be completed.
5	Quality Management	Quality management is highly important for the project to be delivered with the required quality the stakeholders expect. This will be done by doing inspections on site and performing the relevant checks on the designs.
6	Resource Management	Resource management will be used to evaluate the resources versus the workload. This will be done for 2 main reasons. The first is to avoid overworking resources and to ensure the work is done properly, and the second is so that quality is not compromised.
7	Communication Management	Communication management is key for all projects, and this one is no exception. Communication is done in different ways, including reports, meetings, and constant updates to all parties.

8	Risk Management	Risk management will be monitored to identify any risk and mitigate to avoid any delays or issues during project execution.
9	Procurement Management	Procurement management is the proper managing of acquiring materials or tools to have a project completed. This will be done using proper procurement processes.
10	Stakeholder Management	Stakeholder management will be done by having regular meetings to inform and update stakeholders of any issue, milestone, or accomplishment the project might have.

The project management process groups are listed below.

- Initiating Process Group: These are the processes that define the project. This is also the approval to proceed with the project.
- Planning Process Group: These are the processes that establish the scope of the project, clarify objectives, and define the plan of action needed to get the objectives that are needed to complete the project (PMI, 2017, p.23).
- Executing Process Group: These include processes that are performed to complete the work defined on the Project Management Plan (PMI, 2017, p.23).
- Monitoring and Control Process Group: These include processes that are required to track, review, and regulate the progress and performance of the

project; identify any areas in which the changes of the plan are required; and initiate the corresponding changes (PMI, 2017, p.23).

- Closing Process Groups: These include processes performed to formally complete or close the project phase or contract (PMI, 2017, p.23).

2.2.6 Project life cycle

Project life cycles are a series of phases that represent the evolution of a product from concept through delivery, growth, maturity, and retirement. The project lifecycles consist of 5 phases. These are Initiation, Planning, Executing, Monitoring and Control, and Closing phases. In addition to this, there can be different lifecycles, and they can be understood better in relation to scope, cost, and time (PMI, 2017, p.56).

Predictive Life Cycle can be understood as the project where everything is in line and there are no setbacks. Issues are mitigated immediately. This can also be referred to as the waterfall life cycles (PMI, 2017, p.56).

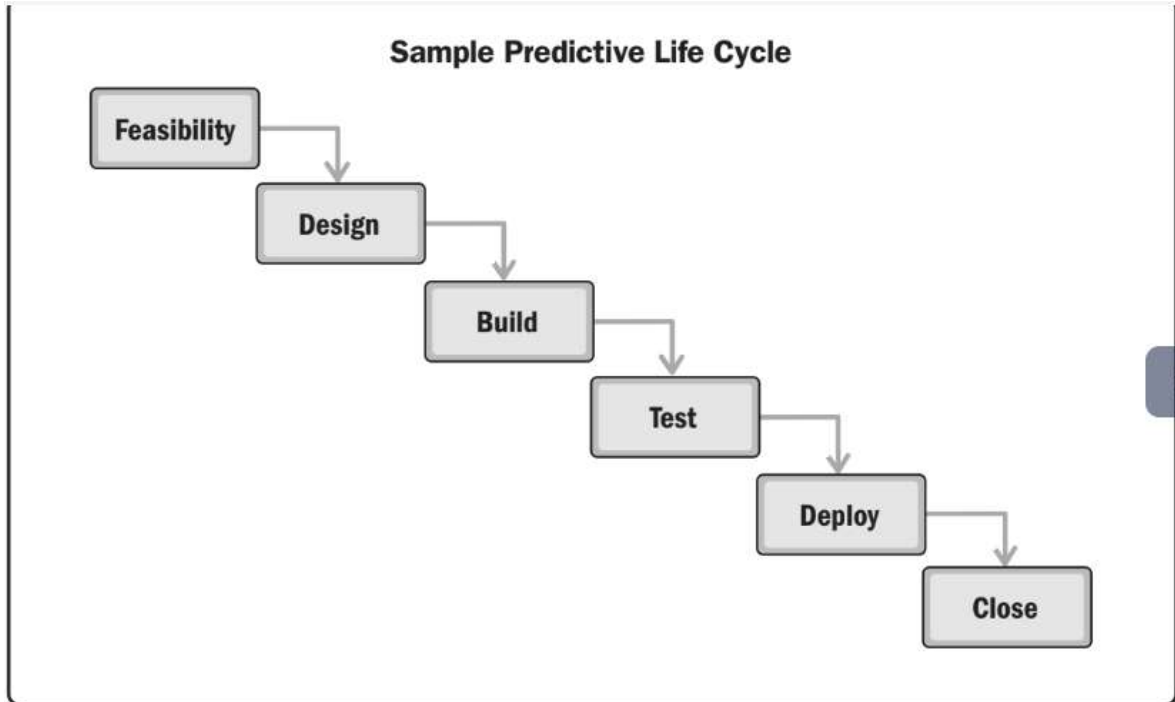


Figure 2 Predictive Life Cycle (PMBOK, 2017)

Iterative Life Cycle can be understood when the scope is clearly defined and maintained, but cost and time are modified as the team gets a better picture as the project advances (PMI, 2017, p.56).

Incremental Lifecycle can be understood when the product is produced through a series of iterations, meaning it goes through different cycles until the product is the desired one (PMI, 2017, p.56).

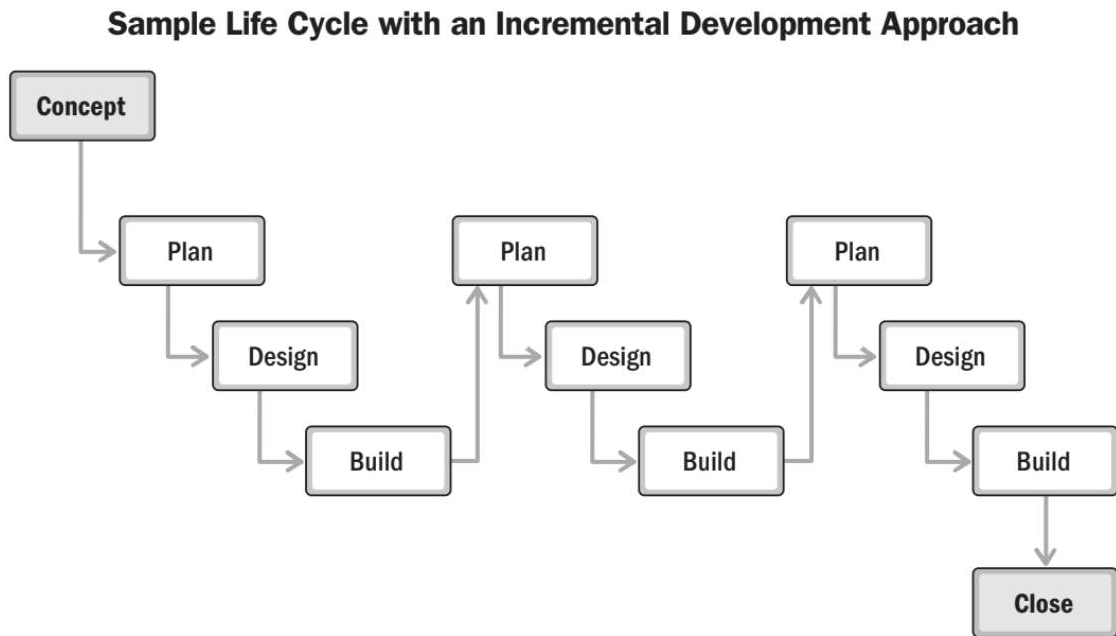


Figure 3 Sample Life Cycle with Incremental Approach (PMBOK 2017)

Hybrid Lifecycle is a combination of both predictive and adaptive life cycles. This is because they have their requirements established, and the remaining elements are enhanced as the project is executed to follow the adaptive life cycle (PMI, 2017, p.56).

Adaptive life cycle is also agile, iterative, or incremental. This is because the scope is approved before the iteration starts, then iterations continue until the product is finished (PMI, 2017, p.56).

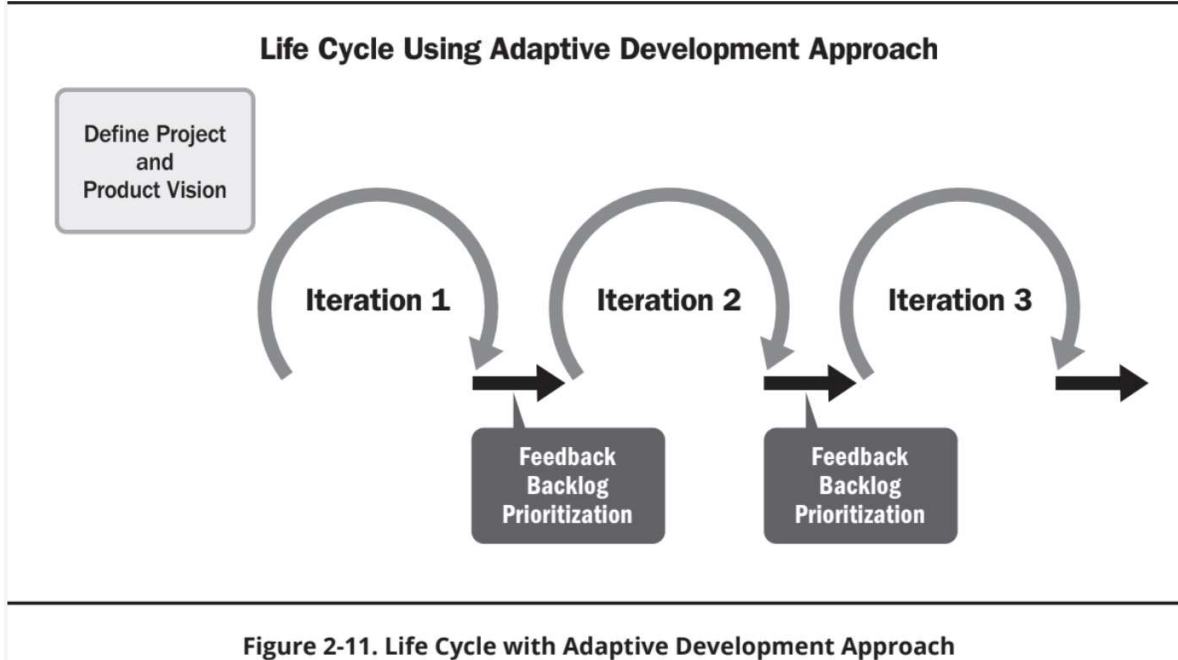


Figure 4 Adaptive Life Cycle with Developmental Approach (PMBOK 2017)

In the FGP project, the life cycle used will be a hybrid lifecycle. This is because in the first instance, the scope is defined and will not change just like a predictive lifecycle, while there will be scenarios or instances where the changes will be made during the execution phase that might need to be modified to complete the required goal.

2.2.6.1 Company strategy, portfolios, programs, and projects

The company strategy is to provide the best engineering solution to its customers. Below are the portfolios and programs the company has.

Portfolio

- Engineering Projects

Programs

- Electrical Engineering Projects
- Civil Engineering Projects
- Renewable Energy Projects

Projects

- Design, Construct, and Commission a 20kW solar system for residential uses.

2.3 Other applicable theory/concepts related to the project topic and context.

2.3.1 Current situation of the problem or opportunity in study

In Belize currently, there is little done so far regarding the exploration of using alternative sources of energy, especially in ways to find these kinds of engineering projects more sustainable. This is due to the skillset not readily available locally, and it is something the government or a third party must bring to the country. In addition to this, it is believed that if this project is successful there might be organizations that might be interested in investing in these kinds of projects of projects, and this, in return, will develop the country of Belize.

2.3.2 Previous research done for the topic in study

Based on the preliminary research done, it can be concluded that there is a lot of information about these kinds of successful projects in the region and in the world that are very good examples and pioneers for more projects like this. The preliminary research mainly focused on project management practices, hence the reason the PMBOK is one of the main

sources. As it relates to the other sources, they are more from a more focused perspective on actual best project management practices on similar projects like the following reference, *Renewable Energies Potential in Jamaica, Solar Energy, Technologies, and Project Delivery for Buildings*. Project management for the Oil and Gas Industry developed by Loy, D., & Coviello, M. Finally, in reference to the green project management references, these are to help mold the project in a greener and more sustainable way and to assist in the implementation of the best project management practices.

2.3.3 Other theory related to the topic in study

The reason for this project is to provide the residents of Belize with an alternative source of power at a more renewable and cheaper way. This Project Management Plan will provide a roadmap for accomplishment by facilitating planning and process reviews.

The Project Management Plan will target all areas of best practices which will define how the project will be executed, monitored, and controlled. Key components include an Integration Plan by means of Project Charter, Scope, Time, Cost, Quality, Resources, Communication, Risk, Procurement, and Stakeholder Management Plans.

3 METHODOLOGICAL FRAMEWORK

3.1 Information sources

To effectively answer research questions, the researcher should know about previous research and current perspectives related to the topic. Information sources are all elements that offer information relevant to the problem of study. Reviewing literature allows the researcher to see if a solution has already been put forth to the problem under investigation. It can also offer innovative ideas and perspectives not previously considered by the researcher and identify research gaps on the topic. Information sources can be books, encyclopedias, magazines, databases, newspapers, libraries, catalogues, and the internet. Some of these are often categorized as primary, secondary, and tertiary materials.

3.1.1 Primary sources

According to the Seton Hall University Library, primary sources are original materials, regardless of format. Letters, diaries, minutes, photographs, artifacts, interviews, and sound or video recordings are examples of primary sources created as a time or event is occurring.

In this Project Management Plan , some sources include meetings and interviews with different stakeholders, for example,

- Belize Electricity Limited (BEL) they are used to provide clarity on the processes and established agreements.
- Central Building Authority (CBA) provides or supports by having the laws established, the documentation required.

- The Project Management Book of Knowledge provides information of all the project management processes, The main source to be used to complete the project management plan.

3.1.2 Secondary sources

On the other side, a secondary source of information is one that was created later by someone who did not experience first-hand or participate in the events or conditions you are researching. To a historical research project, secondary sources are generally scholarly books and articles.

For this reason, secondary sources being utilized for this project are the

- PMBOK Guides from background information related to the knowledge areas also the deliverables that are required.
- Other projects like this one provide an idea of the documentation that can be used as a guide and can be developed or tailored to fit this project.
- Design Software gives an overview of the requirements in terms of materials that may or may not be required to carry out the works.
- PMI Database provided information related to the 10 knowledge areas that serve as a guide to development of this project.
- Engineering Handbooks provide background information on electrical and solar systems.

Table 1 Information sources (L. Yah, 2023)

Objectives	Information sources	
	Primary	Secondary
1. Develop an integration Management Plan	<ul style="list-style-type: none"> • Meetings • Review programs 	<ul style="list-style-type: none"> • PMBOK Guide • PMI 2016 and 2017. • Similar projects.
2. To create a Scope Management Plan	<ul style="list-style-type: none"> • Meetings • Review programs and previous projects. 	<ul style="list-style-type: none"> • PMBOK Guide • PMI database and other projects similar
3. To create a Resource Management Plan	<ul style="list-style-type: none"> • Meetings • Review programs 	<ul style="list-style-type: none"> • PMBOK Guide • PMI database and other projects similar
4. To create a Communication Management Plan	<ul style="list-style-type: none"> • Past projects, • Meetings 	<ul style="list-style-type: none"> • PMBOK Guide • PMI database and other projects similar
5. To create a Procurement Management Plan	<ul style="list-style-type: none"> • Meetings • Trends, • Papers 	<ul style="list-style-type: none"> • PMBOK Guide • PMI database and other projects similar

6. To create a Cost Management Plan	<ul style="list-style-type: none"> • Historical Data • Energy formulas 	<ul style="list-style-type: none"> • Web Information • Past projects • Quotations
7. To develop a Quality Management Plan specific to quality of these kind of works, applying and following standards	<ul style="list-style-type: none"> • Meetings, • Surveys/Site visits • BEL Standards, • NEC 2008 	<ul style="list-style-type: none"> • PMBOK Guide • PMI database and other projects similar. • Engineers Handbooks
8. To establish a Risk Management Plan that analyzes the project holistically	<ul style="list-style-type: none"> • Meetings, • Schedule Management Plan 	<ul style="list-style-type: none"> • PMBOK Guide • PMI database and other projects similar
9. To create a Schedule Management Plant to monitor the project's lifecycle. Defining timelines and milestones.	<ul style="list-style-type: none"> • Emails • Gantt Chart • Meetings • 	<ul style="list-style-type: none"> • PMBOK Guide • PMI database and other projects similar • MS Project • MS Excel
10. To create a Stakeholder Management Plan to identify and effectively manage them throughout the	<ul style="list-style-type: none"> • Meetings, • Schedule Management Plan 	<ul style="list-style-type: none"> •

project life cycle based on their level of interest and impact to the project.		
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3.1.3 Research methods

According to the University of New Castle Library Guides, “Research methods are the strategies, processes or techniques utilized in the collection of data or evidence for analysis in order to uncover new information or create better understanding of a topic.” The methods to be utilized in the Project are the Analytical, Descriptive, and the Quantitative Methods.

3.1.3.1 Analytical Method

The analytical method involves critical thinking skills and the evaluation of facts and information relating to current research.

3.1.3.2 Descriptive Method

The descriptive method aims to describe a population, situation, or phenomenon studied by answering the questions how, what, when, and where if a research problem, rather than why.

3.1.3.3 Quantitative Method

Quantitative research is the process of collecting and analyzing numerical data. It can be used to find patterns and averages, make predictions, test causal relationships, and generalize results to wider populations.

Table 2 Research Methods (L. Yah, 2023)

Objectives	Research methods		
	Analytical Method	Descriptive Method	Quantitative Method
Develop and integrate Management Plan	Evaluate the different options available.		
To create a Stakeholder Management Plan	The Stakeholder Management Plan will be done from team engagement, meetings, and feedback.		The Stakeholder Management Plan will assist in the measurement of progress, development, engagement.
To create a Resource Management Plan	The Resource Management Plan will be done by analyzing the scope and schedule for it to be aligned.		To properly measure team performance, KPI, progress, constraints.

To create a Communication Management Plan	Communication Management Plans will be done using the scope, schedule, and stakeholder management plans.	Observe the trend solar-Grid in the country	
To create a Procurement Management Plan	Procurement Management Plan will be developed to improve the process and have it standardized.		Will be used to find ways to manage purchase, savings and finding better prices.
To create a Cost Management Plan	The Cost Management Plan will be derived from other projects	To conduct a check and balance and have visibility of the saving	This method entails managing costs, variations and changing orders.
To develop a Quality Management Plan specific to quality of these kind of works, applying and following standards.	Will include a variety of stakeholders and experts to use analytical research during studies to find the most relevant information to	This method will use data collection which allows for gathering in depth information to ensure quality assurance.	This method will be used to find make predictions, test casual

	apply to the quality management.		
To establish a Risk Management Plan that analyzes the project holistically.	A Risk Management Plan will be developed from data observed from construction documents as well as interviews with experts.	To utilize a selection or development of data gathering instruments to aid in determining the risk.	It can be used to find patterns and averages, make predictions, test causal relationships, and generalize results to be able to identify risk and how to respond to them.
To create a Schedule Management Plan to monitor the project's lifecycle, defining timelines and milestones.	A Schedule Management Plan will be developed from data observed from the progress of works.	This method will use data collection which allows for gathering in depth information to ensure the schedule is going as planned.	Will assist in the process of collecting and analyzing past data in reference to time span for deliverables and assist to create the management plan.
To create a Scope Management Plan	A Scope Management Plan will be developed	This will aim to accurately and systematically identify the resources needed	This method will be used to find patterns and averages, make predictions, test,

		to develop the scope of the project.	and generalize results.
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3.1.4 Tools

A tool in project management is “something tangible, such as a template or software program, used in performing an activity to produce a product or result” (PMI, 2017). The tools to be utilized are:

- Expert judgment: to obtain feedback from skilled personnel, this is done by interviews, literature review from previous projects like this one.
- Data gathering: such as case studies, checklist, and interviews
- Critical path method to prevent project schedule problems, this is to identify any issues with the timelines, constraints, and possible impact to the project. This is to be done by means of software.
- Interpersonal and team skills: by reviewing other projects, teamwork, find ways to pick up possible issues before they occur. Review by site visits, interviews, documentation, literature etc.
- Communication: all means of communication including emails, meetings both presential or virtual, phone calls etc. all methods that can assist in the communication to all stakeholders and also other professionals in the field.

Table 3 Tools (L. Yah, 2023)

Objectives	Tools
Develop and integrate Management Plan	Microsoft suite, including Excel and Word
To create a Stakeholder Management Plan	Microsoft suite, including Excel and Word
To create a Resource Management Plan	Microsoft suite, including Excel and Word
To create a Communication Management Plan	Microsoft suite, including Excel and Word, Microsoft teams, calls, meetings, visits.
To create a Procurement Management Plan	Microsoft suite, including Excel and Word, also an inventory management system.
To create a Cost Management Plan	Microsoft suite, including Excel and Word, also an inventory management system, finance tools.
To develop a Quality Management Plan	Face-to-face meetings to analyze required data relating to the project quality. Microsoft suite, Skype, Zoom, Teams etc.
To establish a Risk Management Plan	Microsoft suite, including Word and Excel
To create a Schedule Management Plan	Microsoft suite, including Word and Project, Power Point.
To create a Scope Management Plan	Microsoft suite, including Word and Excel

3.1.5 Assumptions and constraints

The PMBOK Guide describes an assumption as factor in the planning process that is true, real, or certain without proof or demonstration. On the other hand, a constraint is defined as a limiting factor that affects the execution of a project, program, portfolio, or process (PMI, 2016).

Table 4 Assumptions and Constraints (L. Yah, 2023)

Objectives	Assumptions	Constraints
Develop and integrate Management Plan	That plans integrate and are all aligned.	That the team does not agree with the plan.
To create a Stakeholder Management Plan	That the information is readily available.	Stakeholder requirements and interest may change during the project
To create a Resource Management Plan	That the resources allocated are enough and have the required skillset.	Budget cost for labor may change during the project
To create a Communication Management Plan	That the team understands the plan quickly and that work progresses. Also, that all stakeholders agree to the established means of communication.	Unavailability of key stakeholders limiting information.
To create a Procurement Management Plan	That all materials are procured as planned, that all permits and relevant approvals are received on time.	Getting new suppliers, new markets, new mindset.
To create a Cost Management Plan	The project will be completed as per budget and in alignment cost management plan.	Economic conditions may change.
To develop a Quality Management Plan	All goods procured will be of good quality as in the procurement process.	That the required material is discontinued or prohibited.
To establish a Risk Management Plan	All possible risk has been identified.	Unexpected risk may occur that might not be captured immediately.
To create a Schedule Management Plan	The time allotted will be enough for full project implementation since all stakeholders will work expeditiously to ensure the timely preparation for and execution of their respective tasks.	Delays in information from stakeholder will prolong the project.
To create a Scope Management Plan	All stakeholders will be supportive and instrumental in the facilitation of works	A time to gather all necessary information to

Objectives	Assumptions	Constraints
	related to the development of the scope management.	develop the Scope Management Plan to be collated in a short space of time.

3.1.6 Deliverables

A deliverable is defined as any unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project.

Deliverables may be tangible or intangible (Project Management Institute, 2017).

Table 5 Deliverables (L. Yah, 2023)

Objectives	Deliverables
Develop an Integration Management Plan	Integration Management Plan- a document to coordinate all the necessary elements of the project to successfully complete the project.
To create a Stakeholder Management Plan	Stakeholder Management Plan- is a plan that identifies all individuals and entities impacted by the project, ensuring their expectations are understood, written, and taken into consideration during project execution.
To create a Resource Management Plan	Resource Management Plan- identifies, and manages all resources needed to complete the project.
To create a Communication Management Plan	Communication Management Plan- is a plan that ensures effective communication with all stakeholders and tracks all means of communication throughout the project's lifecycle.
To create a Procurement Management Plan	Procurement Management Plan- documents the development and administration of agreements for products and services needed from external providers.
To create a Cost Management Plan	Cost Management Plan- is a plan that estimates and manages the budget for all deliverables and project activities.

To develop a Quality Management	A Quality Management Plan- is a plan that ensures all project deliverables are met to all stakeholder's expectation as well as all existing norms and regulations.
To establish a Risk Management Plan	A Risk Management Plan- is a plan that analyzes all risk both positive and negative, with the plan to decrease the negative and increase the positive.
To create a Schedule Management Plan	A Schedule Management Plan- defines the timelines for all deliverables to ensure they are completed timely.
To create a Scope Management Plan	A Scope Management Plan- is a document to establish the work required to complete the project successfully.

4 RESULTS

4.1 Integration Management

4.1.1 Introduction

Project integration management includes the process and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the project management process groups. (PMBOK 2016). The primary goal of integration management is to ensure that all elements of a project are effectively coordinated and aligned to achieve project objectives.

4.1.2 Project Integration Management Processes

The integration of all the other processes is not an easy task and is not straightforward. In this project the company will use the Change Control Process to manage all changes required or requested from all different management plans or areas. This change control process will help and have a bigger picture of what one change can affect the others even if it's not related to that specific plan. With all these changes made this will reduce the risk of delays. A tool to be used is the Kanban, this is to have a visual of all changes with their respective solution and also to have a visual on the entire picture.

4.1.2.1 Develop Project Charter:

This process involves defining the project at a broad level. The project charter formally authorizes the project and provides the Project Manager with the authority to apply resources to project activities.

PROJECT CHARTER	
Formalizes the project start and confers the project manager with the authority to assign company resources to the project activities. Benefits: it provides a clear start and well-defined project boundaries.	
Date	Project Name
28 th November 2023	Project Management Plan for the design and installation of a 20-kW hybrid solar solution for residential applications in Belize.
Knowledge Areas / Processes	Application Area (Sector / Activity)
Knowledge areas: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management and Project Stakeholders Management. Process groups: Initiating, Planning, Executing, Monitoring & Controlling, Closing	Renewable Energy, Energy Sector
Start Date	Finish Date
29 th August 2023	
Project Objectives (General and Specific)	
General Objective: To develop a project management plan for the designing and construction of a 20-kW solar solution for residential application in Belize. Specific Objectives: 1. Develop an Integration Management Plan 2. To create a Stakeholder Management Plan 3. To create a Resource management plan. 4. To create a communication management plan 5. To create a Procurement management plan 6. To create a Cost management plan 7. To develop a Quality Management 8. To establish a Risk management plan 9. To create a schedule management plan 10. To create a Scope Management Plan	
Project Purpose or Justification (Merit and Expected Results)	

Figure 5 Project Charter (L. Yah, 2024)

4.1.2.2 Develop Project Management Plan:

This process involves defining, preparing, and coordinating all plan components and consolidating them into an integration Project Management Plan. The Project Management Plan becomes the primary document for guiding project execution and control.

-

4.1.2.3 Develop and Manage Project Work:

This process involves carrying out the Project Management Plan by performing the activities included in it. It involves leading and performing the work defined in the Project Management Plan, including Scope Management, Schedule Management, Cost Management etc.

4.1.2.4 Monitor Project Knowledge:

This is the process of using existing knowledge and creating new knowledge to achieve the project's objectives and contribute to organizational learning. This is done via software, using a project management information system.

4.1.2.5 Monitor and Control Project Work:

This process involves carrying out the Project Management Plan by performing the activities included in it. It involves leading and performing the work defined in the Project Management Plan.

4.1.2.6 Perform Change Control

This process involves reviewing all change requests, approving changes, and managing changes to deliverables and project documentation. It ensures that only approved and validated changes are implemented.

The change control process consists of the following.

- **Initiation:** it starts when the change request is being logged using the change request form
- **Evaluation:** it is evaluated by the project team.
- **Approval:** based on the information provided, and investigation carried out and all possible impacts and risks it might have to other processes, the relevant approval or rejection is given.
- **Update Change log-** the change log is updated with all new information provided or gathered. This means updating all other plans, for example, schedule, risk, cost. Etc.
- **Implementation:** once approved the change is implemented and finally communicated to all stakeholders.

CHANGE REQUEST FORM		
Change Description		
Project Name:	Change Name:	Number:
Requested By:	Contact:	Date:
Description of Change:		
Reason for Change:		
Priority [Circle One]: 1. High 2. Medium 3. Low		
Impact on Deliverables:		
Impact of Not Responding to Change (and Reason Why):		
Date Needed:	Approval of Request:	Date:
Change Impact		
Tasks/Scope Affected:		
Cost Evaluation:		
Risk Evaluation:		
Quality Evaluation:		
Additional Resources:		
Duration:		
Additional Effort:		
Impact on Deadline:		
Alternative and Recommendations:		
Comments:		
Sign Offs		
[Circle One]: 1. Accepted 2. Deferred 3. Rejected 4. More Info Requested		
Comments:		
Project Manager Signature:	Date:	
Decision Maker Signature:	Date:	

Figure 6 Change Request Form (L. Yah, 2024)

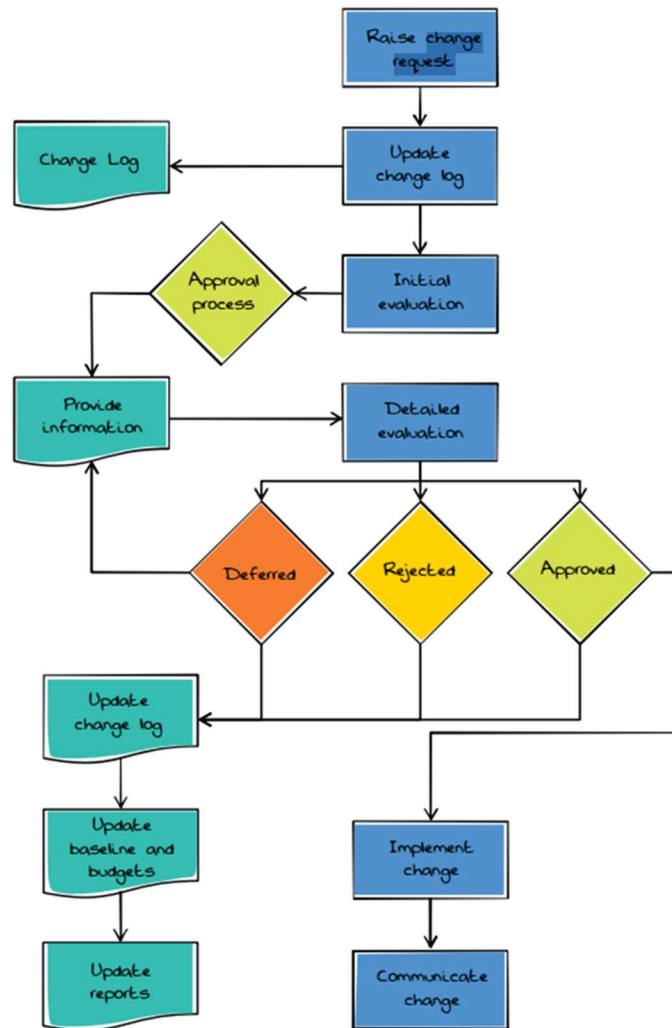


Figure 7 Change Control Process (L. Yah, 2024)

4.1.2.7 Close Project or Phase

This process involves finalizing all project activities, completing all deliverables, obtaining customer or stakeholder acceptance, and closing out the project or project phase.

Project Closeout Report**Project Title:** [Design and Install a 20kVA Solar System_]**Project Manager:** [Project Manager's Name]**Project Completion Date:** [Completion Date]**1. Project Overview**

[Provide a brief overview of the project, including its objectives, scope, duration, and key stakeholders.]

2. Project Achievements

- Summarize the achievements and deliverables of the project, highlighting key milestones and outcomes.
- Include any significant accomplishments, innovations, or lessons learned during the project lifecycle.

3. Scope Management

- Review the project scope and any changes or modifications that occurred throughout the project.
- Document any scope deviations, variances, or challenges encountered and how they were addressed.

4. Schedule Management

- Assess the project schedule and timeline against the planned schedule.
- Identify any schedule deviations, delays, or accelerations and their impact on project milestones.

5. Cost Management

- Review the project budget and expenditures against the planned budget.
- Document any cost overruns, savings, or financial discrepancies and their root causes.

6. Quality Management

- Evaluate the quality of project deliverables and outcomes against established quality standards.
- Highlight any quality issues, defects, or corrective actions taken to ensure project quality.

Figure 8 Project Closeout Template (L. Yah, 2024)

7. Risk Management

- Assess the effectiveness of risk management strategies and actions implemented throughout the project.
- Document any unforeseen risks, issues, or mitigations and their impact on project outcomes.

8. Stakeholder Management

- Review stakeholder engagement and communication strategies employed during the project.
- Document stakeholder feedback, satisfaction levels, and any unresolved issues or concerns.

9. Lessons Learned

- Summarize key lessons learned from the project, including successes, challenges, and areas for improvement.
- Identify best practices, insights, and recommendations for future projects based on project experiences.

10. Project Documentation

- Compile all project documentation, including plans, reports, contracts, and correspondence.
- Ensure that documentation is organized, labeled, and archived for future reference and audit purposes.

11. Project Closeout Activities

- Confirm completion of all project deliverables and closure of project activities.
- Finalize contracts, agreements, and payments with vendors, suppliers, and contractors.
- Obtain formal acceptance and sign-off from stakeholders and project sponsors.

12. Acknowledgments

- Express gratitude to project team members, stakeholders, sponsors, and other contributors for their support and contributions to the project's success.

13. Next Steps

- Outline any follow-up actions or recommendations arising from the project closeout process.
- Identify any ongoing responsibilities, warranties, or maintenance requirements for project deliverables.

Figure 9 Project Closeout Template (L. Yah, 2024)**14. Project Closeout Approval**

This Project Closeout Report is approved by:

[Project Manager's Name], Project Manager Date: [Date]

[Stakeholder's Name], Sponsor Date: [Date]

Figure 10 Project Closeout Template (L. Yah, 2024)

4.2 Scope Management Plan

4.2.1 Introduction

The Scope Management Plan provides an outline of the framework for this project, which details how the project scope will be defined, developed, and verified. It documents the scope management approach; roles and responsibilities as they pertain to project scope, scope definition; verification, control measures, and scope change control; and the project's work breakdown structure. Any project communication which relates to the project's scope should adhere to the Scope Management Plan.

The figure below shows the inputs, tools and techniques, and outputs of the plan scope management process.

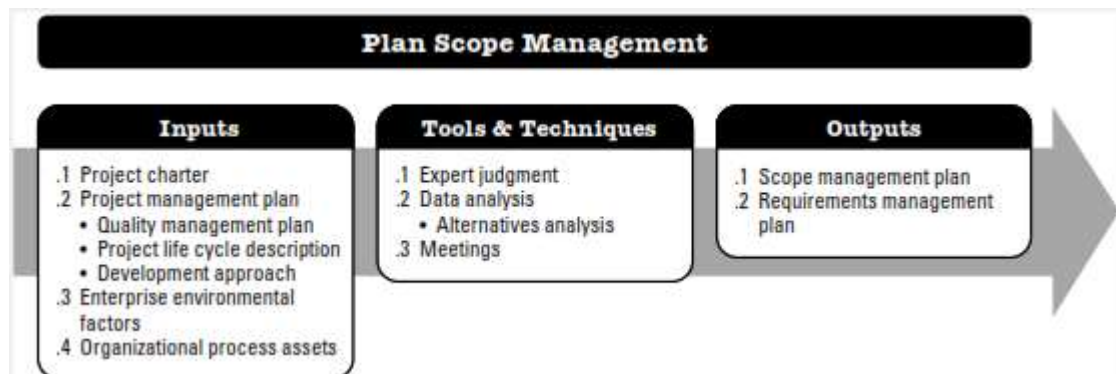


Figure 11 Plan Scope Management process flow. A Guide to the Project Management Body of Knowledge (p.134), 2017

The inputs include the project charter, other information from past projects, organizational processes, tools used includes meetings, expert judgement with skillful resources, and the outputs include the scope definition and the WBS.

The Scope Management approach will be used to identify and define the actions required to deliver the project's requirements and ensure that the work is completed according to the project's schedule and budget.

This provided the procedures and responsibilities undertaken to effect any required change to the scope of the work. The changes can be initiated by the Project Manager, stakeholders, or any member of the project team. This will be monitored and controlled using the change management process. This is to be evaluated and analyzed from all angles to see the effects on the project's schedule, cost, quality, resources etc. This change request is to be approved by the Project Manager by the change control board if established.

4.2.2 Roles and Responsibilities

The Project Manager, sponsor, and technical team will all play key roles in managing the scope of the project. With that in mind, they must be aware of their responsibilities to ensure that the work performed on the project is within the agreed scope throughout the project life cycle. The table below shows the roles and responsibilities of the scope management of the project.

Table 6 Stakeholder Role and Responsibilities (L. Yah, 2023)

Name	Role	Responsibility
Aaron Noh	Owner Project Sponsor	Approve or disapprove scope changes. Accept deliverables
Leiber Yah	Project Manager	Measure and verify project scope. Facilitate scope change requests. Conduct impact assessments of the scope change requests. Approves or disapproves scope changes.

Engineers/Technicians	Workers	Recommend and justify the scope changes required by them.

4.2.3 Scope Definition

The projects consist of designing, building, and commissioning of a 20kW solar system to be used in residential buildings in Belize. This is to minimize the bill payments to the utility company and, in addition to this, contribute to the go green campaign the government has launched.

The details scope is as follows:

- Design phase: based on the customer's request a survey will be conducted to gather all relevant information to do the design. Once this is completed the relevant design is to be done. This is in conjunction with the owner since he/she would need to provide feedback. This can either be ground mounted or roof top mounted structures. Once this is completed all relevant approvals will be requested.
- Procurement: the procurement of all materials and other services will be triggered once the project is approved and accepted by the owner. This includes both local and foreign materials.
- Construction: the construction phase starts when all materials are received, but the preliminaries can start without having all materials, for example setting out.
- Commissioning: this entails the testing phase of the project, also the integration, verification of all functions of the system, both physical and software. Ensuring the

relevant parameters are put in place. That the expected energy is produced.

Establish remote monitoring and testing.

- Handover: finally, the project handover to the customer, with all relevant trainings, closeout document and manuals to be finalized and handed over.

The designed system should have an energy production of 80-90 percent of the total energy consumption between 7 am and 6 pm. The structure is to be mounted on the roof of the desired house and should be anchored properly to withstand winds of a category 3 hurricane. All these installations are to be installed following all current regulations required by regulatory bodies.

4.2.4 Work Breakdown Structure

The WBS is a subdivision of all the tasks that are grouped in work packages for them to be manageable. This is the baseline for other processes throughout the process execution.

Table 7 WBS (L. Yah, 2023)

WBS	Task Name
1	20 kVA Solar Solution
1.1	Design Phase
1.1.1	Initial Survey
1.1.2	Design Started
1.1.3	Designing
1.1.4	Approvals
1.1.5	Customer Approval
1.2	Procurement Process
1.2.1	RFQ
1.2.2	Materials arrived
1.3	Construction
1.3.1	Civil Works
1.3.2	Mounting Brackets assemble and solar panels installation
1.4	Commissioning
1.4.1	Testing all connections
1.4.2	Integration of systems together
1.4.3	Final testing and verification
1.5	Handover
1.5.1	Trainings
1.5.2	handing over of all documetation
1.5.3	Project Closeout

4.2.5 Scope Validation

Scope validation outputs include accepted deliverables, as well as any change request, as well as project documentation updates, for example the charters, Schedule Management Plan, cost management plan etc.

4.2.5.1 Scope Change Management process

The Change Management Plan documents tracks and manages the necessary information required to effectively manage project change from project inception to delivery. The Change Management Plan is created during the Planning Phase of the project. Its intended audience includes the Project Manager, project team, project sponsor and any stakeholder who assists in carrying out the plan. Any change in the scope of the project will be managed via the Change Request Form to be submitted with relevant information for the request for change to be presented to the Change Control Board or stakeholders for approval.

4.2.5.2 Scope Control

Scope control involves monitoring the project scope, managing changes to scope, and ensuring that project deliverables remain within the defined scope boundaries. In this project the scope is to be controlled by conducting weekly meetings with all stakeholders. These minutes of the meeting are to be documented and shared with all stakeholders, both present and absent. In addition to this, filling the relevant checklists that monitor the progress of all tasks related to the scope is to avoid any scope creep and ensure

all works are aligned to the agreed scope. Any change in scope will need to be analyzed in the change management process. This will be initiated by populating the change request form.

4.2.5.2.1 Change Control Process

The change control process consists of the following.

- **Initiation:** it starts when the change request is being logged using the change request form
- **Evaluation:** it is evaluated by the project team.
- **Approval:** based on the information provided, and investigation carried out and all possible impacts and risks it might have to other processes, the relevant approval or rejection is given.
- **Update Change log-** the change log is updated with all new information provided or gathered. This means updating all other plans, for example, schedule, risk, cost. Etc.
- **Implementation:** once approved the change is implemented and finally communicated to all stakeholders.

CHANGE REQUEST FORM		
Change Description		
Project Name:	Change Name:	Number:
Requested By:	Contact:	Date:
Description of Change:		
Reason for Change:		
Priority [Circle One]: 1. High 2. Medium 3. Low		
Impact on Deliverables:		
Impact of Not Responding to Change (and Reason Why):		
Date Needed:	Approval of Request:	Date:
Change Impact		
Tasks/Scope Affected:		
Cost Evaluation:		
Risk Evaluation:		
Quality Evaluation:		
Additional Resources:		
Duration:		
Additional Effort:		
Impact on Deadline:		
Alternative and Recommendations:		
Comments:		
Sign Offs		
[Circle One]: 1. Accepted 2. Deferred 3. Rejected 4. More Info Requested		
Comments:		
Project Manager Signature:	Date:	
Decision Maker Signature:	Date:	

Figure 12 Change Request Form (L. Yah, 2024)

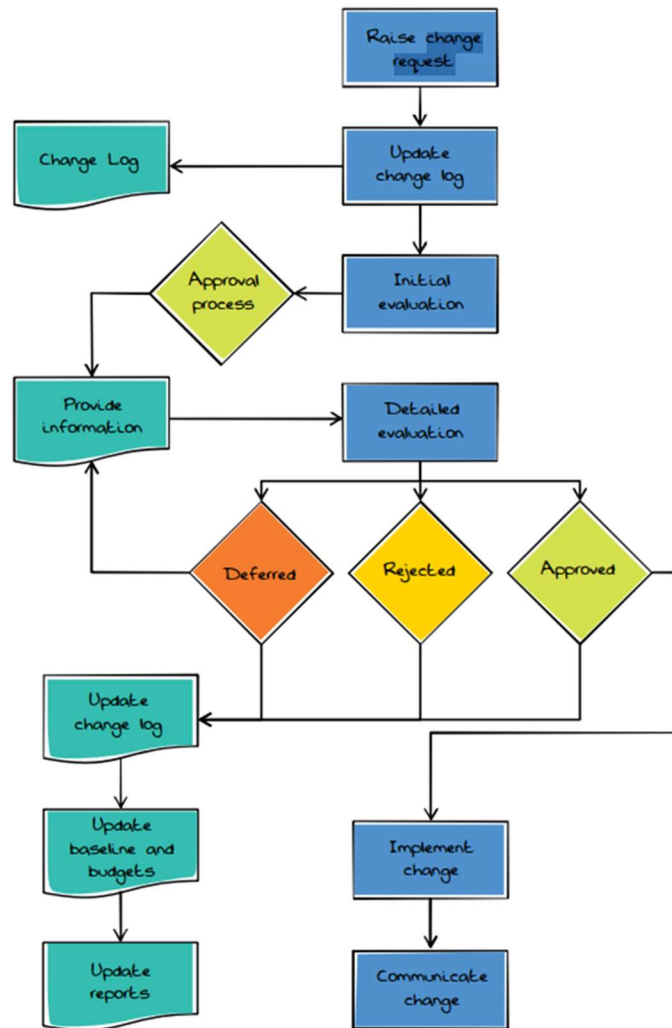


Figure 13 Change Control Process (L. Yah, 2024)

4.3 Stakeholder Management Plan

4.3.1 Introduction

Project Stakeholder management is defined in the PMBOK as the process required to identify people, groups or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effective engaging stakeholders in project decisions and execution. In addition to this, it also states that it supports the work of the project team to analyze stakeholder expectations, assess the degree to which.

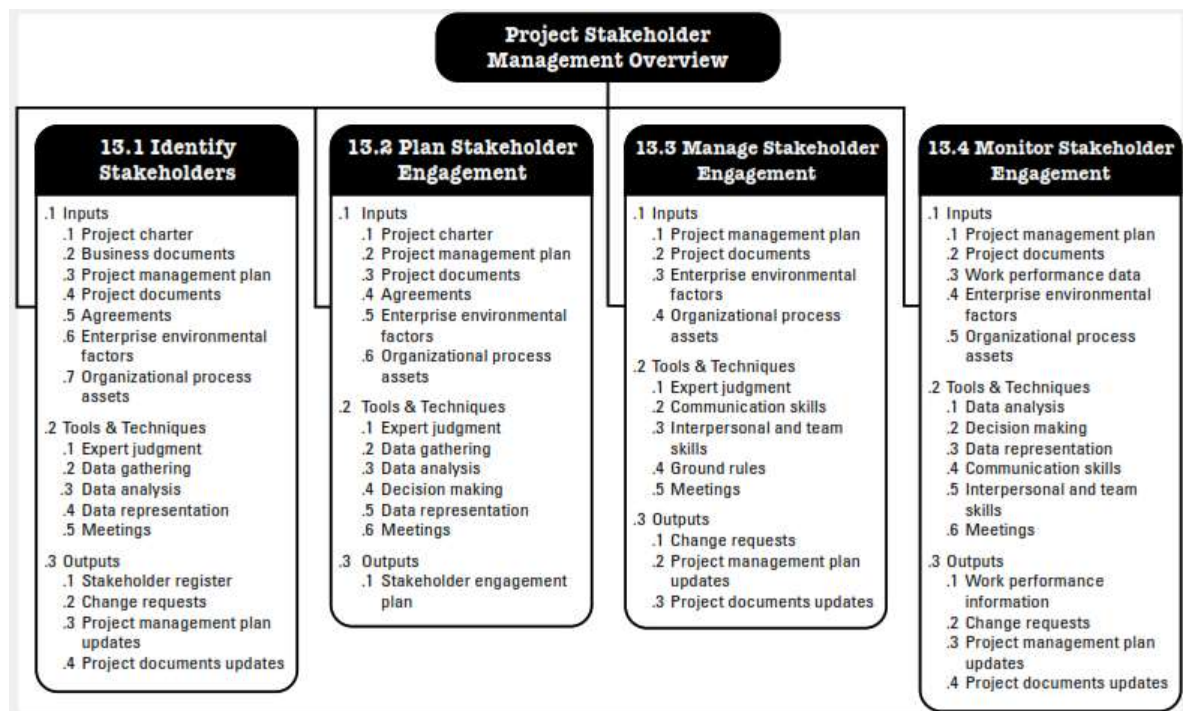


Figure 14 Project Stakeholder Management Overview (PMBOK 2017)

4.3.2 Stakeholder Identification

The PMBOK states that the process of identifying project stakeholders includes the analysis and documenting relevant information regarding their interests, involvement, interdependencies, influence, and potential impact on project success.

This allows the project team to identify and focus on each stakeholder with the help of the stakeholder risk matrix shown below, which outlines the stakeholder and their influence/impact on the project.

Table 8 Stakeholder Matrix (L. Yah, 2024)

Stakeholder	Expectation	Communication Type	Medium	Influence	Impact
Project Sponsor	High interest- approval of documentations/ designs and no objection to contractor/s	Meetings, site visits, reports	Face to Face, phone calls, virtual calls	High	High
Project Manager	High Interest- Communicates directly with the Project Sponsor, ensures duties are aligned with scope	Meetings, site visits, reports, well informed with scope	Face to Face, phone calls, virtual calls	High	High
Technical team	Med Interest- conduct installation as per standards and required.	Consults with engineers, reports	Face to Face, phone calls, virtual calls	Med	Med
Procurement team	Med Interest- ensures materials and equipment are acquired as requested and in due time.	Consults with PM, reports to PM	Face to Face, phone calls, virtual calls	Med	High
Engineers	Med Interest – ensures quality and standards are maintained	Well informed, informs to PM,	Face to Face, phone calls, virtual calls	Med	High
Supplier	Med Interest- ensure the adequate materials is provided.	Reports to Procurement team,	Face to Face, phone calls, virtual calls	Med	High
Regulatory bodies (Gov't)	Low interest- Certify and approve requests	Consultation with the approval of designs and necessary permits.	Reports, phone calls, virtual calls	Low	Med

4.3.3 Power/Interest Classification

Stakeholders are plotted on the grid in relation to the power and interest they have in respect of the project.

The Power/Interest grid typically categorizes stakeholders into four quadrants:

- **High Power, High Interest:** These stakeholders have significant influence over the project and are highly interested in its outcome. They often include key decision-makers, top management, and major project sponsors. It's crucial to fully engage and collaborate with these stakeholders, as their support and involvement are essential for project success.
- **High Power, Low Interest:** Stakeholders in this quadrant possess considerable power but may have limited interest or involvement in the project. They might include regulatory bodies, government agencies, or senior executives who are not directly involved in day-to-day project activities. While their influence can impact the project, they may require periodic updates or high-level reports to maintain their support.
- **Low Power, High Interest:** These stakeholders have a strong interest in the project's outcome but possess relatively little power to influence it directly. They could include user groups, community representatives, or subject matter experts whose expertise is valuable to the project. Engaging with these stakeholders

through regular communication and involvement in relevant discussions can help ensure their needs and concerns are addressed.

- **Low Power, Low Interest:** Stakeholders in this quadrant have limited influence over the project and minimal interest in its outcome. They may include peripheral stakeholders, such as public members or individuals with tangential connections to the project. While it's important to keep these stakeholders informed, the level of engagement required is typically lower compared to other quadrants.

With an axis for both power and interest, the table clearly distinguishes each stakeholder into categories as per the below.

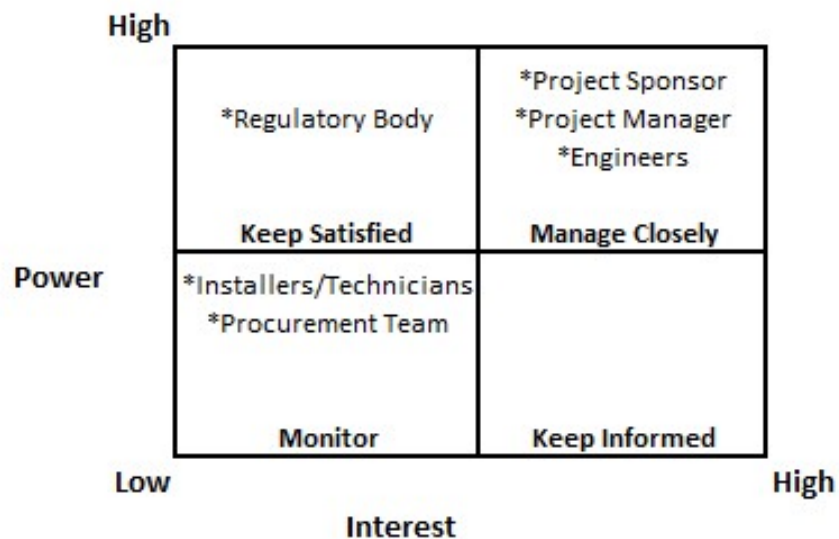


Chart 1 Stakeholder Power/Interest Group (L. Yah, 2023)

4.3.4 Plan Stakeholder Management.

The stakeholder management component aims at developing appropriate management strategies to effectively engage stakeholders throughout the project life cycle, based on the analysis of their needs, interests, and potential impact on project execution.

The Stakeholder Analysis Register and Communication Plan provides the Project Manager with all stakeholders' information needed, including their roles and responsibilities. With this data, the Project Manager will engage each stakeholder throughout the lifecycle of the project. The level of engagement required for each stakeholder may vary over the course of the project. For instance, during the beginning stages of the project, it might be necessary for the Project Manager to engage key stakeholders to be highly involved, for example, the Project Sponsor and Engineers. These highly engaged key stakeholders in the early stages of the project are pivotal for project kickoff. Then as the project goes along, the engagement might decrease if necessary.

4.3.5 Monitor and Control Stakeholder Engagement

Managing stakeholder engagement helps to ensure that stakeholders involved in the design and construction of the system clearly understand the project goals, objectives, benefits, and risks for the project, as well as how their contribution will enhance project success.

Maintaining constant and proper communication ensures timelines are met and delays due to lack of engagement or communication are avoided.

Stakeholder	Expectation	Communication Type	Medium	Influence	Impact
Project Sponsor	High interest- approval of documentations/ designs and no objection to contractor/s	Meetings, site visits, reports	Face to Face, phone calls, virtual calls	High	High
Project Manager	High Interest- Communicates directly with the Project Sponsor, ensures duties are aligned with scope	Meetings, site visits, reports, well informed with scope	Face to Face, phone calls, virtual calls	High	High
Technical team	Med Interest- conduct installation as per standards and required.	Consults with engineers, reports	Face to Face, phone calls, virtual calls	Med	Med
Procurement team	Med Interest- ensures materials and equipment are acquired as requested and in due time.	Consults with PM, reports to PM	Face to Face, phone calls, virtual calls	Med	High
Engineers	Med Interest – ensures quality and standards are maintained	Well informed, informs to PM,	Face to Face, phone calls, virtual calls	Med	High
Supplier	Med Interest- ensure the adequate materials is provided.	Reports to Procurement team,	Face to Face, phone calls, virtual calls	Med	High
Regulatory bodies (Gov't)	Low interest- Certify and approve requests	Consultation with the approval of designs and necessary permits.	Reports, phone calls, virtual calls	Low	Med

Figure 15 Communication Methods (L. Yah, 2024)

The project team will address all concerns of stakeholders and provide feedback to make sure communications are being received and understood and to capture important information to help adjust and respond to problem areas.

Individual stakeholders will be encouraged to participate and to voice questions and concerns with the most serious issues and concerns that are raised being addressed in a formal, rigorous process through the Issues and Risk Logs.

The project Issues Log is another tool to be used to collect, document, and address concerns raised by stakeholders and stakeholder management risks that have materialized into issues that must be managed.

The stakeholders identified and their information documented in the Stakeholder Analysis Register will be reviewed at least weekly to ensure the plan is meeting project expectations and to make modifications if required.

The stakeholder engagement assessment matrix shows the current level of engagement and the desired level of engagement that will be needed for the project's success. Table 9 depicts the stakeholder engagement assessment matrix.

Table 9 Stakeholder Engagement Assessment Matrix (L. Yah, 2024)

Stakeholder	Unaware	Resistant	Neutral	Supportive	Leading
Project Sponsor				Current	Desired
Project Manager				Current	Desired
Technical team			Current	Desired	
Procurement team			Current	Desired	
Engineers			Current	Desired	
Supplier	Current			Desired	
Regulatory bodies (Gov't)	Current			Desired	

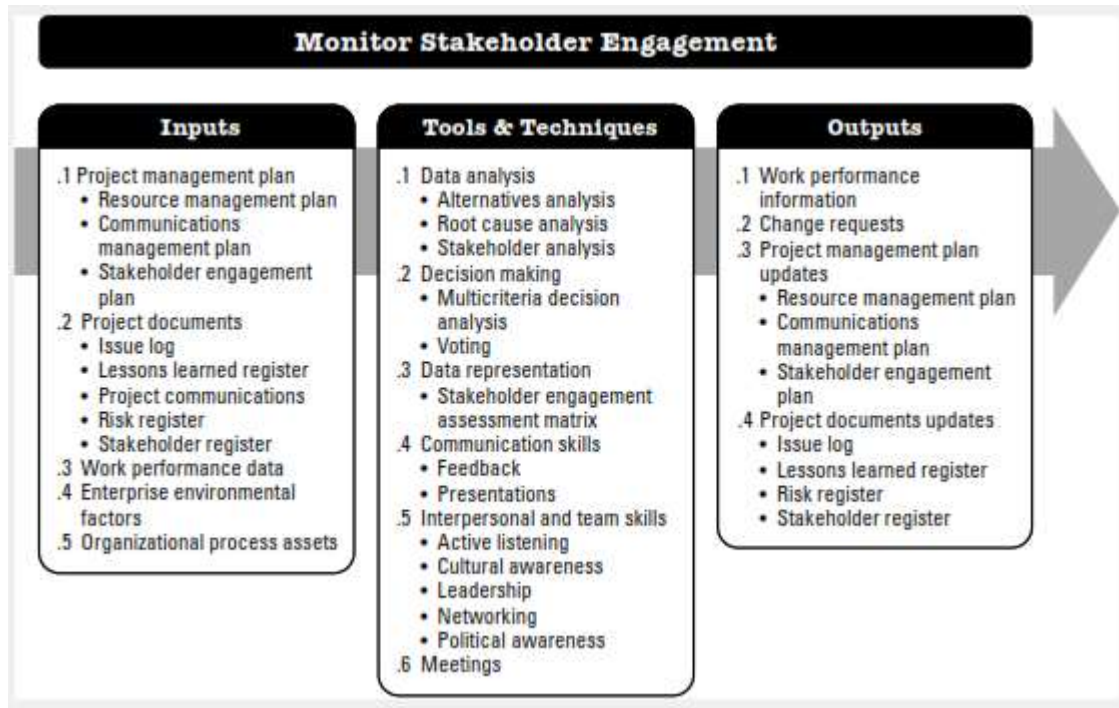


Figure 16 Monitor Stakeholder Engagement (PMBOK 2017)

Issues Log				
Project Name				
Project Manager				
Document Number				
Project Owner				
Date				
ID	Reported by	Priority	Description	Recommendation
001	The stakeholder who reported the issue	The priority of the requirement (Low, Med, High)	What is the issue about. What is it delaying or causing to the project.	Brief recommendation of any
002				
003				
004				

Figure 17 Issues Log (L. Yah, 2024)

4.4 Resource Management Plan

4.4.1 Introduction

The Resource Management Plan defines the roles and responsibilities of team members, how to resolve conflicts, and the training of team members. The Resource Management Plan also guides how the project's physical resources will be allocated and managed.

The Resource Management Plan aims to achieve project success by acquiring appropriate resources. The plan contains two main sections: human resources and material resources. The human resources section details how personnel will be identified and acquired, their roles and responsibilities, training opportunities, team building strategies, performance appraisals, rewards, and recognition programs, and how to effectively manage the project team's activities.

4.4.2 Role Definition

To plan the resources required for the project, it is important for the Project Manager along with the project team to prioritize the required resources and manage them to ensure they are properly utilized. In addition to this, resources are selected based on expertise and background knowledge on the specific tasks.

4.4.3 Roles and Responsibilities

4.4.3.1 Project Sponsor

The Project Sponsor is responsible for funding the project and is the end user of the project deliverable. The Sponsor is to be well abreast of all decisions made and challenges met when executing the project. His support and clear understanding are paramount in the success of the project. Finally, since he is the end user, he is to conduct the relevant acceptances for the project to be closed and be classified successful.

4.4.3.2 Project Manager

The Project Manager (PM) is responsible for the overall success of the project. The PM must authorize and approve all project expenditures. The PM is also responsible for approving that work activities meet established acceptability criteria and fall within acceptable variances. The PM will be responsible for reporting project status in accordance with the communications management plan. The PM must possess the following skills: leadership/management, budgeting, scheduling, and effective communication.

4.4.3.3 Engineer

The engineers are responsible for coordinating and supervising the technical aspects of the projects. The engineers will be responsible for reviewing and applying works according to the standards established by the governing bodies, for example, PUC standards and CBA standards, and ensuring works are done in compliance with the relevant quality checklists and are finished as per the agreed schedule. They are also responsible for the compilation of the final report for approval. The engineers will also oversee field inspections to ensure compliance with standards, quality, and schedule.

4.4.3.4 Installers/Technicians

Installers/Technicians are responsible for conducting the technical work, including the installation of all structures, the solar panels, and the electrical part of the project. All the installations are required to be installed to meet the quality and technical standards. They are also responsible for properly reporting to the technical team and the project manager.

4.4.3.5 Procurement Team

The procurement team is responsible for the acquiring of materials and services. It is required that it abides by the procurement process established. They are responsible for keeping the project team involved in all challenges and updates required.

4.4.4 Resource allocation

All resources are to be allocated at their respective role as per the project's lifecycle, their skills, responsibilities and as per the schedule of the project. See below table.

Table 10 Resource Management Roles and Responsibility (L. Yah, 2024)

Resources	Authority	Responsibility	Competency/Skill
Project Manager	Full authority on all the project resources and project direction.	Responsible of all project management processes, planning, change mangement, leading the project, and manage communication amongst the teams.	Budgeting, Communication, leadership,
Technical team	Partial authority on the contrusction of the project.	Responsible for all technical aspects of the project this is from the design and construction phases.	Communication, knowledge on electrical and solar sytems.
Procurement team	full control of the procurement process.	responsible to ensure all materials and services are acquired in time.	Leadership, effective communication, decision making, scheduling
Engineers	Full authority on all technical aspects of the project.Suggest changes, proposed recommendations.	Responsible for all technical aspects of the project this is from the design and construction phases.	Leadership, effective communication, decision making, scheduling, Engineering background
Supplier	None	responsible to deliver all materials in time.	background knowledge on the project.
Regulatory bodies (Gov't)	None	provide the relevant approvals.	decision making, communication.

4.4.5 RACI Chart

The RACI chart is a graphical display of the project tasks and team members, which aims to illustrate the responsibilities of team members as they relate to the project tasks.

The following RACI chart shows the relationship between project tasks and team members.

The Project Manager along with the lead technical person or engineers must review and

approve any proposed changes to project responsibilities. Changes will be proposed per the

project's change control process and all changes made must be reflected in the relevant project documents.

In summary, we have the project manager leading or managing all major tasks and processes of the project. This is due to all the documentation required, communication amongst teams and stakeholders. The technical team along with the engineers responsible for the technical aspects of the project including designs, installation, commissioning, and handover. The procurement team is responsible for all logistics aspects of the project including purchasing, transportation etc. and finally, the project sponsor being key in getting his approval for the project to be executed. See below chart.

Table 11 RACI Chart (L. Yah, 2023)

Activity	Project Manager	Project Sponsor	Engineers	Installers/Technician	Procurement team
Initial Survey	A	C	R	R	I
Designing as per Standards	A	I	R	I	I
Getting required approvals	A	C	R	I	I
Customer Approval	R	R	R	I	I
Procurement process	A	I	I	I	R
Construction of structures	A	C	A	R	I
Commissioning	A	I	R	R	I
Signing off/Closeout	A	C	I	I	I
R – Responsible for completing the work A – Accountable for ensuring task completion/sign off C – Consulted before any decisions are made I – Informed of when an action/decision has been made					

4.4.6 Trainings

All the staff that are on the team are familiar with the job. In some instances where a member is not familiar with any aspect of the job, they will be taught by their colleagues or by a person on a higher level, a manager for example. In instances where new technology or new process are implemented, then the company will seek external services for the training to be done.

4.4.7 Material Resource Management

The project team will use expertise and consultation to determine the material type required and the quantity of material required to complete the project successfully.

4.4.8 Control Material Resources

The control resources process is applied from the design all the way to the completion of all phases of the project. This is to be done on a regular basis due to changes in the project schedule that may impact on the use of resources. In this process, the Project Manager ensures that the resources assigned and allocated for the project activities are available, monitor proposed usage versus actual usage and subsequently take corrective actions to keep the project on track to ensure efficient and timely use of project resources. All of this is led by the Project Manager but is supported by the other stakeholders, for example the engineers and technical team that are more in the field.

4.4.8.1 Control Resources

Monitoring and controlling of resources are essential in project management to make timely and accurate decisions. Control Resources gives a visual of the actual product data versus the planned and adapts to changes as the project progress. Work performance and status reports will provide all the necessary data about the project's resource usage. These reports will be used to ensure that resources are available as planned, forecast resources needed, and identify deviations and corrective actions. All identified changes must be submitted per the project's change control process. All relevant project documents must be updated to reflect all approved change requests.

4.5 Schedule Management Plan

4.5.1 Introduction

The Project Schedule Management Plan is the organization of the project activities and tasks including its duration, dependencies, and milestones.

According to the PMBOK Guide Sixth Edition, the Plan Schedule Management knowledge area contains six processes: plan schedule management, define activities, sequence activities, estimate activity durations, develop schedule, and control schedule. The schedule is an important part of this project as it will provide the project team, sponsor, and all stakeholders with an insight into the project status at any given time throughout the project

lifecycle. The purpose of this plan is to define the approach that will be used to create, execute, monitor, and control the project schedule.

4.5.2 Schedule Management and Development

The Schedule Management Plan was created using Microsoft Project 2016. This plan was developed using other information including all activities, milestones, from the Scope Management Plan of the project. The activities were determined from past knowledge and projects like this one used as guides and references. All these tasks along with their respective duration and dependencies were added to have a visual of the entire project's duration. This can be seen in the schedule duration table. This also helped in the creation of the critical path, which is shown below.

The schedule is in alignment with the deliverables identified in the project's Work Breakdown Structure (WBS), from the approved WBS constructed as part of the Scope Management Plan.

The Project Manager along with the technical experts will review the assigned project tasks, and the entire project team must agree to the proposed work package assignments, durations, and schedule. The schedule will have to be reviewed and accepted by the Project Sponsor as well as the technical team including the engineers.

The Project Manager will also collaborate with technical experts, and other professionals in the project management team to oversee the implementation of the schedule.

4.5.3 Project Schedule

The project schedule indicates what needs to be done, which resources must be utilized, and when the project is due. It's the timetable that outlines start and end dates and milestones that must be met for the project to be completed on time. It produces a schedule for the execution of the project, monitoring and controlling by analyzing activity sequences, durations, resource requirements and schedule constraints. Some components to be considered are:

1. Defining the project milestones
2. Identifying and sequencing activities
3. Estimating durations

The key benefit of this process is that it generates a schedule with planned dates for completing project activities and the project team can review the activities they were assigned with the respective start and finish date. Revising and maintaining the project schedule on an ongoing basis is key to sustaining a realistic and achievable schedule. The table below shows the schedule for this project.

Table 12 Schedule Duration (L. Yah, 2024)

WBS	Task Name	Duration	Start	Finish	Resource Names
1	20 kVA Solar Solution	172 days	Sun 12/3/23	Tue 7/30/24	
1.1	Design Phase	46 days	Sun 12/3/23	Mon 2/5/24	Engineer
1.1.1	Initial Survey	1 day	Mon 12/4/23	Mon 12/4/23	Engineer
1.1.2	Design Started	0 days	Sun 12/3/23	Sun 12/3/23	Engineer
1.1.3	Designing	20 days	Tue 12/5/23	Mon 1/1/24	Engineer
1.1.4	Approvals	10 days	Tue 1/2/24	Mon 1/15/24	Project Manager,Project Sponsor
1.1.5	Customer Approval	15 days	Tue 1/16/24	Mon 2/5/24	Engineer,Project Manager,Project Sponsor
1.2	Permits	15 days	Tue 2/6/24	Mon 2/26/24	
1.2.1	PUC Approval	15 days	Tue 2/6/24	Mon 2/26/24	Engineer
1.3	Procurement Process	70 days	Tue 2/27/24	Mon 6/3/24	Procurement Team
1.3.1	RFQ	10 days	Tue 2/27/24	Mon 3/11/24	Procurement Team
1.3.2	Materials arrived	60 days	Tue 3/12/24	Mon 6/3/24	Procurement Team
1.4	Construction	20 days	Tue 6/4/24	Mon 7/1/24	Engineers/Installers
1.4.1	Civil Works	10 days	Tue 6/4/24	Mon 6/17/24	Engineers/Installers
1.4.2	Mounting Brackets assemble and solar panels installation	10 days	Tue 6/18/24	Mon 7/1/24	Engineers/Installers
1.5	Commissioning	16 days	Tue 7/2/24	Tue 7/23/24	Engineers/Installers
1.5.1	Testing all connections	3 days	Tue 7/2/24	Thu 7/4/24	Engineers/Installers
1.5.2	Integration of systems together	10 days	Fri 7/5/24	Thu 7/18/24	Engineers/Installers
1.5.3	Final testing and verification	3 days	Fri 7/19/24	Tue 7/23/24	Engineers/Installers
1.6	Handover	5 days	Wed 7/24/24	Tue 7/30/24	Engineer,Project Manager,Project Sponsor
1.6.1	Trainings	2 days	Wed 7/24/24	Thu 7/25/24	Engineer,Project Manager,Project Sponsor
1.6.2	handing over of all documentation	2 days	Fri 7/26/24	Mon 7/29/24	Engineer,Project Manager,Project Sponsor
1.6.3	Project Closeout	1 day	Tue 7/30/24	Tue 7/30/24	Engineer,Project Manager,Project Sponsor

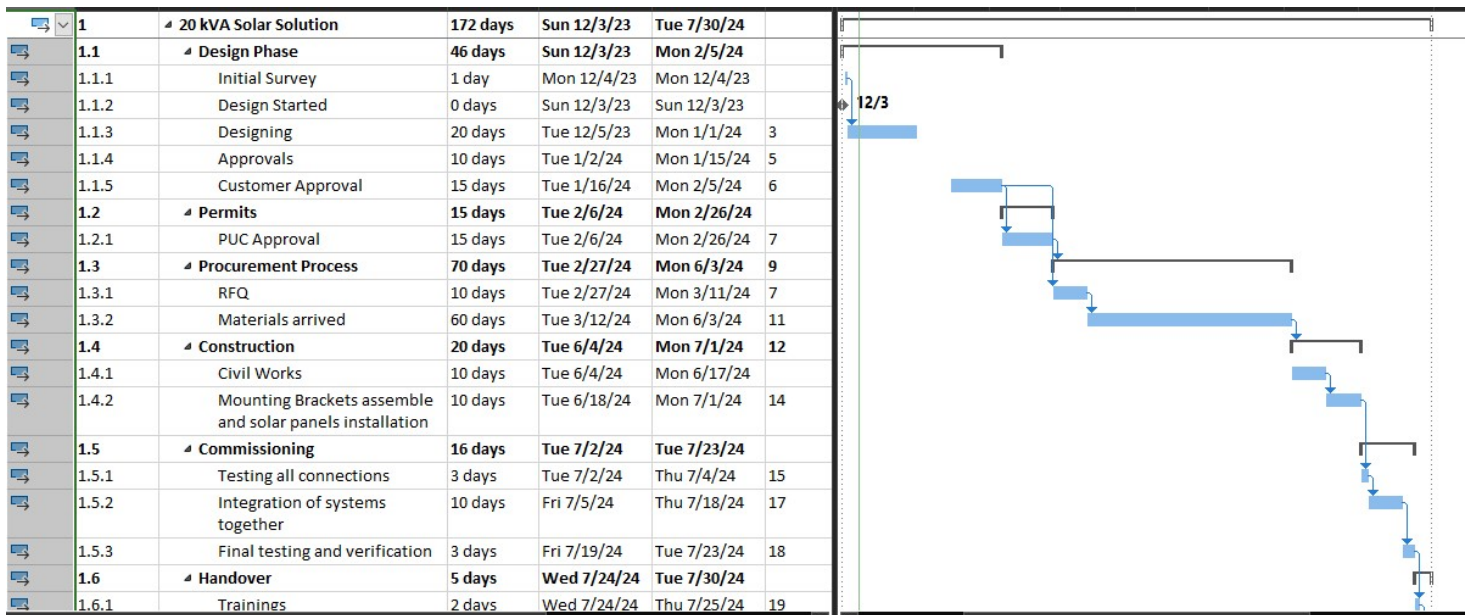


Figure 18 Project Schedule Illustrating all project activities (L. Yah, 2023)

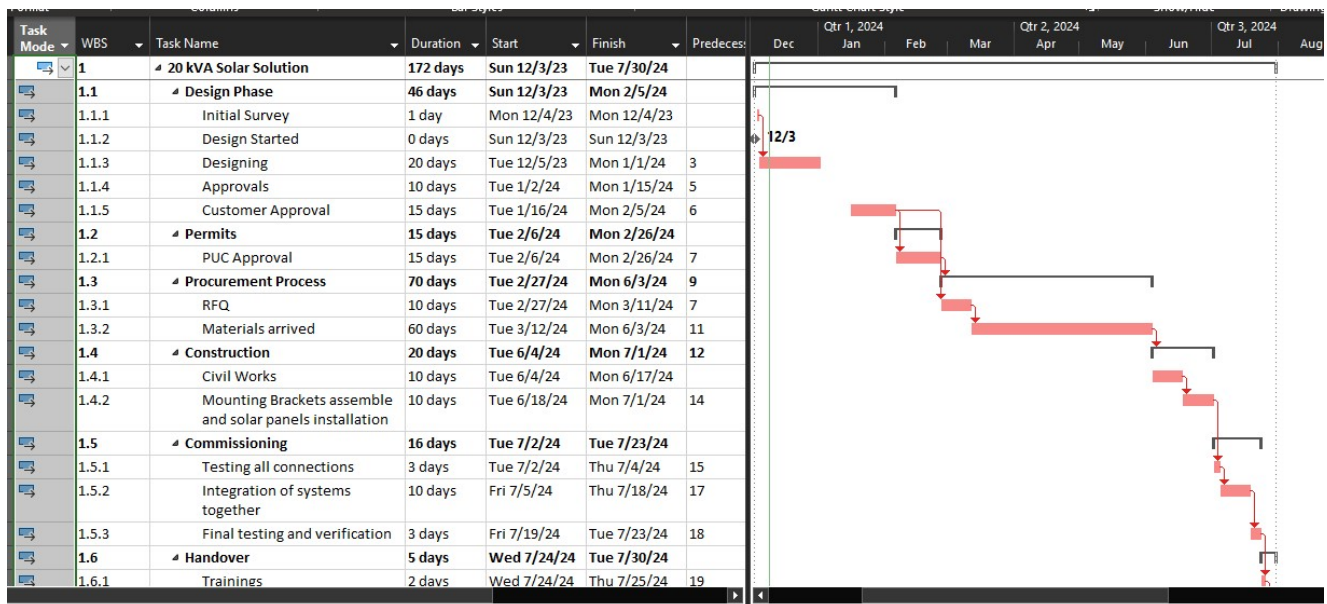


Figure 19 Critical Path for the project (L. Yah, 2023)

The Project Manager meets with all the team members and stakeholders to review the schedule and make recommendations if any changes are required since this is what everyone is expected to follow it.

4.5.4 Schedule Control

The PMBOK® Guide 6th Edition states that the key benefit of Control Schedule is that it provides the means to recognize deviation from the plan and take timely corrective and preventive action, thus minimizing risks.

The Project Manager will be responsible for scheduling a weekly recurring meeting with the project team members to review and update the actual start, actual finish,

and completion percentages as presented by the task owners. During this meeting, any variation to the schedule and the impact it will have on the project will be highlighted. The Project Manager will be responsible for submitting schedule change requests and for reporting the status to stakeholders in accordance with the project's communication plan.

In addition to meetings, resource optimization techniques will assist in the proper management of the team vs the deliverables required. This is to conduct proper resource allocation.

The use of software will be necessary, this is to make changes and analyze other aspects of the project. For example, the effects on costs, timelines, resources, etc.

Finally, all changes required or requested to the schedule of the project will need to be addressed in the change control process.

The change control process consists of the following.

- Initiation: it starts when the change request is being logged using the change request form
- Evaluation: it is evaluated by the project team.
- Approval: based on the information provided, and investigation carried out and all possible impacts and risks it might have to other processes, the relevant approval or rejection is given.
- Update Change log- the change log is updated with all new information provided or gathered. This means updating all other plans, for example, schedule, risk, cost. Etc.

- Implementation: once approved the change is implemented and finally communicated to all stakeholders.

CHANGE REQUEST FORM		
Change Description		
Project Name:	Change Name:	Number:
Requested By:	Contact:	Date:
Description of Change:		
Reason for Change:		
Priority [Circle One]: 1. High 2. Medium 3. Low		
Impact on Deliverables:		
Impact of Not Responding to Change (and Reason Why):		
Date Needed:	Approval of Request:	Date:
Change Impact		
Tasks/Scope Affected:		
Cost Evaluation:		
Risk Evaluation:		
Quality Evaluation:		
Additional Resources:		
Duration:		
Additional Effort:		
Impact on Deadline:		
Alternative and Recommendations:		
Comments:		
Sign Offs		
[Circle One]: 1. Accepted 2. Deferred 3. Rejected 4. More Info Requested		
Comments:		
Project Manager Signature:	Date:	
Decision Maker Signature:	Date:	

Figure 20 Change Request Form (L. Yah, 2024)

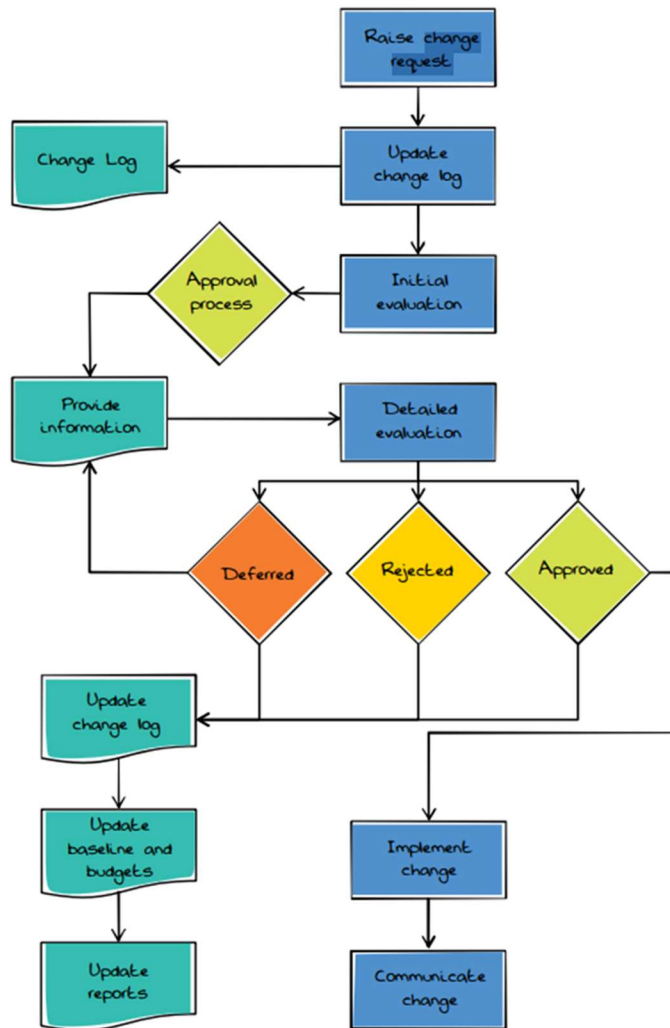


Figure 21 Change Control Process (L. Yah, 2024)

4.6 Communication Management Plan

4.6.1 Introduction

Communication is very important in the execution of all projects. This is because without communication, teams cannot work properly, ideas get created, the vision gets diverted etc.

This includes the necessary processes to ensure that the information needs of the project and the stakeholders are met through development of methods and implementation of activities designed to achieve effective information exchange (PMI, 2017, p.359).

4.6.2 Communication Management Approach

This plan identifies and defines the roles of the people involved and includes a communications matrix that maps the communication requirements of this project. It documents the communications requirements, the information being communicated, and the audience for each communication, the frequency of communication, and the individual responsible for the communication or dissemination of the information to the appropriate audience.

The communication plan contains the below:

- Communication requirements for each stakeholder.
- Communication schedule for all events, methods etc.
- Matrix of all resources invoiced along with their requirements.

The plan also provides an in-depth guide for conducting meetings and details the communication rules and how the meetings will be conducted. This Communications Plan was developed in conjunction with the Management Team from the Department of Youth Services to meet the overall objective of this Communications Management Plan which is to promote the success of the project by meeting the information needs of project stakeholders.

Table 13 Stakeholder Requirement (L. Yah, 2024)

Stakeholder	Requirements
Project Sponsor	<ul style="list-style-type: none"> • Project status information (schedule, budget, and scope) • Understanding of critical project risks and issues • Information required to approve each project phase
Project Manager	<ul style="list-style-type: none"> • Detailed project status information (schedule, budget, and scope) • Understanding of current project deliverables' quality • Detailed knowledge of all risks, issues and change requests
Technical team	<ul style="list-style-type: none"> • Status of the activities and tasks they have been asked to perform • Awareness of events which may affect their ability to undertake their role
Procurement team	<ul style="list-style-type: none"> • Status of the activities and tasks they have been asked to perform • Awareness of events which may affect their ability to undertake their role
Engineers	<ul style="list-style-type: none"> • Status of project activities and task status information • Day-to-day knowledge of issues and risks identified

Table 14 Communication Matrix (L. Yah, 2024)

Event	Objective	Method	Frequency	Participants	Owner	Deliverable
--------------	------------------	---------------	------------------	---------------------	--------------	--------------------

Project Sponsor	To open project and discuss the scope	In person	Once	Project Sponsor, Project Manager, Engineers	Project Manager	Minutes of Meeting
Project Team meetings	Project updates and discusses challenges and risks.	In person	Weekly	Project Team	Project Manager	Minutes of Meeting
Technical meetings	Discuss challenges, progress on works	In person	On-demand	Technical Project team	Engineers	Minutes of Meeting
Project Status report	Update meetings for the team, milestones, accomplishments	In person	Bi-Weekly	Project Manager	Project Manager	Project Status Report
Procurement Team meetings	Report on the purchase and payments status of equipment	In Person	On-demand	Procurement team, Project Team	Project Manager	Procurement Report

4.6.3 Changes requested by the communication plan.

Any changes requested to be made to the communication plan should follow the change management process, where the project team or the change control board.

The change control process consists of the following.

- Initiation: it starts when the change request is being logged using the change request form

- Evaluation: it is evaluated by the project team.
- Approval: based on the information provided, and investigation carried out and all possible impacts and risks it might have to other processes, the relevant approval or rejection is given.
- Update Change log- the change log is updated with all new information provided or gathered. This means updating all other plans, for example, schedule, risk, cost. Etc.
- Implementation: once approved the change is implemented and finally communicated to all stakeholders.

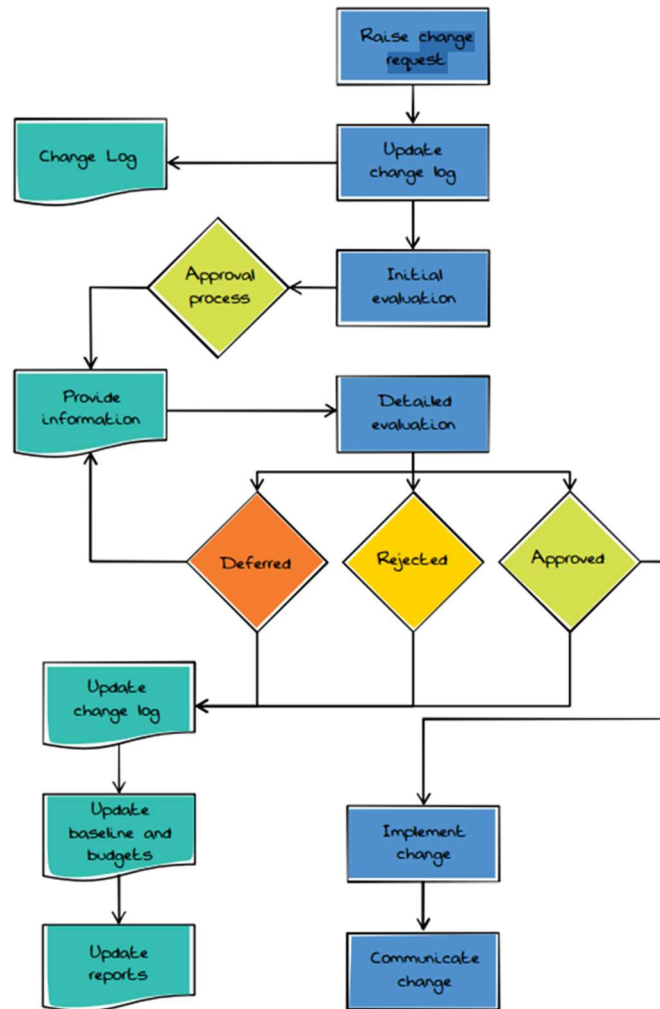


Figure 22 Change Control Process (L. Yah, 2024)

CHANGE REQUEST FORM		
Change Description		
Project Name:	Change Name:	Number:
Requested By:	Contact:	Date:
Description of Change:		
Reason for Change:		
Priority [Circle One]: 1. High 2. Medium 3. Low		
Impact on Deliverables:		
Impact of Not Responding to Change (and Reason Why):		
Date Needed:	Approval of Request:	Date:
Change Impact		
Tasks/Scope Affected:		
Cost Evaluation:		
Risk Evaluation:		
Quality Evaluation:		
Additional Resources:		
Duration:		
Additional Effort:		
Impact on Deadline:		
Alternative and Recommendations:		
Comments:		
Sign Offs		
[Circle One]: 1. Accepted 2. Deferred 3. Rejected 4. More Info Requested		
Comments:		
Project Manager Signature:	Date:	
Decision Maker Signature:	Date:	

Figure 23 Change Request Form (L. Yah, 2024)

4.7 Procurement Management Plan

4.7.1 Introduction

The Procurement Management Plan describes the activities undertaken during the procurement process. It explains how the project will manage the procurement process,

from developing procurement documents to contract closure. This plan identifies and defines the goods and services that the project will need to acquire from external sources, the items that will be procured, the types of contracts that the project will utilize, the approval process for contracts, and the matrices that will be used to determine the most suitable suppliers. The procurement plan will align with the project's scope, budget, and schedule and establish firm contract deliverables and deadlines. The plan will also discuss procurement risk management and the project's procurement constraints.

This plan will always guide the project's procurement activities, and any deviation from this plan must be approved by the project's Change Control Board.

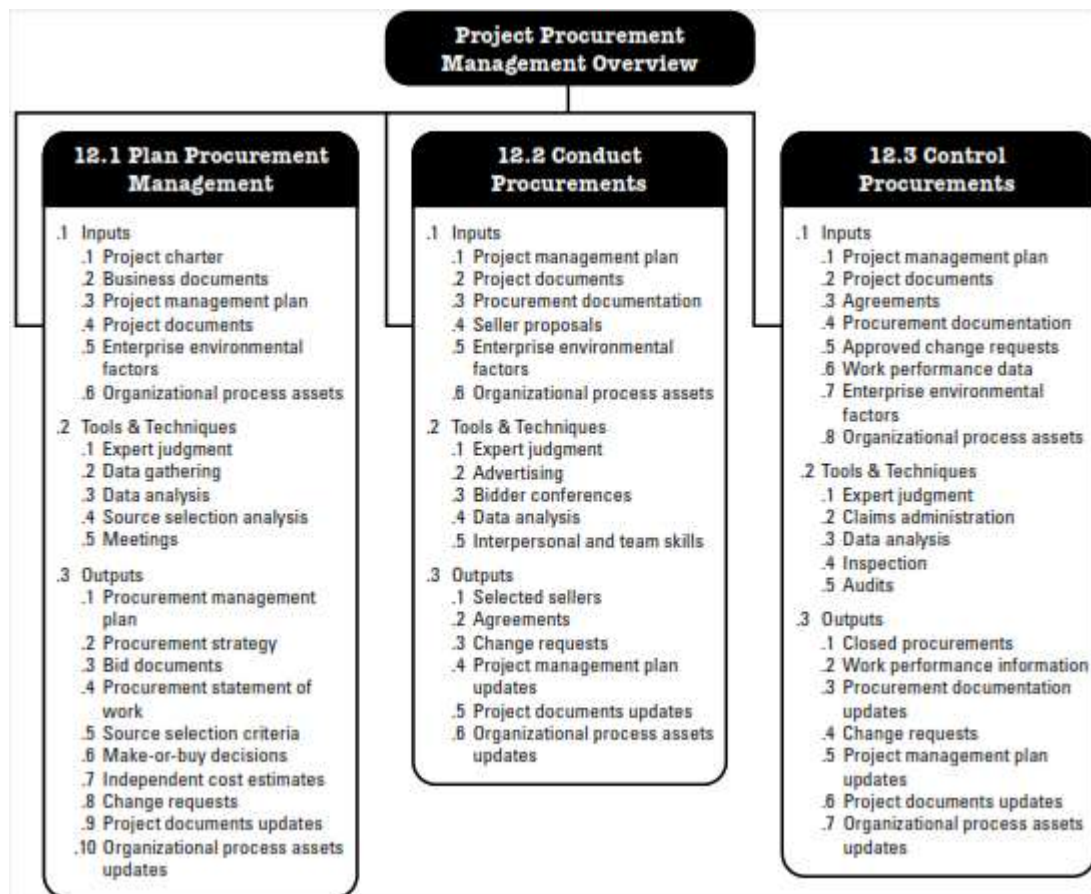


Figure 24 Procurement Management Overview (PMBOK, 2017)

4.7.2 Procurement Strategy

The Project Manager will work closely with the procurement team to carry out the procurement process for the project. The procurement policies will guide the project and will follow the following steps.

- The designs should be prepared as a design package.
- The technical team are to review the specifications and provide baseline costs.

- The technical team should provide an expected timeline.
- The Project Manager and engineers approve the list of items to be procured and submit to the procurement team.
- The procurement team then starts the vendor engagement process, selection, purchasing, work on the contracting process as per company's guidelines.

For this specific project, a firm-fixed price contract is to be drawn up with the suppliers to acquire all necessary materials. The project team will work closely with the procurement team to develop a request for proposals (RFP) which defines the type of items or services required, their quantities, and required delivery dates. The procurement team will then solicit RFPs from various prequalified vendors to procure the items within the required period and at a reasonable cost. All procurement activities have potential risks, such as unrealistic schedules and costs, the capacity capabilities of vendors, shipping delays, and inadequate vendor performance. The project team must manage these risks to ensure project success. Project risks will be addressed in the following the project's Risk Management Plan.

Other aspects considered are the delivery methods of the materials. This is to be specified in the quotations and proposal provided by the suppliers. Also, payment terms, since in this project fixed price contracts will be used, it should specify the time required for the payment to be completed.

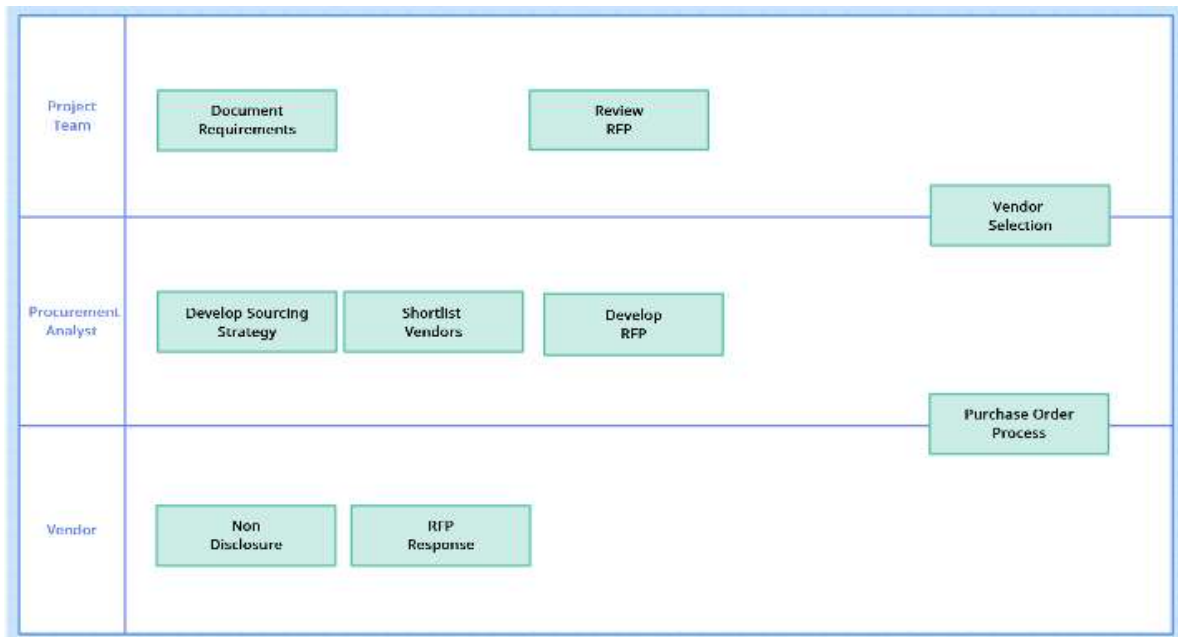


Figure 25 Procurement Process (L. Yah, 2024)

4.7.3 Procurement Documents

Standardized forms and templates are used in the procurement process to manage procurement activities and contracts efficiently. These standard documents have been developed to provide the adequate detail necessary to manage the procurement process effectively. See below templates.

- RFP Template contains statement of works, terms and conditions, selection criteria,
- Term of Reference also known as a Terms of Reference or Terms of Reference Document, is a formal document that outlines the objectives, scope, responsibilities, and deliverables of a project, task, or initiative. It serves as a guide for project stakeholders, providing clarity and direction for the work to be undertaken.

Terms of Reference Solar System Material Acquisition

Terms of Reference

Materials for 20 kVA solar system.

1. Background

2. Objective

3. Scope of Work

4 Outputs

5 Duration

6 Proposal structure and scoring criteria

6.1 Type of Contract and Budget

6.3 Financial Proposal

6.5 Proposal evaluation [if procurement processes of authority allow for this]

6.6 Submission information

Figure 26 Terms of Reference Template (L. Yah, 2024)

- Bid Summary/ Evaluation Document: structured document used by organizations to assess and compare bids or proposals submitted by vendors or contractors in response to a request for proposal (RFP) or invitation to bid (ITB). This template serves as a tool for evaluating and selecting the most suitable vendor or contractor based on predefined criteria and requirements.

1. Details																					
Requested by: _____																					
Department: _____																					
2. Quote Analysis					Vendor 1				Vendor 2				Vendor 3			Vendor 4					
					Payment Terms: Net 60 Days				Payment Terms: Net 60 Days				Payment Terms: Net 30 Days			Payment Terms: Net 30 Days					
					Incoterm				Incoterm				Incoterm			Incoterm					
No.	Item	Part Number	Manufacturer	Item ID	UOM	Qty	Unit Price	Total Cost	Selected Vendor	Lead time	Qty	Unit Price	Total Cost	Lead time	Unit Price	Total Cost	Lead time	Qty	Unit Price	Total Cost	
1	Item description																				
	Discount																				
	Freight																				
	Subtotal																				
	GST							\$0.00					\$0.00			\$0.00					\$0.00
	Total							\$0.00		USD			\$0.00		USD		\$0.00		USD		\$0.00
Warranty Terms																					
Quotation Expiration Date																					
Accepted/Rejected quotation																					
3. Negotiations and Pricing																					
Additional Comments																					

Figure 28 Bid Summary and Evaluation Template (L. Yah, 2024)

- A Request for Quote (RFQ) Template is a document used by organizations to solicit quotes or pricing proposals from potential suppliers or vendors for goods or

services. It typically outlines the requirements, specifications, and terms and conditions related to the procurement process.

RFQ Request Details							
<p>Kindly select Source Type below: <u>Local</u></p>							
No.	Recommended Suppliers						
1						
2						
3						
4						
5						
Details of Items being Requested							
No.	Description	Part Number	Manufacturer	Brand	UOM	Quantity	
1							
2							
3							
4							
5							
6							

Figure 29 Request for Quotation Template (L. Yah, 2024)

4.7.4 Procurement Selection Criteria

The following decision criteria will be the basis for selecting and awarding contracts under this project:

- Capability and capacity
- Quality
- Product cost and lifecycle costs
- Expected delivery date

A bid evaluation panel will convene to measure the criteria and select the successful

bidder based on the weighted average of the specified criteria. The manager of the procurement team will be responsible for reviewing and signing all contracts

4.7.5 Control Procurement

The procurement and the project team are responsible for managing all external suppliers to ensure that the selected vendors provide all the goods or services as specified in the RFP and the contract documents. The Project Manager will hold weekly progress meetings to discuss the status of each procurement process until all items or services are delivered and considered acceptable. All documented specifications for each product will be reviewed and compared against actual deliverables to ensure compliance with the requirements established in the project specifications. Requirement changes will also be discussed at these meetings; however, all changes must follow the company's change management process. The project team will conduct performance reviews, inspections, and audits for each vendor based on the metrics and standards established by the project to analyze vendor and quality performance. This evaluation will form part of the project's repository and will be used in future projects to determine the vendor's eligibility to submit future bids.

The change control process consists of the following.

- Initiation: it starts when the change request is being logged using the change request form
- Evaluation: it is evaluated by the project team.

- Approval: based on the information provided, and investigation carried out and all possible impacts and risks it might have to other processes, the relevant approval or rejection is given.
- Update Change log- the change log is updated with all new information provided or gathered. This means updating all other documentation, for example, schedule, risk, cost management plans as well as contracts, draft TORs, RFQ requests etc.
- Implementation: once approved the change is implemented and finally communicated to all stakeholders.

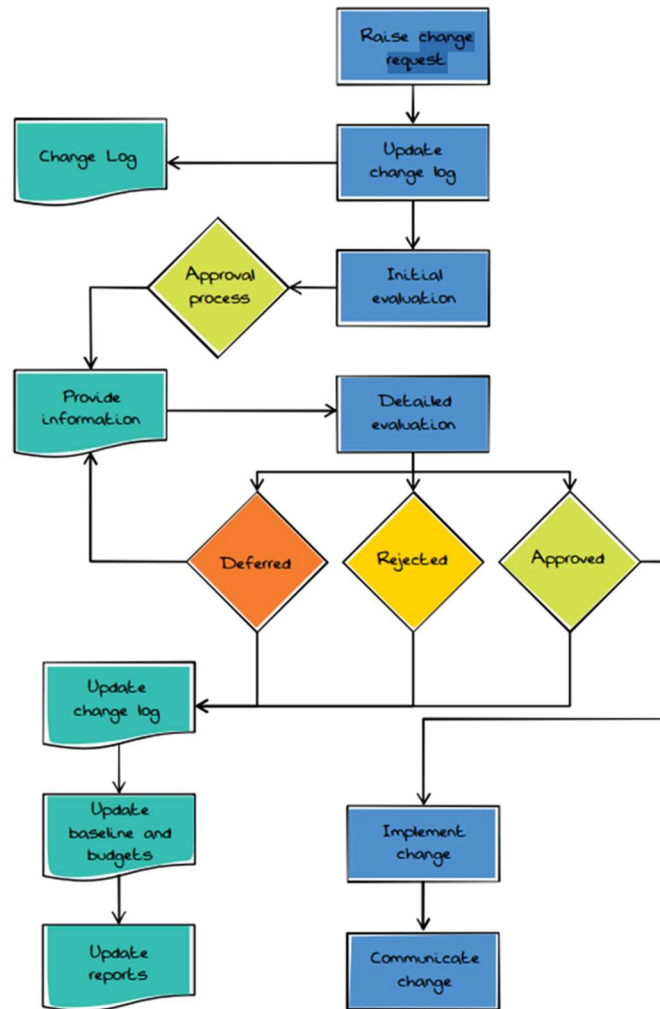


Figure 30 Change Control Process (L. Yah, 2024)

CHANGE REQUEST FORM		
Change Description		
Project Name:	Change Name:	Number:
Requested By:	Contact:	Date:
Description of Change:		
Reason for Change:		
Priority [Circle One]: 1. High 2. Medium 3. Low		
Impact on Deliverables:		
Impact of Not Responding to Change (and Reason Why):		
Date Needed:	Approval of Request:	Date:
Change Impact		
Tasks/Scope Affected:		
Cost Evaluation:		
Risk Evaluation:		
Quality Evaluation:		
Additional Resources:		
Duration:		
Additional Effort:		
Impact on Deadline:		
Alternative and Recommendations:		
Comments:		
Sign Offs		
[Circle One]: 1. Accepted 2. Deferred 3. Rejected 4. More Info Requested		
Comments:		
Project Manager Signature:	Date:	
Decision Maker Signature:	Date:	

Figure 31 Change Request Form (L. Yah, 2024)

4.8 Cost Management Plan

4.8.1 Introduction

The PMBOK 2017 defines a Procurement Management Plan as the activities to be undertaken during the procurement process. It should document whether international competitive bidding, national competitive bidding, local bidding etc. should be done.

The Cost Management Plan is part of the Project Management Plan that stipulates how the cost of the project will be estimated, structured, monitored, and controlled (PMI, 2017). According to the PMBOK (2017, p.231,) cost management refers to “the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling cost so that the project can be completed within the approved budget.”

4.8.2 Cost Estimate

Cost Estimate provides data on the cost of resources to complete the project. It includes the cost for labor, equipment, supplies, services, facilities, and materials (PMI, 2017). In a summary, PMI (2017, p. 240) defines estimate cost as “the process of developing an approximation of the cost of resources needed to complete project work.”

The cost estimate is using a baseline cost estimate for all materials that have been used in previous projects as well as monitoring price changes throughout the year; this is to guarantee the best materials are available at the best price. In addition to this, other projects are used as reference for this cost estimate.

4.8.3 Cost Management Approach

The cost management approach will assist in estimating, allocating, and controlling costs during the period of the project. Earned Value Management (EVM) calculations will be utilized to measure, manage, and monitor the financial performance of the project. This will provide a snapshot of the project's status to determine if the project is ahead or behind schedule, and over or under budgeted. This will be done by calculating the EVM of the project by multiplying the percentage completed by the total project budget. The Project Manager is accountable for bookkeeping for cost deviations and offering the Project Sponsor options for getting the challenge back on budget once the project is off budget. The Project Sponsor has the authority to make modifications to the project to keep within budget.

4.8.4 Project Cost Monitoring

On a weekly basis, the Project Manager will be responsible for the tracking of expenses and ensuring the cost management plan is followed. The tracking consists of conducting comparisons between the predictive and the actual costs to provide a projection of the upcoming expenses. This is to be done using the Earned Value Management technique. The approach for cost performance measurement is to use the EVM for measuring and controlling the project costs, the four metrics included.

- **Cost Variance (CV)**
- **Schedule Variance (SV)**
- **Cost Performance Index (CPI)**

- **Schedule Performance Index (SPI)**

Cost Metric	Green (Watch)	Yellow (Alert)	Red (Critical)
CPI	$0.90 \leq \text{CPI} \leq 1.05$	Less than 0.85 or Greater 1.10	Less than 0.80 or Greater 1.15
SPI	$0.90 \leq \text{SPI} \leq 1.05$	Less than 0.85 or Greater 1.10	Less than 0.80 or Greater 1.15

Figure 32 Cost Metric (L. Yah 2024)

- Schedule Variance (SV) – indicating whether the project is ahead or behind. $\text{SPI} < 1.0$ means project is behind schedule. $\text{SPI} > 1.0$ means project is ahead of schedule.
- Cost Variance (CV) – difference between project earned value and actual costs.
- Schedule Performance Index (SPI) – measure of the project’s schedule efficiency
- Cost Performance Index (CPI) – measure of the project’s cost efficiency. $\text{CPI} < 1.0$ project is over budget; $\text{CPI} > 1.0$ project is under budget.

4.8.5 Cost Change Control Process

The Cost Change Control process will be triggered when there are any changes that will cost budget overruns and it will follow the established change control process shown below. The Project Manager will ensure that any change is approved by the project sponsor before proceeding.

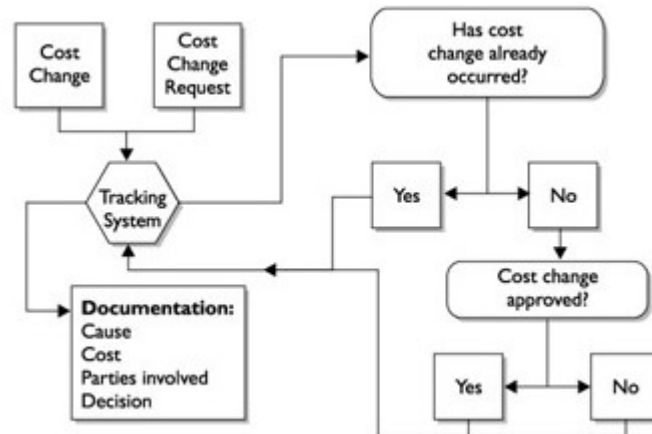


Figure 33 Cost Change Control Process (PMP Study Guide, 2003)

4.8.6 Total Project Cost

The cost estimate provided below was done using past information along with estimates provided by suppliers. In addition to the labor costs that have been seen on previous projects like this project.

Table 15 Project Cost (L. Yah 2024)

Task Name	Duration	Unit Prices	Contingency Reserve	Contingency	Cost
20 kVA Solar Solution	87 days				
Design Phase	31 days		5%	\$ 300.00	\$ 6,000.00
Initial Survey	1 day	\$ 1,000.00			
Designing	10 days	\$ 4,000.00			
Approvals	5 days	\$ 1,000.00			
Customer Approval	15 days				
Procurement Process	25 days		10%	\$ 4,000.00	\$ 40,000.00
RFQ	5 days	\$ 31,000.00			
Materials arrived	20 days	\$ 9,000.00			
Construction	35 days		10%	\$ 1,050.00	\$ 10,500.00
Civil Works	10 days	\$ 4,000.00			
Mounting Brackets assemble and solar panels installation	10 days	\$ 6,500.00			
Commissioning	16 days		5%	\$ 350.00	\$ 7,000.00
Testing all connections	3 days				
Integration of systems together	10 days				
Final testing and verification	3 days	\$ 7,000.00			
Handover	5 days		5%	\$ 75.00	\$ 1,500.00
Trainings	2 days				
Handing over of all documentation	2 days	\$ 1,500.00			
Project Closeout	1 day				
				\$ 5,775.00	\$ 65,000.00
				Grand Total	\$ 70,775.00

4.9 Quality Management Plan

4.9.1 Introduction

To ensure the highest quality products and deliverables produced by this project, there are two main goals for the Quality Management Plan, which are ensuring a quality end-product and ensuring that all the processes involved during the project lifecycle are carried out efficiently. The plan also utilizes the previously constructed plans to set standards that will regulate the quality of goods and services being delivered during the design and construction process. This plan is broken down into three main processes: Quality Planning, Quality Assurance, and Quality Control.

4.9.2 Quality Management Plan

The Quality Management Plan for this project will include quality standards that are applicable to the project which can be validated by the projects processes and deliverables. The quality of the project will be assured during the project by satisfactory complying with the standards and requirements agreed upon. During the project lifecycle, any non-conformances found will be identified and addressed immediately. An integrated quality approach will be used to define, measure, and improve quality.

4.9.3 Quality planning

Quality planning is the process of relating quality requirements or standards for the project to its actual tasks and deliverables, while also documenting how the project will comply with the requirements established. The quality requirements are to be listed on the Project Requirements Log. This is to be agreed by all parties involved. See below chart shown.

The requirements include the following

- Civil works: ensure all mounting structures are strong enough to withstand category 3 hurricanes. This is the responsibility of the engineers to ensure the work is done properly and as per design.
- The electrical installation should meet the NEC 2008 standards in addition to the local utility standards (BEL). The Electrical engineers are responsible of ensuring that the work is done as per the NEC. The NEC is the guide to verify this.
- The solar system efficiency: should have a high efficiency rating to maximize energy production. This is to be confirmed by the electrical engineers, comparing the test results at the factory with the actuals.
- Inverter Efficiency and Durability: inverters should be Grid tied compatible with a high efficiency rating. Be durable and must be able to withstand outdoor elements. As per the manuals and specifications requested.
- Monitoring and Maintenance: to track the performance of the solar system and identify any issues or anomalies promptly. Establish a maintenance plan for regular inspection, cleaning, and servicing to optimize system performance and prolong its

lifespan. The network engineer is responsible in ensuring the system is working properly as per design and as per manuals.

Table 16 Quality Requirements Log (L. Yah, 2024)

Project Name				
Project Manager				
Document Number				
Project Owner				
Date				
ID	Requested by	Priority	Description	Acceptance Criteria
001	The stakeholder who requested the requirement	The priority of the requirement (Low, Med, High)	The feature, function, condition, or capability that is required from the project, product, service or result. This include standards, standard Operating procedures	The criteria that the requirement must have for it to be accepted by the project stakeholders
002				
003				
004				

4.9.4 Quality Assurance

The Quality Assurance section explains how the project will define and document the quality requirements auditing process. This also focuses on the processes used to design and build the solar system. The process used by the team is an iterative process that will include measuring, analyzing, data processing, and continuous improvement where necessary. The Project Manager can conduct audits from time to time to ensure objectivity.

Table 17 Quality Assurance Metrics (L. Yah, 2024)

Process action	Acceptable process standards	Process phase	Assessment Interval
Leveling of structure	Before installation After installation Upon completion of the project.	Installation of frame structure	Daily until structure completed
Anchoring of structure	Using approved brackets and structure Tested before weight applied Strength tested upon completion	Installation of frame structure	Daily until structure completed
Electrical	Tested by installer Tested by engineer. Re tested at the end of the project. This is to ensure it complies with NEC 2008	Commissioning	Completion of electrical installation
Solar System efficiency	Tested by engineer at the end ensuring all the parameters are configured and the system is performing as designed	Commissioning	Completion of electrical installation

Table 18 Quality Assurance Log (L. Yah, 2024)

Quality Assurance Log					
Project Name					
Project Manager					
Document Number					
Project Owner					
ID	Review date	Process Reviewed	Findings	Resolution	Resolution date
001					
002					
003					
004					

4.9.5 Quality Control

Quality control involved the constant monitoring and control of quality activities to assess performance and quality overall. This quality control will be done by doing the below. Failure to meet the quality standards the project will have serious implications, as this might put at risk the entire project, due to perhaps not meeting all inspections that are required for the project to be finalized. All these issues will be tracked in the issues logs and tracked by the Project Manager and the Engineers.

- **Walkthroughs:** formal and informal reviews requiring no advance preparation typically used to understand scope and brainstorm
- **Inspection:** include the review of specific items or deliverables. This is to evaluate corrections or recommendations based on specific conditions. See below template to document all inspections.

- Milestone Reviews:** reviews held at milestone during the project lifecycle that evaluates where certain quality factors are addressed and followed adequately.

In addition to the surveys carried out, the relevant documentation needs to be populated. This includes the quality inspection report for both civils and electrical. Any issue found should be documented in the issues log. All templates are shown below.

Quality Inspection Report

Project Title: [Project Title]

Inspection Date: [Date]

Inspector: [Inspector's Name]

Item Inspected: [Specify the item or product being inspected]

Location: [Specify the location where the inspection took place]

Summary of Inspection:

[Provide a summary of the inspection, including any observations, findings, or issues identified.]

Inspection Details:

Item No.	Description	Criteria/Specification	Actual Result	Comments
1	Galvanized Structure	[Specify Criteria]	[Actual Result]	[Additional Comments]
2	Footings	[Specify Criteria]	[Actual Result]	[Additional Comments]
3	Support Brackets	[Specify Criteria]	[Actual Result]	[Additional Comments]
...

Overall Assessment:

[Provide an overall assessment of the quality of the item inspected, including any recommendations or actions needed.]

Inspector's Signature: _____

Date: _____

Approval:

This Quality Inspection Report is approved by:

[Project Manager's Name], Project Manager Date: [Date]

Figure 34 Quality Inspection Report (L. Yah, 2024)

Electrical Inspection Report

Project Title: [Project Title]

Inspection Date: [Date]

Inspector: [Inspector's Name]

Location: [Specify the location where the electrical inspection took place]

Summary of Inspection:

[Provide a summary of the electrical inspection, including any observations, findings, or issues identified.]

Inspection Details:



Item No.	Description	Criteria/Specification	Actual Result	Comments
1	Electrical Wiring	[Specify Criteria]	[Actual Result]	[Additional Comments]
2	Circuit Breakers	[Specify Criteria]	[Actual Result]	[Additional Comments]
3	Electrical Panels	[Specify Criteria]	[Actual Result]	[Additional Comments]
4	Grounding System	[Specify Criteria]	[Actual Result]	[Additional Comments]
5	Panels	[Specify Criteria]	[Actual Result]	[Additional Comments]
6	Inverters	[Specify Criteria]	[Actual Result]	[Additional Comments]
7	Monitoring System	[Specify Criteria]	[Actual Result]	[Additional Comments]

Overall Assessment:

[Provide an overall assessment of the electrical system, including any recommendations or actions needed to address identified issues.]

Inspector's Signature: _____

Date: _____

Approval:

This Electrical Inspection Report is approved by:

[Project Manager's Name], Project Manager Date: [Date]

Figure 35 Electrical Quality Inspection Report (L. Yah, 2024)

4.9.6 Quality Metrics

The parameters to be checked include the following:

- **Electrical Parameter:** this should have a voltage of 120VAC/208VAC on the output. The frequency of the generation is 60Hz. The energy output should be clean with little to no harmonics. As established in the NEC and BEL standards.
- **Energy production:** this should have a the normal “hat” behavior, meaning that it increases as the sun comes out and decreases as the sun goes down. Also, that it meets the 20kVA as per design. This is compared with actual benchmarks given by manufacturers.
- **Monitoring System:** ensuring the monitoring system is operating means all sensors are reading accurate, this is confirmed with the actual readings of the system. Also ensure all alarms and reports are generated as expected.

Once any parameter is detected not be as per design. It should be recorded in the quality control log. This will then trigger an investigation and in effect an investigation should be done in order to address the issue.

Table 19 Quality Control Log (L. Yah, 2024)

Quality Control Log					
Project Name					
Project Manager					
Document Number					
Project Owner					
ID	Review date	Process Reviewed	Findings	Resolution	Resolution date
QC-001					
QC-002					
QC-003					
QC-004					

4.10 Risk Management Plan

4.10.1 Introduction

Risk management involves identifying the risks and analyzing their potential impacts and the possibility that the risk will occur while executing the project. It also consists of creating a risk response plan to show how risks will be treated.

Risk management occurs throughout the project's lifecycle and is essential to completing the project successfully. A good Risk Management Plan ensures that plans are in place to minimize potential threats or maximize project opportunities. The project will benefit as follows by practicing good risk management:

- Identification of potential project problems early and develop plans and strategies to help reduce or avoid their impacts.
- Identification of potential opportunities and take advantage of them.

- It enables a reduction in rework and keeps the project schedule and budget on track.
- It allows you to be initiative-taking instead of reactive.
- It increases the likelihood of project success.

4.10.2 Risk Identification

Risk identification is the process of identifying individual project risks as well as sources of overall project risk, and documenting their characteristics,” (PMI, 2017). The risk breakdown structure is a hierarchical display of potential risks grouped and represented in a descending order detailing the definition of sources of risks.

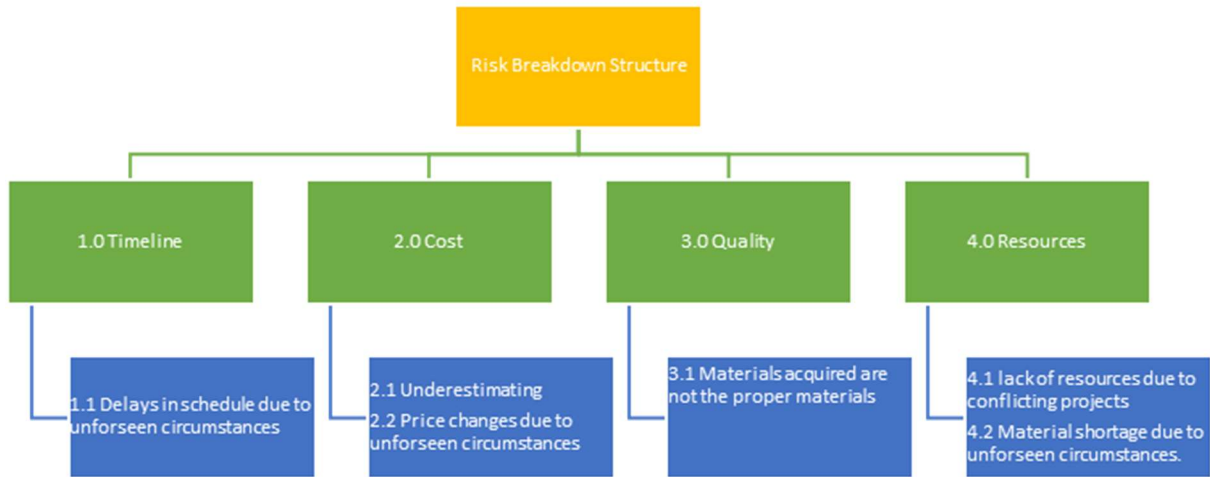


Chart 2 Risk Breakdown Structure (L. Yah, 2023)

Table 20 Risk Register (L. Yah, 2023)

RBS Code	Cause	Description	Consequence	Owner	Probability	Impact	Px	Risk Response	Strategy
1.1	Delays in schedule due to weather or unforeseen circumstances.	Timelines at Risk	Delays in the project	Project Manager	3	5	15	Mitigate	Work additional time to compensate or get additional resources
1.2	The inverters not working as expected	Non-Compatibility	Delays in the project	Project Manager	1	5	5	Mitigate	Ensure the units are tested at the factory before shipped.
2.1	Regulatory Permits	Timelines at Risk	Delays in the project	Engineer	2	5	10	Avoid	Be in constant communications, get feedback at a timely manner
2.2	Price Changes	Change in market	Affect the budget	Procurement team	3	4	12	Mitigate	Double check prices, and add contingency
3.1	Insurance and Warranty Risks	Operation	project owners vulnerable to financial losses or liabilities in the event of accidents, damages, or equipment failures.	Procurement team	1	3	3	Mitigate	Ensuring the system is insured with a comprehensive plan.
4.1	Lack of resources	Overburdened workers	Delays in timelines	Project Manager	2	3	6	Mitigate	Work additional time to compensate or get additional resources
4.2	Materials shortage	Supplier issues	delays and quality at risk	Project Manager/Procurement team	3	5	15	Mitigate	Have more materials on stock in case required.

4.10.3 Risk Prioritization

The probability-impact assessment was done for all risks included in the Risk Register shown below. The Project Manager will be able to prioritize risks based on their impact on the tasks and eventually project. The probability-impact matrix shown below was done to show the risks along with their respective possibility of occurrence versus the impact of them. The risks are detailed in the risk register also highlighting the risk response along with the respective traffic.

As seen on the register, 4 were identified to have a higher PX, meaning that they are the ones to closely monitor this is due to their impact on the project. On the other hand, the other 3 risks are not likely to happen. But still they are still to be monitored in order for them to either stop becoming a risk or lower its probability.

Probability	Impact				
	Very Low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Most likely to occur	5	10	15	20	25
likely to occur	4	8	12	16	20
Moderate Change to occur	3	6	9	12	15
Unlikely to occur	2	4	6	8	10
Very likely to occur	1	2	3	4	5

Chart 3 Probability-Impact Matrix (L. Yah, 2024)

4.10.4 Risk Response Planning

Risk response planning is the process of developing options and actions to enhance opportunities or reduce threats to the project's objectives. From the risk identification, there are three risks rated as medium, which are the highest rated, the Project Manager should take action to lower it. This can be done by using the schedule reserve, which is a pre-planned time reserve, also referred to as "buffer time" that can be incorporated in the project plan. In addition to this, verifying material quantity, pricing, and timelines with the relevant suppliers will help to mitigate the highlighted risks.

4.10.5 Risk Monitoring and Control

The identified risks will be monitored continuously during the project life cycle. In this process, any new changes or addressed risk will need to be identified and logged in the risk register.

Risk monitoring and control starts at the risk identification stage when risks are identified before they happen. Risk monitoring is continuously checking whether the identified risks are still there if the probability or impact has changed during the execution of the project.

Table 21 Risk Register (L. Yah, 2023)

RBS Code	Cause	Description	Consequence	Owner	Probability	Impact	Px	Risk Response	Strategy
1.1	Delays in schedule due to weather or unforeseen circumstances.	Timelines at Risk	Delays in the project	Project Manager	3	5	15	Mitigate	Work additional time to compensate or get additional resources
1.2	Limited feedback from stakeholders	Timeline delay	Delays in decision making	Project Manager	2	3	6	Mitigate	Follow the communication management plan.
2.1	Underestimating	Estimating errors	Conflict and quality jeopardized	Engineering team	3	4	12	Avoid	Double check prices, and add contingency
2.2	Price Changes	Change in market	Affect the budget	Procurement team	3	4	12	Mitigate	Double check prices, and add contingency
3.1	Materials acquired are not correct	Incopatability	delays in schedule and possible quality affected	Procurement team	2	4	8	Mitigate	Have samples sent first to have them tested
4.1	Lack of resources	Overburdened workers	Delays in timelines	Project Manager	2	3	6	Mitigate	Work additional time to compensate or get additional resources
4.2	Materials shortage	Supplier issues	delays and quality at risk	Project Manager/Procurement team	3	5	15	Mitigate	Have more materials on stock in case required.

5 CONCLUSIONS

This document addressed the ten knowledge areas as specified by the Project Management Institute to specify how the project will be conducted, monitored, and controlled. The plans highlighted cover distinct aspects of the project management practice to be applied for the construction of a solar system solution for residential use. This is to provide alternative energy solutions to the residents of Belize, both in rural and urban areas. In addition to this, this project will assist in the reduction of greenhouse gas emissions to our environment and finally to create cost saving for the residents.

Below are the results of the Project Management Plan:

1. A description of the fundamental principles of project management.
2. A project charter was developed, this includes a detailed statement outlining the scope and deliverables of the project. This was acknowledged and approved for it to be executed accordingly.
3. A Scope Management Plan was developed, detailing how the project will be defined, developed, monitored, controlled, and verified. Ensuring all tasks are recorded and properly tracked. One of the key deliverables in this plan is the WBS.
4. A Schedule Management Plan was developed, defining the timeline for all projects, tasks, and deliverables. All this assists in tracking all deliverables and ensuring they are finished in time. All this represented holistically in a Gantt chart using MS Project.
5. The Resources Management Plan was developed as a guide to identify, purchase, and manage all the resources needed to complete the project successfully.
6. The Procurement Management Plan was developed to establish how the project will manage the procurement process. This includes acquisition of both goods and services. The creation of standard documentation was also important, for example TOR and SOW.
7. The Stakeholder Management Plan was developed successfully to identify all individuals affected both positively and negatively by the execution of the project. This also analyzed the proper engagement of the resources, maintaining them updated throughout the project lifecycle.

8. The Communication Management Plan was successfully developed to establish a plan on how to communicate with all stakeholders. This is maintaining all the stakeholders well informed of everything that is happening on the project. the relevant means were established in the communication plan.
9. A Risk Management Plan was developed to define all possible risks that could cause any delay on the project. These risks were analyzed using the established template to weigh in their impact on the project selection. Finally, this highlights the risks and their possible solution to them.
10. A Quality Management Plan was created to ensure all deliverables are made up to the required standards, for example PUC, and CBA. Checklists were also developed to conduct inspections and the final inspection checklist.
11. The Integration Management Plan was created for the project to work in sync with the other management plans like the cost, schedule, scope etc. With this, the work, communication and updating of all relevant documentation made the project easier.
12. The P5 analysis not only ensures responsible execution of the project regarding the requirement of sustainability, but also guarantees the quality of project deliverables, and the project on a whole.

6 RECOMMENDATIONS

The following are recommendations addressed to the project team that should be considered during the planning and execution of the project to ensure successful completion of the project:

1. Ensure the proper use of the required standards.
2. Use the project management methodologies, processes, tools, techniques, and activities presented in this document. This includes the specific plans, Scope, Schedule, Risk, Quality, Cost, Resources, Communication, Procurement and Stakeholder management to successfully complete the project also for monitoring and control of the agreed timelines, budgeted costs, risks, and quality.
3. With the effective monitoring of the project strategy and the proper following of the change management process.
4. Ensure the agreed timelines, budget, plans etc. are all signed by all stakeholders to have the relevant documentation in place in case of future references.
5. Ensure proper resources are assigned, this is to avoid resources being overwhelmed with work.
6. The Project Manager should be engaged for all decisions this is to provide feedback from the project management best practices.

7. Embrace the green project management practices in order for the project to be green and minimize the negative impact on the environment.

7 VALIDATION OF THE FGP IN THE FIELD OF REGENERATIVE AND SUSTAINABLE DEVELOPMENT AND P5 ANALYSIS

The Green Project Management (2019) states that we consume more resources than the planet can provide. Even before this assertion, policymakers had already noted that there was a need for more sustainable development. However, the implemented solutions did not have as significant an impact as expected. Regenerative development goes beyond sustainability, and it takes on a more holistic approach, in building the capacity of the existing support system and utilizing linkages for the improved well-being of society (Muller, n.d.). The Regensis Group described regenerative development as an approach that enhances living things' ability to co-exist and co-evolve in ways that allow the planet to reach its full potential for diversity, complexity, and creativity (Mang, Haggard, & Regensis, 2016).

Sustainable development, climate change, and regenerative development have taken project management into an era beyond the triple bottom line where success is concerned. Projects are no longer judged to be successful based on being finished on time, within budget, etc., but success is also deemed successful based on their long-term sustainability, building capacities, and overall impact on society's well-being. Therefore, sustainability and regenerative development must be incorporated into the Project Management Plan to implement, monitor, and deliver the project.

Analyzing the three main topics established by the GPM using the P5 analysis, it can be concluded that the below benefits or impact will be experienced.

People

Social Equity: The project promotes social equity by providing homeowners with the means to access clean, renewable energy. This reduces energy poverty and enhances the quality of life for residents, aligning with the "People" dimension by improving overall well-being.

Job Creation: Solar installations create job opportunities, contributing to livelihoods and economic empowerment for the local workforce. This supports the "People" dimension by increasing employment opportunities.

Education and Awareness: The project includes education and awareness programs that empower people with knowledge about solar energy benefits, supporting informed decision-making and active community participation.

Planets

Carbon Emission Reduction: By shifting from fossil fuels to solar energy, the project significantly reduces carbon emissions, thereby mitigating climate change and protecting the planet. This is by the materials being used. This aligns with the "Planet" dimension by fostering environmental sustainability.

Resource Conservation: Solar panels are recyclable, promoting resource efficiency and reducing waste, which is in line with the "Planet" dimension's emphasis on responsible resource management.

Prosperity

Economic Growth: The project stimulates local economic growth through job creation and reduced energy costs for homeowners. This contributes to the "Prosperity" dimension by enhancing the financial well-being of individuals and communities.

Energy Cost Savings: By reducing energy bills for homeowners, the project increases disposable income, supporting economic prosperity at the household level.

7.1 P5 Analysis

The Green Project Management P5 Impact Analysis is a tool that can be used to incorporate sustainability into projects. One of the tool's primary purposes is to identify potential positive and negative sustainable impacts for analysis and decision-making.

However, this tool also helps organizations align their strategies with sustainable performance through principle-based project management techniques while linking them to Sustainable Development Goals.

Below is a P5 impact analysis conducted for the project to design and construct a 20 kVA solar system for residential use in Belize.

People Impacts	Initial Score	New Score	Change
Labor Practices and Decent Work	3.3	1.7	1.7
Society and Customers	3.0	1.0	2.0
Human Rights	2.0	1.0	1.0
Ethical Behavior	4.0	1.0	3.0
Overall People Score	1.2		
Planet Impacts	Initial Score	New Score	Change
Transport	3.5	1.0	2.5
Energy	5.0	2.0	3.0
Land Air, and Water	4.0	2.0	2.0
Consumption	2.5	1.0	1.5
Overall Planet Score	1.5		
Prosperity Impacts	Initial Score	New Score	Change
Project Feasibility	3.5	1.5	2
Business Agility	3.5	1	2.5
Local Economic Impact	4	1	3
Overall Prosperity Score	1.2		
Overall Project P5 Score	1.3		

Chart 4 P5 Analysis Score (L. Yah, 2023)

Chart 6 People Impacts- Society and Customers (L. Yah, 2023)

Category	Human Rights	Lens	Scored?	Description (Cause)	Potential Sustainability Impact	Impact Score Before	Proposed Response	Impact Score After	Change	
Element	Description									
 Harassment and Discrimination	Harassment and discrimination involves the measures adopted to ensure a safe, respectful, and non-discriminatory workplace environment. This includes developing policies that protect employees from unjust treatment, creating an inclusive environment, implementing effective reporting procedures for instances of inappropriate behavior, and providing sufficient training for management on how to handle such issues.	Lifespan							0	
		Servicing								0
		Effectiveness								0
		Efficiency								0
 Age-Appropriate Labor	Age-appropriate labor means ensuring that children are not put in dangerous or exploitative situations while still allowing them to develop essential job skills. It is used to describe work suitable for a person's skill level and maturity.	Lifespan							0	
		Servicing								0
		Effectiveness								0
		Efficiency								0
 Forced and Involuntary Labor	Forced and involuntary labor means any work or service that is extracted from a person under the menace of punitive action against themselves or their families. It includes work where the payment is below subsistence levels, or where the payment is in goods which are not desirable. Forced and involuntary labor can take many forms including human trafficking, debt bondage, enslavement, and unjustly long working hours.	Lifespan							0	
		Servicing								0
		Effectiveness								0
		Efficiency								0
 Dignity, Diversity, Equity, and Inclusion	Dignity, diversity, equity, and inclusion (DDEI) is a set of values, principles, and practices that create an environment where everyone involved in the project feels respected, safe, and valued. It also involves providing opportunities for everyone to take part in relevant decision-making processes without facing discrimination or being subject to unfair treatment.	Lifespan							0	
		Servicing								0
		Effectiveness								0
		Efficiency								0
		Fairness	Yes	Discrimination or challenges due to different religions or race		2	Advocate inclusion as part of the project deliverables.	1	-1	

Chart 7 People Impacts- Human Rights (L. Yah, 2023)

Planet Impacts									
Category	Transport	Lens	Scored?	Description (Cause)	Potential Sustainability Impact	Impact Score Before	Proposed Response	Impact Score After	Change
Element	Description								
	Local procurement is the practice of purchasing products and services from local suppliers.	Lifespan							0
		Servicing							0
		Effectiveness	Yes	Foreign purchases only		3	Acquire as much from local companies or providers	1	-2
		Efficiency							0
		Fairness							0
	Digital communication is the use of digital tools and platforms to communicate about the project. These tools can include websites, email newsletters, social media accounts, messaging applications, and other digital communication channels.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
	Traveling and commuting is the movement of project-related personnel between different locations. Traveling and commuting may include getting to the project site, attending off-site meetings, conducting off-site presentations, collecting data, and providing off-site support.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
	Logistics is the planning and execution of activities related to transporting goods, raw materials, and services for use by the project. Logistics includes activities such as scheduling transportation, estimating costs, coordinating personnel, and making sure that all necessary procedures are completed on time.	Lifespan	Yes	Multiple cargo shipments and charges		4	Conduct consolidated purchases and shipments	1	-3
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0

Chart 8 Planet Impacts- Transport (L. Yah, 2023)

Plant Impacts									
Category	Energy	Lens	Scored?	Description (Cause)	Potential Sustainability Impact	Impact Score Before	Proposed Response	Impact Score After	Change
Element	Description								
	Energy consumption is the amount of energy used by the project throughout its duration. It encompasses all aspects of energy use from office lighting to the energy required for transportation.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
	GHG emissions are gases (mostly carbon dioxide and methane) released into the atmosphere as a direct result of activities associated with the project. This includes emissions as a direct result of project energy consumption as well as emissions from transport of procured goods, raw materials, and services. It also includes GHG emissions caused by the distribution, operation, and disposal of the project product.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
	Renewable energy, also called alternative energy, is energy generated from sources that are replenished at a faster rate than they are consumed. These sources include solar, wind, water, and geothermal power. Clean energy return (CER) refers to the amount of renewable energy generated by the project or the project's product that is in excess of the amount needed. CER is normally returned to the grid for use by others.	Lifespan	Yes			5	To commissioning of the site	2	-3
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0

Chart 9 Plant Impacts- Energy (L. Yah, 2023)







Category	Land, Air, and Water	Lens	Scored?	Description (Cause)	Potential Sustainability Impact	Impact Score Before	Proposed Response	Impact Score After	Change
Element	Description								
 Biological Diversity	Biological diversity, also known as biodiversity, refers to the variety of life forms on Earth. It includes all ecosystems and all species of plants, animals, bacteria, fungi, and microorganisms that make up a particular environment or habitat. It also includes all genetic variations of those species.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
 Air and Water Quality	Air and water quality involves measures of contamination in air and water sources.	Lifespan	Yes	No adherence to environmental health conditions		4	Engineers to ensure pollution is very limited and provide checks reports	1	-3
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
 Water Consumption	Water consumption is the usage of water during project activities. Although construction, manufacturing, and agricultural projects are probably the major users of water, all projects use water to some extent.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
 Water Displacement	Water displacement is the practice of diverting water sources that have been disrupted by the project away from areas that are prone to flooding and contamination. Methods include dam construction, rerouting flowing water, building artificial wetlands, landscaping with rain gardens, and installing flood barriers. Water displacement is mostly an issue with construction, manufacturing, and agricultural projects.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
 Soil Erosion and Regeneration	Soil erosion is the loss of topsoil due to human activities such as construction, road building, or agricultural practices. It can be exacerbated by changes in the natural land cover and can have significant negative effects on local ecosystems. As with water displacement, soil erosion is mostly an issue with construction, manufacturing, and agricultural projects. Regenerative design is a practice that draws on an understanding of how ecosystems function so that the project will regenerate resources rather than depleting them.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness							0
 Noise Pollution	Noise pollution is the creation of excessive, unpleasant, or disruptive sounds that can diminish quality of life. Noise	Lifespan	Yes	The noise affecting the neighbourhood		4	Engineers to ensure noise levels are maintained. And also have a plan	2	-2

Chart 10 Planet Impacts - Land, Air, Water (L. Yah, 2023)



Category	Consumption	Lens	Scored?	Description (Cause)	Potential Sustainability Impact	Impact Score Before	Proposed Response	Impact Score After	Change
Element	Description								
 Recycling and Reuse	Recycling involves transforming a waste item into a useful one. Items that can be recycled run the gamut from plastic water bottles to computers to electrical generators. Reuse involves using the same item again and again or finding a new purpose for it.	Lifespan							0
		Servicing							0
		Effectiveness							0
		Efficiency							0
		Fairness	Yes	Reuse of materials to avoid pollution		3	enforce the reusing of materials, also recycling	1	-2
 Waste Disposal	Disposal of assets is the process of getting rid of an item which has reached the end of its useful life. This includes everything from consumer electronics to public infrastructure such as roads and bridges. Generally, assets should not be disposed of until they are no longer fit for use. Disposal of goods and materials is the practice of getting rid of items that are no longer needed or wanted for the project. This includes disposing of both hazardous and non-hazardous waste in accordance with	Lifespan							0
		Servicing							0
		Effectiveness	Yes	Proper disposal of materials		2	find adequate forms and place to dispose non usable materials	1	-1
		Efficiency							0

Chart 11 Planet Impacts – Consumption (L. Yah, 2023)





Prosperity Impacts										
Category	Project Feasibility	Lens	Scored?	Description (Cause)	Potential Sustainability Impact	Impact Score Before	Proposed Response	Impact Score After	Change	
 Business Case Analysis Business case analysis is the process of developing a business case that provides justification for the initiation or continuation of the project. It involves analysing the underpinning logic of funding the project. This requires identifying the expected benefits and dis-benefits, likely costs and revenues, staffing requirements, major risks, schedule alternatives, and stakeholder impacts associated with a proposed project.	Description	Lifespan							0	
		Servicing							0	
		Effectiveness							0	
		Efficiency							0	
		Fairness							0	
 Financial Analysis Financial analysis is the process of evaluating the project from a monetary perspective. Typically, it is used to analyze whether the project warrants initial or additional funding.	Description	Lifespan	Yes	The project sponsory don't want to finance the project		4	The proper financials are to be presented along with the savings in order for the project be feasible.	1	-3	
		Servicing							0	
		Effectiveness							0	
		Efficiency							0	
		Fairness							0	
 Social Return on Investment Social return on investment (SROI) is a framework for measuring and accounting for project results and outcomes by including social and environmental costs and benefits along with the traditional economic ones. It is based on the idea that projects create value in ways other than just financial returns. For example, a community development project may create value by improving the health and well-being of residents, reducing crime, and increasing social cohesion.	Description	Lifespan							0	
		Servicing								0
		Effectiveness								0
		Efficiency	Yes	Project will not go overbudget		3	Budget to be monitored closely.	2	-1	
		Fairness							0	
 Modeling and Simulation Modeling is the creation of a physical, mathematical, or logical representation of the project using representative characteristics of the project.	Description	Lifespan							0	
		Servicing							0	
		Effectiveness							0	
		Efficiency							0	
		Fairness							0	

Chart 12 Prosperity Impact- Project Feasibility (L. Yah, 2023)



Prosperity Impacts									
Category	Business Agility	Lens	Scored?	Description (Cause)	Potential Sustainability Impact	Impact Score Before	Proposed Response	Impact Score After	Change
 Flexibility Flexibility is the ability to adjust to changing circumstances or situations. It requires the capacity to modify plans or approaches when faced with unexpected challenges.	Description	Lifespan							0
		Servicing							0
		Effectiveness	Yes	Changes due to unforeseen circumstances, leak on roof		4	the proper studies and tests are to be done from all aspects.	1	-3
		Efficiency							0
		Fairness							0
 Resiliency Resiliency is the ability of the project to recover from or adjust easily to adverse conditions such as extreme market fluctuations, political or economic instability, natural disasters, or health emergencies. Resiliency does not make problems go away; it means having the ability to cope with them despite the unexpected stress.	Description	Lifespan							0
		Servicing							0
		Effectiveness	Yes	The constant changes on the market due to natural disasters, wars etc.		3	A contingency need to be put in place in order to mitigate this.	1	-2
		Efficiency							0
		Fairness							0

Chart 13 Prosperity Impacts- Business Agility (L. Yah, 2023)

Category	Market and Economic Stimulation	Lens	Scored?	Description (Cause)	Potential Sustainability Impact	Impact Score Before	Proposed Response	Impact Score After	Change	
 Local Economic Impact	Local economic impact includes the direct and indirect effects the project has on the economy of its local area. This can include job creation, increased spending in the local economy, or increased regional development.	Lifespan							0	
		Servicing								0
		Effectiveness								0
		Efficiency								0
		Fairness								0
 Indirect Benefits	Indirect benefits are the positive impacts that go beyond the immediate outcomes of the project and may not always be immediately visible. These benefits can include improved quality of life, increased economic activity in the local area, and environmental improvements such as cleaner air or water.	Lifespan							0	
		Servicing								0
			Yes	The high electricity bills being paid as well as the contamination		4	The production of green energy, which helps the planet as well as the lowering of expenses.	1		-3
		Effectiveness								0
		Efficiency								0
 ESG Disclosures and Sustainability Reporting	ESG disclosures are information about an organization's performance and practices related to environmental, social, and governance issues. Information from the project is used as input to the ESG disclosures of the sponsoring organization(s). Sustainability reporting provides information about an organization's policies, practices, and performance related to sustainability. It covers a wide range of topics such as energy efficiency, carbon emissions, resource conservation, human rights, labor practices, and community engagement. Information from the project is used as input to the sustainability reporting of the sponsoring organization(s).	Lifespan							0	
		Servicing								0
		Effectiveness								0
		Efficiency								0
		Fairness								0

Chart 14 Prosperity Impacts- Market and Economic Simulation (L. Yah, 2023)

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APPENDICES

7.2 Appendix 1: FGP Charter

CHARTER OF THE PROPOSED FINAL GRADUATION PROJECT (FGP)

1. Student name

Leiber Yah

2. FGP name

Project Management Plan for the design and installation of a 20-kW hybrid solar solution for residential applications in Belize.

3. Application Area (Sector or activity)

Renewable Energy

4. Student signature



5. Name of the Graduation Seminar facilitator

Roger Valverde Jimenez

6. Signature of the facilitator



7. Date of charter approval

29th August 2023

8. Project start and finish date.

29th August 2023	23 rd October 2023
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9. Research question

What elements are needed for a 20kW solar systems to be effectively designed and installed for residential application in Belize using a Project Management Plan.

10. Research hypothesis

Is it possible to design a 20-kW solar system for residential applications in Belize using a Project Management Plan.

11. General objectives

To develop a Project Management Plan for the designing and construction of a 20-kW solar solution for residential application in Belize.

12. Specific objectives

1. Develop and integrate Management Plan
2. To create a Stakeholder Management Plan
3. To create a Resource Management Plan.
4. To create a Communication Management Plan
5. To create a Procurement Management Plan
6. To create a Cost Management Plan
7. To develop a Quality Management Plan
8. To establish a Risk Management Plan
9. To create a Schedule Management Plan
10. To create a Scope Management Plan

13. FGP purpose or justification

The purpose of the project is to provide an alternative way in which the residents of Belize can use as power sources other than the utilities. This is to help with environmental impacts already existing. In addition to this, implement proper project management practices to the country of Belize since many at times these skillsets must come from foreigners due to the country lacking this skillset. Finally, to advocated Green Project Management practices and sustainability to country of Belize.

14. Work Breakdown Structure (WBS). In table form, describing the main deliverable as well as secondary, products or services to be created by the FGP.

- 1 Graduation Seminar
 - 1.1 FGP Deliverables
 - 1.1.1 "Introduction Module
Appendix 1 FGP Charter (Items 1-10)
Appendix Bibliographical Research)"
 - 1.1.2 "FGP Charter
Appendix 1 FGP Charter (Items 11 & 12)
Appendix 2 FGP WBS
Self-assessment)"
 - 1.1.3 "FGP Charter
Correction
Appendix 1 FGP Charter (Items 13-19)"
 - 1.1.4 "Theoretical Framework
Corrections
Chapter 2 Theoretical Framework
Appendix 1 FGP Charter items 20)
Self-Assessment 2"
 - 1.1.5 "Methodological Framework
Chapter 3
Appendix 1 FGP Charter item 21"
 - 1.1.6 "Introduction
Corrections
Chapter 1 Introduction
Chapter 7 Project validation in the regenerative and sustainable development
Appendix 1 FGP Charter (item 22) Appendix 3 FGP Schedule"
 - 1.1.7 "Corrections to complete document
Executive Summary
Abstract
Bibliography references, Indexes (content, figures, Charts)
Signed FGP Charter"
 - 1.1.8 Annexes
 - 1.1.8.1 Bibliography
 - 1.1.8.2 Schedule
 - 1.2 Graduation Seminar Approved
- 2 Tutoring Process
 - 2.1 Tutoring Process
 - 2.1.1 Tutor Assignment
 - 2.1.2 Communication
 - 2.2 Adjustments of previous chapters
 - 2.3 Chapter IV Development
 - 2.3.1 Integration Management
 - 2.3.2 Scope Management
 - 2.3.3 Schedule Management
 - 2.3.4 Cost Management
 - 2.3.5 Quality Management
 - 2.3.6 Resource Management
 - 2.3.7 Communications Management
 - 2.3.8 Risk Management
 - 2.3.9 Procurement Management
 - 2.3.10 Stakeholder Management.
 - 2.4 Chapter V Conclusions.
 - 2.5 Chapter IV Recommendations
- 3 Reading by Reviewers
 - 3.1 Reviewers assignment request
 - 3.1.1 Assignment of two reviewers
 - 3.1.2 Communication
 - 3.1.3 FGP Submission to reviewers
 - 3.2 Reviewers work
 - 3.2.1 Reviewer 1
 - 3.2.1.1 FGP Reading
 - 3.2.1.2 Reader 1 Report
 - 3.2.2 Reviewer 2
 - 3.2.2.1 FGP Reading
 - 3.2.2.2 Reader 2 Report
- 4 Adjustments
 - 4.1 Report for reviewers
 - 4.2 FGP Update
 - 4.3 Second review by reviewers
- 5 Presentation to Board of Examiners
 - 5.1 Final Review by Board
 - 5.2 FGP Grade Report.

15. FGP budget

Transportation - 200 USD
Printing – 100 USD
Lodging and Subsistence 500 USD
Shipping 200 USD
Total budget 1000 USD

16. FGP planning and development assumptions.

- That the information is readily available
- That 15 hours per week will be dedicated during the FGP development
- That a proper scope is defined.
- Adequate timeline aligned with the deliverables.
- No scope creeps.

17. FGP constraints

- That funding is available for the FGP to be completed.
- Not getting feedback timely and clearly.
- Lack of communication
- Resource constraints can be financial, facilities or information.

18. FGP development risks

- Any hurricane striking might delay the completion of the FGP.
- Any health issue that might prevent from completing the FGP.
- Failure to adhere to ethical and legal guidelines can lead to delays.
- Procrastination

19. FGP main milestones

Milestones are related to deliverables on the second level (deliverables) and third level (control accounts) of the WBS of section 14 of this Charter. At the same time the deliverables are related to the specific objectives (in the case of the FGP please include the times for the tutorship reviews as well as for the readership).

Deliverable	Finish estimated date
1.0 FGP	
1.1 Charter	October 16, 2023
1.2 FGP WBS	September 11, 2023
1.3 Chapter 3 Theoretical Framework	September 25, 2023
1.4 Chapter 3 Methodical Framework	October 2, 2023
1.5 Chapter 2 Introduction	October 9, 2023
1.6 Executive Summary	October 16, 2023
1.7 Bibliography	October 16, 2023
1.8 Schedule	October 9, 2023
1.9 Graduation Seminar Approval	October 23, 2023
2.0 Tutoring Process	January 30, 2024
3.0 Reading by reviewers	February 20, 2024
4.0 Adjustments	March 19, 2024
5.0 Presentation to the Board of Examiners	March 20, 2024
6.0 Final Review by Board	March 21, 2024
7.0 FGP Grade Report	March 26, 2024

20. Theoretical framework

20.1 Estate of the “matter”

The current situation is that in Belize there are limited engineers and firms that implement green project management for these kinds of projects. Hence the reason the implement or bring to light this new type of project management and sustainability.

20.2 Basic conceptual framework

Green Project management, Project Management Principles, Process Groups, Sustainability,

21. Methodological framework

Objective	Name of deliverable	Information sources	Research method	Tools	Restrictions
Develop and integrate Management Plan	Integrate management plan	Primary & Secondary	Analytical Method	Microsoft suite, including Excel and Word	This will be one size only. That the size is as required
To create a stakeholder Management Plan	Stakeholder Management Plan	Primary & Secondary	Analytical Method Quantitative Method	Microsoft suite, including Excel and Word	That the information is readily available That the information is not up to date
To create a Resource Management Plan.	Resource Management Plan	Primary & Secondary	Analytical Method Quantitative Method	Microsoft suite, including Excel and Word	That it will be for residential only. That the project it is rejected
To create a Communication Management Plan	Communication	Primary & Secondary	Analytical Method Descriptive Method	Microsoft suite, including Excel and Word	All green from the Works do not complete

			Quantitative Method		as stipulated in the scope and perceptions may change.
To create a Procurement Management Plan	Procurement Management	Primary & Secondary	Analytical Method Descriptive Method Quantitative Method	Microsoft suite, including Excel and Word, also an inventory management system.	All green from the Works do not complete as stipulated in the scope and perceptions may change.
To create a Cost Management Plan	Cost Management plan	Primary & Secondary	Analytical Method Descriptive Method Quantitative Method	Microsoft suite, including Excel and Word, also an inventory management system.	The project will be completed as per budget and in alignment cost management plan Economic Conditions my change
To develop a Quality Management Plan specific to quality of	A Quality Management Plan	Primary & Secondary	Analytical Method Descriptive Method	Face-to-face meetings to analyze required data relating to the project quality.	All good procured will be of good quality as in the

these kind of works, applying and following standards			Quantitative Method	Microsoft suite, skype, zoom, teams etc.	procurement process Poor quality items may be procured.
To establish a Risk Management Plan that analyzes the project wholistically	A Risk Management Plan	Primary & Secondary	Analytical Method	Microsoft suite, including word	All possible risks have been identified. Unexpected risk may occur
To create a Schedule Management Plan to monitor the project's lifecycle. Defining timelines and milestones.	A Schedule Management Plan	Primary & Secondary		Microsoft suite, including word and project	The time allotted for the will be enough for full project implementation Since all stakeholders will work expeditiously to ensure the timely preparation for and execution of their respective tasks. Delays in information from

					stakeholder will prolong the project
To create a Scope Management Plan	A Scope Management Plan	Primary & Secondary	Descriptive	Microsoft suite, including word and excel	All stakeholders will be supportive and instrumental in the facilitation of works related to the development of the scope management. A time to gather all necessary information to develop the Scope Management Plan to be collated in a short space of time.

22. Validation of the work in the field of regenerative and sustainable development.

7.3 Appendix 2: FGP WBS

- WBS must include tasks from the complete FGP life cycle, starting from the graduation seminar and ending with the presentation to the Board of Examiners.
- Must be created in WBS Chart pro tool or other layout approved on the WBS practice standard.

ID	Task
1	Graduation Seminar
1.1	FGP Deliverables
1.1.1	Introduction Module Appendix 1 FGP Charter (Items 1-10) Appendix Bibliographical Research)
1.1.2	FGP Charter Appendix 1 FGP Charter (Items 11 & 12) Appendix 2 FGP WBS Self-assessment)
1.1.3	FGP Charter Correction Appendix 1 FGP Charter (Items 13-19
1.1.4	Theoretical Framework Corrections Chapter 2 Theoretical Framework Appendix 1 FGP Charter items 20) Self-Assessment 2
1.1.5	Methodological Framework Chapter 3 Appendix 1 FGP Charter item 21
1.1.6	Introduction Corrections Chapter 1 Introduction Chapter 7 Project validation in the regenerative and sustainable development Appendix 1 FGP Charter (item 22) Appendix 3 FGP Schedule
1.1.7	Corrections to complete document Executive Summary Abstract Bibliography references, Indexes (content, figures, Charts) Signed FGP Charter

1.1.8	Annexes
1.1.8.1	Bibliography
1.1.8.2	Schedule
1.2	Graduation Seminar Approved
2	Tutoring Process
2.1	Tutoring Process
2.1.1	Tutor Assignment
2.1.2	Communication
2.2	Adjustments of previous chapters
2.3	Chapter IV Development
2.3.1	Integration Management
2.3.2	Scope Management
2.3.3	Schedule Management
2.3.4	Cost Management
2.3.5	Quality Management
2.3.6	Resource Management
2.3.7	Communications Management
2.3.8	Risk Management
2.3.9	Procurement Management
2.3.10	Stakeholder Management.
2.4	Chapter V Conclusions.
2.5	Chapter IV Recommendations
3	Reading by Reviewers
3.1	Reviewers' assignment request
3.1.1	Assignment of two reviewers
3.1.2	Communication
3.1.3	FGP Submission to reviewers
3.2	Reviewers work
3.2.1	Reviewer 1
3.2.1.1	FGP Reading
3.2.1.2	Reader 1 Report
3.2.2	Reviewer 2
3.2.2.1	FGP Reading
3.2.2.2	Reader 2 Report
4	Adjustments
4.1	Report for reviewers
4.2	FGP Update
4.3	Second review by reviewers
5	Presentation to Board of Examiners
5.1	Final Review by Board

5.2	FGP Grade Report.
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7.4

Appendix 3: FGP Schedule

- Must be directly related to the WBS and its work packages. Must include activities, duration, start date, finish date and resources.
- Must be created in MS Project or similar approved software.

Task Mode	Task Name	Duration	Start	Finish	Predecessors
Auto Scheduled	Final Graduation Project	151 days	Tue 8/29/23	Tue 3/26/24	
Auto Scheduled	FGP Start	151 days	Tue 8/29/23	Tue 3/26/24	
Auto Scheduled	1. Graduation Seminar	40 days	Tue 8/29/23	Mon 10/23/23	
Auto Scheduled	1.1 FGP Deliverables	35 days	Tue 8/29/23	Mon 10/16/23	
Auto Scheduled	1.1.1 Charter Items 1 to 10, Preliminary bibliographical research	5 days	Tue 8/29/23	Mon 9/4/23	
Auto Scheduled	1.1.2 Charter items 11 and 12, FGP WBS, Self-Assessment	5 days	Tue 9/5/23	Mon 9/11/23	5
Auto Scheduled	1.1.3 Correction, Charter items 13-19	5 days	Tue 9/12/23	Mon 9/18/23	6
Auto Scheduled	1.1.4 Corrections, Chapter 2 Theoretical Framework, Charter Item 20, Self-Assessment 2	5 days	Tue 9/19/23	Mon 9/25/23	7
Auto Scheduled	1.1.5 Corrections, Chapter 3 Methodological framework, Chart item 21	5 days	Tue 9/26/23	Mon 10/2/23	8
Auto Scheduled	1.1.6 Corrections, Chapter 1 Introduction, Chapter 7 Project Validation in the Regenerative and Sustainable design, Charter Item 22, FGP Charter	5 days	Tue 10/3/23	Mon 10/9/23	9
Auto Scheduled	1.1.7 Corrections, Executive Summary, Abstract, Bibliographical reference, Indexes, Signed FGP Charter	5 days	Tue 10/10/23	Mon 10/16/23	10
Auto Scheduled	1.2 Graduation Seminar Approval	5 days	Tue 10/17/23	Mon 10/23/23	11
Auto Scheduled	2. Tutoring Process	65 days	Tue 10/24/23	Mon 1/22/24	
Auto Scheduled	2.1 Tutor	3 days	Tue 10/24/23	Thu 10/26/23	

Auto Scheduled	2.1.1 Tutor Assignment	1 day	Tue 10/24/23	Tue 10/24/23	12
Auto Scheduled	2.1.2 Communication	2 days	Wed 10/25/23	Thu 10/26/23	15
Auto Scheduled	2.2 Adjustments of Previous chapters (if needed)	5 days	Fri 10/27/23	Thu 11/2/23	16,15
Auto Scheduled	2.3 Chapter 4 Development (Results)	47 days	Fri 11/3/23	Mon 1/8/24	17
Auto Scheduled	2.4 Chapter 5 Conclusions	5 days	Tue 1/9/24	Mon 1/15/24	18
Auto Scheduled	2.5 Chapter 6 Recommendations	5 days	Tue 1/16/24	Mon 1/22/24	19
Auto Scheduled	Tutor Approval	0 days	Mon 1/22/24	Mon 1/22/24	20
Auto Scheduled	3. Reading by Reviewers	21 days	Tue 1/23/24	Tue 2/20/24	
Auto Scheduled	3.1 Reviewers Assignment Request	5 days	Tue 1/23/24	Mon 1/29/24	
Auto Scheduled	3.1.1 Assignment of two reviewers	2 days	Tue 1/23/24	Wed 1/24/24	21
Auto Scheduled	3.1.2 Communication	2 days	Thu 1/25/24	Fri 1/26/24	24
Auto Scheduled	3.1.3 FGP submission to reviewers	1 day	Mon 1/29/24	Mon 1/29/24	25
Auto Scheduled	3.2 Reviewers Work	16 days	Tue 1/30/24	Tue 2/20/24	
Auto Scheduled	3.2.1 Reviewer 1	10 days	Tue 1/30/24	Mon 2/12/24	
Auto Scheduled	3.2.1.1 FGP reading	9 days	Tue 1/30/24	Fri 2/9/24	26
Auto Scheduled	3.2.1.2 Reader 1 report	1 day	Mon 2/12/24	Mon 2/12/24	29
Manually Scheduled	3.2.2 Reviewer 2	10 days	Wed 2/7/24	Tue 2/20/24	
Auto Scheduled	3.2.2.1 FGP Reading	9 days	Wed 2/7/24	Mon 2/19/24	26
Auto Scheduled	3.2.2.2 Reader 2 report	1 day	Tue 2/20/24	Tue 2/20/24	32
Auto Scheduled	4. Adjustments	20 days	Wed 2/21/24	Tue 3/19/24	
Auto Scheduled	4.1 Report for reviewers	9 days	Wed 2/21/24	Mon 3/4/24	33

Auto Scheduled	4.2 FGP Update	1 day	Tue 3/5/24	Tue 3/5/24	35
Auto Scheduled	4.3 Second Review by Reviewers	10 days	Wed 3/6/24	Tue 3/19/24	36,35
Auto Scheduled	5. Presentation to Board of Examiners	5 days	Wed 3/20/24	Tue 3/26/24	
Auto Scheduled	5.1 Final Review by Board	2 days	Wed 3/20/24	Thu 3/21/24	37
Auto Scheduled	5.2 FGP Grade Report	3 days	Fri 3/22/24	Tue 3/26/24	39
Auto Scheduled	FGP End	0 days	Tue 3/26/24	Tue 3/26/24	40

7.5 Appendix 4: Preliminary bibliographical research

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7.6 Appendix 5: Philologist Letter

Stephanie Flores Bradshaw

Lot 18 Castillo Estate
13.5 Miles Philip Goldson Highway
Belize District, Belize
+501-605-7888 | sdfloresbradshaw@gmail.com

Academic Tutor
Master's Degree in Project Management
Universidad para la Cooperación Internacional
C. 35, Barrio Escalante
San José 10101
Costa Rica

January 31, 2024

Re: Philological Review of Final Graduation Project submitted by Leiber Yah in partial fulfilment of requirements for a Master's Degree in Project Management (MPM)

Dear Academic Tutor,

With this letter, I confirm that I have reviewed the Final Graduation Project (FGP) submitted by MPM candidate Leiber Yah entitled "Project Management Plan to Design and Build a 20KW Solar System for Residential Use."

I hereby confirm that Mr. Yah has made all the corrections to the FGP as I have advised as philologist. It is my professional opinion that the document meets the literary and linguistic standards in written English as required for the MPM by the Universidad para la Cooperación Internacional.

Warm Regards,



Stephanie Flores Bradshaw

Philologist