UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)

PROJECT MANAGEMENT PLAN FOR THE CONSTRUCTION OF CENTRALIZED WASTEWATER TREATMENT SYSTEM AT UN HOUSE, JUBA, SOUTH SUDAN

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DEDICATION

I dedicate this project to my loving wife, Mrs. Nirmala Lama (Chand), who forever admired, stayed calm, and remained very supportive in my academic career. Her passion encouraged me to pursue my passions, structural engineering and project management, to contribute to my nation in its proper development of infrastructures and the society I serve.

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This project has provided one of the most fulfilling experiences to me as a student at the University for International Cooperation pursuing a master's in project management. I want to thank all the support gained from the team members of UCI for providing the required information throughout the course.

I am indeed grateful to all individuals who helped me in the journey to complete my project, including Professor Carlos Benes and all the lecturers who influenced my academic growth during my study at UCI.

Moreover, I am thankful to God, who guided me to enroll at UCI with this program. Finally, I want to express my humble gratitude to UCI for pursuing an MPM degree online and realize its importance in my professional and personal life.

ABSTRACT

This document aims to develop a project management plan to construct a centralized wastewater treatment system at UN House, Juba, South Sudan, to improve the wastewater facilities and meet the United Nations environmental standards. The facilities have already been worn out, passed their useful life, and overloaded because of the continuous increase in population in the UN camp without expanding the wastewater treatment facilities.

The final product of this project consists of a document with a project management plan for the construction of a centralized wastewater treatment system. This project management plan consists of the final deliverables of the project that correspond to the subsidiary management plans: scope, schedule, cost, quality, resources, communications, risks, procurements, and stakeholder management plans. Each subsidiary plan contains the processes, procedures, and tools necessary to manage the project in a structured and appropriate way. An analytical problem-solving methodology and the guidance provided by the project management institute are adopted to carry out this project development plan.

Furthermore, it can be helpful for project managers to use this plan referring to its quality management and quality control to ensure the structures are built and equipment are installed based on standard design and specifications. It is essential to complete the project within the allocated budget and the scheduled timeframe. In contrast, delaying any projects will add a significant amount to the project cost. Therefore the action plan provided here will help the project managers for the successful completion of the project.

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ABBREVIATIONS AND ACRONYMS

UNMISS – United Nations Mission in South Sudan

JMEC – Joint Monitoring and Evaluation Commission

RPF – Regional Force Protection

ES – Engineering Section

PS – Procurement Section

SRSG – Special Representative of Secretary-General

DMS – Director of Mission Support

CSD – Chief Service Delivery

CE – Chief Engineer

SE – Sate Engineer

CAS – Conventional Activated Sludge

PMI – Project Management Institute

PMP – Project Management Plan

RBS – Risk Breakdown Structure

WBS – Work Breakdown Structure

RCC – Reinforcement Cement Concrete

UCI – Universidad Para La Cooperation International

BS – British Standards

COY – Company

BOQ – Bill of Quantity

CPR – Contractor’s Performance Report

EXECUTIVE SUMMARY

Wastewater management has been a problem for all United Nations Missions worldwide. Similarly, in United Nations Mission in South Sudan also had some wastewater management systems, including concrete septic tanks, metal soak pits with lifting pumps, some wastewater treatment plants, and oxidation ponds. However, during wastewater assessment in December 2018, it was observed that the Wastewater was partially treated with Wastewater overflowing through Oxidation ponds into a nearby stream that carries Wastewater away from the UNMISS compound. This water is not safe for the community people around this stream water. Therefore, it was advised to solve this problem immediately through short-term and long-term action plans. The short-term action plan included cleaning and expansion of Oxidation ponds, increase the frequency of sewage trucks. At the same time, the long-term action plan was to establish a centralized wastewater treatment system to treat all Wastewater produced at UN House within the premises.

A meeting with the director of mission support (DMS), Mission Environmental Action Plan (MEAP) was discussed. UNMISS was recorded as a significant wastewater risk in UN House, Tomping, Malakal, Bentiu, and Renk. The DMS has suggested that the chief engineer provide a detailed project plan and prioritize wastewater management above all other issues and challenges. The critical triggers for significant wastewater risks were septic tank overflow events and wastewater discharge to the stream. Wastewater management was one of the biggest challenges to UNMISS even though it spends a large amount of money on honeysucker contracts every year. The existing project management approach was not sufficient to successfully deliver the product in such a critical situation.

This study aimed to create a project management plan useful as guidelines for successfully executing the projects. In this regard, UNMISS has some unsuccessful project experiences in the past because of an inefficient project management approach. Therefore, developing and using a project management plan will help define the project objectives, success criteria, and resource

allocation. In addition, UNMISS also needs to manage the Wastewater professionally to fulfill Wastewater and environmental management needed at UN House.

The general objective of this project was to develop a project management plan to build a centralized wastewater treatment system to mitigate the risks from Wastewater within and outside of the UN House premises in Juba, South Sudan. The specific objectives were: to create project charter in order to define key input elements to develop project management plan, to build scope management plan ensuring the project completion successfully, to build schedule management plan to manage the time schedule of the project, to develop cost management plan to ensure the project budget, monitored and controlled, to create quality management plan to ensure the project meets the organization's quality policies and quality requirements, to make resource management plan to identify, acquire and manage required resources for the project, to develop communication management plan to ensure the communication between project manager and its stakeholders, to create risk management plan to increase the impact of positive risks and decrease the effects of harmful threats, to make procurement management plan to develop and administer agreements such as contracts and to develop stakeholder management plan to analyze stakeholder's expectations and their effective engagement.

The analytical and problem-solving methodology was used for the research. The primary source used to gather information were the discussions among stakeholders, meeting minutes, and A Guide to the Project Management Body of Knowledge (PMBOK Guide) Sixth Edition. The data were analyzed to create the components of each subsidiary plan used to develop the project management plan. The project management plan, developed by using PMBOK Guide Sixth Edition, provided a new methodology for the project team to build a detailed project management plan to improve the organization's management of the project. This document can be considered a guideline of the Project Management Plan to implement similar projects in the future.

1. INTRODUCTION

1.1. Background

United Nations Mission in South Sudan was founded in the Republic of South Sudan to support the Government's peace consolidation efforts and stimulate longer-term state-building and economic development. UNMISS also assists the government in exercising its responsibilities for conflict prevention mitigation and resolution protecting civilians. UNMISS also helps the Government develop the capacity to strengthen security, establishing the rule of law and justice sectors in South Sudan.

UNMISS Engineering Section provides support services to UNMISS staff, Military, and police components throughout the country. The engineering section is responsible for construction, infrastructures, and maintenance, including buildings, roads, water and sanitation, environment, power plants, etc. UNMISS Engineering Section has been doing similar construction works for more than ten years in this country; however, this project is unique and new for the mission. At UN House, UNMISS has built about four concrete septic tanks, about eleven metal soak pits with lifting pumps, three wastewater treatment plants, and three oxidation ponds in which Wastewater is pumped and discharged from the septic tanks. However, these septic tanks and soak pits lack the proper design practices and wastewater spillage within the camp. As a result, the Wastewater overflows into the stream passing through the UNMISS camp. After exiting the UNMISS camp, the stream passes through the local community, which is the main risk of getting the local population infected from water-borne diseases and environmental and health hazards.

During wastewater assessment in December 2018, it was observed that partially treated Wastewater overflowing through Oxidation ponds into nearby streams, carrying Wastewater away from the UNMISS compound. This water is not safe for the community people around this stream. Therefore, it was advised to solve this

problem immediately through short-term and long-term action plans. The short-term action plan included cleaning and expansion of Oxidation ponds, increase the frequency of sewage trucks. At the same time, the long-term action plan was to establish a centralized wastewater treatment system to treat all Wastewater produced at UN House within the premises.

Mission Environmental Action Plan (MEAP) recorded UNMISS having a significant wastewater risk in UN House, Tomping, Malakal, Bentiu, and Renk in a meeting with the mission support. The DMS has suggested that the chief engineer provide a detailed project plan and prioritize wastewater management above all other issues and challenges. The critical triggers for significant wastewater risks were septic tank overflow events and wastewater discharge to the stream. Wastewater management was one of the biggest challenges to UNMISS even though it spends a large amount of money on honeysucker contracts every year. The existing project management approach was not sufficient to successfully deliver the product in such a critical situation.

After discussing with the engineering and environmental team, the meeting immediately recommended implementing short-term and long-term action plans. The short-term action plan was cleaning and expanding Oxidation ponds, increasing the frequency of sewage trucks, and introducing lime treatment. The long-term action plan was to establish a centralized wastewater treatment system to treat all Wastewater produced within the UN House by designing the facility, constructing proper septic tanks, conveyance systems, and conventional activated sludge (CAS) systems. The design should consider the current population, future population growth, and water consumption rate. The project will be a stand-alone to fulfill the requirement to mitigate the wastewater risk at UN House.

1.1.1. Statement of the problem

Mission Environmental Action Plan (MEAP) recorded UNMISS having a significant wastewater risk in UN House, Tomping, Malakal, Bentiu, and Renk in a meeting with the mission support. UNMISS is the only mission in Peacekeeping with significant risk from Wastewater.

The DMS communicated to the CE and the Environmental Engineers to develop a mitigation plan with a schedule for Wastewater risks at UN House. She emphasized that we need to take the matter much more seriously, and the issue of Wastewater takes priority above all the other problems and challenges. Although we started improving the Wastewater Conveyance System in Aug 2019, there are still events that trigger significant wastewater risks. Therefore, the engineering section should review the overall project planning for the centralized wastewater management system and communicate to the DMS as part of our plan to eliminate the significant wastewater risk. The critical triggers for significant wastewater risks are the Blackwater discharge, Greywater discharge, Septic/holding tank overflow events, and Septic hydraulic retention times less than 24 hours.

Wastewater management has been one of the biggest challenges to UNMISS even though it has been spending a significant amount of money on honeysucker contracts every year to dispose of the Wastewater to the government dumping sites. However, the project management approach in use is not sufficient to successfully deliver the product of this criticality. Hence, a solid Project Management Plan to be developed to manage the project in a professional way to construct a centralized wastewater treatment system to fulfill wastewater management needs.

1.1.2. Purpose

The purpose of this Final Graduation Project (FGP) is to create a project management plan that will guide the project's execution to maximize the chance of its success.

1.1.3. General objective

To develop a project management plan to build a centralized wastewater treatment system to mitigate the risks from Wastewater within the UN House premises in Juba, South Sudan.

1.1.4. Specific objectives

- To create a project charter to define key input elements to develop a project management plan.
- To develop a scope management plan to ensure that the project includes all the work required to complete the project successfully.
- To develop a schedule management plan to manage the timely completion of the project.
- To develop a cost management plan to ensure the project cost is determined, monitored, and controlled.
- To create a quality management plan to ensure the project meets the organization's quality policies and quality requirements.
- To create a resource management plan to identify, acquire and manage required resources for the project.
- To develop a communication management plan to ensure the project's information needs and stakeholders are met.
- To create a risk management plan to increase the impact of positive risks and decrease negative risks.
- To create a procurement management plan to develop and administer agreements such as contracts, MOAs, POs.
- To develop a stakeholder management plan to analyze stakeholder's expectations and effective engagement.

2. THEORETICAL FRAMEWORK

2.1. Company/Enterprise framework

2.1.1. Company/Enterprise background

United Nations Mission in South Sudan was established in 2011 under Chapter VII of the UN Charter and the Security Council by its resolution 1996 (2011) of 8 July 2011. According to the initial mandate, UNMISS was to support the government of South Sudan in peace, security, long term state-building, and economic development;

Following the political and security crisis that broke out with violence in South Sudan in December 2013, the Security Council approved to increase the overall troop and police strength of UNMISS temporarily. Accordingly, the military forces were increased up to 12,500 personnel, and the police component was raised to 1,323 personnel. UNMISS has various tasks as per the current mandate; they protect civilians, monitor and investigate human rights, create conditions conducive to the delivery of humanitarian assistance, support and implement agreements, and actively participate in and support the work of the JMEC. In addition, the Security Council decided to increase 4,000 troops as a regional protection force (RPF).

The UNMISS is led by the Secretary-General's Special Representative (SRSG), the organization's head. The UNMISS has two Substantive divisions and Mission support. Mission Support Division has three Pillars, Budget and Human Resources, Logistic Service Delivery, and Supply Chain Management. These pillars have several sections and units, and Engineering Section is one of the many other sections under the Logistic Service Delivery Pillar. In addition, the engineering Section has several units, and it provides engineering services to all these UNMISS components, including military, police, and civilian staff throughout the country.

Engineering service includes; building the camps, offices-buildings and accommodation facilities, water sanitation and environment, power generation,

road, airstrips, other infrastructures, and their maintenance throughout the country through in-house resources including civilian and military engineers and materials, and outsourced contractors.

For the development of FGP to create a project management plan for the construction of a centralized conventional wastewater treatment system, only the Engineering Section has been considered an organization. All the mission and vision statements are considered for Engineering Section accordingly. A high-level organizational structure has been provided above the Engineering Section. The detailed organizational structure has been considered only for Engineering Section in United Nations Mission in South Sudan (UNMISS) throughout the mission area/country.

2.1.2. Mission and vision statements

Mission

The main mission is to strengthen the performance and efficiency of the engineering section, manage service delivery in a safe, effective, client-oriented manner and provide timely engineering support to all UNMISS components. Likewise, it manages human resources by strengthening human resource management and occupation efficiency, including gender parity and managing budget by exercising effective budgetary control and prudent financial and budget and improving the working relationship between engineering and all stakeholders, especially procurement, finance, and budget units. In addition, it improves the working environment within the engineering section by improving coordination, performance, monitoring, and reporting of all engineering units. Implement efficiency gains and explore transactional environmental initiatives to reduce UNMISS ecological footprint and enhance occupational health and safety of the engineering team. Effectively managed assets, inventory, and machines compliance with the international public sector accounting standard (IPSAS) standard in the enterprise resource management system (UMOJA).

Vision:

To be a well-organized engineering section and become a center of excellence in skills and innovations. Develop an attitude to attain competency and professionalism by meeting all the UNMISS regularity compliance and practicing UNMISS standard operating procedures (SOPs).

2.1.3. Organizational structure

Under the leadership of the Chief Engineer, UNMISS Engineering Section has two main organizational structures. The one at the headquarters in the capital city in Juba has the Office of Chief Engineer with admin office, senior military staff officer (SSO), Planning and design unit, Engineering operation unit with project management, Engineering budget and contract management unit, Environmental engineering unit, Warehouse and asset management, power generation and electrical unit. These units look after overall engineering requirements throughout the country.

The other organizational structure is in each of the ten (10) states under State/Field Engineer leadership. Every state engineer's office has various units, including the Building maintenance unit, water and sanitation unit, Power generation and electrical unit, Construction and maintenance unit, Facility management unit, Heating and ventilation unit, Military engineering company attachment, Admin and asset management unit. These units implement the projects planned from the engineering headquarters and carry out day-to-day engineering operations, including water supply and sanitation, construction, repair, and maintenance of the offices, accommodations, and other infrastructure facilities. In addition, each state has a Military Staff Officer responsible for coordinating and task the attached military engineering company. Figure 1 provides an Organizational structure overview of the UNMISS Engineering Section.

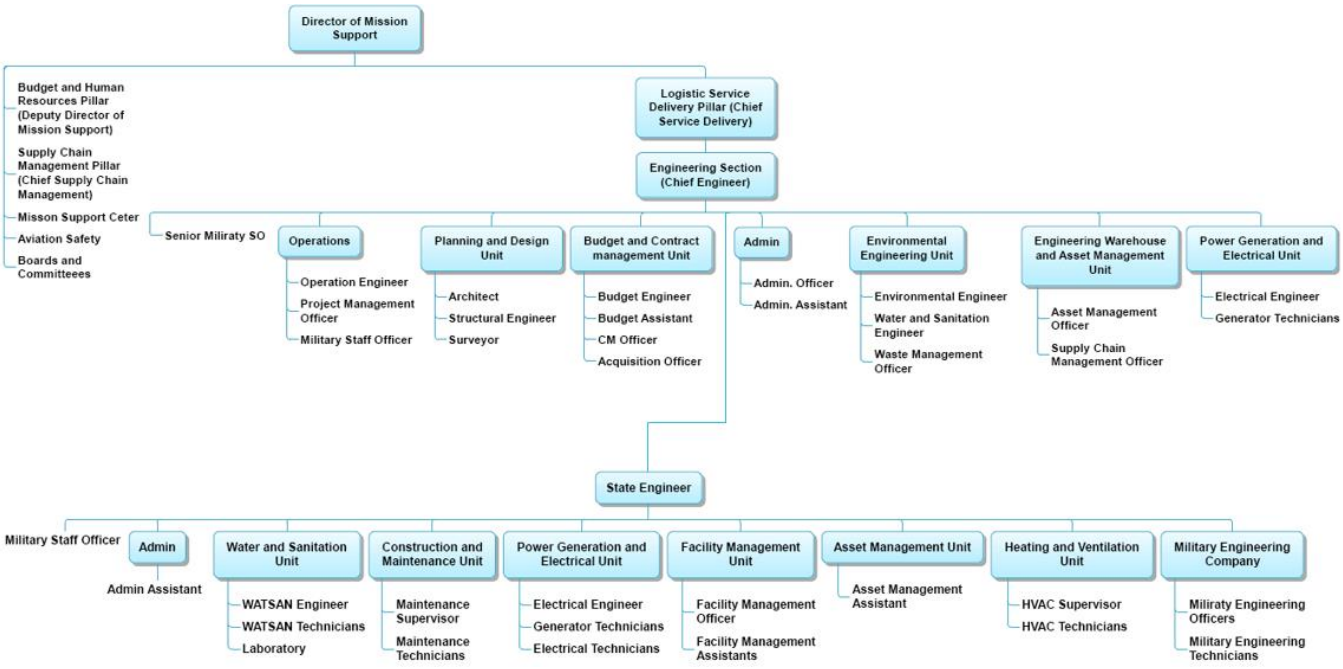


Figure 1 Organizational structure (Source: UNMISS Intranet. 2020)

2.1.4. Products offered

The engineering section offers the following products and services: Planning and designing engineering projects and services, producing project management plans, producing project documents, contract documents including the scope of work (SOW), statement of requirements (SOR), specifications, engineering drawings based on PRINCE2 project management methodology. This section also offers construction services, facility management, fower generation via generators and solar farms, environmental management services, repair and maintenance of roads, buildings, airstrips, and infrastructures. Likewise, it also builds the military, police, and civilian camps, conducting feasibility studies, technical surveys, and laboratory investigations and tests. Similarly, it builds and operates conventional and modern water and wastewater treatment facilities, planning, designing, constructing, and managing waste management facilities. It also supervises military engineering works, outsourced contractors, and manages the engineering contracts.

The development of the Final Graduation Project is to create a project management plan to construct a centralized wastewater treatment system that will provide a professional project management system. The project management plan will help manage the project categorized as the most critical project among many other engineering projects. The product of this project is the centralized wastewater treatment facility which includes septic tanks, conveyance systems, lift stations, recycling systems, etc. The facility will treat all kinds of Wastewater generated in the camp and discharge it into the environment in an environmentally safe manner, following the WHO wastewater management guidelines and standards.
Nhemafuki, A. (2020). Engineering Section Work Plan for the Fiscal Year 2020/21).

2.2. Project Management concepts

2.2.1. Project

A project is defined as a unique set of coordinated activities, having specific start and finish points, implemented by an individual or organization to meet specific objectives within the agreed time, cost, quality, and performance parameters. Lester, Albert. (2014). Project Definition

According to the PMBOK Guide, a project is a temporary endeavor to create a unique product, service, or result. Projects are carried out to fulfill objectives by producing deliverables. An objective has to be defined as an outcome in which the work has to be directed, the purpose has to be achieved, a result has to be obtained, a product has to be produced, or a service has to be performed. A deliverable is defined as a unique and verifiable product, result, or service required to complete a process, phase, or project. Deliverables can be tangible or intangible—Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.) (p.4). Project Management Institute

2.2.2. Project management

As per the PMBOK Guide 6th edition, project management applies skills, knowledge, tools, and techniques to each project activity to meet the project requirements. Project management can be undertaken appropriately using the project management processes identified for the project and their integration. As a result, project management helps organizations to execute projects effectively and efficiently. In addition, effective project management helps individuals, groups, and organizations to meet their business objectives.

2.2.3. Project life cycle

The PMBOK Guide defines the project life cycle as "a collection of generally sequential project phases whose name and number are determined by the control needs of the organization or organizations involved in the project" (PMI, 2004, p. 368). These phases are a collection of logical groupings of related activities that usually culminate in a deliverable. The PMBOK Guide describes their sequence as beginning with an initial phase, followed by a series of intermediate phases, and ending in a final phase. Processes that aid in the completion of the deliverable are performed in each phase.
Sliger, M. (2008). Agile project management and the PMBOK guide. Paper presented at PMI Global Congress 2008 - North America, Denver, CO. Newtown Square, PA: Project Management Institute.

A project life cycle can be defined as the series of project phases in which a project passes from its start point to completion. It provides the basic framework to manage the project. The basic framework applies to all the projects regardless of any specific project work involved. The phases can be iterative, sequential, or overlapping. Projects can be mapped to the generic lifecycle, as shown in below figure 2.

Project life cycles are generally predictive or adaptive. Within a project life cycle, one or more phases are associated with developing the product, service, or result.

These are called a development life cycle. Development life cycles can be predictive, interactive, incremental, adaptive, or a hybrid model.

As per the incremental life cycle, the project's scope is determined at the early stage of the life cycle. Then, the deliverable is produced through a series of repetitions within a scheduled time frame. Phases of this cycle can be overlapped or happen sequentially.
The predictive life cycle is also known as the planning-focused life cycle. In this life cycle, project scope, time, and cost are determined as soon as possible in the project life cycle.

Adaptive life cycles are flexible and agile. The detailed scope is defined and approval before the start of an iteration. The projects can be broken down into sub-projects that can be undertaken individually.

A hybrid life cycle can be a combination of two life cycles to create a new approach. The project elements that have fixed requirements, or are well known, follow a predictive development life cycle. Those elements that are still evolving follow an adaptive life cycle.

The project management team is the one to determine the best life cycle that fits their projects. The project life cycle should be flexible in dealing with the variety of factors present in the project. The project life cycles are independent of product life cycles. Product life cycles are the series of phases representing the evolution of a product—project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.) (p.19). Project Management Institute

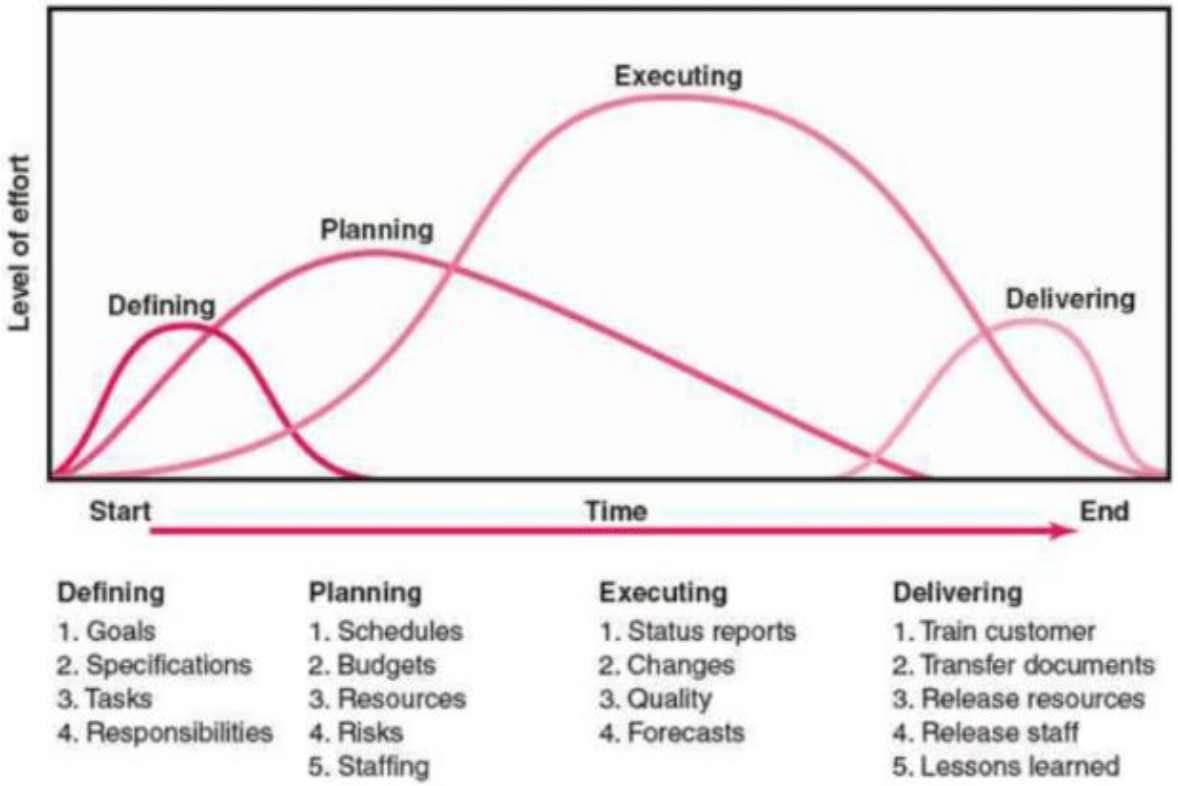


Figure 2 Project Life Cycle. Gray & Larson. (2006). (p6). Stages of the Project Life Cycle.

The project was chosen for FGP; constructing a centralized wastewater treatment system will employ the hybrid life cycle model. Therefore, it has some project elements with fixed requirements and will follow a predictive development life cycle. However, the project also has some still evolving aspects that will follow an adaptive development life cycle.

2.2.4. Project management processes

The project life cycle manages my executing a series of project management activities called the project management processes. Each project management process produces outputs from inputs by using suitable project management tools and techniques. The output of the project management processes can be a deliverable or an outcome. Thus, project management processes are linked logically by the outputs that they produce. Figure 3 below shows an overview of how inputs, tools and techniques, and outputs relate to each other within a process.

Figure 3 Example Processes: Inputs, Tools & Techniques, and Outputs. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.) (p.22). Project Management Institute.

A Project Management Process Group can be defined as a logical grouping of project management processes to achieve specific project objectives. Project process groups are independent of project phases; they can be divided into the following five groups.

Initiation Process Group:

The initiation process group is the start of the project, defining the project on a broad level. In this phase, a business case is created in the beginning. At this stage, we check whether the project is feasible and can be undertaken. If feasibility testing needs to be done, it has to be completed at this stage.

Planning Process Group:

This phase is an essential part of successful project management and focuses on developing a roadmap that everyone in a team will follow. This phase typically begins with setting SMART and CLEAR goals.

SMART Goals – It helps to ensure that the goals have been thoroughly evaluated. The goals should be measurable, attainable, realistic, specific, and timely.

CLEAR Goals – This method of setting goals helps the goals be collaborative, limits, emotional, appreciable, and refinable.

During the planning process group, the project's scope is defined, and a project management plan is developed. This involves identifying the cost, quality, time to

complete the project, and available resources. Then, the project baselines are established using the scope, schedule, and cost of a project.

At this stage, the roles and responsibilities of the project team and stakeholders are clearly defined to ensure that everyone involved knows his or her accountability.

Execution Process Group:

In this phase, deliverables are developed and completed. This phase starts with a "kick-off" meeting, where the teams involved are introduced to each other, and team members are informed of their responsibilities. The main tasks to complete during this phase are: developing a team, assigning resources, implement project management plans, etc. Then, PM directs and manages project execution and sets up tracking systems, meetings, update project schedule, modify project plans as needed. Even though the project monitoring phase has a different set of requirements, the execution, monitoring, and control processes coincide.

Monitoring and Control Process Group:

In this phase, project progress and performance are measured to ensure that things are happening as per the project management plan. Project managers may use key performance indicators (KPIs) to check if the project is on track. The project manager shall pick two to five of the KPIs to measure the performance of the project. This phase aims to measure if the project is on schedule, within the budget, and meets stakeholder objectives.

Closing Process Group:

This phase occurs after a project. When the project is complete, the project manager often holds a meeting to evaluate what went well in a project and what did not go well to identify project failures. This is helpful to record the lessons learned so that improvements can be made for future projects.

When the project is complete, there may still be few tasks that need to be completed. Together with the contractor, the project manager will need to create a project punch list of things that needs to be done. After rectifying the punch list, the project manager and the contractor should do the final inspection before processing the handover of the project.
Kate, Eby (2018). Demystifying the 5 Phases of Project Management. Smartsheet.

To create the project management plan to construct a centralized wastewater treatment system that will employ all these processes. The project employs in-house resources, including human (Military and civilian) and physical resources, and outsources contractors. Since it has diverse resources, having a project management plan and effective management of all the project management processes is crucial. Figure 4 shows an overview of the project processes group, and figure 6 shows the process groups interact in a phase or project

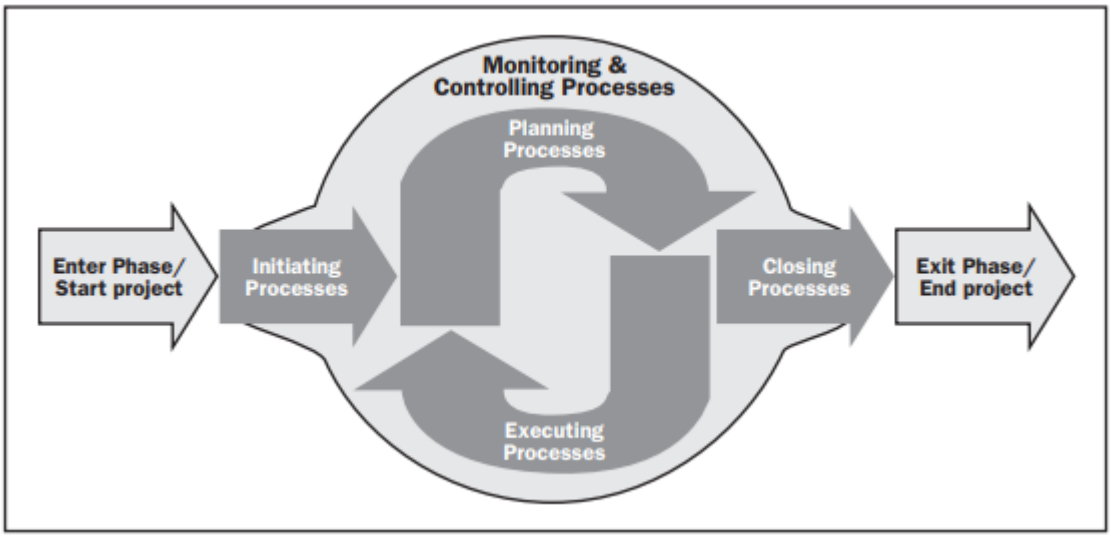


Figure 4: Project Management Process Group. Project Management Institute. (2008). A Guide to Project Management Body of Knowledge (PMBOK Guide) (4th ed.). Project Management Institute.

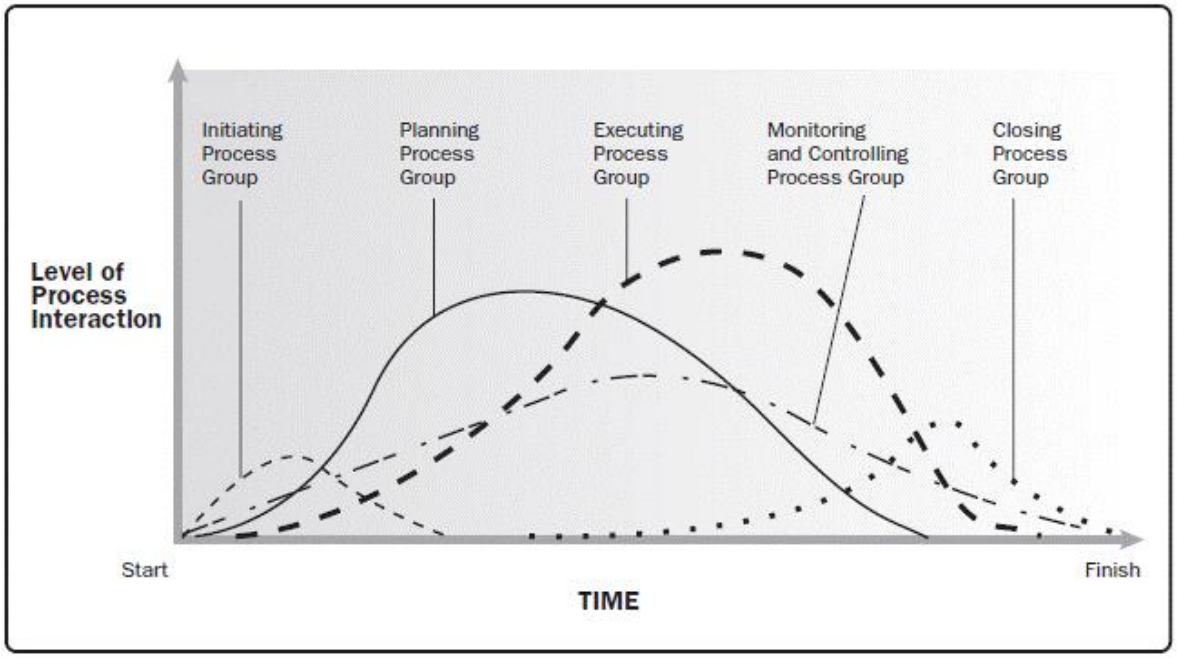


Figure 5: Project Management Process Group. Project Management Institute. (2008). A Guide to Project Management Body of Knowledge (PMBOK Guide) (4th ed.). Project Management Institute.

During the development of FGP to create the project management plan to construct a centralized wastewater treatment system, the first two process groups, namely: Initiating Process Group and Planning Process Group, will be employed. The rest of the three process groups will be used in the later stages as per the sequential progression of the project.

2.2.5. Project management knowledge areas

The project management knowledge area is an area of project management defined by the requirements of the knowledge. It is described in terms of its component processes, practices, inputs, outputs, tools, and techniques. The knowledge areas are defined separately from the project management perspective. The ten knowledge areas identified are used in most projects: Project Integration, Scope, Schedule, Cost, Quality, Resource, Communications, Risk, Procurement, and Stakeholder Management. The ten knowledge areas are described below.
Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.6. Project Integration management:

This knowledge area contains the tasks that hold the overall project together and integrate it into a unified whole.

Develop Project Charter: One of only two processes during the Initiation phase, developing a project charter initiates the project and authorizes the project manager.

Develop Project Management Plan: This is the primary guiding document for the project manager and the result of the planning phase. It is used to ensure a successful outcome of the project. The project management plan is distributed and approved by relevant stakeholders, particularly the project sponsor, and changes are tracked through the log change.

Direct and Manage Project Work: This process encompasses the production of the project's deliverables.

Manage Project Knowledge: Most projects require acquiring additional knowledge, which requires active management to ensure the project finishes on time and within budget.

Monitor and Control Project Work: This process contains the work necessary to monitor the project, perform earned value analysis and project status reports, and identify potential project changes.

Perform Integrated Change Control: In this process, the change control is carried out. This process manages project changes whether the project requires change request forms, project sponsor approvals, and another administrative or basic changelog.

Close Project or Phase: This process contains all the required tasks to close the project or the project phases.

Hartnry, Jon. (2016). The Ten PMBOK Knowledge Areas. Project Engineer.

Figure 6 shows the overview of project integration management.

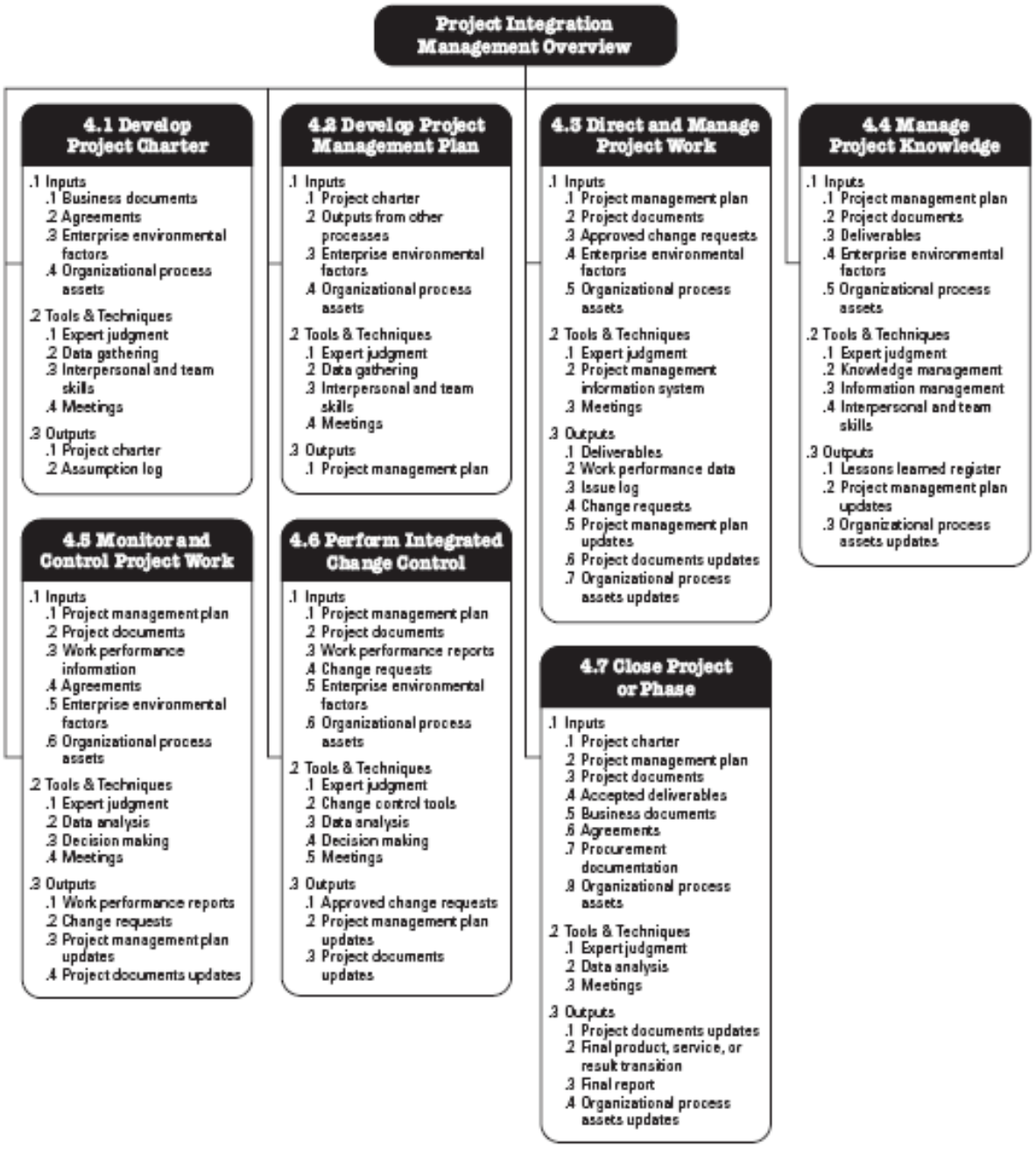


Figure 6: Project Integration Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.7. Project Scope management:

In the project scope, we define the features and function of the project. Project scope is a detailed outline of all aspects of a project that includes all activities, resources, timeline, deliverables, risks, and constraints. Project scope management is the process that helps to determine and document the project goals, tasks, deliverables, timeline, and budgets.

Plan Scope Management: It is the part of the project management plan where we create a scope management plan that documents how the project scope will be defined, validated, and controlled. It gives direction to the project manager on how the scope will be managed throughout the project.

Collect Requirements: The detailed requirements of the final product or service are collected as per the stakeholder's needs at this stage. Collect requirements helps to create a project scope.

Define Scope: A scope statement is created based on the project charter. It is the process where a detailed description of the project and product is developed.

Create WBS: Project deliverables are subdivided into smaller components to manage the project in a better way. This process is called creating a work breakdown structure (WBS). WBS can be made in either a graphical or tabular form.

Validate Scope: The process of formalizing acceptance of the completed project deliverables is known as validating scope. This process is performed regularly throughout the project.

Control Scope. It is the process of monitoring the project's status and product and regularly revising to manage the changes if required. Controlling scope makes sure that the scope baseline is maintained throughout the project.

Product scope: The features and functions that describe a product, service, or result are known as product scope.

Project scope: The work performed to produce a product, service, or result with the specified features and functions is known as the project scope.

Figure 7 indicates an overview of the project scope management.

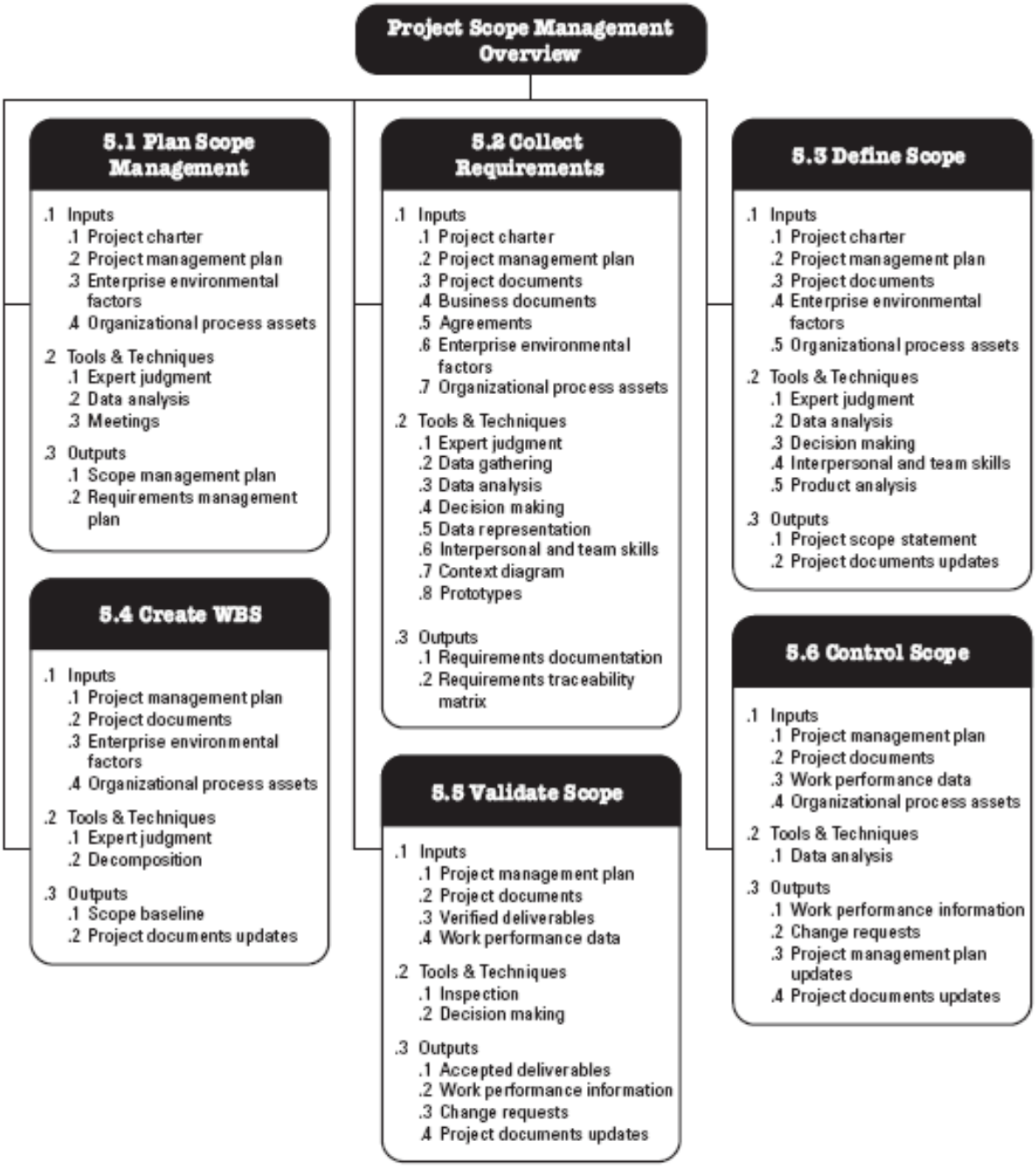


Figure 7: Project Scope Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.8. Project Schedule management:

The process required to manage the timely completion of the project is known as project schedule management.

Plan Schedule Management: The schedule management plan gives detailed guidelines by establishing the policies, procedures. It provides the direction on when the project will be delivered when milestones will be achieved. It also includes information such as how the schedule will be created, monitored, what tools will be used, how the schedule will be managed throughout the project and the circumstances under which it will be changed.

Define Activities: The project is divided into various tasks. Defining activities is the method to identify the specific tasks to be performed to produce the product. In this process, work packages decompose into tasks or activities. The process of defining activities is different from Creating WBS within the Scope Management knowledge area; however, they are generally the same in practice.

Sequence Activities: The process of identifying the relationship between various project tasks and sequencing them so that it makes it easy to produce deliverables. These relationships in between tasks can be of Finish to Start (FS), Finish to Finish (FF), Start to Start (SS), and Start to Finish (SF).

Estimate Activity Durations: In this process, the time required to complete individual activities is determined along with the estimated resources. It gives the amount of time each activity will take to complete. The cumulative sum of the time required for all the activities gives the project duration.

Develop Schedule: After knowing the sequence, duration, and resource required for each activity, a schedule is produced. Various tools and techniques create a project schedule, such as network analysis, critical path method, resource optimizing, etc.

Control Schedule: In this process, monitoring the status of the project to adjust and update the project schedule and managing the changes to the schedule baseline has to be done.

Figure 8 gives an overview of project schedule management.

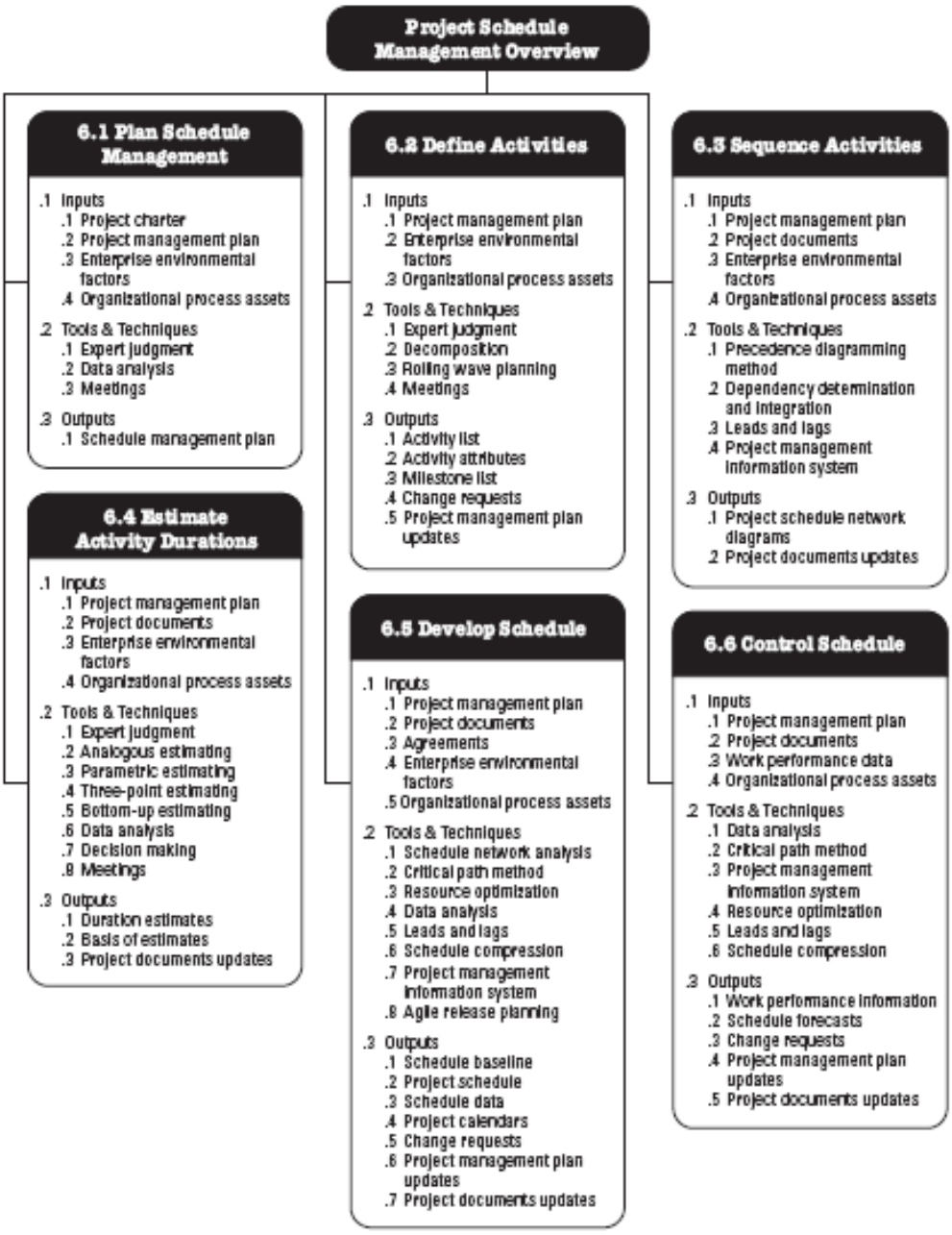


Figure 8: Project Schedule Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.9. Project Cost management:

Project budget is one of the essential parts of the project. Cost management of the project is planning, estimating, budgeting, funding, managing, and controlling the costs of the project to ensure that project can be completed within the approved budget.

Plan Cost Management: The process where the methodologies on how the project cost will be estimated, budgeted, funded, managed, and controlled are explained. This will work as guidelines and direction on cost management throughout the project.

Estimate Costs: This is the process of estimating the approximate cost of each task, taking into account the resources, labor, materials, equipment, and any other item of the cost necessary to complete the task. Various methods of estimating, including parametric, bottom-up, three-point, data analysis, are the techniques to estimate and cost each item.

Determine Budget: This is the process of rolling up the cost of each task into an overall project budget to establish the cost baseline. The cost baseline is the approved project budget based on the time phase; this includes contingency reserves but excludes management reserves.

Control Costs: This is the process of monitoring the project's status to update the project cost. Earned value analysis is performed regularly in certain intervals to determine the project status at various points of time. This process is also maintained throughout the project.

Figure 9 provides an overview of the project cost management processes.
Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

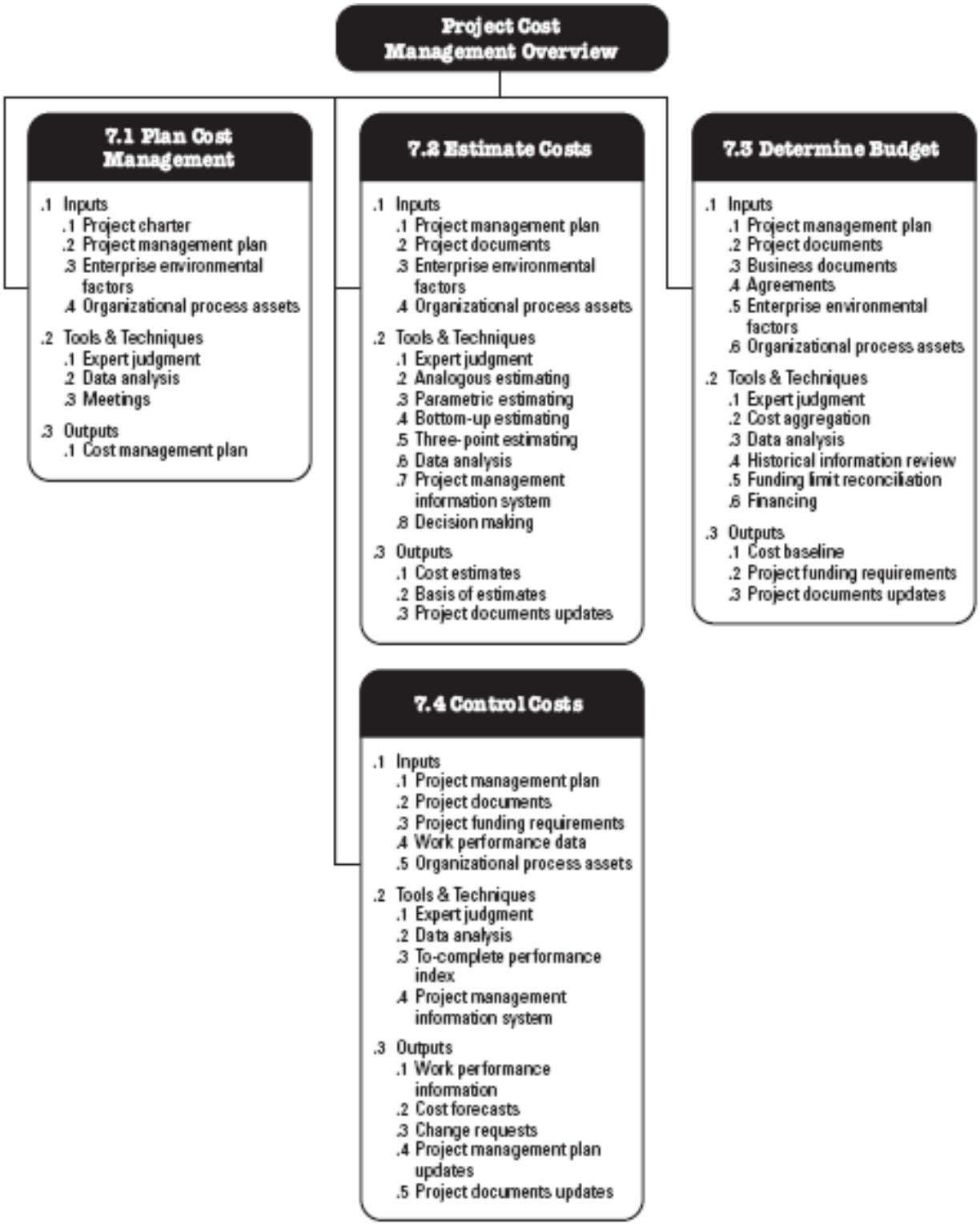


Figure 9: Project Cost Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.10. Project Quality management:

Quality is one of the triple constraints of Time, Cost, and Quality. Therefore, when there is a requirement for better quality, need for more time or cost. Due to this integral nature of the quality of the project's deliverables, the level of the quality requirement should be established during project planning and specified in the project management plan.

Plan Quality Management: It is the process where the quality level or standards for the project and each of its deliverable is identified. We should mention how quality will be managed and verified throughout the project in quality management; this will include the requirement of the codes, specifications, standard procedures, statement of requirements, etc., that is expected for the project.

Manage Quality: The process that translates and implements a quality management plan to the project and its deliverables ensures that the quality parameters are met, standard processes are followed. In addition, tests are conducted as required throughout the project as per the quality management plan.

Control Quality: In this process, the standard procedures, tests, and deliverables are inspected to ensure they conform to the quality standards as per the requirement by conducting regular monitoring.

Quality and grade are not the same concepts. Quality as a delivered performance or result is "the degree to which a set of inherent characteristics fulfill requirements" (ISO 9000).
Grade as a design intent is "a category assigned to deliverables having the same functional use but different technical characteristics." The project manager and project team are responsible for managing the trade-offs associated with delivering quality and grade levels. While a quality level that fails to meet quality requirements is always a problem, a low-grade product may not be a problem.

For example:

It may not be a problem if a suitable low-grade product (one with a limited number of features) is of high quality (no obvious defects).

It may be a problem if a high-grade product (one with numerous features) is of low quality (many defects).

Figure 10 provides an overview of the project quality management processes.

Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

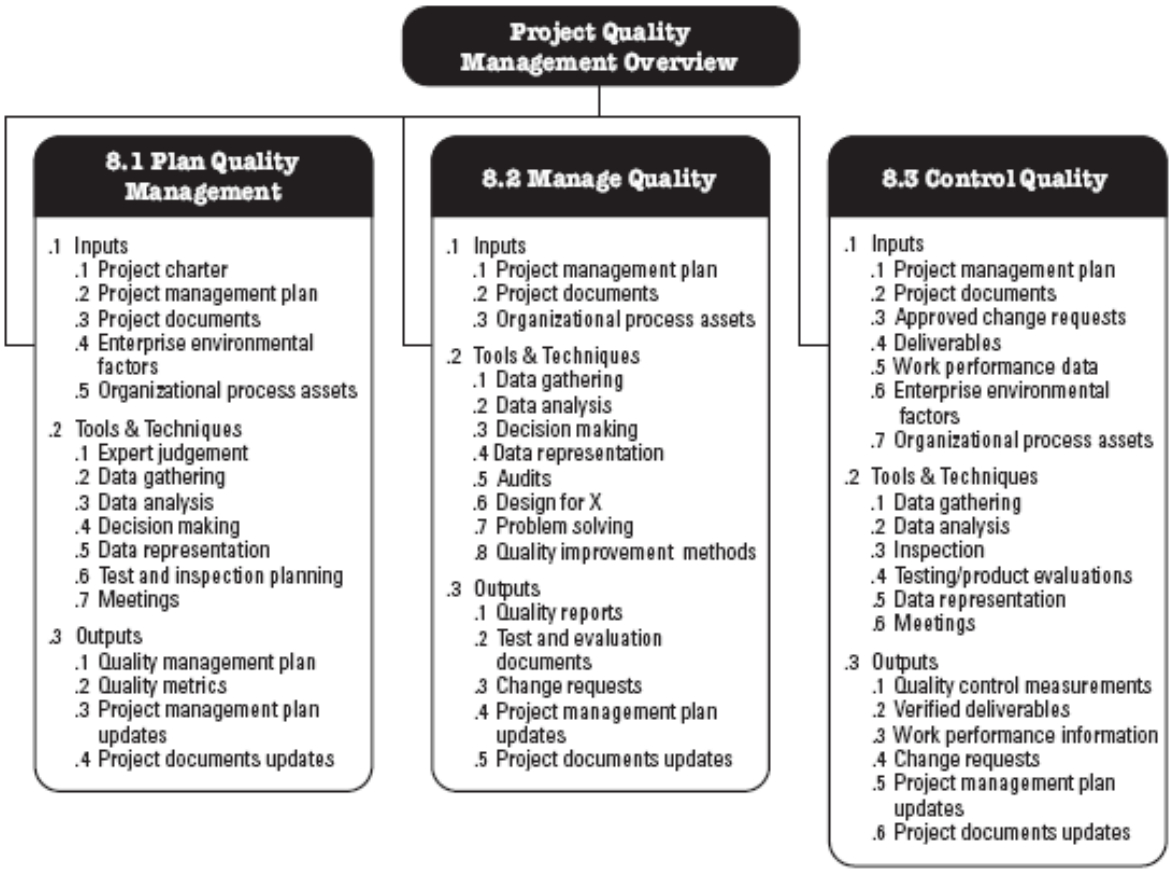


Figure 10: Project Quality Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.11. Project Resource management:

The project team is one of the essential factors in the success of a project. If we have a good team, there will be a high probability of having a successful project. Project resource management is the process of estimating resources, acquiring the right resources, ensuring team satisfaction, and tracking team performance.

Plan Resource Management: This is when we define how to estimate, acquire, manage and utilize physical resources and human resources. Human Resource Management Plan provides guidelines on roles and responsibilities required by the project and how they fit within the project structure.

Estimate Activity Resources: It is the process of estimating human and other physical resources, including machines and equipment required to complete the project successfully.

Acquire Resources: This is the process of obtaining the required resources for the project. This process makes sure that the estimated necessary resources are available in quantity needed at the right time and place.

Develop Team: The process of providing training or orientation to develop the necessary competencies of the team to complete the project. Creating the team environment and interaction between team members should also be actively managed to succeed.

Manage Team: The process of engaging the project team effectively, tracking their performance, providing feedback, and resolving the issues actively to enhance their performance and optimize project performance.

Control Resources: This process provides the guidelines that ensure that physical resources are assigned and allocated to the project are available as planned. The planned resources against the actual use of resources are

monitored, and their performance is evaluated to ensure optimum productivity of the project. Hartnry, Jon. (2016). The Ten PMBOK Knowledge Areas. Project Engineer. Figure 11 provides an overview of Project Resource Management.

Figure 11: Project Resource Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.12. Project Communication management:

Developing a communications plan is essential to keep all stakeholders "in the loop" throughout the project and communicate early and often when unexpected issues occur. Regular communication with stakeholders is a critical factor that allows stakeholders to be satisfied even when unexpected changes happen

Plan Communications Management: This is the process of identifying the regular communication requirements of each stakeholder, such as progress updates, progress reports, any issues, changes, etc., and developing an appropriate approach and the procedures to plan for project communication activities.

Manage Communications: Manage communication is the efficient and effective flow of information between the project team and the stakeholders by timely collection, distribution, storage, managing, monitoring, and decomposing the project information. Manage communication includes effective communication, choice of appropriate technologies, methods, and techniques to accommodate the changing needs of stakeholders and the project.

Monitor Communications: Monitor communication is the process that ensures the information needs of the stakeholders as planned. The process is performed throughout the project. Hartnry, Jon. (2016). The Ten PMBOK Knowledge Areas. Project Engineer.

Figure 12 provides an overview of project communication management.

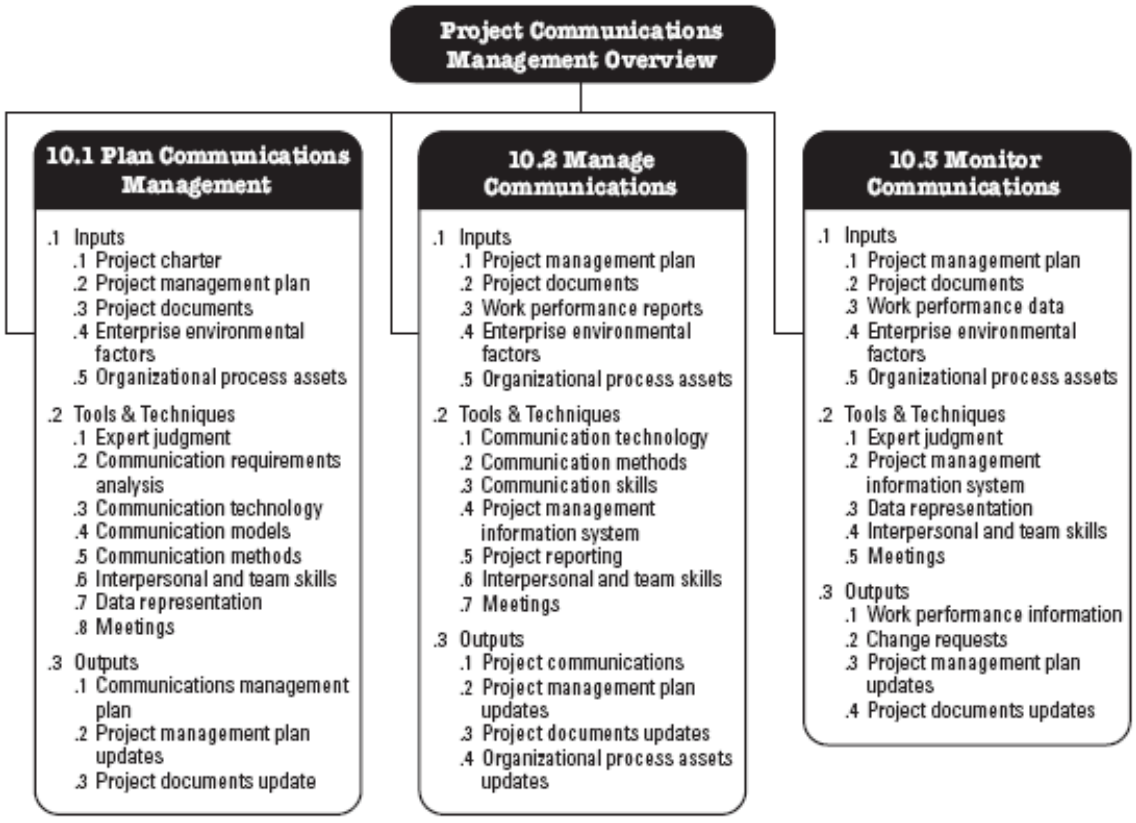


Figure 12: Project Communication Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.13. Project Risk management:

Project risks are rarely identified at the front and analyzed within the project management plan. As a result, project risk management has become one of the most underestimated parts of project management. Project risk management includes the process of planning risks, identifying, analyzing, response planning, response implementing, and monitoring risk on a project. This process ensures the increased impact of positive risks and reduces negative risks to optimize the probability of project success.

Plan Risk Management: In this knowledge area, conducting risk management activities for a project is defined. Planning on how risks will identify, categorize, and

prioritize; how the response will be planned, implemented, and monitored is done to plan risk management.

Identify Risks: This is the process of identifying project risks and their sources. The risk register is maintained to record and document major risks to the project.

Perform Qualitative Risk Analysis: Once the risks are identified, they are categorized and prioritized for further analysis to access their probability of occurrence, impact, other characteristics, and then they are ranked according to priority.

Perform Quantitative Risk Analysis: This is the process where the combined effect of identified project risks is numerically analyzed. The impact of risks to the project budget, schedule, scope, or any other part of the project is analyzed.

Plan Risk Responses: This is developing options of the responses to address individual and overall project risks. For the most critical risks, response options are drafted and shared with all the stakeholders.

Implement Risk Responses: The risk responses identified and agreed upon in the previous step are implemented at this stage.

Monitor Risks: While implementing the project risk responses, they should be monitored regularly to track and verify whether they are implemented as agreed, identify and analyze any new risks, and evaluate them throughout the project.

Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

Figure 13 below shows an overview of project risk management.

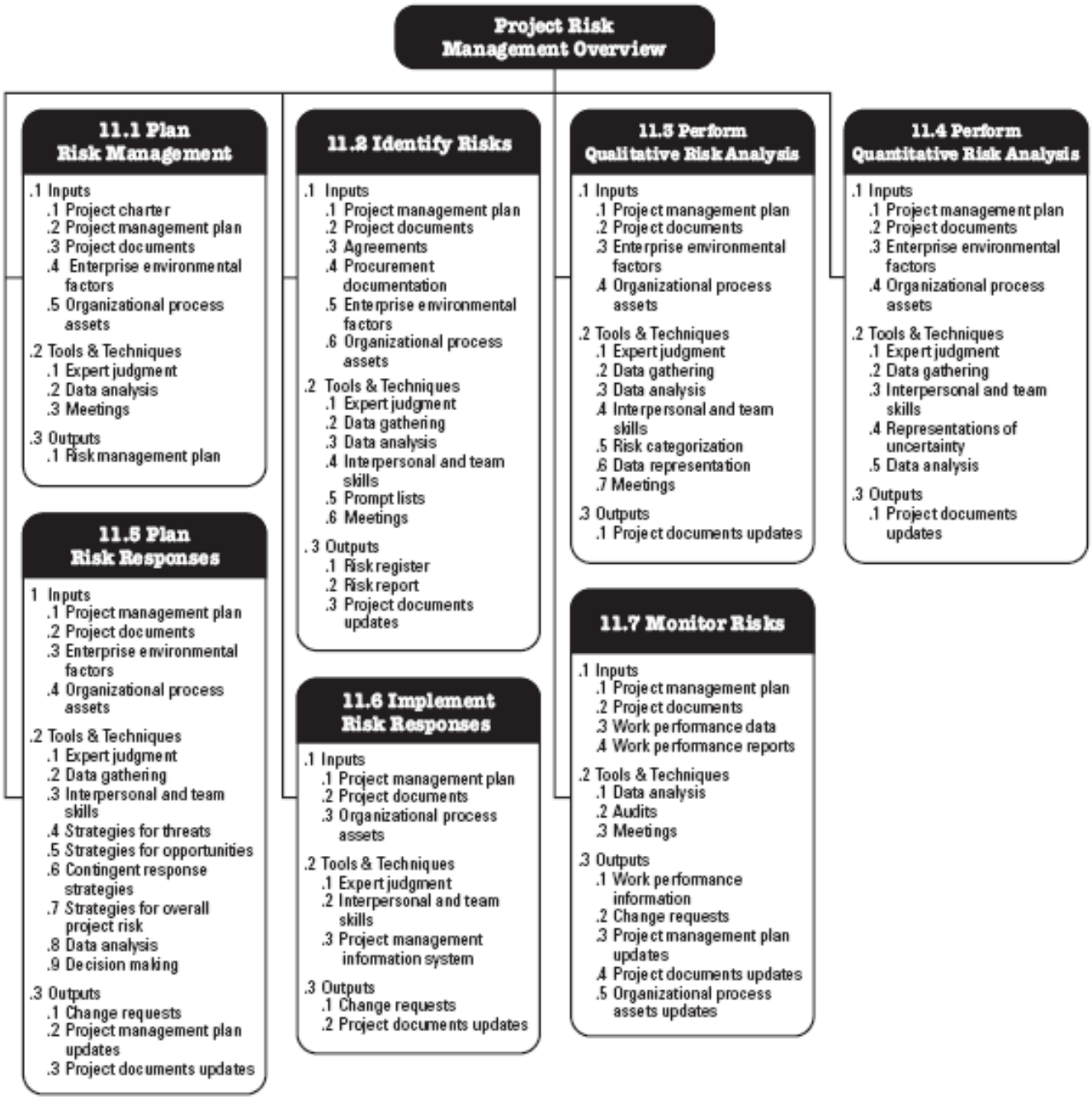


Figure 13: Project Risk Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.14. Project Procurement management:

Project procurement management is the process of acquiring or purchasing the service, product, or results from outside the project team.

Plan Procurement Management: This is the process of specifying the procurement approach, identify the outside procurement needs of the project and parameters under which the contractors will be procured, and identify potential sellers.

Conduct Procurements: Hiring contractors by obtaining responses from various vendors, selecting a seller, and awarding a contract. The process involves producing the statements of work, conditions of contract, requests for proposals, soliciting the responses, and selecting a vendor.

Control Procurements: During the project, execution contractors must manage the procurement relationship and monitor contract performance to provide early warning of any project changes. Hartnry, Jon. (2016). The Ten PMBOK Knowledge Areas. Project Engineer.

Figure 14 provides an overview of project procurement management.

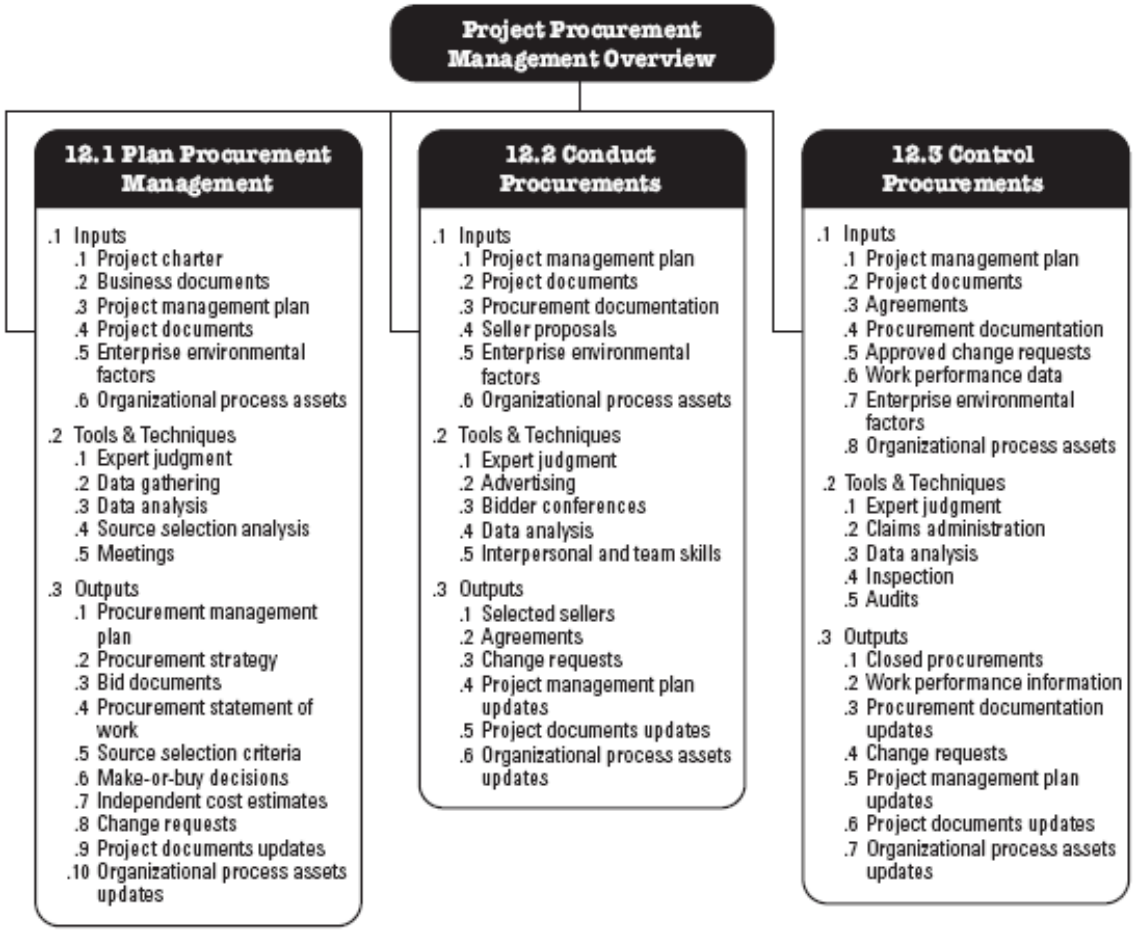


Figure 14: Project Procurement Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

2.2.15. Project Stakeholder management:

There is nothing more important than the project's stakeholders. We could, in theory, declare a project a success if the stakeholders are satisfied, but the project was a disaster. Therefore, the stakeholders should be managed actively, and their concerns should be addressed within the project management plan.

Identify Stakeholders: This is the process at the project initiation phase, where the major and minor stakeholders are identified and their concerns recorded and documented.

Plan Stakeholder Engagement: In this process, listing each stakeholder and developing an appropriate approach to involve stakeholders based on their needs, priorities, interest, and potential impact on the project.

Manage Stakeholder Engagement: The process of engaging stakeholders during project execution to meet their needs, expectations and address the issues is called manage stakeholder engagement.

Monitor Stakeholder Engagement: In this process, during implementation, monitoring stakeholders' relationships and preparing strategies to engage stakeholders should be done. Each stakeholder should be considered to determine if their needs are being addressed and if changes need to make, ensure that they are made. Hartnry, Jon. (2016). The Ten PMBOK Knowledge Areas. Project Engineer.

Figure 15 provides an overview of the project stakeholder management.

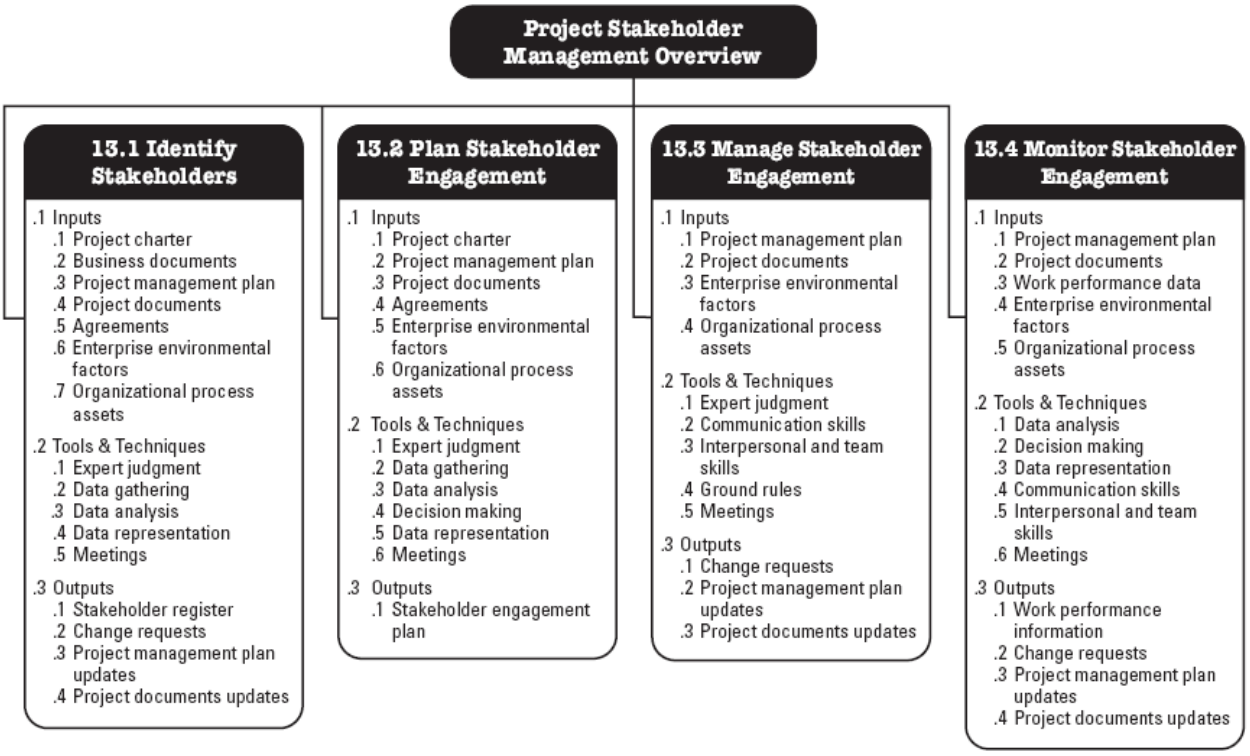


Figure 15: Project Stakeholder Management Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

3. METHODOLOGICAL FRAMEWORK

3.1. Information sources

The source of information can be a person, thing, or place from which information comes, arises, or is obtained. That source might then inform a person about something or provide knowledge about it.
(Definition. https://www.definitions.net/definition/information+source)

3.1.1. Primary sources

Primary sources are the original materials on which other research is based. Primary resources include original written works, poems, diaries, court records, interviews, surveys, original research, and academic journals. Mary, Woodley. CSUN Oviatt Library. https://libguides.merrimack.edu/research_help/Sources

3.1.2. Secondary sources

Secondary sources describe or analyze primary sources; this includes reference materials, dictionaries, encyclopedias, textbooks, and books and articles that interpret, review or synthesize original research work. Mary, Woodley. CSUN Oviatt Library. https://libguides.merrimack.edu/research_help/Sources
Chart 1 below shows the list of information sources for each specific objective.

Chart 1 Information sources (Source: H. Chand. Author of the Study. Nov 2020)

Objectives	Information sources	
	Primary	Secondary
To create a project charter to define key input elements to develop a project management plan.	Meeting minutes, emails, assessment reports, historical information, site assessment, and personal discussion with the direct stakeholders of the project.	PMBOK Guide and internet.
To develop a scope management plan to ensure that the project includes all the work required to complete the project successfully.	Meeting minutes, emails, assessment report, lab test results, personal discussion with stakeholders, site assessment, and information from a similar past project implemented in UN Mission in Lebanon.	PMBOK Guide, test book, and internet.
To develop a schedule management plan to manage the timely completion of the project.	Meeting minutes, emails, and personal discussions with the direct stakeholders.	PMBOK Guide and internet.
To develop a cost management plan to ensure the project cost is determined, monitored, and controlled.	Meeting minutes, emails, site assessment, personal discussion with the stakeholders, and estimating and costing documents.	PMBOK Guide and internet.
To create a quality management plan to ensure the project meets the organization's quality policies and quality requirements.	Meeting minutes, assessment reports, emails, personal discussion with stakeholders, engineering specifications, and already established UNMISS Engineering SORs	PMBOK Guide and internet.
To create a resource management plan to identify, acquire and manage required resources for the project.	Meeting minutes, emails, and personal discussions with stakeholders.	PMBOK Guide and internet.
To develop a communication management plan to ensure the information needs of the project and its stakeholders are met.	Meeting minutes, emails, and personal discussions with stakeholders of the project.	PMBOK Guide and internet.
To create a risk management plan to increase the impact of positive risks and decrease negative risks.	Meeting minutes, emails, and personal discussions with stakeholders.	PMBOK Guide and internet.
To create a procurement management plan to develop and administer agreements such as contracts, MOAs, POs.	Meeting minutes, emails, and personal discussions with stakeholders.	PMBOK Guide and internet.

Objectives	Information sources	
	Primary	Secondary
To develop a stakeholder management plan to analyze stakeholder's expectations and effective engagement.	Meeting minutes, emails, and personal discussions with stakeholders.	PMBOK Guide and internet.

3.2. Research methods

Research methods are defined as the strategies, processes, or techniques utilized to collect data or evidence for analysis to understand a topic better. There are different types of research methods that use other tools for data collection. Research methods. University of Newcastle Library guides. https://libguides.newcastle.edu.au/researchmethods

3.2.1. Analytical method

In this method, the tools used to address these complex issues are based on analytical approaches developed in the scope of the operations research discipline to resolve complex project management issues.

Operations Research and Enterprise Systems. (Jan 2020). Research Gate. (https://www.researchgate.net/publication/337899569_Combining_Machine_Learning_and_Operations_Research_Methods_to_Advance_the_Project_Management_Practice/citations)

The analytical research attempts to establish why it is that way or how it came to be. Thus, it usually concerns itself with cause-effect relationships.

Prof. Yang. Basic Concepts of Research in Economics. California State University. (https://www.csus.edu/indiv/y/yangy/145ch1.htm)

3.2.2. Problem-solving `method

Problem-solving is the mental process of analyzing a situation, learning what options are available, and choosing the alternative to get desired outcome or some other selected goal.

Problem Solving. Nature Research. https://www.nature.com/subjects/problem-solving.

Chart 2 below shows the list of research methods for each specific objective.

Chart 2 Research methods (Source: H. Chand. Author of the Study. Nov 2020)

Objectives	Research methods	
	Analytical method	**Problem-solving method**
To create a project charter	This approach will be employed by using the information received from the sources identified in objective 1 in Chart 1 to make the decisions while creating the project charter.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.
To develop a scope management plan.	This approach will be employed by using the information received from the sources identified in objective 2 in Chart 1 to make the decisions while developing a scope management plan.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.
To develop a schedule management plan.	This approach will be employed by using the information received from the sources identified in objective 3 in Chart 1 to make the decisions while creating the project charter.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.
To develop a cost management plan.	This approach will be employed by using the information received from the sources identified in objective 4 in Chart 1 to make the decisions while creating the project charter.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.
To create a quality management plan.	This approach will be employed by using the information received from the sources identified in objective 5 in Chart 1 to make the decisions while creating the project charter.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.
To create a resource management	This approach will be employed by using the information received from the sources identified in objective 6 in Chart 1 to make	This approach will be employed by analyzing a situation, learning what options are available, and choosing the

Objectives	Research methods	
	Analytical method	**Problem-solving method**
plan.	the decisions while creating the project charter.	alternative to get the desired outcome.
To develop a communication management plan	This approach will be employed by using the information received from the sources identified in objective 7 in Chart 1 to make the decisions while creating the project charter.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.
To create a risk management plan.	This approach will be employed by using the information received from the sources identified in objective 8 in Chart 1 to make the decisions while creating the project charter.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.
To create a procurement management plan.	This approach will be employed by using the information received from the sources identified in objective 9 in Chart 1 to make the decisions while creating the project charter.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.
To develop a stakeholder management plan.	This approach will be employed by using the information received from the sources identified objective 10 in Chart 1 to make the decisions while creating the project charter.	This approach will be employed by analyzing a situation, learning what options are available, and choosing the alternative to get the desired outcome.

3.3. Tools

The definition of a tool provided by Merriam-Webster's collegiate dictionary (1996) is something (as an instrument or apparatus) used in operating or necessary in the practice of a vocation or profession (Merriam-Webster Inc., 1996). Project management tools are aids to assist an individual or team effectively organize work and manage projects and tasks, such as templates, charts, software programs. Chart 3 below shows the list of tools used for each specific objective.

Chart 3 Tools (Source: H. Chand. Author of the Study. Nov 2020)

Objectives	Tools
To create a project charter.	Project charter, meeting minutes, stakeholders engagement, and expert judgment.
To develop a scope management plan.	Scope management plan template, Requirement traceability matrix, Requirement documentation template, Work breakdown structure generator, Meetings, and Expert judgment.
To develop a schedule management plan.	The schedule management plan, Microsoft project professional 2013, Activity list, meeting minutes, and Expert judgment.
To develop a cost management plan	Cost management plan template, Microsoft excel worksheet, Estimating and costing template, Meetings, expert judgment.
To create a quality management plan.	Quality management plan template, Quality checklist, Control chart, Flowchart, Pareto chart, Scatter diagram, Meetings, Expert judgment. Non-conformance report template.
To create a resource management plan.	A resource management template, resource list template, team assignment template, Microsoft project professional 2013, meetings, Expert judgment.
To develop a communication management plan.	A communication management plan template, Communication channel template, Communication matrix, Meetings, and Expert judgment.
To create a risk management plan.	Risk management plan template, Risk register, Meetings.
To create a procurement management plan.	Procurement management plan template, Expert judgment, Data gathering, Meetings, Contractors performance evaluation templates, Evaluation criteria template, Memorandum of understanding (MOU) template, Purchase Order (PO) template, Low-value acquisition (LVA) template.
To develop a stakeholder management plan.	Stakeholder management plan template, Stakeholder register template, Stakeholder analysis chart and Microsoft Excel worksheet.

3.4. Assumptions and constraints

An assumption is what we believe to be true. These are circumstances that are expected during your project's life cycle. We make assumptions based on our experience or the information available in our hands. Assumptions may or may not

be true. Sometimes, they can be true, and sometimes they can be false, and it may affect the project, which adds risk to the project.

The PMBOK Guide recognizes six project constraints: scope, schedule, quality, budget, resources, and risk. Among these constraints, scope, schedule, and budget are known as triple constraints. These constraints are defined at the initial stage of the project. A constraint can be categorized into two types: business constraints and technical constraints.

Business constraints: Business constraints depend on the state of the organization. These are high-level constraints and usually defined when the project starts, such as time, budget, resources, etc. Changes to these constraints are rare, and the project management team must abide by these constraints.

Technical Constraints: Technical constraints limit the design choices for the projects. They are fixed, and any change to the technical specifications can affect the project planning.

Constraints and assumptions are an essential part of the project. These constraints and assumptions need to be identified, controlled, and monitored throughout the project. An assumption is a condition that we think to be true, and a constraint is a limitation on a project. Assumptions need to be analyzed, while constraints need to be identified throughout the project lifecycle. Intelligent management of assumptions and constraints is necessary to minimize obstructions to complete a project. Chart 4 below shows the list of assumptions and constraints used for each specific objective.

Fahad, Usmani. (2020). Assumptions and Constraints in Project Management. PM Study Circle.

Chart 4 Assumptions and Constraints (Source: H. Chand. Author of the Study. Nov 2020)

Objectives	Assumptions	Constraints
To create a project charter	The project charter will be created before all other subsidiary documents.	Timely completion of the project charter and signing it off is the constraint.
To develop a scope management plan.	Stakeholders have shared all the information required to develop the scope management plan.	Stakeholders are making frequent changes in the scope of the project.
To develop a schedule management plan.	Time allocation to develop a project management plan is sufficient.	A time extension is allowed.
To develop a cost management plan.	The project cost has been calculated in detail and precisely. The budget is allocated for the project.	The budget for the construction of a centralized wastewater treatment system must not exceed the contract amount.
To create a quality management plan.	The quality management plan will identify the technical, operational, organizational, and managerial quality requirements.	We are meeting quality requirement parameters by locally available resources employed, including the military engineering team.
To create a resource management plan.	The organization has sufficient resources to implement the project. The project resource management plan will identify all the resources necessary for the project to complete promptly.	Getting a high-performance team in the local market, getting sufficient materials in the local market, and expected output from the military unit are the main constraints.
To develop a communication management plan	The organization has good communication tools and technology in place to fulfill the communication requirements of the project.	Availability of reliable internet and language due to diverse working environments are the main constraints.
To create a risk management plan.	Sufficient historical information and data are available to identify most of the project risks.	To predict the risks at the initial stage of the project planning due to volatile security situations.
To create a procurement management plan.	The organization's procurement section will process activities promptly and identify the appropriate contractor with expertise in building a wastewater treatment system.	To get contractors on time for an outsourced portion of the project. Also, delay in in-house project activities due to military rotation and COVID situation.
To develop a stakeholder	The stakeholder management plan will identify project stakeholders. Stakeholders	Active participation of stakeholders and delays in the decision-making process

Objectives	Assumptions	Constraints
management plan.	will provide the required inputs.	are the main constraints.

3.5. Deliverables

A deliverable is any unique and verifiable product, result, or ability to perform a service required to complete a process or project. Deliverables are typically the outcomes of the project and can include components of the project management plan.

Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

The deliverables to be developed for the FGP are: project charter, scope management plan, schedule management plan, cost management plan, quality management plan, resource management plan, communication management plan, risk management plan, procurement management plan, and stakeholder management plan, including the associated matrices and templates. Chart 5 below shows the list of deliverables for each specific objective.

Chart 5 Deliverables (Source: H. Chand. Author of the Study. Nov 2020)

Objectives	Deliverables
To create a project charter.	Project charter
To develop a scope management plan.	Scope management plan, Requirement document, and Requirement traceability matrix
To develop a schedule management plan.	Schedule management, Activity list, Schedule network diagram, Schedule in Gantt chart, Resource assignment, and activity duration.
To develop a cost management plan.	Cost management, Project funding requirements, and Cost baseline.
To create a quality management plan.	Quality management plan and Quality requirement templates for lab tests.
To create a resource management plan.	Resource management plan and Resource breakdown structure.
To develop a communication management plan.	Communication management plan and Communication matrix.
To create a risk management plan.	Risk management plan and Risk register.

To create a procurement management plan.	The procurement management plan, Performance evaluation report, Non-conformance template, and Meeting minutes template.
To develop a stakeholder management plan.	Stakeholder register, Stakeholder analysis chart, and Stakeholder management plan,

4. RESULTS

This chapter will be developed with your tutor as part of the tutoring process (not during the graduation seminar).

4.1. PROJECT CHARTER

Creating a project charter, the specific objective one (1), was the first to define the key input elements in developing the project management plan. The project charter was created based on the available project-related documents, contract documents, other relevant information, and analyzing data for wastewater quality tests. The template from PMI was used as a tool to create the project charter.

As per PMPOK, the Project Charter consisted of the project description, objectives, scope, deliverables, assumptions, constraints, preliminary risks, budget, a summary milestone schedule, relevant historical information, identification of the project manager, and the sponsor's authorization.
Figure 16 below shows the Inputs, Tools & Techniques, and Outputs required to develop the project charter.

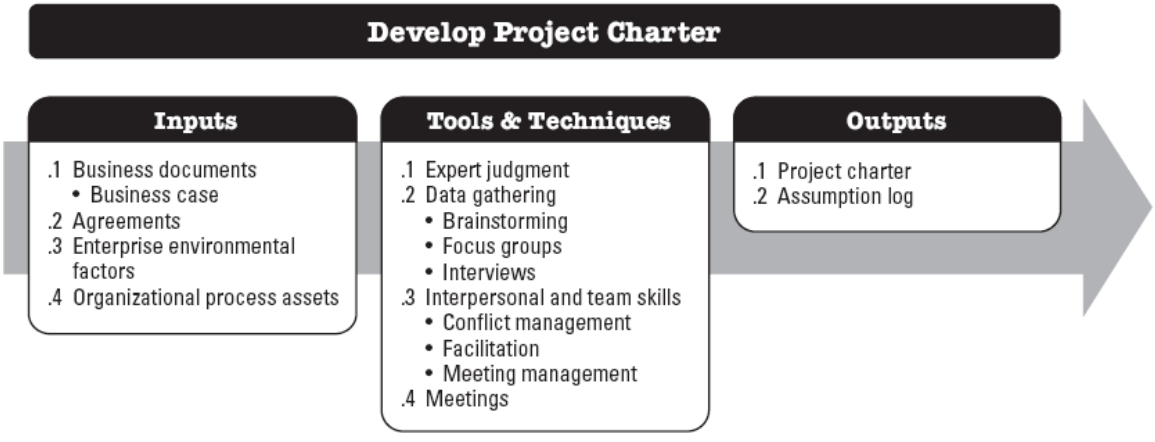


Figure 16: Develop Project Charter Overview. Project Management Institute. (2017). A Guide to Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

UNMISS developed project mandate and business case, employing the PRINCE2 approach; however, there was no further project management plan other than these two documents. After reviewing these documents, contract documents, and SOWs, the project charter was developed below figure 17 as per the PMBOK Guide (6th ed.).

4.1.1. Project purpose

4.1.2. Business case/need

During the wastewater assessment at UN House in December 2018, it was observed that partially treated wastewater overflowing through Oxidation ponds. In addition, the nearby stream carries wastewater from the UNMISS compound close to the Eastern Gate, a negative hydraulic connection that allows untreated/contaminated water to exit UNMISS premises.

After discussion among the engineering and environmental team, it was decided to initiate immediately short-term and long-term action plans. The short-term action plan was cleaning and expanding Oxidation ponds, increasing the frequency of sewage trucks, and introducing lime treatment. The long-term action plan was to establish a centralized wastewater treatment system to treat all wastewater produced within the UN House by constructing septic tanks and Conventional Activated Sludge (CAS) System considering the current and near-future population in the UN House.

4.1.3. Business objective/justification

As a long-term solution, the CAS plant will be a stand-alone project to fulfill the requirement to mitigate the wastewater risk at UN House. The treatment process will extract pollutants, remove toxicants, neutralize coarse particles, and kill pathogens present in the water. The plant will ensure that the quality of water discharged to the environment, such as

discharging into the public water bodies, or for agricultural land or use for dust control of the roads and meets the guidelines set by the DFS waste management policy and UNMISS WATSAN SOP. Following objectives were established:

a. Establish a centralized wastewater treatment facility that generates a positive contribution to the environment, self-sustainable, and creates economic benefits to the organization by recycling and reusing the treated wastewater.
b. To design and build reinforced cement concrete septic tanks in order to achieve sufficient sizes to hold wastewater at least for 24 hours retention time.
c. To design and build a conveyance system to transport wastewater from septic tanks to the CAS plant.
d. To design and build a CAS plant with at least 600cum capacity to treat wastewater generated in the camp, and that is economically feasible to construct and projects a positive image of the United Nations regarding the wastewater management system.

4.1.4. Project description

Stakeholders

Director of Mission Support (DMS)
Chief Service Delivery (CSD)
Chief Engineer (CE)
Head of Environmental Engineering Unit (HEEU)
Environmental Affairs Officer
Field Engineer (FE)
Military Engineering Company
Project Manager (PM)
Contractor
Residents of UN House

Measurable project objective and related success criteria

Following factors have been set to measure the success criteria

Project objectives achieved

Scope achieved and project completed within the assigned cost and time.

Benefits realized

Stakeholder satisfaction

Requirements

The electromechanical equipment must be of the latest technology that should be compatible with the digital monitoring system. In addition, pumps and pipelines to be used must be made of materials with good withstanding strength against salts and metals in the wastewater.

Constraints

The procurement process to implement should not be delayed, and the project should not exceed US$ 838,975.00. The project should be completed in 12 months.

Assumptions

Weather:

It was assumed that the rainy season in Juba remains for six months; therefore, the construction work should be accelerated during dry weather.

It was assumed that there is a high probability of seepage from the wall of the septic tanks or the CAS plant; therefore, waterproofing materials should be used while building reinforced concrete structures under the ground.

Finance and budget:

It was assumed that the project is funded sufficiently, and the project can be implemented with US$ 838,975.00.

Schedule:

It was assumed that the project would be completed in 12 months.

Resources:

It was assumed that organization has a sufficient workforce and required materials for the in-house portion of the project.

Preliminary scope statement

The project includes the following items:

Thirteen septic tanks in various locations

Six conveyance systems

Construction of 600 cum/day capacity, the Conventional Activated Sludge (CAS) System consisting: Activation tank, Clarification tank, Filtration unit, Backwash pumping system, Chlorine dosing station, Clarified concrete water tank, Clarified water pumping system for storage of chlorinated water, Reed bed and Lifting station.

Item excluded:

Wetland

Screening

Grit removal chamber

4.1.5. Project Risks

Performance:

Limited resources for the inhouse portion of the project

Poor performance may lead to poor quality

Schedule:

A longer rainy season may prevent construction works

Delay due to shipping during COVID19 Pandemic

Delay in procurement

Cost:

Rock can be found in the foundation, which may have a cost implication

Occupational health and safety:

Lack of compliance with OHS during construction and installation

4.1.6. Project Deliverables

Project charter

Design of septic tanks

Drawings of septic tanks

Design proposal for CAS plant

Drawings for CAS plant

Contract document

Health, safety, and environmental management plan

Progress reports to the client

Septic tanks constructed

Conveyance system constructed and installed

Conventional Activated Sludge System constructed, installed, and commissioned.

4.1.7. Summary of the Milestone schedule

WBS	Task Name	Start	Finish
1.2.3	Design Completed	Mar 30 '20	Mar 30 '20
1.3.3	Contract signed	Jul 15 '20	Jul 15 '20
1.4.3	Mobilization completed	Jul 15 '20	Jul 15 '20
1.5.1.1.8	Construction of septic tanks completed	Jul 15 '20	Jul 15 '20
1.5.1.2.7	Construction of conveyance system completed	Jul 15 '20	Jul 15 '20
1.5.2.9	Construction of CAS Plant completed	Jul 15 '20	Jul 15 '20
1.7.7	End of the Project	Jul 9 '21	Jul 9 '21

4.1.8. Project Budget

The cost of the CAS project is about US$ 488,975, construction of septic tanks and conveyance systems is about US$ 350,000, which comes to a total of US$ 838,975.

Chart 6 Project Budget Chart (Source: H. Chand. Author of the Study. Nov 2020)

S.N.	Description	Cost (US$)
A	**CAS Plant**	
A.1	Substructure and Foundation	103,010.00
A.2	Activation Tank	130,838.00
A.3	Clarification Tank with Sludge Pump	73,095.00
A.4	Sand Filters and Backwash Pumping System	132,772.00
A.5	Chlorine Dosing Station	10,230.00
A.6	Concrete Water Tank for Clarified Water	14,146.00
A.7	Pumping Station	8,744.00
A.8	Reed bed and Lifting Station	16,122.00
	Total of A	**488,975.00**
B	Septic tanks and Conveyance System	
B.1	Construction of Septic tanks	300,000.00
B.2	Construction and installation of a conveyance system	50,000.00
	Total of B	**350,000.00**
	Total of A+B	**838,975.00**

4.1.9. Project Approval

In order to get project approval, the project centralized conventional wastewater treatment system (CAS) should be completed and commissioned by 09 July 2021 by meeting all the requirements and agreed scope.

4.1.10. Project manager

The project manager is Mr. Hark Bahadur Chand. The assistant project manager is Mr. Kinzang Dorji, will act on behalf of PM in his absence.

Responsibility includes:

Supervision

Coordination

Quality control

Reporting

Monitoring

Payment processing

Substantial completion certificate issuance processing

4.1.11. Authorization

Authorized by: Date:

4.2. SCOPE MANAGEMENT PLAN

After identifying the stakeholders, PM developed the scope management plan. The project charter was used as input, along with the consultation and engagement of the key stakeholders. The design and drawing of a similar project were received in the United Nations Interim Force in Lebanon (UNIFIL). Figure 18 below shows the detail of the scope management process for the project “Construction of Centralized Wastewater Treatment System at UN House, Juba, South Sudan.”

4.2.1. Plan Scope Management:

The construction of a centralized wastewater treatment system at UN House will be designed as a standalone project that can treat all the wastewater produced in the various camps, including military, police camps, and civilian offices and accommodations.

The project's product will have various septic tanks as required, a conveyance system, and a conventional activated sludge system. The distribution of recycled water and any works related to expanding the oxidation ponds will not be the scope of his project.

The project manager, Sponsor, and Team will play key roles in scope management throughout the project. For a centralized wastewater treatment system, scope management will be the responsibility of the project manager. This project's scope has been defined by the scope statement, work breakdown structure (WBS), and WBS dictionary and documented.

Any scope change proposal will be initiated by the Project Manager, Stakeholders, or any member of the project team. All change requests shall be submitted as change orders to the project manager, who will then evaluate the change request. Upon acceptance of the scope change request, it will be processed by the project manager to the project sponsor.

The Project Manager is responsible for approving strictly technical scope changes, whereas the Project Sponsor is responsible for approving scope changes affecting time and costs parameters.

Upon approval of scope changes, the project manager will update all project documents and communicate the scope change to all stakeholders through a change order. After receiving the feedback and input from the project manager and stakeholders, the Project sponsor will decide to accept the final project deliverables and project scope.

The Project Manager, Sponsor, and Team will play key roles in managing the project's scope. Therefore, the project sponsor, manager, and team members must be aware of their responsibilities to ensure that work performed on the project is within the established scope throughout the project's duration.

Requirement Management Plan

The requirements of the project and the product were identifying by collecting the data such as the population, daily water demand, and daily wastewater generation at UN House. The population shall be obtained from the accommodation management unit for the civilians, and the population for uniformed personnel shall be obtained from each troop contribution country (TCCs) through force headquarters. Similarly, the data for daily water demand shall be collected from the day-to-day water delivery/consumption records and monthly water consumption records for civilian and TCC camps. Finally, the volume of the wastewater generated will be calculated based on the standards for wastewater generation.

The requirements will be calculated and documented in the excel file. Based on these data, the number and sizes of septic tanks and the centralized wastewater treatment plant's capacity will be determined. The detailed design of the facility will be designed after consulting with the engineering section of the United Nations

Interim Force in Lebanon (UNIFIL) and by organizing a visit to UNIFIL where a similar facility has been built in Beirut.

The document will be maintained in an excel sheet throughout the project. It will be accessible to the project manager, sponsor, and project team. In addition, the documents will be uploaded to the UNMISS Engineering project server.

4.2.2. Collect Requirements

Chart 7: Calculation of wastewater generation and analysis of the requirements (Source: H. Chand. Author of the Study. Nov 2020)

S. N.	Camp/Contingent	Daily Water Consumption (in Cum)
1	UN House civilian (UNMISS + FAO + UNFPA + UNOPS + Contractors + Day workers = 1100)	500
2	CHINBATT (700)	90
3	NEPBATT (450)	50
4	BANCEC (270)	32
5	NEPFPU (140)	16
6	RWANFPU2 (160)	19
7	RWANFPU3 (160)	19
	Total (2980 users)	**726 cum per day**

Calculation of wastewater generation:

Considering 80% of water consumption to be converted into wastewater, the quantity of wastewater generated becomes 580.80 cum per day.

Chart 8: Design of septic tanks. (Source: H. Chand. Author of the Study. Nov 2020)

Population estimation:

S.No.	Description	Location	Number of Houses Connected	Population	Remarks
1	Septic tank 1	A Cluster	22	44	All houses in A Cluster
			4	8	Part of B Cluster
			23	46	Part of C Cluster/Old Houses
			59	118	Entire E Cluster
			31	62	Part of F Cluster
			43	86	Entire G Cluster
			11	22	Entire H Cluster (UNFPA)
			10	20	Combodian Military Police Accom
			1 Ablution at Crime Investigation Office	30	Near G Cluster
			Sub Total	436	
			10% extra population considering sharing accommodations	44	
			Total	**480**	

S.No.	Description	Location	Number of Houses Connected	Population	Remarks
1	Septic tank 2	B Cluster	17	34	Part of B Cluster
			46	92	Part of C Cluster
			29	58	Entire D Cluster
			10	20	Entire FAO accommodation
			Sub Total	204	
			10% extra population considering sharing accommodations	20	
			Total	**224**	

S.No.	Description	Location	Number of Houses Connected	Population	Remarks
1	Septic tank 3	F Cluster	42	84	Part of FB Cluster
		Engineering Office	1 Ablution	30	Existing Engg Ablution
		Engineering Office	2 Ablutions	60	Planned Engg Ablutions
			Sub Total	174	
			10% extra population considering sharing accommodations	17	
			Total	**191**	
			Grand Total Population in all clusters	**895**	
			Daily water consumption in all cluster	**500000**	**Liters per day**
			Daily water consumption per person per day	**558**	**L/P/P**

Typical design calculation of Septic Tank:

As per British standard, the below formula to calculate the wastewater flow for a septic tank.		
C=A+P(RQ+NS)		
Where,		
C – Capacity of septic tank in liters		
P – Number of People/Users	191	
A – 2000 Liters as constant	2000	Liters
R – Detention period of Sewage in Days	2	Days
Q – Sewage Flow in liter per per person per day (90% of daily water consumption)	558	Liters/Day
N – Number of years in which sludge will be removed	2	years
S – Sludge accumulation in liters per person/year	30	Liters/Person/Year
Simplification of (RQ+NS)	1176.8193	Liters
Now we rewrite the formula as C=A+P(RQ+NS)	227243.21	Liters
Capacity of septic tank in cum=	227.24	Cum
Considering effective depth of septic tank, 2m d=	2.00	M
Area of septic tank A=C/D	113.62	Sqm
Taking ration of L:B = 4:1, L=4B		
B x 4B =A =	113.62	Sqm
B=	5.33	
A=	21.32	
Providing free board of 0.3m, depth of spetic tank D = d+0.3	2.30	
Therefore, final dimention of Septic tank is,		
L=	**21.32**	**Output**
B=	**5.33**	
D=	**2.30**	

So, ideal # of ST and size can be as below		**Adjusted size**
Number of septic tanks	**2**	
L=	**12.00**	
B=	**4.00**	
D=	**2.80**	

Chart 9: Requirement Traceability Matrix. (Source: H. Chand. Author of the Study. Nov 2020)

Requirement Traceability Matrix									
Project Name:			Construction of centralized wastewater treatment system at UN House						
Project Manager:			Hark Bahadur Chand						
Project Description:			Project will consists of construction of RCC Septic Tanks at various locations, Conveyance System and a Conventional Activated Sludge (CAS) System at Former ETHBATT Caamp in UN House						
ID	**WBS ID**	**Description**	**Business Need**	**Project Objectives**	**Deliverables**	**Owner**	**Product Development Stage**	**Architectural / Deign Document**	**Implemented at**
1	1.1	Septic Tank 1	Receive sewage from Cluster A, D, E, G and F Septic Tank	Primary treatment	2 x RCC ST	PM	50% completed	Drawing ST	Cluster A
	1.2	Septic Tank 2	Receive sewage from Cluster B and C	Primary treatment	1 x RCC ST	PM	0% completed	Drawing ST	Cluster B
	1.3	Septic Tank 3	Receive sewage from Cluster F	Primary treatment	1 x RCC ST	PM	50% completed	Drawing ST	Cluster F
	1.4	Septic Tank 4	Receive sewage from Cluster A Septic Tank, All Offices, NEPBATT, CHINBATT ST and RWAN FPU2 ST	Primary treatment	2 x RCC ST	PM	100% completed	Drawing ST	Next to Water point
	1.5	Septic Tank 5 (Equilization Tank)	Receive sewage from All Septic Tanks	Primary treatment	5 x RCC ST	PM	30% completed	Drawing ST	Former ETHBATT Camp
	1.6	Septic Tank 6	Receive sewage from CHINBATT Camp 2	Primary treatment	1 x RCC ST	PM	0% completed	Drawing ST	CHINBATT Camp 2
	1.7	Septic Tank 7	Receive sewage from RWAN FPU 2 Camp	Primary treatment	1 x RCC ST	PM	0% completed	Drawing ST	RWANFPU2 Camp
2	2.1	Conveyance System 1	Pump sewage from ST F to ST A	Sewage Transportation	Pump and Pipeline	PM	100% completed	Drawing ST	From ST in Cluster F to A
	2.2	Conveyance System 2	Pump sewage from ST A to ST Next to Water Point	Sewage Transportation	Pump and Pipeline	PM	100% completed	Drawing ST	From ST in Cluster A to ST Next to Water Point
	2.3	Conveyance System 3	Pump sewage from ST RWANFPU2 to ST at CHINBATT Camp 2	Sewage Transportation	Pump and Pipeline	PM	0% completed	Drawing ST	From ST in RWANFPU2 to ST at CHINBATT Camp 2
	2.4	Conveyance System 4	Pump sewage from ST at CHINBATT Camp 2 to ST next to Water Point	Sewage Transportation	Pump and Pipeline	PM	0% completed	Drawing ST	From ST at CHINBATT Camp 2 to ST next to Water Point
	2.5	Conveyance System 5	Pump sewage from ST at Cluster B to Equilization Tank	Sewage Transportation	Pump and Pipeline	PM	50% completed	Drawing ST	From ST at Cluster B to Equilization Tank
	2.6	Conveyance System 6	Pump sewage from ST next to Water Point to Equilization Tank	Sewage Transportation	Pump and Pipeline	PM	100% completed	Drawing ST	From ST next to Water Point to Equilization Tank
3	3.1	Activation Tank	Receive sewage from EQ Tank	Primary treatment	2 x Activated Tanks	PM	75% completed	CAS Drawings	Former ETHBATT Camp
	3.2	Clarification Tank and Sludge Pumps	Receive sewage from Activation Tank	Primary treatment	2 x Clarified Tanks	PM	50% completed	CAS Drawings	Former ETHBATT Camp
	3.3	Sand Filter and Backwashing Pumping System	Receive water from Clarification Tank	Secondary treatment	1 x Rapid Sand Filteration Unit	PM	50% completed	CAS Drawings	Former ETHBATT Camp
	3.4	Chlorine Dosing Station	Receive water from sand filter	Tertiary treatment	1 x Dosing Station	PM	0% completed	CAS Drawings	Former ETHBATT Camp
	3.5	Clarified Concrete Water Tank for Chlorinated water	Receive treated water after chlorination	Storage	1 x Water Storage tank with 4 chambers	PM	10% completed	CAS Drawings	Former ETHBATT Camp
	3.6	Reed Bed and Lifting Station	To consume sludge and pump excess sludge back to Activation Tank	Consume and Pump	2 x Reed Beds and 1 x LS	PM	0% completed	CAS Drawings	Former ETHBATT Camp

4.2.3. Define Scope

The defined scope is the process of developing a detailed description of the project and project; this includes the components of the project or product, project deliverables, exclusions, and information on how the work will be carried out.

The scope of the project was defined through the collection of the required data to build the facility. Based on the daily water consumption, the volume of the wastewater generation was determined by applying the wastewater generation standards. The locations were identified where septic tanks needed to be built by assessing the existing sewer networks and the holding tanks. Based on the population and the daily wastewater generation, the number and the sizes of septic tanks were designed by applying the engineering standards with a retention time of 24 hours to allow primary treatment to happen in each septic tank. The lift pumps and the conveyance system were designed to pump wastewater from each septic tank to the equalization tanks before being pumped to the CAS Plant.

The CAS plant consists of its five major components: Activation tank, clarification tank, Rapid sand filter, Clarified water storage tank, and Reed beds. The water from the rapid sand filter unit should be chlorinated by installing a dosing pump, and then it is stored in the water storage tanks for further distribution to oxidation ponds and its reuse.

Project scope statement

The project scope statement gives a detailed description of the project, the deliverables, acceptance criteria, and the project exclusion. The project scope statement also includes the works that should not be performed to eliminate unnecessary works outside the project scope.

Project scope description

The project includes 13 x Reinforced concrete septic tanks at eight locations, a 6 x Conveyance system that includes the lift pump and the HDPE pipeline, and a CAS plant of treatment capacity of 600 cum per day. Each septic tank consists of three chambers with maintenance hole covers and installing a lift pump in the third chamber.

Each lift station consists of a pump installed in each septic tank to pump wastewater from each septic tank and transporting the wastewater through HDPE pipe to another septic tank up to the equalization tank and the CAS plant.

The CAS plant consists of the Activation tanks, Clarification tanks with sludge pumps, Rapid sand filter with backwash pumps, Chlorine dosing station with dosing pump and container, Water storage tank to storage chlorinated water, and further distribution to oxidation ponds and for its reuse. Finally, the Reed beds consume the remaining sludge from the Clarification tanks with a sludge pump to pump excess sludge back to the Activation tanks.

Project deliverables

- Requirement collection sheet
- Preliminary EIA report
- Design of septic tanks and conveyance system
- Design of CAS plant document
- Cost estimation document
- BOQ
- Task Order document for Military Engineering COY
- Notice to Proceed for Contractor
- Construction of 13 x RCC Septic tanks
- Construction of 6 x Conveyance system
- Construction of 2 x RCC Activation tanks
- Construction of 2 x RCC Rapid sand filter unit
- Construction of 1 x Chlorine dosing station
- Construction of 1 x RCC water storage tank

- Construction of 1 x Reed bed
- Inspection reports
- Snag list
- Site cleaning report
- Contractor's performance evaluation reports
- Project closure report
- Project management document: Planning, Scheduling, Monitoring, Reporting, Meeting, and Site Management.

Acceptance criteria

All the reinforced cement concrete works for the CAS plant should be built of M35 grade of the concrete with the provision of waterproofing. There should be no defects in the structures, in the pumps, rapid sand filtration unit, dosing system. In addition, the CAS plant should be commissioned and confirmed of its treatment capacity of 600 cum per day. Chart 10 below shows an overview of the project deliverables and their acceptance criteria.

Chart 10: Acceptance Criteria. (Source: H. Chand.Author of the Study. June 2021)

Project Deliverables	Acceptance Criteria
Requirement collection sheet	All the current and future populations should be considered.
Preliminary EIA report	The environmental report should capture the impact of the untreated wastewater on the community while discharging and leaking into the stream.
Design of septic tanks and conveyance system document	Design should be done based on the population and the by using BS codes.
Design of CAS plant document	The treatment capacity of the plant should be 600 cum per day.
Cost estimation document	Estimating and costing of the resources should be prepared by using engineering norms and the current market rates.

Project Deliverables	Acceptance Criteria
BOQ	BOQ should be prepared by using UNMISS standard template with sufficient specification and clarifications.
Task Order document for Military Engineering COY	Standard UNMISS TO template should be used to task the Military Engineering team.
Notice to Proceed for Contractor	A standard template should be used for the contractor for NTP.
Construction of 13 x RCC Septic tanks	M25 Concrete grade should be sued.
Construction of 6 x Conveyance system	UNMISS provided pipes, and sewage pumps should be sued.
Construction of 2 x RCC Activation tanks	M25 Concrete grade should be used. Blowers and aeration system should be installed as per its manual.
Construction of 2 x RCC Rapid sand filter unit	M25 Concrete grade, filtration media, and mechanism should be installed as per its manual.
Construction of 1 x Chlorine dosing station	An in-line dosing system should be used with a dosing tank of sufficient size.
Construction of an RCC clear water storage tank	M25 Concrete should be sued with waterproofing admixtures.
Construction of 1 x Reed bed	M25 Concrete should be used with the appropriate provision of plants as per the design and specifications.
Inspection reports	All the reports should be documented.
Snag list	Snag list should be generated jointly by the client and contractor and should be documented.
Site cleaning report	The site cleaning report should be documented.
Contractor's performance evaluation reports	Intermediate and final CPR reports should be prepared, documented, and submitted to the procurement section.
Project closure report	Project closure report should be prepared with the lesson learned and documented.
Project management document: Planning, Scheduling, Monitoring, Reporting, Meeting, and Site Management	The project management plan and its subsidiary plans should be realistic and documented. Key subsidiary plans such as work schedules should be published at the site office.

Project exclusion

Wetland, Screening, and Grit removal chambers are excluded from the scope. In addition, distribution lines for the treated water for its reuse from the water storage tank to the carwash or any TCC camps are excluded in the scope.

4.2.1. Create WBS

Figure 17: Work Breakdown Structure. (Source: H. Chand. Author of the Study. Nov 2020)

Figure 20 below shows an overview of the work breakdown structure

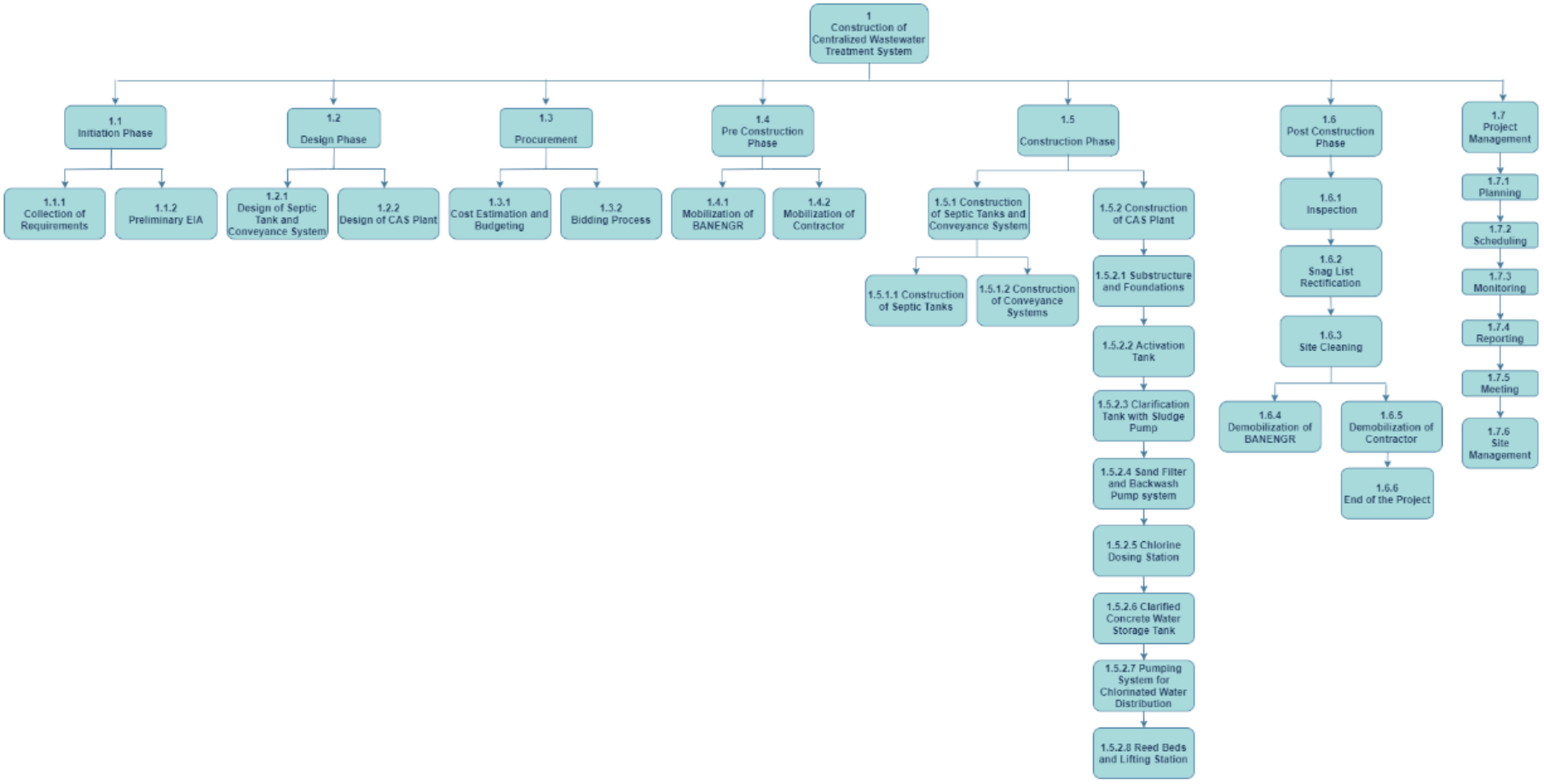


Chart 11: Work Breakdown Dictionary. (Source: H. Chand. Author of the Study. Nov 2020)

WBS	Name of the Task	Detail Description of task	Deliverables	Resources Required
1	Construction of Centralized Wastewater Treatment System at UN House			
1.1	Initiation			
1.1.1	Collect Requirements	Meeting with stakeholders, data collection on population, assessment of existing wastewater infrastructures	Requirement documentation	Requirement templates, teamwork for assessment, information from stakeholders
1.1.2	Preliminary Environmental Assessment	Preliminary environmental assessment (EIA)	EIA report	UN Environmental standard document
1.2	Design			
1.2.1	Design of Septic Tanks and Conveyance System	Design the septic tanks and conveyance based on the population and other design criteria	Design Templates, drawings, and specification	Design codes, Auto CAD, Excel
1.2.2	Design of CAS Plant	Design the CAS plant with its components	Design Template	Design codes, Auto CAD, Design documents from the previous project
1.3	Procurement			
1.3.1	Cost Estimation and Determine Budget	Prepare the detailed estimate of the quantity and determine the cost	Detailed estimate and Abstract of cost sheets	Excel
1.3.2	Bidding process	Prepare SOW, BOQ, Specification, compile the drawings to prepare tender document	Tender document	Tender document templates
1.4	Pre-Construction			
1.4.1	Mobilization of BANENGR	Mobilize engineering team, materials, and equipment	Site handover document	Team, materials, and workforce
1.4.2	Mobilization of Contractor	Contractor mobilizes team, materials, and equipment	Site handover document	Team, materials, and workforce
1.5	Construction			
1.5.1	Septic Tanks and Conveyance System (In-House)			
1.5.1.1	Construction of Septic Tank	Construction of septic tanks	Septic tanks	Excavator, backhoe, loader, dump trucks, concrete mixture, crane, cement, sand aggregates, shuttering, formwork, reinforcement bars
1.5.1.2	Construction of Conveyance	Construction of conveyance system	Conveyance system	Excavator, backhoe, loader, dump

WBS	Name of the Task	Detail Description of task	Deliverables	Resources Required
	System			trucks, pipes, sewage pumps, fittings
1.5.2	CAS Plant (Outsourced)			
1.5.2.1	Substructure and Foundations	Construction work in foundation	Foundation structure	Excavator, backhoe, loader, dump trucks, concrete mixture, crane, cement, sand aggregates, shuttering, formwork
1.5.2.2	Activation Tank	Construction of activation tank	Concrete activation tank	The concrete mixture, cement, sand, aggregates, shuttering, formwork, reinforcement bars
1.5.2.3	Clarification Tank with Sludge Pumps	Construction of clarification tank	Concrete activation tank with sludge pump	The concrete mixture, cement, sand, aggregates, shuttering, formwork, reinforcement bars, sludge pump
1.5.2.4	Sand Filter and Backwashing Pumping System	Construction of sand filter and backwash unit	Sand filter with backwash unit	The concrete mixture, cement, sand, aggregates, shuttering, formwork, reinforcement bars, filter media, backwash pumps
1.5.2.5	Chlorine Dosing Station	Construction of chlorine dosing station	Chlorine dosing station	Chlorine dosing tank, dosing pump
1.5.2.6	Clarified Concrete Water Tank for Chlorinated Filtrate	Construction of clarified water storage tank	Water storage tank	The concrete mixture, cement, sand, aggregates, shuttering, formwork, reinforcement bars
1.5.2.7	Pumping System for Chlorinated Water Distribution	Installation of pumps for distribution system	Pump station	Concrete base, pumps, distribution pipe network
1.5.2.8	Reed Bed and Lifting Station	Construction of Reed beds with the installation of sludge pumps	Reed bed units and pumps	The concrete mixture, cement, sand, aggregates, shuttering, formwork, reinforcement bars
1.6	Post Construction			
1.6.1	Inspection	Inspection of products	Inspection report	Inspection template
1.6.2	Snag List Rectification	Producing snag list	Snag list documentation	Snag list template
1.6.3	Site Cleaning	Removing engineering wastes and Site cleaning	Site cleaning report	Site cleaning checklist

4.2.2. Validate Scope

Under this process, the project manager will verify the project deliverables against the original scope as defined in the scope statement, WBS, WBS dictionary, and the quality parameters. Then, the project should inspect the product and prepare the checklist to verify each element of the product meets the requirements.

The snag list will be produced, and a change request or the request for correction will be made and documented. Once corrections are made, the project will be inspected again for the final inspection for acceptance by the project sponsor. The contractor's performance evaluation report will be prepared and submitted to the procurement section for future record at various project stages

4.2.3. Control Scope

The project manager monitors the status of the project and product scope and manages changes to the scope baseline. The process will be maintained throughout the project. Controlling the project scope ensures that all requested changes and recommended corrective actions are processed through the integrated change control process. Control scope is an important part of the project as an uncontrolled expansion to product or project scope without adjustment to time, cost, and resources is referred to as scope creep. Lessons learned from the earlier project and lessons learned at each project stage should be recorded and documented for future use.

4.3. SCHEDULE MANAGEMENT PLAN

Introduction

Project schedule management is the process that is required to manage the timely completion of the project.

4.3.1. Plan schedule management

Schedule management plan

The project schedule will be prepared by using Microsoft Project 2013. The schedule baseline will be established, a milestone list, activity list, and project network diagram will be produced. The duration of each activity will be calculated based on the parametric estimate method. The schedule will be controlled by monitoring the actual work performance against the schedule baseline, which will help forecast the project completion dates. Adjustment to the schedule will be made accordingly. Any change required will be processed through the project manager to the sponsors for review and approval or rejection by maintaining the change control process.

4.3.2. Define activities

Chart 12: Activity List. (Source: H. Chand. Author of the Study. Nov 2020)

S.N.	WBS	Task Name	Duration	Predecessors	Successors	Resource Names
1	**1**	**Construction of Centralized Wastewater Treatment System at UN House**	**566 days**			
2	**1.1**	**Initiation**	**38 days**			
3	1.1.1	Collect Requirements	15 days		6,7	PM
4	1.1.2	Preliminary Environmental Assessment	7 days		6,7	PM
5	**1.2**	**Design**	**30 days**			
6	1.2.1	Design of Septic Tanks and Conveyance System	15 days	3,4	10	PM and Environment Engineer
7	1.2.2	Design of CAS Plant	30 days	3,4	8	PM and Environment Engineer
8	1.2.3	Design Completed	0 days	7	10	
9	**1.3**	**Procurement**	**105 days**			
10	1.3.1	Cost Estimation and Determine Budget	15 days	6,8	11	Procurement Section
11	1.3.2	Bidding process	32 days	10		Procurement Section
12	1.3.3	Contract signed	0 days			
13	**1.4**	**Pre-Construction**	**15 days**			
14	1.4.1	Mobilization of BANENGR	05 days		20	BANENGR
15	1.4.2	Mobilization of Contractor	15 days		37	Contractor
16	1.4.3	Mobilization completed	0 days			
17	**1.5**	**Construction**	**370 days**			
18	**1.5.1**	**Septic Tanks and Conveyance System (In-House)**	**370 days**			
19	**1.5.1.1**	**Construction of Septic Tank**	**355 days**			**BANENGR**
20	1.5.1.1.1	Construction of septic tank 1	50 days	14	21,29	
21	1.5.1.1.2	Construction of septic tank 2	50 days	20	22,29	
22	1.5.1.1.3	Construction of septic tank 3	50 days	21	23,30	
23	1.5.1.1.4	Construction of septic tank 4	50 days	22	24,31	

S.N.	WBS	Task Name	Duration	Predecessors	Successors	Resource Names
24	1.5.1.1.5	Construction of septic tank 5	50 days	23	25,32	
25	1.5.1.1.6	Construction of septic tank 6	50 days	24	26,33	
26	1.5.1.1.7	Construction of septic tank 7	50 days	25	34	
27	1.5.1.1.8	Construction of septic tanks completed	0 days			
28	**1.5.1.2**	**Construction of Conveyance System**	**370 days**			**Engineering Section**
29	1.5.1.2.1	Construction of Conveyance System 1	15 days	21,20		
30	1.5.1.2.2	Construction of Conveyance System 2	15 days	22		
31	1.5.1.2.3	Construction of Conveyance System 3	15 days	23		
32	1.5.1.2.4	Construction of Conveyance System 4	15 days	24		
33	1.5.1.2.5	Construction of Conveyance System 5	15 days	25		
34	1.5.1.2.6	Construction of Conveyance System 6	15 days	26		
35	1.5.1.2.7	Construction of conveyance system completed	0 days			
36	**1.5.2**	**CAS Plant (Outsourced)**	**341 days**			
37	1.5.2.1	Substructure and Foundations	45 days	15	38	Contractor
38	1.5.2.2	Activation Tank	60 days	37	39	Contractor
39	1.5.2.3	Clarification Tank with Sludge Pumps	45 days	38	40	Contractor
40	1.5.2.4	Sand Filter and Backwashing Pumping System	70 days	39	41	Contractor
41	1.5.2.5	Chlorine Dosing Station	10 days	40	42	Contractor
42	1.5.2.6	Clarified Concrete Water Tank for Chlorinated Filtrate	20 days	41	43	Contractor
43	1.5.2.7	Pumping System for Chlorinated Water Distribution	10 days	42	44	Contractor
44	1.5.2.8	Reed Bed and Lifting Station	21 days	43	47	Contractor
45	1.5.2.9	Construction of CAS Plant completed	0 days			
46	**1.6**	**Post Construction**	**19 days**			
47	1.6.1	Inspection	1 day	44	48	PM
48	1.6.2	Snag List Rectification	7 days	47	49	Contractor
49	1.6.3	Site Cleaning	7 days	48	50,51	Contractor
50	1.6.4	Demobilization of BANENGR	1 day	49		BANENGR
51	1.6.5	Demobilization of Contractor	1 day	49	59	Contractor

S.N.	WBS	Task Name	Duration	Predecessors	Successors	Resource Names
52	**1.7**	**Project Management**	**556 days**			
53	1.7.1	Planning	182 days		54,56,57,58	PM & Sponsor
54	1.7.2	Scheduling	30 days	53	55	PM
55	1.7.3	Monitoring	343 days	54		PM
56	1.7.4	Reporting	343 days	53		PM
57	1.7.5	Meeting	343 days	53		PM
58	1.7.6	Site Management	343 days	53		PM
59	1.7.7	End of the Project	0 days	51		

Chart 13: Milestone List. (Source: H. Chand. Author of the Study. Nov 2020)

WBS	Task Name	Start	Finish
1.2.3	Design Completed	Mar 30 '20	Mar 30 '20
1.3.3	Contract signed	Jul 15 '20	Jul 15 '20
1.4.3	Mobilization completed	Jul 15 '20	Jul 15 '20
1.5.1.1.8	Construction of septic tanks completed	Jul 15 '20	Jul 15 '20
1.5.1.2.7	Construction of conveyance system completed	Jul 15 '20	Jul 15 '20
1.5.2.9	Construction of CAS Plant completed	Jul 15 '20	Jul 15 '20
1.7.7	End of the Project	Jul 9 '21	Jul 9 '21

4.3.3. Sequence activities

It is the process of identifying and document relationships among the project activities. The project schedule network diagram establishes an interrelationship of activities to finish the project scope and achieve the objectives.

Project schedule network diagram

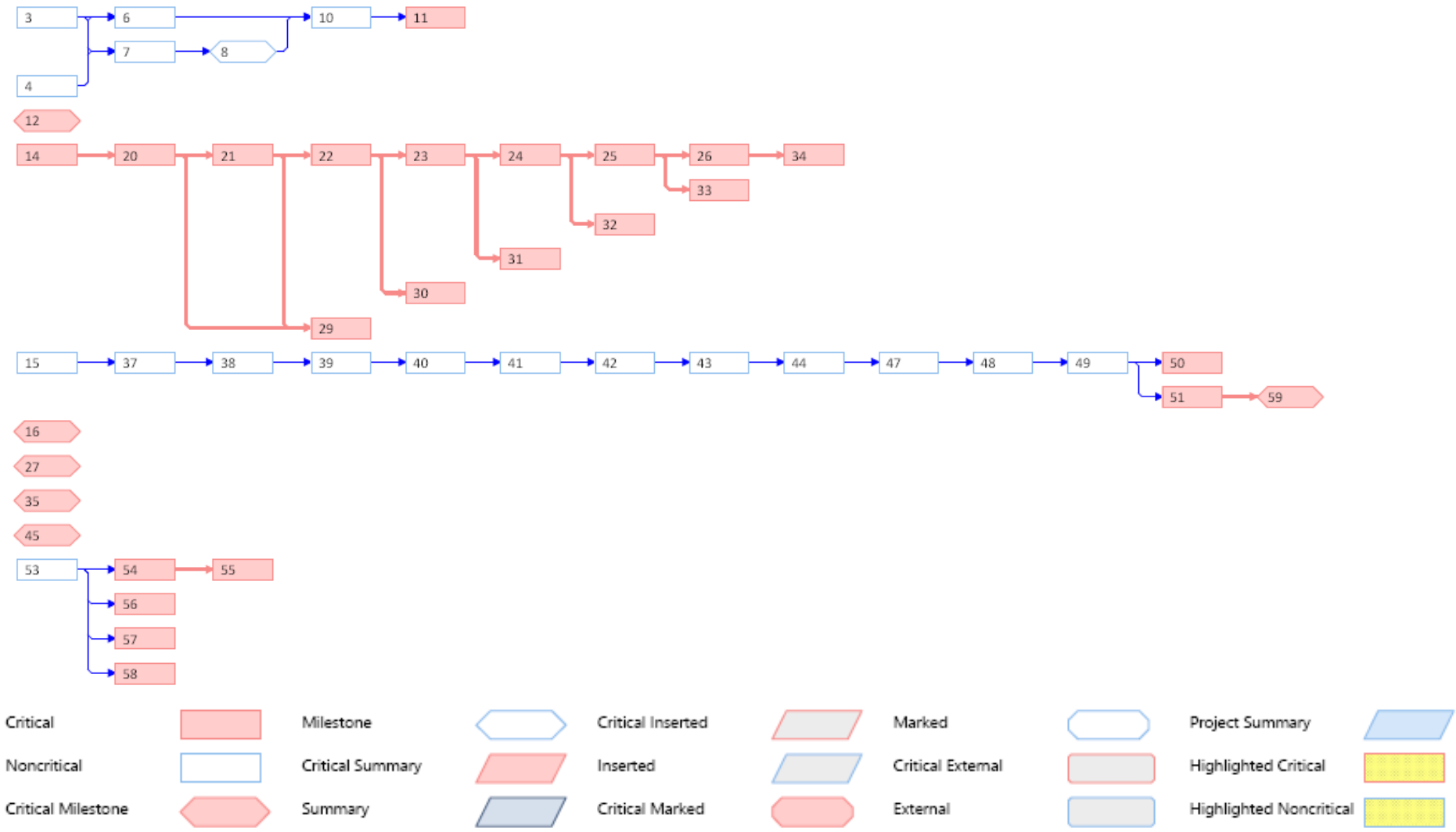


Figure 18: Schedule Network Diagram. (Source: H. Chand. Author of the Study. Nov 2020)

4.3.4. Estimate activity durations

Duration estimate

It is the process where the duration of each activity is calculated. The number of work periods needed to complete each activity with estimated resources is called the duration.

Basis of estimate

In this project, parametric estimating was employed. The duration of each activity was estimated based on the engineering norms, such as the time required to do the site clearance in a square meter, the time required for fixing shuttering work, the time required to cast one cubic meter of the concrete, etc.

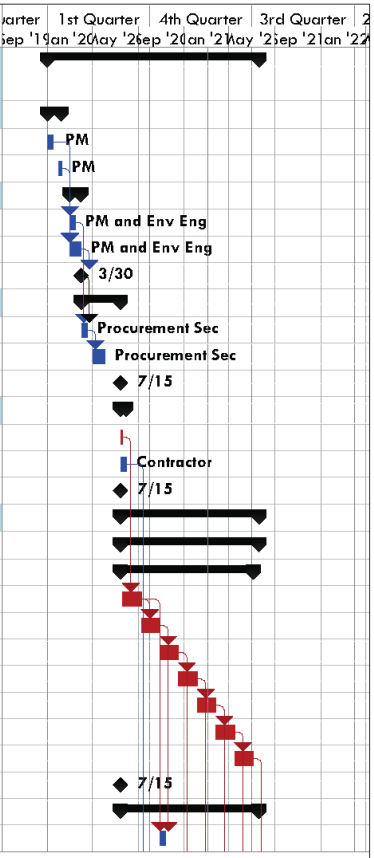
4.3.5. Develop schedule

Schedule baseline

The schedule will produce a project schedule based on the parametric estimating, adjust quickly, and update it to stay on track through the project. The performance of the project is monitored and compared with the help of the project baseline.

Figure 19: Project Schedule. (Source: H. Chand. Author of the Study. Nov 2020)

ID	WBS	Task Name	Duration	Start	Finish	Predecessors	Successors
1	**1**	**1 Construction of Centralized Wastewater Treatment System at UN House**	**566 days**	**Jan 1 '20**	**Jul 19 '21**		
2	**1.1**	**1.1 Initiation**	**38 days**	**Jan 1 '20**	**Feb 7 '20**		
3	1.1.1	1.1.1 Collect Requirements	15 days	Jan 1 '20	Jan 15 '20		6,7
4	1.1.2	1.1.2 Preliminary Environmental Assessment	7 days	Feb 1 '20	Feb 7 '20		6,7
5	**1.2**	**1.2 Design**	**30 days**	**Mar 1 '20**	**Mar 30 '20**		
6	1.2.1	1.2.1 Design of Septic Tanks and Conveyance System	15 days	Mar 1 '20	Mar 15 '20	3,4	10
7	1.2.2	1.2.2 Design of CAS Plant	30 days	Mar 1 '20	Mar 30 '20	3,4	8
8	1.2.3	1.2.3 Design Completed	0 days	Mar 30 '20	Mar 30 '20	7	10
9	**1.3**	**1.3 Procurement**	**105 days**	**Apr 1 '20**	**Jul 15 '20**		
10	1.3.1	1.3.1 Cost Estimation and Determine Budget	15 days	Apr 1 '20	Apr 15 '20	6,8	11
11	1.3.2	1.3.2 Bidding process	32 days	May 1 '20	Jun 1 '20	10	
12	1.3.3	1.3.3 Contract signed	0 days	Jul 15 '20	Jul 15 '20		
13	**1.4**	**1.4 Pre Construction**	**15 days**	**Jul 15 '20**	**Jul 29 '20**		
14	1.4.1	1.4.1 Mobilization of BANENGR	5 days	Jul 15 '20	Jul 19 '20		20
15	1.4.2	1.4.2 Mobilization of Contractor	15 days	Jul 15 '20	Jul 29 '20		37
16	1.4.3	1.4.3 Mobilization completed	0 days	Jul 15 '20	Jul 15 '20		
17	**1.5**	**1.5 Construction**	**370 days**	**Jul 15 '20**	**Jul 19 '21**		
18	**1.5.1**	**1.5.1 Septic Tanks and Conveyance System (In-House)**	**370 days**	**Jul 15 '20**	**Jul 19 '21**		
19	1.5.1.1	1.5.1.1 Construction of Septic Tank	355 days	Jul 15 '20	Jul 4 '21		
20	1.5.1.1.1	1.5.1.1.1 Construction of septic tank 1	50 days	Jul 20 '20	Sep 7 '20	14	21,29
21	1.5.1.1.2	1.5.1.1.2 Construction of septic tank 2	50 days	Sep 8 '20	Oct 27 '20	20	22,29
22	1.5.1.1.3	1.5.1.1.3 Construction of septic tank 3	50 days	Oct 28 '20	Dec 16 '20	21	23,30
23	1.5.1.1.4	1.5.1.1.4 Construction of septic tank 4	50 days	Dec 17 '20	Feb 4 '21	22	24,31
24	1.5.1.1.5	1.5.1.1.5 Construction of septic tank 5	50 days	Feb 5 '21	Mar 26 '21	23	25,32
25	1.5.1.1.6	1.5.1.1.6 Construction of septic tank 6	50 days	Mar 27 '21	May 15 '21	24	26,33
26	1.5.1.1.7	1.5.1.1.7 Construction of septic tank 7	50 days	May 16 '21	Jul 4 '21	25	34
27	1.5.1.1.8	1.5.1.1.8 Construction of septic tanks completed	0 days	Jul 15 '20	Jul 15 '20		
28	1.5.1.2	1.5.1.2 Construction of Conveyance System	370 days	Jul 15 '20	Jul 19 '21		
29	1.5.1.2.1	1.5.1.2.1 Construction of Conveyance System 1	15 days	Oct 28 '20	Nov 11 '20	21,20	



Date: Mar 6 '21

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

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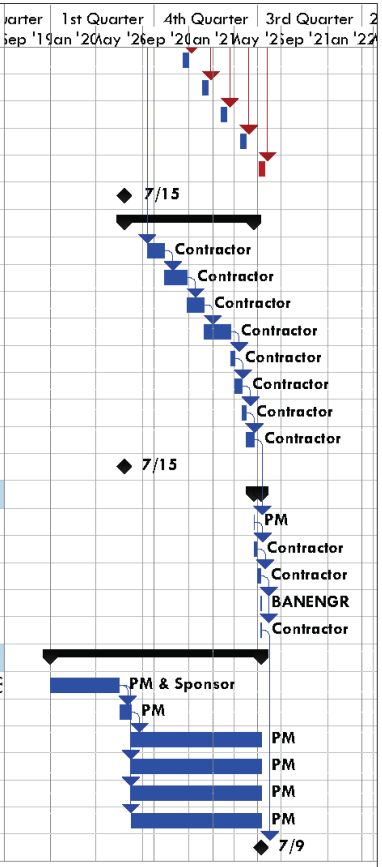
ID	WBS	Task Name	Duration	Start	Finish	Predecessors	Successors
30	1.5.1.2.2	1.5.1.2.2 Construction of Conveyance System 2	15 days	Dec 17 '20	Dec 31 '20	22	
31	1.5.1.2.3	1.5.1.2.3 Construction of Conveyance System 3	15 days	Feb 5 '21	Feb 19 '21	23	
32	1.5.1.2.4	1.5.1.2.4 Construction of Conveyance System 4	15 days	Mar 27 '21	Apr 10 '21	24	
33	1.5.1.2.5	1.5.1.2.5 Construction of Conveyance System 5	15 days	May 16 '21	May 30 '21	25	
34	1.5.1.2.6	1.5.1.2.6 Construction of Conveyance System 6	15 days	Jul 5 '21	Jul 19 '21	26	
35	1.5.1.2.7	1.5.1.2.7 Construction of conveyance system completed	0 days	Jul 15 '20	Jul 15 '20		
36	**1.5.2**	**1.5.2 CAS Plant (Outsourced)**	**341 days**	**Jul 15 '20**	**Jun 20 '21**		
37	1.5.2.1	1.5.2.1 Substructure and Foundations	45 days	Sep 13 '20	Oct 27 '20	15	38
38	1.5.2.2	1.5.2.2 Activation Tank	60 days	Oct 28 '20	Dec 26 '20	37	39
39	1.5.2.3	1.5.2.3 Clarification Tank with Sludge Pumps	45 days	Dec 27 '20	Feb 9 '21	38	40
40	1.5.2.4	1.5.2.4 Sand Filter and Backwashing Pumping System	70 days	Feb 10 '21	Apr 20 '21	39	41
41	1.5.2.5	1.5.2.5 Chlorine Dosing Station	10 days	Apr 21 '21	Apr 30 '21	40	42
42	1.5.2.6	1.5.2.6 Clarified Concrete Water Tank for Chlorinated water	20 days	May 1 '21	May 20 '21	41	43
43	1.5.2.7	1.5.2.7 Pumping System for Chlorinated Water Distribution	10 days	May 21 '21	May 30 '21	42	44
44	1.5.2.8	1.5.2.8 Reed Bed and Lifting Station	21 days	May 31 '21	Jun 20 '21	43	47
45	1.5.2.9	1.5.2.9 Construction of CAS Plant completed	0 days	Jul 15 '20	Jul 15 '20		
46	**1.6**	**1.6 Post Construction**	**19 days**	**Jun 21 '21**	**Jul 9 '21**		
47	1.6.1	1.6.1 Inspection	1 day	Jun 21 '21	Jun 21 '21	44	48
48	1.6.2	1.6.2 Snag List Rectification	7 days	Jun 22 '21	Jun 28 '21	47	49
49	1.6.3	1.6.3 Site Cleaning	7 days	Jul 1 '21	Jul 7 '21	48	50,51
50	1.6.4	1.6.4 Demobilization of BANENGR	1 day	Jul 9 '21	Jul 9 '21	49	
51	1.6.5	1.6.5 Demobilization of Contractor	1 day	Jul 9 '21	Jul 9 '21	49	59
52	**1.7**	**1.7 Project Management**	**556 days**	**Jan 1 '20**	**Jul 9 '21**		
53	1.7.1	1.7.1 Planning	182 days	Jan 1 '20	Jun 30 '20		54,56,57,58
54	1.7.2	1.7.2 Scheduling	30 days	Jul 2 '20	Jul 31 '20	53	55
55	1.7.3	1.7.3 Monitoring	343 days	Aug 1 '20	Jul 9 '21	54	
56	1.7.4	1.7.4 Reporting	343 days	Aug 1 '20	Jul 9 '21	53	
57	1.7.5	1.7.5 Meeting	343 days	Aug 1 '20	Jul 9 '21	53	
58	1.7.6	1.7.6 Site Management	343 days	Aug 1 '20	Jul 9 '21	53	
59	1.7.7	1.7.7 End of the Project	0 days	Jul 9 '21	Jul 9 '21	51	

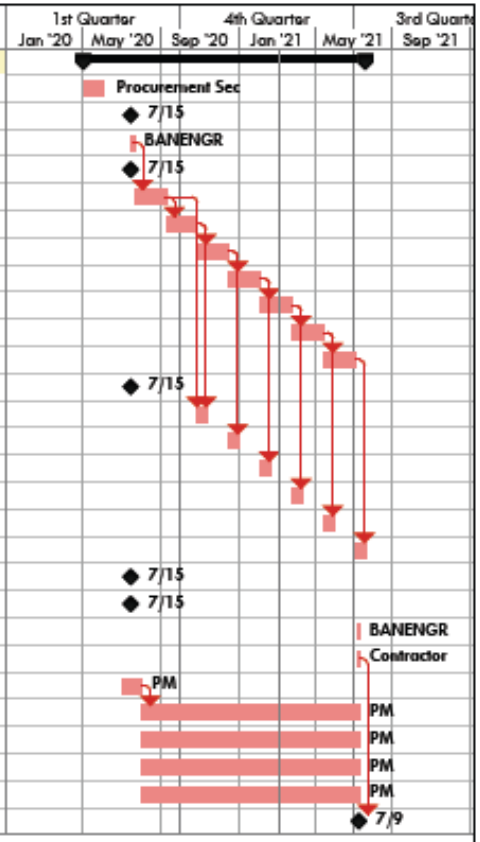


Date: Mar 6 '21

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

Figure 20: Project Critical Task. (Source: H. Chand. Author of the Study. Nov 2020)

ID	WBS	Task Name	Duration	Start	Finish	Predecessors	Successors
		Critical: Yes	**445d**	**May 1 '20**	**Jul 19 '21**		
11	1.3.2	1.3.2 Bidding process	32 days	May 1 '20	Jun 1 '20	10	
12	1.3.3	1.3.3 Contract signed	0 days	Jul 15 '20	Jul 15 '20		
14	1.4.1	1.4.1 Mobilization of BANENGR	5 days	Jul 15 '20	Jul 19 '20		20
16	1.4.3	1.4.3 Mobilization completed	0 days	Jul 15 '20	Jul 15 '20		
20	1.5.1.1.1	1.5.1.1.1 Construction of septic tank 1	50 days	Jul 20 '20	Sep 7 '20	14	21,29
21	1.5.1.1.2	1.5.1.1.2 Construction of septic tank 2	50 days	Sep 8 '20	Oct 27 '20	20	22,29
22	1.5.1.1.3	1.5.1.1.3 Construction of septic tank 3	50 days	Oct 28 '20	Dec 16 '20	21	23,30
23	1.5.1.1.4	1.5.1.1.4 Construction of septic tank 4	50 days	Dec 17 '20	Feb 4 '21	22	24,31
24	1.5.1.1.5	1.5.1.1.5 Construction of septic tank 5	50 days	Feb 5 '21	Mar 26 '21	23	25,32
25	1.5.1.1.6	1.5.1.1.6 Construction of septic tank 6	50 days	Mar 27 '21	May 15 '21	24	26,33
26	1.5.1.1.7	1.5.1.1.7 Construction of septic tank 7	50 days	May 16 '21	Jul 4 '21	25	34
27	1.5.1.1.8	1.5.1.1.8 Construction of septic tanks completed	0 days	Jul 15 '20	Jul 15 '20		
29	1.5.1.2.1	1.5.1.2.1 Construction of Conveyance System 1	15 days	Oct 28 '20	Nov 11 '20	21,20	
30	1.5.1.2.2	1.5.1.2.2 Construction of Conveyance System 2	15 days	Dec 17 '20	Dec 31 '20	22	
31	1.5.1.2.3	1.5.1.2.3 Construction of Conveyance System 3	15 days	Feb 5 '21	Feb 19 '21	23	
32	1.5.1.2.4	1.5.1.2.4 Construction of Conveyance System 4	15 days	Mar 27 '21	Apr 10 '21	24	
33	1.5.1.2.5	1.5.1.2.5 Construction of Conveyance System 5	15 days	May 16 '21	May 30 '21	25	
34	1.5.1.2.6	1.5.1.2.6 Construction of Conveyance System 6	15 days	Jul 5 '21	Jul 19 '21	26	
35	1.5.1.2.7	1.5.1.2.7 Construction of conveyance system completed	0 days	Jul 15 '20	Jul 15 '20		
45	1.5.2.9	1.5.2.9 Construction of CAS Plant completed	0 days	Jul 15 '20	Jul 15 '20		
50	1.6.4	1.6.4 Demobilization of BANENGR	1 day	Jul 9 '21	Jul 9 '21	49	
51	1.6.5	1.6.5 Demobilization of Contractor	1 day	Jul 9 '21	Jul 9 '21	49	59
54	1.7.2	1.7.2 Scheduling	30 days	Jul 2 '20	Jul 31 '20	53	55
55	1.7.3	1.7.3 Monitoring	343 days	Aug 1 '20	Jul 9 '21	54	
56	1.7.4	1.7.4 Reporting	343 days	Aug 1 '20	Jul 9 '21	53	
57	1.7.5	1.7.5 Meeting	343 days	Aug 1 '20	Jul 9 '21	53	
58	1.7.6	1.7.6 Site Management	343 days	Aug 1 '20	Jul 9 '21	53	
59	1.7.7	1.7.7 End of the Project	0 days	Jul 9 '21	Jul 9 '21	51	



Date: Mar 8 '21

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

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4.3.6. Control schedule

Work performance information

The actual work performance will be compared against the schedule baseline. In addition, the start and finish date and duration variance will be calculated at the work package and control account levels.

Schedule forecast

The schedule forecast will be updated based on the project performance in the past and expected performance in the future, which will help plan for corrective actions to minimize the negative impacts on the project.

Change request

Any changes required for the project, such as changes on the design due to site conditions such as rock found in foundations, time extension, etc., will be processed officially through the change control process. Any changes required will be reported through the project manager to project sponsors for review and approval.

4.4. COST MANAGEMENT PLAN

Introduction:

Management of the project cost includes the processes required in planning, estimating, budgeting, financing, funding, managing, and controlling costs of the projects to complete the project within the approved budget.

4.4.1. Plan Cost management

The project cost was prepared by using Microsoft Excel with referring to the project designs and drawings. The cost baseline was established by adding 5% of construction cost as a contingency reserve, and the project budget was established by adding 7% of construction cost. The cost of each activity was calculated based on the parametric estimate method, and the cost will be controlled by monitoring the actual work performance against the cost baseline. The cost baseline will help to forecast the project cost and required adjustment on the cost. Any change required will be processed through the project manager to the sponsors for review and approval or rejection by maintaining the change control process.

4.4.2. Estimate Cost

The cost estimate is the approximate cost of the project to complete. In this project, the entire project was considered in the following way:

In-house part: In this portion of the project, the construction of septic tanks and conveyance systems to be built by mobilizing available resources within the organization. The materials were to be used from the available engineering stores, and any shortfalls to be purchased through existing/established long-term system contracts when necessary. The UNMISS Military Engineering team and UNMISS Engineering team will be utilized as workforce for these in-house activities.

Outsourced part: This includes the construction of conventional activated sludge (CAS) system. This project is a major construction that was decided to build by the

outsourced contractor after going through all the tender and procurement processes.

Operation and Maintenance: This includes operation and maintenance of the plant by using the existing workforce with UNMISS Engineering and adding the required number of additional local individual contractors for the short term. In the long run, there will be a separate outsourced mission-wide contractor for the operation of plant and equipment, including water treatment plants, wastewater treatment plants, pumps, generators, etc. The operation and maintenance of the CAS plant will also be part of that outsourced contractor.

Basis of Estimate

In this project, parametric and expert judgment estimating processes were employed. A parametric estimating method was adopted to construct septic tanks and conveyance systems. The materials and cost of each activity were estimated based on the engineering norms, such as the materials, workforce, tools, and equipment required to do each task. Such as the cost to cast one cubic meter of the concrete work, the cost of the pipeline and pumps to complete the conveyance system, etc.

The construction cost of the CAS plant was estimated using an expert's judgment process for a similar project built in the past. The designs, drawings, and BOQ were received from the United Nations Interim Force in Lebanon (UNIFIL), which was the basis of this cost estimation. Some of the items that were not required for UNMISS were eliminated in the BOQ and design. The construction of the CAS plant was made as a lump sum and design-build contract. The contractor should design the CAS plant of the given capacity provided with the reference drawings and bid their price to complete the facility as required.

4.4.3. Determine Cost

Cost Baseline :

The cost of the project excluding management reserve is called cost baseline.

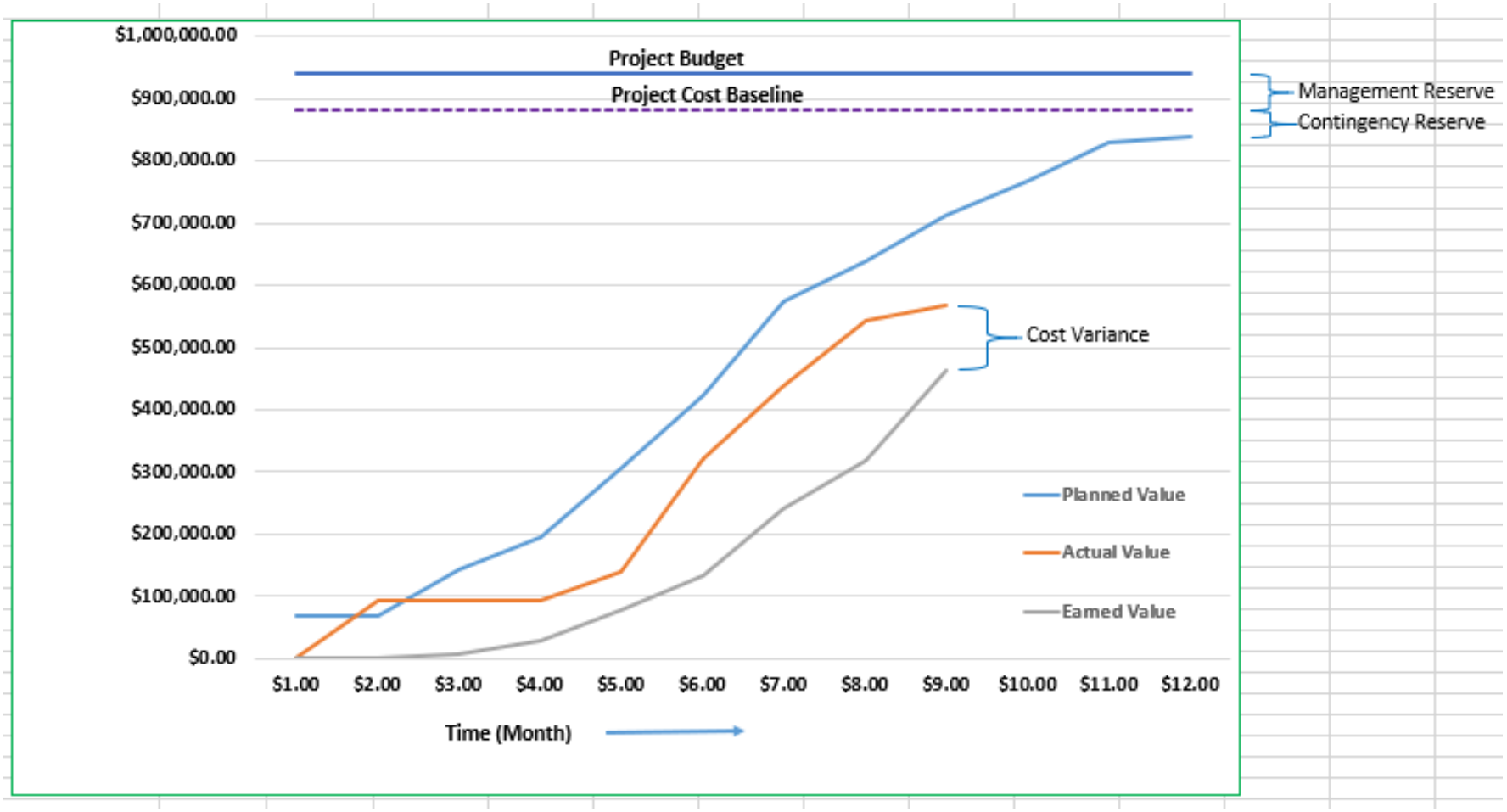
Chart 14: Project Cost Allocation. (Source: H. Chand. Author of the Study. Nov 2020)

Codes	Work Packages	Cost (US$)	Allocation (%)
1.5	**Construction**		
1.5.1	**Septic Tanks and Conveyance System (In-House)**		
1.5.1.1	**Construction of Septic Tank**		
1.5.1.1.1	Construction of septic tank 1	$46,153.85	5.50%
1.5.1.1.2	Construction of septic tank 2	$23,076.92	2.75%
1.5.1.1.3	Construction of septic tank 3	$23,076.92	2.75%
1.5.1.1.4	Construction of septic tank 4	$46,153.85	5.50%
1.5.1.1.5	Construction of septic tank 5	$115,384.62	13.75%
1.5.1.1.6	Construction of septic tank 6	$23,076.92	2.75%
1.5.1.1.7	Construction of septic tank 7	$23,076.92	2.75%
1.5.1.2	**Construction of Conveyance System**		
1.5.1.2.1	Construction of Conveyance System 1	$8,000.00	0.95%
1.5.1.2.2	Construction of Conveyance System 2	$7,000.00	0.83%
1.5.1.2.3	Construction of Conveyance System 3	$10,000.00	1.19%
1.5.1.2.4	Construction of Conveyance System 4	$8,000.00	0.95%
1.5.1.2.5	Construction of Conveyance System 5	$10,000.00	1.19%
1.5.1.2.6	Construction of Conveyance System 6	$7,000.00	0.83%
1.5.2	**CAS Plant (Outsourced)**		
1.5.2.1	Substructure and Foundations	$103,010.00	12.28%
1.5.2.2	Activation Tank	$130,838.00	15.60%
1.5.2.3	Clarification Tank with Sludge Pumps	$73,095.00	8.71%
1.5.2.4	Sand Filter and Backwashing Pumping System	$132,772.00	15.83%
1.5.2.5	Chlorine Dosing Station	$10,230.00	1.22%
1.5.2.6	Clarified Concrete Water Tank for Chlorinated water	$14,146.00	1.69%
1.5.2.7	Pumping System for Chlorinated Water Distribution	$8,744.00	1.04%
1.5.2.8	Reed Bed and Lifting Station	$16,122.00	1.92%
Cost of construction		**$838,957.00**	
Contingency Reserves @ 5% of Cost of Construction		$41,947.85	5.00%
Project Cost Baseline		**$880,904.85**	
Management Reserves @ 7% of Cost of Construction		$58,726.99	7.00%
Total Project Budget		**$939,631.84**	

Chart 15: Project Cost Baseline. (Source: H. Chand. Author of the Study. Nov 2020)

	Cost (US$)											
Time (Month)	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21
	$69,230.77											
			$23,076.92									
					$46,153.85							
							$115,384.62					
									$23,076.92			
											$23,076.92	
						$50,000.00						
			$51,505.00	$51,505.00								
					$65,419.00	$65,419.00						
							$36,547.50	$36,547.50				
								$26,554.40	$53,108.80	$53,108.80		
											$10,230.00	
											$14,146.00	
											$8,744.00	
											$8,061.00	$8,061.00
Planned Value	69230.77	0.00	74581.92	51505.00	111572.85	115419.00	151932.12	63101.90	76185.72	53108.80	64257.92	8061.00
Planned value (Cummulative)	$69,230.77	$69,230.77	$143,812.69	$195,317.69	$306,890.54	$422,309.54	$574,241.66	$637,343.56	$713,529.28	$766,638.08	$830,896.00	$838,957.00
Actual Cost	$0.00	$92,307.69	$0.00	$0.00	$48,895.70	$181,552.95	$115,384.62	$105,295.40	$23,076.92			
Actual Value (Cummulative)	$0.00	$92,307.69	$92,307.69	$92,307.69	$141,203.39	$322,756.34	$438,140.96	$543,436.36	$566,513.28			
Earned Value (% completed of planned work so far)	0.00%	2.00%	5.00%	15.00%	25.00%	32.00%	42.00%	50.00%	65.00%			
Earned Value (Cummulative)	$0.00	$1,384.62	$7,190.63	$29,297.65	$76,722.64	$135,139.05	$241,181.50	$318,671.78	$463,794.03			
Cost Baseline	$880,904.85	$880,904.85	$880,904.85	$880,904.85	$880,904.85	$880,904.85	$880,904.85	$880,904.85	$880,904.85	$880,904.85	$880,904.85	$880,904.85
Project Budget	$939,631.84	$939,631.84	$939,631.84	$939,631.84	$939,631.84	$939,631.84	$939,631.84	$939,631.84	$939,631.84	$939,631.84	$939,631.84	$939,631.84

Figure 21: Project Cost Performance Baseline. (Source: H. Chand. Author of the Study. Nov 2020)



Project Funding Requirement: The fund for the project was allocated from the engineering budget of 2020/2021 for the construction of the entire CAS plant through an outsourced contract, including all the required resources and construction services. The construction of septic tanks and conveyance system was to be built by using the existing resources such as construction materials available within the engineering store as well as the current system contracts such as the contract for ready-mix concrete (RMC), arrangement for supplying cement, sand, aggregates, timbers, plywood, nails and other required tools. In addition, the workforce required to construct septic tanks and conveyance systems will be made available by utilizing BANENGINEERING Company and UNMISS Engineering.

4.4.4. Control Cost

Work performance information: The actual work performance will be compared against the cost baseline. The variance in the cost will be calculated at the work package level and control account level.

Cost forecast: The cost forecast will be updated based on the project performance in the past and expected performance in the future, which will help plan for corrective actions to minimize the negative impacts on the project.

Change request: Any changes that may be required for the project, such as changes in design due to site conditions such as rock found in foundations, etc., the extension of the cost, etc., will be processed officially through the change control process. Any changes required will be reported through the project manager to project sponsors for review and approval.

4.5. QUALITY MANAGEMENT PLAN

Introduction

It is the process of aligning an organization's quality requirement policy in planning, managing, and controlling projects to meet stakeholder's objectives.

4.5.1. Plan quality management

The objective of the quality management plan is to establish the guidelines, procedures, and specifications of the work to produce the product to achieve the quality requirement set in the project.

In this project, legislation, regulation, standards, and codes adopted by the Government of South Sudan will be employed. In the absence of these, the best-accepted industry practice shall be utilized throughout the contract duration. In addition, the United Nations approved environmental and occupational health and safety (OSH) standards will be followed throughout the project.

The Contractor shall consult with the UNMISS representative or the PM to complete the Field Occupational Safety Risk Assessment. A quality management plan will ensure that hazards to all persons are identified, assessed, and associated risk control measures are in place as per the United Nations DPKO Field Occupational Safety Risk Management Policy. The Field Occupational Safety Risk Assessment will be reviewed and updated during performance review meetings with the contractor.

The project manager will monitor the quality and document the quality test results/reports produced during the implementation. In addition, the project manager will review the test results of the conducted samples, any corrective measures required will be advised by the PM to carry out.

For the outsourced portion of the contract, the contractor shall develop, implement, and maintain a Quality Control Plan (QCP). QCP will ensure that all engineering, construction, materials, equipment, and quality provided under the contract follow

the contract provisions, applicable laws, codes and standards, and sound engineering and construction practices unless specifically instructed otherwise by UNMISS. The QCP shall comprise the measures to be taken by the contractor to ensure the contractor, their subcontractors, and suppliers comply with the quality and performance requirements of the contract. The Quality Control measures are adequate to cover all operations, including on-site and off-site activities.

The statement of the work developed by UNMISS for this project attached with the contract document will be taken as the reference document for the detailed specifications and the procedures of each work item. In addition, provided standard templates with the contract documents will be used as references.

Quality Matrix: Key Performance Indicators (KPIs) apply to each essential service described in this SOW. UNMISS shall apply the following Key Performance Indicators (KPIs) for assessing performance, quality of work, and other elements that would be advantageous to UNMISS under the envisaged contract. Such indicators shall become contractually binding. Chart 14 below shows an overview of the project quality matrix.

Chart 16: Quality matrix

No.	Key Performance Indicator	Methodology	Acceptable Performance Level (APL)	Performance Credits (PC)
(i)	Mobilization	Compliance with mobilization milestones	up to 5 days delay	More than 5 but less than 10 days; 5% of mobilization cost 10 – 20 days; 7% >20 days 10%
(ii)	Specifications of components	The number of non-compliance during the monthly reporting period will be measured	no instance of noncompliance	1 occurrence; 2% of monthly invoice 2-3 occurrences; 3% >3 occurrences; 5%
(iii)	Project	Evaluated monthly	up to 7 days	8 days; 2% of monthly

No.	Key Performance Indicator	Methodology	Acceptable Performance Level (APL)	Performance Credits (PC)
	Schedule	from Contractor's progress report and approved schedule	delay	invoice 9 - 14 days; 3% 15 – 20 days; 4% >20 days; 5%
(iv)	Environmental Conservation	Evaluated monthly	no instance of noncompliance	1 occurrence; 2% of monthly invoice 2 occurrences; 3% 3 occurrences; 4% >3 occurrences; 5%
(v)	Safety	Periodic and random checks	no instance of noncompliance	1 occurrence; 2% of monthly invoice 2 occurrences; 3% >2 occurrences; 5%

Implications of non-compliance with KPI: The Contractor shall perform all duties and deliver services within the KPIs during the contract implementation period. UNMISS will apply the Performance Credits indicated in the above table if the contractor does not meet performance expectations.

4.5.2. Manage Quality

Quality Reports: The contractor shall conduct the required quality tests as per the best practices and as mentioned in the UNMISS statement of work (SOW). Such as a cube test to verify the strength of concrete for the required concrete grades for various structures.

Test and Evaluation Documents: The contractor's quality plan and the test results/reports to UNMISS Project Manager will be reviewed, and the contractor shall implement any corrections or improvements required.

Change request: Any changes to the quality requirements will be processed officially through the change control process. Any changes required will be reported through the project manager to project sponsors for review and approval.

4.5.3. Control Quality

Quality Control Measurements: The project team and project manager shall make regular site visits. Any site instruction shall be made in verbal and in the written form as required. The testing of the materials shall be conducted in the presence of the project manager or the project team. Site inspection shall be made to monitor and verify the quality, occupational health, and safety compliance, including environmental protection, sustainable practices, and workmanships.

Verify Deliverables: Towards the end of the project, the Contractor, by specifications requirements, shall submit a final inspection of the work to determine if the work can be declared substantially complete. Suppose the work is sufficiently complete in the opinion of the UNMISS Chief Engineer or his representative. In that case, a final inspection shall be conducted by the UNMISS Chief Engineer or his representative, attended by the Contractor, and the UNMISS Project Manager shall develop a punch list of outstanding work items. If all remaining punch list items are inconsequential to the profitable operation of the facility, the contract may be declared substantially complete. After the acceptable completion of all outstanding items, the work may be accepted as complete.

Once the UNMISS Project Manager recognizes that the project is ready for operation or use as per its intended purpose, certain minor punch lists do not hamper the use of the facility. The sponsor (Chief Engineer) or his representative will issue the Contractor a Substantial Completion Certificate.

The UNMISS Chief Engineer or his representative shall issue a Certificate of Final Acceptance to the Contractor for the works and file a Notice of Completion once the contract is completed. The one-year defects liability period has elapsed with no outstanding items remaining.

Work performance information: The actual quality performance of each deliverable and the overall project will be compared against the quality requirements. The work performance document consists of fulfilling the quality requirements, causes of rejection, rework required, recommendations for corrective actions, etc.

4.6. RESOURCE MANAGEMENT PLAN

Introduction

Managing resources is the process of planning, scheduling, and allocating resources in the best possible way. The purpose is to provide an overview of everyone and everything involved in the project and maximize the resources' efficiency.

4.6.1. Plan Resource management

Resource management plan

Planning and managing the resources gives a clear understanding of who is doing what, where, and how long it takes to finish a task. We can also see who has more downtime and who can be reallocated to help with other tasks.

In this project, implementation of the project will be carried out by using two types of resources:

- Inhouse resources
- Outsourced resources

Under in-house resources, UNMISS Engineering will be responsible for managing resources to construct septic tanks and conveyance systems. All the resources, including workforce, materials, tools, and equipment, will be provided by the UNMISS Engineering section. The engineering section will also utilize its Military Engineers, technicians, and heavy engineering equipment to carry out the tasks.

Under outsourced resources, UNMISS will go for the tender process to build a CAS plant through the outsourced contractor. The selected contractor will be responsible for managing all the resources required for its construction. UNMISS will be responsible for its supervision, monitoring, control of the quality, and facilitate the contractor for the payment and other requirements.

Team Charter:

The table below summarizes the team charter for constructing a centralized wastewater treatment system at UN House. Chart 15 shows the team charter.

Chart 17: Team Charter

Project Phase	Task (What)	Duration	Resource Type (Who)	Deliverable
All phases	Project Management	Throughout the project period	Project manager	Project plan, Resources Plan, Risk, etc.
Planning	Write a project document	38 days	Project Manager	Project document
	Design the facility	30 days	Workgroup	Design document
Execution	Procurement	105 days	Procurement Section	Signed contract
	Construction	401 days	Engineering Section, BANENGR, Contractor, and Workgroup	Product / CAS Facility

4.6.2. Estimate Activity Resources

Resource requirements

Estimate activity resources is the process that compiles a thorough listing of the resources that will be needed in completing a project. The main benefit of this process is that it helps identify the type, quantity, and characteristics of resources. As a result, it is more accurate in estimating the cost and duration to complete each activity.

Basis of estimates

In this project, parametric and expert judgment estimating processes were employed. A parametric estimating method was adopted to construct septic tanks and conveyance systems. The materials and workforce of each activity were estimated based on the engineering norms, such as the materials, workforce, tools, and equipment required to do each activity.

For the construction of the CAS plant, BOQ was received from the United Nations Interim Force in Lebanon (UNIFIL), which was the basis for estimating the outsourced contract.

Resource breakdown structure

The below table gives an overview of various resources (human, material, and Equipment) required to implement this project.

Construction of Centralized Wastewater Treatment System										
In-House Part (Engineering Section and Military Engineering Team / BANENGR)										Outsourced Part
Manpower			Materials					Equipment		Contractor
Work group	Skilled Workers	Unskilled workers	Cement	Sand	Aggregates	Re-bar	Shuttering & Formwork	Excavator	Concrete Mixture	All resources
Project Management	Construction	Construction	OPC	Coarse sand	Below 20mm size	TMT	Pywood and Metal bars	Excavation	Mixing of concrete	All the roles

4.6.3. Acquire Resources

Physical resources assignments

All the physical resources required for the in-house part of the project will be acquired from the UNMISS Central Warehouse, such as cement, sand, aggregates, reinforcement bars, shuttering, etc. All the equipment was acquired from the Engineering and Military Engineering Company (BANENGR), such as excavator, backhoe, concrete mixture, etc.

All the physical resources required for the outsourced part of the project were the responsibility of the Contractor.

Project team assignments

Military Engineering Company assigned a Project Officer as a team leader of the military construction team to construct Septic Tanks. UNMISS Engineering Section delegated its Staff Officer for coordination in between Military Engineering and Engineering Section. Engineering Section also assigned a Water and Sanitation

Engineer as a project engineer and UN National staff and Individual Contractor to construct the Conveyance System.
For the out-sourced part of the contract, assigning all the project team required to construct CAS Plant was the Contractor's responsibility.

UNMISS Project Manager was assigned for the project management for both in-house and outsourced parts of the project.

Resource calendar
Resources colander was standard, i.e., working days from Monday to Friday.

4.6.4. Develop Team

Develop a Team involves improving competencies, team interactions, and the organizational/project environment to enhance performance. This process is essential because it increases the project team's productivity, improved teamwork, increased employee morale, and reduced attrition to enhance project performance. Therefore, the development team process should be performed throughout the project.
In this project, while developing a team, the project manager used the skill to motivate, inspire, build, and lead the project team to attain a high level of team performance in meeting the project’s objectives. In order to effectively create a conducive environment to foster team development, the project manager facilitated teamwork and motivated the team by establishing a Rewards and Recognition System for good performance. This reward system was also complemented by providing employees with challenges and opportunities to foster their development further.

Team performance assessments
The performance assessment of the team involved in the in-house part of the project was conducted based on the quality work, timely completion of the tasks, teamwork, UN core values, and competency. The team members were given the

ratings and recommendations accordingly in their performance appraisal and the work experience/recommendation letters.

The performance assessment of the outsourced contractor was conducted as per the below chart 16 provided on the contract document.

Chart 18: Performance Assessment Matrix

No.	Key Performance Indicator	Methodology	Target	Acceptable Performance Level (APL)	Performance Credits (PC)
(i)	Mobilization	Delay in mobilization beyond 30 days	85%	up to 5 days delay	6 – 9 days; 5% of mobilization cost 10 – 20 days; 7% mobilization cost >20 days 10% mobilization cost
(ii)	Specifications of components	The number of non-compliances	100%	0 occurrences	1 occurrence; 1% of monthly invoice 2-3 occurrences; 3% of monthly invoice >4 occurrences; 5% of monthly invoice
(iii)	Project Schedule	Delays in implementing activities as indicated in the work schedule	96%	up to 7 days delay	8 days; 1% of monthly invoice 9 - 14 days; 2% of monthly invoice 15 – 20 days; 3% of monthly invoice >20 days; 4% of monthly invoice
(iv)	Environmental Conservation	The number of non-compliances	100%	0 occurrences	1 occurrence; 1% of monthly invoice 2 occurrences; 2% of monthly invoice 3 occurrences; 3% of monthly invoice >3 occurrences; 4% of monthly invoice
(v)	Safety	The number of non-compliances	100%	0 occurrences	1 occurrences; 1% of monthly invoice 2 occurrences; 3% of monthly invoice >2 occurrences; 5% of monthly invoice

4.6.5. Manage Team

According to PMBOK Guide, managing a team is the process of tracking team member performance, providing feedback, resolving issues, and managing team changes to optimize project performance. The benefit of this process is that it has positive implications for team behavior, manage conflict, and resolve issues. Therefore, this process should be performed throughout the project.

In this project, team issues were discussed in the meeting and recorded in the minutes. Most of the in-house part of the project was related to the shortage of materials, tools, and equipment, which were resolved shortly. Although some

conflicts between workers in the outsourced contractor were observed, UN security was involved in resolving the issues.

4.6.6. Control Resources

Controlling resources is the process that makes sure that the physical resources assigned and allocated to the project are available as planned. Monitoring the planned resources versus actual resource utilization and taking corrective action as necessary is the key to this process. The process also ensures that the assigned resources are available for the project at the right time and in the right place and released when no longer needed. This process will be followed throughout the project.

Resources can be controlled by using work performance data:

Alternatives analysis was used when there was resource utilization variance by conducting its impact and benefiting from each available alternative.

Trend analysis was used to forecast whether we end up needing more resources for the planned work in the near future. We could see if current resource utilization was acceptable or not.

A cost-benefit analysis was adopted when we had some deviation in resource utilization and needed to put some corrective plan in place. We looked at the cost of each possible alternative and the benefits they bring.

Adopted the problem-solving techniques as things usually do not go as per plan and need to take quick decisions to solve problems.

4.7. COMMUNICATION MANAGEMENT PLANT.

Introduction

Project communication management is the process which is required to ensure that information needed for the project and requirement of its stakeholders are met through development standard process and its implementation to achieve effective information exchange.

4.7.1. Plan communication management:

Plan Communications is a communications requirement analysis that includes types of communications to be used, methods or channels of communication, communication methods (pull, push, interactive), number of communication channels, stakeholder engagement matrix). It is the process of developing a suitable approach and plan for project communications based on stakeholder's information needs and available organizational assets. Planning the project communication is important to successful projects. The scope of the FGP "Construction of Centralized wastewater treatment system" has three major activities.

1. Construction of septic tanks;
2. Construction of Conveyance system; and
3. Construction of Conventional Activated Sludge (CAS) System.

The above three activities to be implemented in the following two ways.

In-house: Activities (a) and (b) were to implement by using UN resources such as UN staff, technicians, UN military Engineers, and materials provided by UN warehouses.

Outsource: Activity (C) was to implement an outsource contract where the Contractor will be responsible for designing and constructing the conventional activated sludge system (CAS).

Communication requirement analysis: Communication technology: Most common, available, reliable, and accessible communication technology at UN House, Juba-South Sudan are listed below

Cell phones
Intercom DESK phones
Tetra (UN Radio)
Email
Microsoft teams
Zoom
WhatsApp
Teleconference
Videoconference

Type of communication to be used

Below verbal and non-verbal communication will be used.

Emails
Instant message
Voice calls
Meetings

Internal information needs - Key personnel related to the project in engineering and procurement will exchange the information regarding the contract documents, Contractor's performance evaluation, Contract amendments, time extension, etc. Any information regarding the project status and updates, funding and timelines, etc., shall be asked by DMS or CSD, or CE at any time, which should be communicated internally following the proper communication channels.

External information needs - There will be a need for external information from the Contractor such as the Contractor's staff, equipment, vehicles, progress reports, invoices, etc., which should be exchanged between the Contractor and project manager. There will be information required regarding performance bonds, retention money, signing of contract amendments, etc., which should be exchanged between the Contractor and the focal person in the procurement section.

Communication channels- There will be ten (10) communication channels listed below.

Internal:

In between Project Manager and State Engineer
In between State Engineer and Chief Engineer
In between the Engineering and Procurement section
In between Chief Engineer and Chief Service Delivery
In between Chief Service delivery and Director of Mission Support

External:

In between PM and Contractor
In between PM, SE, and Contractor
In between Contract Management Officer, PM, SE, and Contractor
In between Procurement and Contractor and
In between Engineering, Procurement, and Contractor

Communication methods - Since UNMISS operates a diverse group of people, it must use the below communication methods and channels.

Interactive communication: UNMISS should use this method while communicating between two or more parties to exchange information in real-time in a face-to-face meeting, cell phone, conference call, and Video Conference through Zoom or Microsoft teams. Face-to-face meetings must be conducted at the

site and field offices among SE, PM, MPO, and Contractor, while conference call and video conference shall be employed for the meetings between HQ and field office. Weekly and monthly meetings should also be conducted face-to-face. In addition, maintaining COVID dances and calls to get any urgent information and follow calls to issue gate passes from the security should be communicated via telephones.

Push communication: UNMISS shall use this method of communication to distribute or send Memos, letters, any project document, and emails regarding the project. The channel for this communication has been used through office outlook/emails. In addition, weekly and monthly progress reports, contractor's performance evaluation reports, contract documents, instructions, meeting minutes, and day-to-day access pass to the UNMISS camp should be communicated through emails.

Pull communication: UNMISS has been using this method of communication to give authorization to its staff to access documents, sets of information, organization's best practices, SOP, contract documents, project documents. The channel for this type of communication are the engineering project server and central share drives.

Communication model - This project requires a cross-cultural communication model. There are diverse backgrounds, including different working methods, age, nationality, professional discipline, ethnicity, race, gender, culture, and languages.

4.7.2. Manage communication

Communication is the key to success; this also holds for the project management discipline. In the blog entitled, "Are your Communication Habits Good Enough?" Haus explains that about 75 - 90% of project work requires communication; this

substantiates the importance of communication in project management as it can make or break a project. Similarly, suppose communication is not managed correctly. In that case, project managers risk creating disengaged team members, bad project culture, and loss of confidence in the project and the project manager. Manage Project Communication is the process that ensures collection, creation, distribution, storage, retrieval, management, monitoring, and the ultimate disposition of project information appropriately on time. (PMBOK Guide Pg. 379). It is an executing process and the below tools and techniques used in the Centralized Wastewater Treatment System at UN House project ensure proper project communication management and produce appropriate Outputs.

Communication Skills - Communication skills are abilities used when giving and receiving different kinds of information; it allows project managers to understand and be understood by others. Communication skills involve listening, speaking, observing, and empathizing. Project managers and team members must possess these skills and abilities to ensure effective communication is exercised throughout the project. Communication techniques that the manager of the project will use include:

Communication Competency - Possessing the ability to articulate the purpose of critical messages, build and maintain meaningful relationships, knowing when, how, and the type of information to share, and having the ability to display leadership qualities.

Feedback - The Project manager must be able to listen actively and take the time to analyze and think of the best possible solution to improve the performance of the project resources. The project manager must also be able to provide positive and constructive criticism with the aim to develop team members and improve overall project performance.

Nonverbal - The project manager is expected to show appropriate body language when addressing situations so as not to demotivate team members and other stakeholders through gestures, tone of voice, and facial expression.

Presentations- The project manager is expected to give clear information on roles and responsibilities to team members. PM should also provide regular updates on the project's progress through various means of communication, such as presentations. In addition, the project manager is also expected to possess adequate knowledge of different presentations, programs, and general delivery of information.

Project Management Information System (PMIS) - The introduction of modern technology has made managing communication much easier and more seamless. It has allowed project managers to centralize and identify all the information needed to make informed decisions. The project management method for this project is the PRINCE2, and the below management information systems tools will be used to assist in managing communication.

Electronic project management tools - Microsoft Projects is a widely used and accepted project management software. The manager for this project will use it to develop the schedule, assign resources to tasks, track progress, manage the budget, and analyze workloads. Project documents will be stored in the Microsoft Office Project server, a centrally operated program.

Electronic communications management - Similarly, modern technology has increased the use of electronic modes of communication. In this project, the manager will utilize the following to foster effective communication: Conference calls, video conferences through Zoom or Microsoft Teams. As mentioned above, conference calls and video conferences will be employed for the meetings between HQ and the field office, and emails regarding the project will be sent through the office outlook.

Project Reporting - Project managers are responsible for collecting and distributing project information. The manager for this project will also be responsible for developing any ad hoc reports, presentations, blogs, and other communication about the project. To produce accurate and relevant project reports, the project manager will ensure adequate records are maintained. Information will be stored and updated in the engineering project server and the central share drive.

Interpersonal and Team Skills - Interpersonal skills are the behaviors and tactics a person uses to interact effectively. In the business world, the term refers to an employee's ability to work well with others. Interpersonal skills range from communication and listening to attitude and deportment. Resources will implement the project activities from within the UN and resources from outside the UN. Therefore the project manager must be able to interact and communicate well with people. Therefore, the project manager will employ interpersonal and team skills to manage communication efficiently, as mentioned below.

Active listening – To provide accurate feedback, advice, and instructions, the project manager must practice active listening throughout the project. As a result, the project manager will build trust and connections, identify and solve problems and avoid missing critical information.

Conflict Management – Conflict exists in every project; it is impossible to void. Therefore, the project manager bears the responsibility to effectively qualm all conflicts and disagreements in this project as soon as they appear.

Cultural awareness – The United Nations (UN) is often referred to as a "melting pot" due to the different backgrounds of workers. The UN promotes the preservation and promotion of the fruitful diversity of cultures. Consequently, the project manager is expected to be aware of cultural differences and show respect

and appreciation for each worker. Furthermore, the project manager is expected to treat each team member, worker, and other stakeholders fairly.

4.7.3. Monitor communication

The process of Monitoring Communications encompasses ensuring that the informational needs of the project and its stakeholders are satisfied. This process is critical to maintaining the optimal information flow, as discussed in the communications management plan. The main inputs in the Monitoring Communications process include the project management plan (in the areas of resource, communication, and stakeholder engagement), project documents (such as issues log, lessons learned register, and project communications), and work performance data (PMI, 2017).

To produce adequate outputs for this process, the project manager and team must use tools and techniques like expert judgment, the project management information system, data analysis tools, interpersonal and team skills, and meetings. Moreover, critical outputs of this process include work performance information, change requests, project management plan updates, and project document updates to the Issues log, lessons learned register, and stakeholder register (PMI, 2017).

The tools and techniques utilized in this process and expected outputs will be elaborated on in the below communication management plan.

Tools and Techniques to be Utilized in the Monitor Communications Process

- To analyze the inputs in the Monitor Communications process of the “Centralized Wastewater Treatment System at UN house,” the project manager and team will utilize the expert judgment from individuals within the project team that has specialized knowledge in critical areas of communication, such as virtual communication channels and expert experience in communicating information on other water treatment system projects. If necessary, the team may request communication assistance from the contractor or other expert consultants when

analyzing the inputs for monitoring communication. In addition to utilizing expert judgment, the project manager and team will also leverage their observation and conversation skills to gather work performance data to monitor communications properly.

Project Management Information System (PMIS) - As introduced in the Manage communications section of this Communication Management Plan, this project's project management information system is the PRINCE2 system. To adequately monitor project communications, the project manager will review and verify that all communication information recorded in the PMIS is valid and effectively inform stakeholders as planned. In addition, the project manager will integrate work performance information tools such as stakeholder surveys to verify the effectiveness of the PMIS further.

The Stakeholder Engagement Assessment Matrix - An essential activity in the monitoring communications process includes a frequent review of the stakeholder engagement assessment matrix to gather work performance information on the effectiveness of communications. The matrix will be conducted by reviewing changes in stakeholder engagement between planned (desired) and current engagement levels. The findings of this process will be considered when preparing change requests for the communications management plan.

Work Performance Data - The project manager and team will collect information on how project communication is performing through the collection of stakeholder surveys and the comparison of planned and implemented communication. Moreover, the stakeholder surveys will be utilized to assess the performance of communications conducted. At the same time, the comparison between planned and executed communications will be performed to evaluate if communications are on track with what was expected in the communication management plan. Any deviations from planned communications or inadequate stakeholder assessment of communications will be considered when preparing change requests.

Meeting to Discuss Findings and Formulate Change Requests - The project manager and team will conduct face-to-face and virtual meetings to discuss the findings of the Monitor Communications Process. Based on the discussion of the results, the project manager will then determine if a change request is needed or further stakeholder feedback must be obtained.

If a change request is needed, the project manager and the relevant team members will review the intended change to assess the best course of action to perform the necessary corrective measures. This process will involve determining which project activities and areas will be affected, the communication, and other performance variances resulting from the possible change. In addition, it will determine how the project scope, schedule, and resources will be impacted.

This change request will then be subject to the organization’s Integrated Change Control process, where it will be reviewed for approval.

If the change request is approved, it may result in the following Project Management Plan and Document Updates:

Communications Management Plan, Stakeholder Engagement Plan, Issue Log, Lesson Learned Register, Stakeholder Register

4.8. RISK MANAGEMENT PLAN

4.8.1. Introduction

The risk management plan comes with how risks associated with constructing the Centralized Wastewater Treatment System will be identified, analyzed, and managed. In addition, it indicates the different risk management activities that will be utilized to perform, record, and monitor risk throughout the different phases of the project.

Managing risks is a fundamental aspect of the project management process for the planning and execution phases of the project. The plan provides the methodology to identify and quantify the risks potentially associated with the project, determine the consequence and associated probability, and develop mitigation strategies. Likewise, opportunities will be managed to ensure project success.

Risks can have a negative impact on the successful completion of a project. The following risks may be associated with the Project:

Delays in the procurement process may delay the selection of contractors for the outsourced part of the project, which may delay the overall project delivery
Delays in approval of the funds for the project
Delay in the in-house project due to rotation of Military Engineering Company
The shortfall of construction materials for the in-house part of the project

4.8.2. Risk Management Approach

Risk Identification - The main techniques used to identify the risk associated with the construction of this project are brainstorming, interviews, document reviews, and SWOT analysis of the UNMISS Engineering Section.

Risk Assessment- The risk identified has been assessed and grouped into external and internal risks, so each risk is considered and addressed accordingly. The Project Manager knows the UNMISS Engineering has one of the biggest challenges: logistics, which impacts the project's timely completion.

Risk resolution – three (3) main actions, namely, accept, transfer, and mitigate risk, have been recognized as relatively important steps to be taken to address the risks of the Centralized Wastewater Treatment System. Chart 17 below shows the risk breakdown structure.

Chart 19: Risk Breakdown Structure. (Source: H. Chand. Author of the Study. Nov 2020)

Risk Level-0	Risk Level-1	Risk Level-2
0 All Source of Project Risks	1. External Risks	1.1 Weather
		1.2 Health Crisis
		1.3 Political
		1.4 Financial market
	2. Technical Risks	2.1 Project Design
		2.2 Equipment and Technology Malfunctioning
	3. Management Risks	3.1 Schedule and Resource Constraints
		3.2 Budget Constraints
	4. Occupational Health and Safety Risks	4.1 Safety Measures
		4.2 Safety Compliance
	5. Commercial	5.1 Suppliers and Vendors
		5.2 Contractors and Sub-Contractors
		5.3 Internal Procurement

The Centralized Wastewater Treatment System employed the Probability and Impact matrix to assign impact and probability. The methodology is outlined below:

Green: The risks characterized as green have both a low impact and less likelihood of occurrence. In case of negative risks/ threats, the response required is not necessarily proactive. However, these should be included within the risk register for future monitoring. On the other hand, the positive risks/opportunities within the green category should be monitored or just simply accepted. Accepting opportunity means taking advantage of the opportunity if it arises but not actively pursuing it.

Yellow: The risks that are characterized as yellow have the moderate category. The characterization is dependent on the organization's defined threshold and mostly due to uncertainties of numerous elements individually—the uncertainties which have little impact. Therefore, the probabilities must be estimated subjectively. The most common responses include having insurance or mitigation strategies in place.

Red: The risks characterized as red have both a high impact and a high likelihood of occurrence. A risk that has a negative impact is a threat to the objective that may need priority actions and aggressive responses. The aggressive responses could mitigate the risk or even terminating the project if the risk is too high. A risk with a positive impact is considered an opportunity; it may be obtained easily, with the benefits, and should be targeted first.

Risk = Impact x Probability

From 15 to 25		Red	Mitigate
From 7 to14		Yellow	Transfer
From 1 to 6		Green	Accept

The project manager will be the overall in charge of risk management strategy in regulation coordination with Contractor, State Engineer, Chief Engineer, Contract Management Officer, and Procurement Section.

Chart 20: Project Risk Register with Respons Strategies. (Source: H. Chand. Author of the Study. Nov 2020)

RBS Code	Risk	Consequence	P	I	Px I	Owner	Risk Response Strategy
1.1	External	**Weather:** During May, rain starts. Sometimes it's very heavy, which may interrupt the project progress.	4	4	16	PM	**Mitigate:** Keep monitoring the progress against the schedule and arrange the standby dewatering pumps.
1.2		**Health Crisis:** COVID 19 Pandemic has been creating unpredicted situations and lockdowns; this may interrupt the pace of the work progress.	5	5	25	PM and Contractor	**Mitigate:** Make the provision of food and shelter for ICs as required to accommodate key personnel and workers at the site to avoid them going out of the Camp/site.
1.3		**Political:** Political situation in South Sudan is unpredictable, and change the security threats to the public, and conflict may erupt anytime, which may hamper the project.	2	2	4	PM	Accept: Ensure that all the workers and contractors comply with the rules and regulations and prepare to avoid any involvement in the conflict.
1.4		**Financial market:** The exchange rate in the market is extremely fluctuating; this may impact the market price of the goods and hence may impact the project progress.	3	4	12	Contractor	**Transfer:** Ensure that the variation is submitted in case of an increase in market price beyond the acceptable range.
2.1	Technical	**Project Design:** Change in design or	3	3	9	PM	**Transfer:** Any delay or requirement of additional time

RBS Code	Risk	Consequence	P	I	Px I	Owner	Risk Response Strategy
		any unclarity in the design may impact the project performances and delays.					and schedule due to the change in project design should be discussed and documented as the Contractor may wish to claim.
2.2		**Equipment and Technology Malfunctioning:** The installed electromechanical items may need special support from the manufacturing company. This may delay the project.	4	3	12	Contractor	**Transfer:** All the equipment should be covered with a warranty to ensure that damaged or malfunctioning equipment is replaced. If a manufacturer needs to send their technicians for installation, it should be done accordingly.
3.1	Management	**Schedule and Resource Constraints:** Shortage of materials for the in-house part of the project may delay the project.	5	5	25	PM and Contractor	**Mitigate:** PM to forecast the required materials for the in-house part of the project and acquire them on time and Contractor to plan, forecast, and acquire resources for the out-sourced portion of the project on time.
3.2		**Budget Constraints:** Unavailability of the fund may also delay the project.	2	2	4	PM	**Accept:** Ensure the sufficient fund is allocated and payment of the project invoices are processed on time.
4.1	Occupational Health and Safety Risks	**Safety Measures:** Any incident at the site may happen due to which work progress may get hampered.	3	4	12	Contractor	**Transfer:** Ensure that workers and equipment are covered with insurance.

RBS Code	Risk	Consequence	P	I	Px I	Owner	Risk Response Strategy
4.2		**Safety Compliance:** Lack of compliance with the safety measure may invite unexpected incidents that may become the contractor's liability.	4	4	16	PM and Contractor	**Mitigate:** Conduct daily / weekly OSH briefing and maintain the attendance records at the site.
5.1	Commercial	**Suppliers and Vendors:** Delays in the supply of the materials may delay the project's progress.	3	5	15	PM and Contractor	**Mitigate** Plan for the provision of alternative suppliers and vendors to avoid dependency on limited ones.
5.2		**Contractors and Sub-Contractors:** Under-performance of the Contractors or Sub-Contractors may delay the overall project progress.	3	5	15	PM and Contractor	**Mitigate** Plan for the provision of alternative suppliers and vendors to avoid dependency on limited ones.
5.3		**Internal Procurement:** Delay in the procurement process and selection of outsourced contractors may impact the project's timely completion.	4	4	16	Procurement Section	**Mitigate:** Provision of alternative Contractor to be in place to avoid project failure due to failure of the selected contractor.

4.9. PROCUREMENT MANAGEMENT PLAN

Introduction

In this project, designing, estimating, costing, and drafting the scope of work (SOW) was prepared by the engineering work team, and then the document was then submitted to the procurement section for the next step.

4.9.1. Plan procurement management

According to the PMBOK® Guide (2017), the Procurement Management plan is “the process of documenting project procurement decisions, specifying the approach, and identifying potential sellers.” The procurement section conducted this process as per the United Nations Department of Field Support (UNDFS) procurement manual.

4.9.2. Conduct procurements

It is the process of obtaining the contractor’s response, selecting the contractor, and awarding a contract. The procurement section conducted this part of the procurement process for the outsourced part of the project.

4.9.3. Control procurements

Once the procurement section awards the contract, it sends the signed contract and the contractor to the engineering section for an implementation. During implementation, the project manager is responsible for initiating the control procurement process. For example, if any amendment is required due to the change request or any time or fund extension required, PM should initiate it. The approval and process for amendments through official MEMO and other required supporting documents, justification, and contractor’s performance evaluation report to Chief Procurement Officer (CPO), through Chief Engineer (CE).

4.10. STAKEHOLDER MANAGEMENT PLAN.

Introduction

The success of the Centralized Wastewater Treatment System is highly dependent on the support and involvement of each stakeholder. Stakeholders Management Plan helps the Project Manager and team identify, manage, and monitor stakeholders who may positively or negatively impact the implementation and execution of the project.

There are four processes included in the Stakeholders Management Plan: identify stakeholders, plan stakeholders, manage stakeholder engagement, and control stakeholder engagement. Ultimately, the plan is instrumental as it influences all other subsidiary plans of the Project Management Plan. The project stakeholders will be identified and listed in a stakeholder's register, which is one of the main outputs of the plan stakeholder's management process.

4.10.1. Identify stakeholders

This process involves identifying and data collection about people, groups, and organizations that could impact or influence the project. The project manager would utilize several tools and techniques to identify stakeholders, namely, meetings, consultation, interviews, surveys, and organization assets. The Project Manager would work closely with the Ministry of Tourism, Sports, and Culture to collect the relevant information needed to connect and work with the appropriate stakeholders.

Direct stakeholders:

Director of Mission Support (DMS)
Chief Service Delivery (CSD)
Chief Engineer (CE)
Chief Procurement Officer (CPO)
Head of Environmental Engineering Unit (HEEU)

Field Engineer (FE)
Project Manager (PM)
Contract Management Officer (CMO)
Military Project Officer (MPO)
Staff Officer (SO)
Contractor

Indirect stakeholders:
Residents of UN House

4.10.2. Plan stakeholder management

The Project Manager will assess the level of interest and involvement of each stakeholder using analytical techniques. In addition to assessing the level of stakeholder involvement, the Project Manager would continuously work closely with the relevant stakeholders to avoid conflict and resistance during each phase of the project.

4.10.3. Manage Stakeholder Engagement

The Project Manager is responsible for managing the stakeholders who may influence the project strategically. Considering this, the project team has gone through a series of training to develop their communication, negotiation, soft, and leadership skills to communicate effectively. Furthermore, the input provided from the Communication Management Plan will help to ensure that communication between the project team and stakeholders is fluid. Importantly, the support of the stakeholders is pivotal to the achievement of the project the goal and objectives. Therefore, stakeholders' concerns and needs will be taking into consideration to ensure the best project outcomes. Chart 19 shows an overview of the stakeholders' engagement matrix.

Chart 21: Stakeholders Engagement Matrix. (Source: H. Chand. Author of the Study. Nov 2020)

Stakeholders	Functional area	Roles and responsibilities	Major Requirements	Influence /Impact (L/M/H)	Project Phases					Engagement Level
					Initiation	Planning	Execution	Control	Close	
DMS Director of Mission Support	Project approver	Ensure that the project document has been approved, and fund allocated	Wastewater is treated before discharging it to environment	Medium /High	Consulted	Consulted	Informed	Informed	Informed	Medium
CSD Chief Service Delivery	Project delivery	Ensure that project is part of mission's priority project	Project completed on time	Medium /High	Consulted	Consulted	Informed	Informed	Informed	Medium
CE Chief Engineer	Planning and approving the design & implementation modality	Ensure that design and construction / implementation modality has been finalized on time	Resources are allocated and outsource	Medium	Accountable	Accountable	Informed	Informed	Informed	High
CPO Chief Procurement Officer	Procurement	Ensure that Procurement process has been done	Timely initiation and selection of contractor	Medium /High	Consulted	Responsible	Informed	Informed	Informed	Medium
SE State Engineer	Coordination	Assign PM and project teams	Play as a bridge role in between OM and above stakeholders	Medium /High	Responsible	Responsible	Accountable	Accountable	Accountable	High
PM Project Manager	Project Management (Overall PM)	Ensure that project is carried out within the planned project resources, timelines and is completed as outlined in project plan and Contract.	Ensure planning process and subsidiary ledgers are Completed. Ensure the project work plan is executed as planned.	High/ Medium	Responsible	Responsible	Accountable	Accountable	Accountable	High
CMO Contract Management Officer	Guide PM	Ensure that the implementation is carried out as per contractual terms and conditions	Processing performance management reports received from PM to procurement section	High/ Medium	Responsible	Responsible	Accountable	Accountable	Accountable	High
MPO Military Project Officer	Military Project management	Coordinate between SO and Military team and ensure that activities that need to be carried out by troops are completed as planned	Ensure that activities that need to be implemented by troops are well coordinated and executed as planned	High/ Medium	NA	NA	Responsible	Responsible	Responsible	Medium
SO Staff Officer	Coordination with military counterparts	Coordinate between PM and MPO	Ensure that activities that need to be implemented by troops are well coordinated and executed as planned	High/ Medium	NA	NA	Responsible	Responsible	Responsible	Medium
Contractor	Construction management	Construction of CAS	Execute the construction of CAS	Medium /High	NA	NA	Accountable	Accountable	Accountable	High

4.10.4. Monitor stakeholder engagement

In order to monitor and control stakeholder engagement, the Project Manager will evaluate the current plan and compare it against the actual stakeholder's engagement activities and performance level. Information regarding stakeholder engagement would be recorded and documented using Information Management System.

5. CONCLUSIONS

The project manager created the project management plan for the construction of a centralized wastewater treatment system at UN House, Juba, South Sudan. It has the following professional criteria:

1. The project management plan presented here for the centralized wastewater treatment system can be implemented effectively within the timeline and budget. The project management has been created using the analytical research method and the tools and techniques given in the PMBOK Guide 6th edition. There are ten (10) knowledge areas used to develop a project management plan. Project Charter is the number one subsidiary element of the project management plan. The rest of the subsidiary plans are in line with the project charter.

2. The scope management plan for the “centralized wastewater treatment system” is developed as a second subsidiary element of the project management plan. The plan was created after collecting requirements, the camp population, design, drawings, and using UNMISS standard templates to ensure there are no omissions or duplication of the scope. The wastewater treatment system can treat 600 cum per day.

3. As a third subsidiary element of the project management plan, the Schedule Management Plan is prepared using the tools and techniques provided in the PMBOK guide. The schedule is developed in Microsoft Project 2013, and the total duration of the project is 566 days. The duration of each activity was estimated by using parametric estimating techniques, engineering norms, and standard practices. Finally, the activity list, network diagram, resource assignment table, and Gantt chart were created to adequately allocate the resources and time for each activity to ensure the project's timely completion.

4. As a fourth subsidiary element of the project management plan, the Cost Management Plan was prepared by conducting detail estimating and costing based on the engineering practices, codes, and norms. The Microsoft Excel sheets were used for the calculation of quantities and costs. Cost baseline and S-Curve for the project were developed. The estimated cost of the project is US$ 838,975.00.

5. As a fifth subsidiary element of the project management plan, the Quality Management Plan was created to fulfill UNMISS quality standards, WHO guidelines, DPKO environmental policies, and engineering standards. Quality matrix – KPI and performance evaluation were developed based on the templates available in UNMISS standard contract document.

6. As a sixth subsidiary element of the project management plan, the Resource Management Plan was developed by estimating the required resources, available in-house resources, materials, workforce, equipment, and the outsourced resources or contracts necessary for the project. The team performance assessment and resource breakdown structures were developed.

7. The communication management plan is a seventh subsidiary element of the project management plan. It was developed based on the organization’s existing communication system, available communication devices, and communication requirements. Using the PMIS system using project server, MS Teams, Zooms, WhatsApp, and Mobile phone was the primary communication tool used in this project. In addition, weekly and monthly progress reports were developed, which was the document to be shared with stakeholders.

8. The risk management plan, as an eights subsidiary element of the project management plan. It was developed by using templates to identify, categorize and register the risks and plan the risk response against each risk.

9. The procurement management plan, as a ninth subsidiary element of the project management plan. The procurement plan was briefly summarized in the UNMISS procurement system without a detailed description. It was handled by UNMISS Procurement Section who takes all the procurement processes for all the engineering outsourced projects. After preparing the BOQ, SOW, Estimating, and Costing, the documents were submitted to the procurement section for further processing. Finally, the procurement section selected and signed the contract. Once the contract is signed, the procurement section hands over the Contractor to the Engineering section. For in-house projects, the Engineering section managed all the resources.

10. As a tenth subsidiary element of the project management plan, the stakeholder management plan is prepared by identifying and registering the direct and indirect stakeholders. In addition, the stakeholder engagement matrix was created to understand the stakeholders' category, roles, and need for engagements.

11. Due to the limited staffing in the Engineering section at UN House, the project manager developed all the subsidiary plans using templates, tables, charts, MS Project, MS Excel, Auto CAD, etc. In addition, the PMBOK Guide 2016 and UNMISS standards were used as the guiding documents while preparing the project management plan.

12. Practicing the project management plan for projects is a better way to implement projects successfully; however, it is not easy to make people follow this due to traditional mindset and practices.

6. RECOMMENDATIONS

Below are the recommendations to the UNMISS Engineering Section at UN House for the Construction of Centralized Wastewater Treatment System:

1. The methodology and tools & techniques used to prepare the project management plan for this project were based on PMBOK Guide 6th edition. The project management plan prepared would be used as a benchmark for future engineering projects. Therefore, all UNMISS Engineers and Project Managers can be benefitted from this document.

2. The data and design presented in the document are based on the engineering norms, codes, and standards; this encourages engineering staff to follow professional engineering practices instead of doing things without proper design and calculations. UNMISS Engineers can take advantage of this document and use it as a basis for design and calculations for similar facilities in the future.

3. The UNMISS Engineering section is strongly advised to apply the provided methods, processes, and templates to ensure all the subsidiary plans are implemented; and the project objectives are achieved within the project timeline.

4. Regular monitoring of the project and orientation training to all the engineering staff is recommended to ensure everyone sees each project activity in view of project management, which will open the way forward to start practicing project management.

5. In each subsidiary plan and during implementation, the Engineering section should think in the way of regenerative development to utilize resources in its best possible way by producing fewer wastes, which will benefit the organization in terms of better resource utilization and savings.

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Project documents. UNMISS Centralized wastewater treatment system at UN House, Juba, South Sudan

8. APPENDICES

8.1. Appendix 1: FGP Charter

PROJECT CHARTER	
(Formalizes the project start and confers the project manager with authority to assign company resources to the project activities. Benefits: it provides a clear start and well-defined project boundaries)	
Date:	**Project Name:**
26-Oct-20	Project Management Plan for the construction of centralized wastewater treatment system at UN House, Juba, South Sudan
Knowledge Areas / PM Processes:	**Application Area (Sector / Activity):**
Knowledge Areas: Integration, Scope, Schedule, Cost, Quality, Resources, Communication, Risks, Procurement, and Stakeholders	Construction / Water and Sanitation
PM Processes: Initiation and Planning	
Project Start Date:	**Project Finish date:**
26-Oct-20	30-Apr-21
Project Objectives (General and Specific):	
General Objective:	
To develop a project management plan for the construction of a centralized wastewater treatment system to mitigate the risks from wastewater within the UN House premises in Juba, South Sudan.	
Specific Objectives:	
1. To create a project charter in order to define key input elements to develop a project management plan.	
2. To develop a scope management plan to ensure that the project includes all the work required to	

complete the project successfully.
3. To develop a schedule management plan to manage the timely completion of the project.
4. To develop a cost management plan to ensure the project cost is determined, monitored, and controlled.
5. To create a quality management plan to ensure the project meets the organization's quality policies and quality requirements.
6. To create a resource management plan to identify, acquire and manage required resources for the project.
7. To develop a communication management plan to ensure the information needs of the project and its stakeholders are met.
8. To create a risk management plan to increase the impact of positive risks and decrease the impact of negative risks.
9. To create a procurement management plan to develop and administer agreements such as contracts, MOAs, Pos.
10. To develop a stakeholder management plan to analyze stakeholder's expectations and effective engagement.
Project purpose or justification (merit and expected results):
The purpose of this Final Graduation Project (FGP) is to create a project management plan that will guide the project's execution to maximize the chance of its success. Given that the organization has some unsuccessful project experiences in the past, the development and use of a project management plan will help define the project objectives, success criteria, resources allocation, in general, plan everything needed for the project success. Also, this project management plan will become an organizational asset that might be used as a reference for future project plans. Furthermore, the project for the construction of a centralized wastewater treatment system is critical for the organization. Thus it must be professionally managed to fulfill the environmental and sanitation needs of the area where thousands of UN staff have been residing.
Description of Product or Service to be generated by the Project – Final Project deliverables:
The Final Graduation Project (FGP) will provide a comprehensive project management plan with its subsidiary management plans. The Project Management Plan will address all the good practices recommended in appropriate bibliographical sources such as the Project Management Body of Knowledge (PMBOK 6th Edition). Specific deliverables associated with each specific objective

include 1. Project Charter, 2. Scope Management Plan, 3. Schedule Management Plan, 4. Cost Management Plan, 5. Quality Management Plan, 6. Resource Management Plan, 7. Communication Management Plan, 8. Risk Management Plan, 9. Procurement Management Plan, and 10. Stakeholder Management Plan.

Assumptions:

1. It is assumed that all the required information to execute FGP will be readily available. 2. It is assumed that the organization (UNMISS) will provide all the project-specific information in a timely manner and without significant restriction to create the Project Management Plan.

Constraints:

1. Time: The pre-established timeframe stated by the university for each of the FGP development phases. 2. Resources: There will be only one human resource available to develop the entire FGP.

Preliminary Risks:

If the project management plan for FGP is completed on time, the project will benefit from it, and if it is delayed, it may affect the project's success.

Budget:

US$ 6000 (six thousand U.S. dollars) @ four months of work on an average dedication of 20% and an hourly cost of $10 plus $240 for another cost.

Milestones and dates:

Milestone	**Start date**	**End date**
Final Graduation Project Start	26-Oct-20	26-Oct-20
Graduation Seminar	26-Oct-20	29-Nov-20
Tutoring Process	25-Jan-20	23 Apr-21
Reading by Reviewers	26-Apr-21	14-May-21
Adjustment	17-May-21	11-Jun-21
Presentation to Board of Examination	14-Jun-21	18-Jun-21
Final Graduation Project End	18-Jun-21	18-Jun-21

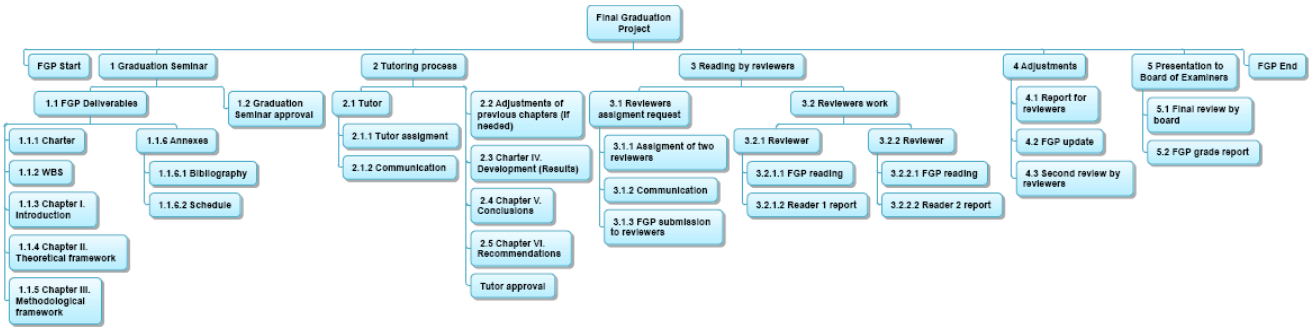
Relevant historical information:

UNMISS was founded in the Republic of South Sudan (UNMISS) to support the government’s efforts for peace consolidation, stimulating longer-term state-building and economic development, and assisting the government in exercising its responsibilities conflict prevention mitigation and resolution protecting civilians. UNMISS also helps the government develop the capacity to establish the rule of law and strengthen Sudan's security and justice sectors.

UNMISS Engineering Section has been doing similar construction works for more than ten years in this country. For example, at UN House, UNMISS has built about four concrete septic tanks, about 11 metal soak pits with lifting pumps, three wastewater treatment plants, and three oxidation ponds in which the wastewater was pumped and disposed-off from the septic tanks. However, these projects have been implemented without proper project management practices. Thus, this project will be the first one that will be implemented by creating the appropriate Project Management Plan.
Stakeholders:
Direct stakeholders: Director of Mission Support (DMS) Chief Service Delivery (CSD) Chief Engineer (CE) Head of Environmental Engineering Unit (HEEU) Field Engineer (FE) Project Manager (PM) Indirect stakeholders: Residents of UN House
Approval:

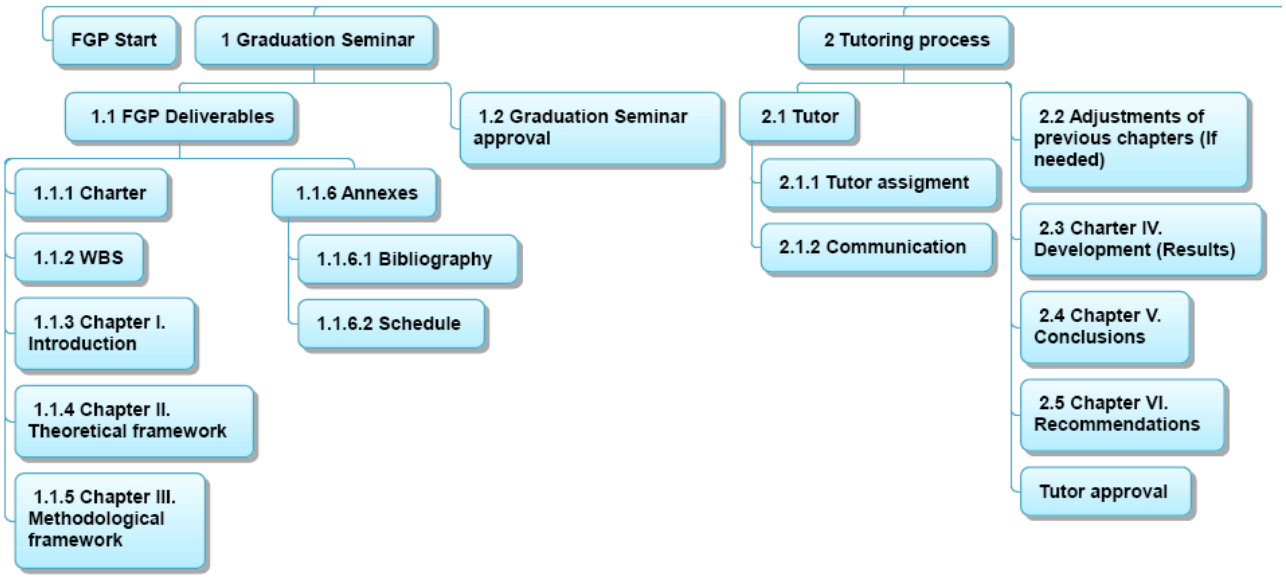
Project Manager: Hark Bahadur Chand	Signature: Hark B. Chand	
Authorized by: Asharam Nhemafuki	Signature: A. Nhemafuki	
		Version:26 Jan 2020

8.2. Appendix 2: FGP WBS

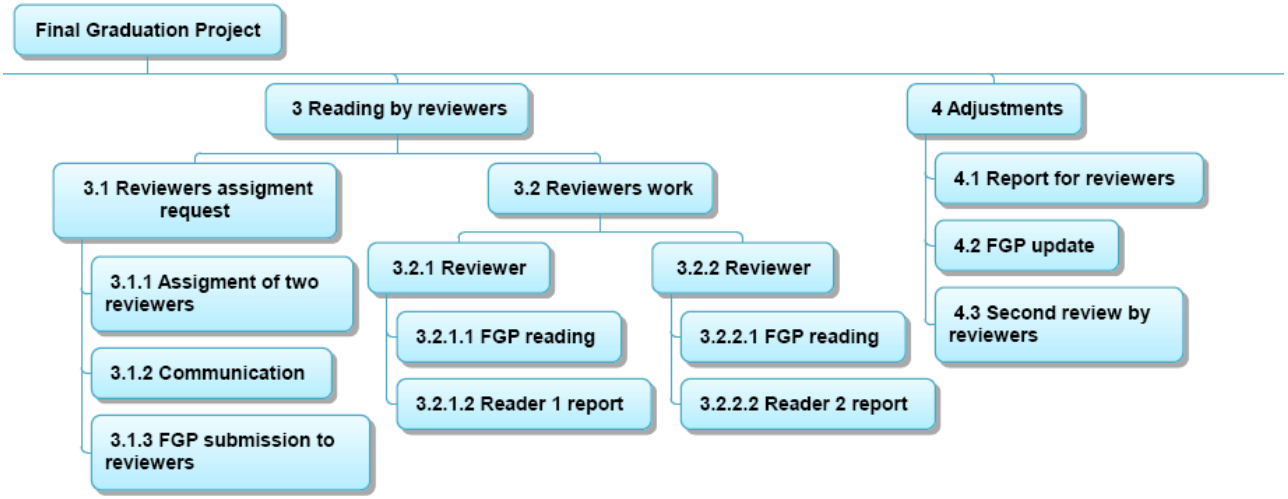


Note: Above WBS has been split into three parts to make the WBS readable.

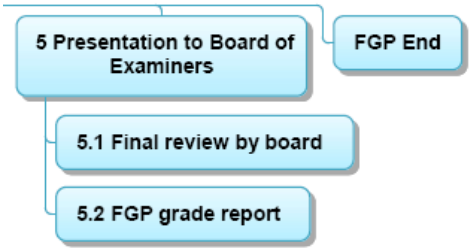
Part: 1



Part: 2

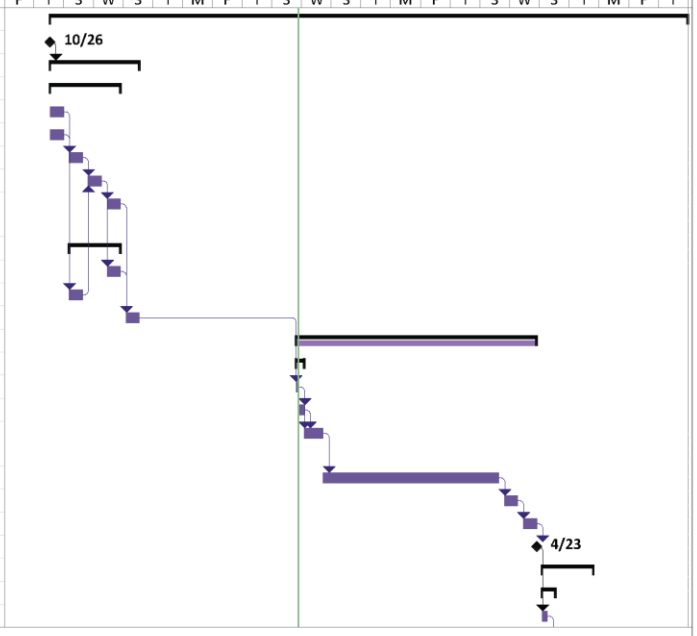

Final Graduation Project
3 Reading by reviewers
4 Adjustments
3.1 Reviewers assigment request
3.2 Reviewers work
4.1 Report for reviewers
4.2 FGP update
4.3 Second review by reviewers
3.1.1 Assigment of two reviewers
3.1.2 Communication
3.1.3 FGP submission to reviewers
3.2.1 Reviewer
3.2.2 Reviewer
3.2.1.1 FGP reading
3.2.1.2 Reader 1 report
3.2.2.1 FGP reading
3.2.2.2 Reader 2 report

Part : 3


5 Presentation to Board of Examiners
FGP End
5.1 Final review by board
5.2 FGP grade report

8.3. Appendix 3: FGP Schedule

ID	Task Name	Duration	Start	Finish
1	**Final Graduation Project**	**170 days**	**Oct 26 '20**	**Jun 18 '21**
2	FGP Start	0 days	Oct 26 '20	Oct 26 '20
3	**1 Graduation Seminar**	**25 days**	**Oct 26 '20**	**Nov 27 '20**
4	**1.1 FGP Deliverables**	**20 days**	**Oct 26 '20**	**Nov 20 '20**
5	1.1.1 Charter	5 days	Oct 26 '20	Oct 30 '20
6	1.1.2 WBS	5 days	Oct 26 '20	Oct 30 '20
7	1.1.3 Chapter I. Introduction	5 days	Nov 2 '20	Nov 6 '20
8	1.1.4 Chapter II. Theoretical framew	5 days	Nov 9 '20	Nov 13 '20
9	1.1.5 Chapter III. Methodological framework	5 days	Nov 16 '20	Nov 20 '20
10	**1.1.6 Annexes**	**15 days**	**Nov 2 '20**	**Nov 20 '20**
11	1.1.6.1 Bibliography	5 days	Nov 16 '20	Nov 20 '20
12	1.1.6.2 Schedule	5 days	Nov 2 '20	Nov 6 '20
13	1.2 Graduation Seminar approval	5 days	Nov 23 '20	Nov 27 '20
14	**2 Tutoring process**	**65 days**	**Jan 25 '21**	**Apr 23 '21**
15	**2.1 Tutor**	**3 days**	**Jan 25 '21**	**Jan 27 '21**
16	2.1.1 Tutor assigment	1 day	Jan 25 '21	Jan 25 '21
17	2.1.2 Communication	2 days	Jan 26 '21	Jan 27 '21
18	2.2 Adjustments of previous chapters (If needed)	5 days	Jan 28 '21	Feb 3 '21
19	2.3 Charter IV. Development (Results)	47 days	Feb 4 '21	Apr 9 '21
20	2.4 Chapter V. Conclusions	5 days	Apr 12 '21	Apr 16 '21
21	2.5 Chapter VI. Recommendations	5 days	Apr 19 '21	Apr 23 '21
22	Tutor approval	0 days	Apr 23 '21	Apr 23 '21
23	**3 Reading by reviewers**	**15 days**	**Apr 26 '21**	**May 14 '21**
24	**3.1 Reviewers assigment request**	**5 days**	**Apr 26 '21**	**Apr 30 '21**
25	3.1.1 Assigment of two reviewers	2 days	Apr 26 '21	Apr 27 '21

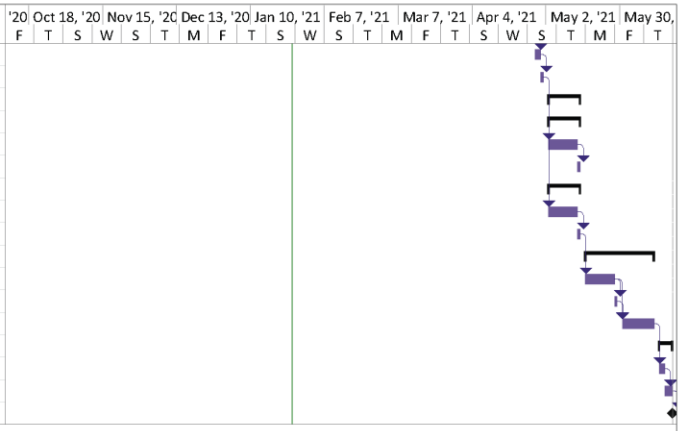


Project: FGP WBS
Date: Jan 26 '21

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

Page 1

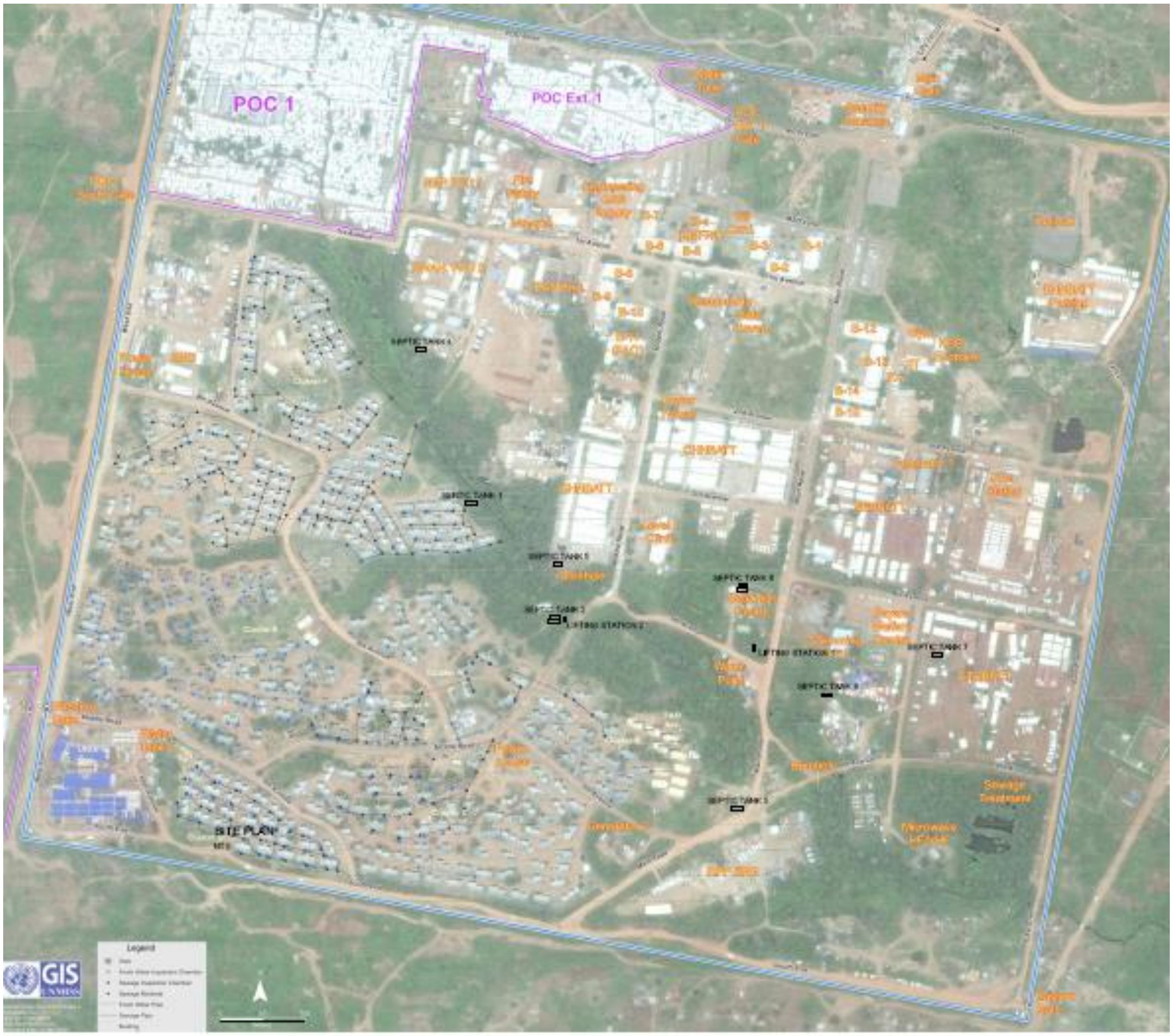
ID	Task Name	Duration	Start	Finish
26	3.1.2 Communication	2 days	Apr 28 '21	Apr 29 '21
27	3.1.3 FGP submission to reviewers	1 day	Apr 30 '21	Apr 30 '21
28	**3.2 Reviewers work**	**10 days**	**May 3 '21**	**May 14 '21**
29	**3.2.1 Reviewer**	**10 days**	**May 3 '21**	**May 14 '21**
30	3.2.1.1 FGP reading	9 days	May 3 '21	May 13 '21
31	3.2.1.2 Reader 1 report	1 day	May 14 '21	May 14 '21
32	**3.2.2 Reviewer**	**10 days**	**May 3 '21**	**May 14 '21**
33	3.2.2.1 FGP reading	9 days	May 3 '21	May 13 '21
34	3.2.2.2 Reader 2 report	1 day	May 14 '21	May 14 '21
35	**4 Adjustments**	**20 days**	**May 17 '21**	**Jun 11 '21**
36	4.1 Report for reviewers	9 days	May 17 '21	May 27 '21
37	4.2 FGP update	1 day	May 28 '21	May 28 '21
38	4.3 Second review by reviewers	10 days	May 31 '21	Jun 11 '21
39	**5 Presentation to Board of Examiners**	**5 days**	**Jun 14 '21**	**Jun 18 '21**
40	5.1 Final review by board	2 days	Jun 14 '21	Jun 15 '21
41	5.2 FGP grade report	3 days	Jun 16 '21	Jun 18 '21
42	FGP End	0 days	Jun 18 '21	Jun 18 '21



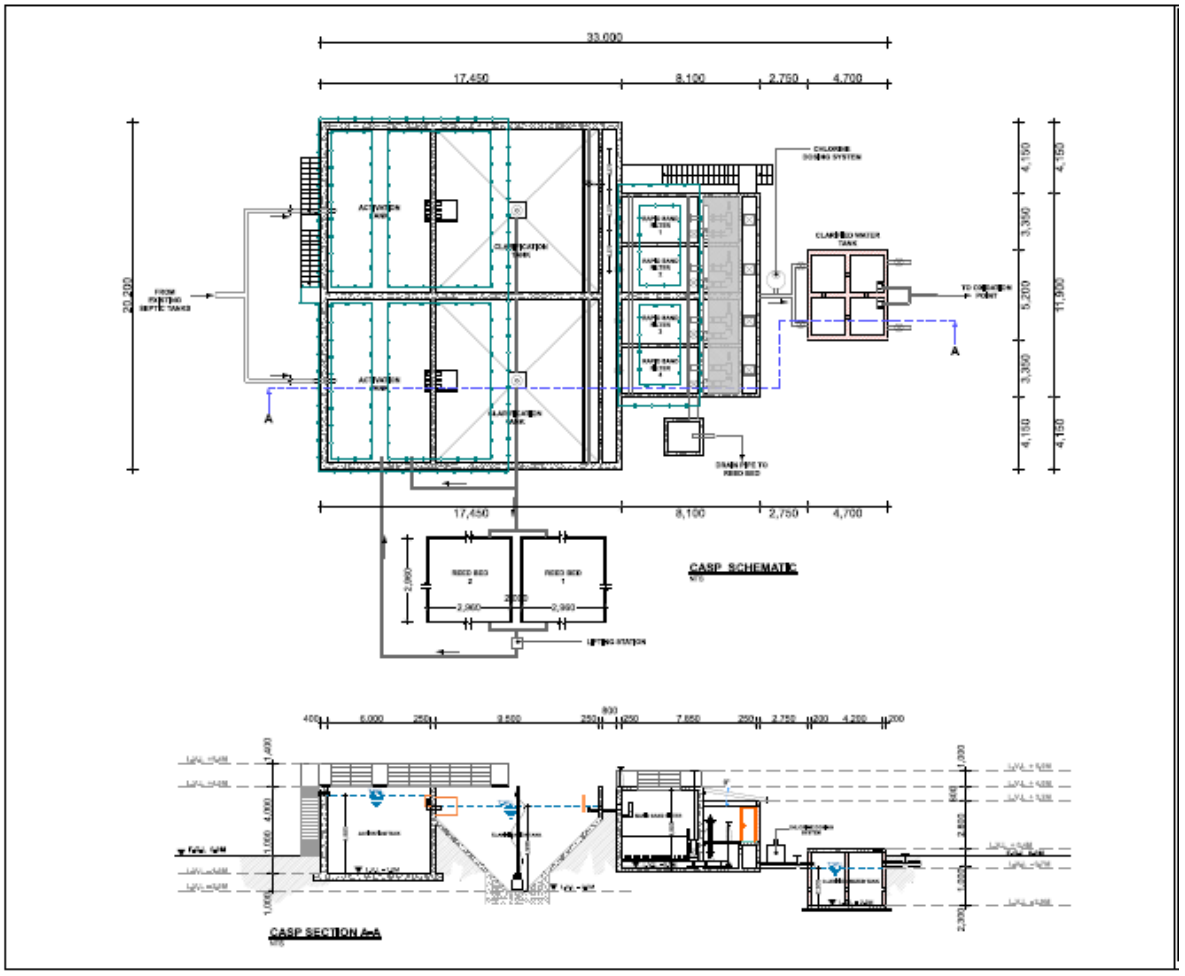
Project: FGP WBS
Date: Jan 26 '21

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

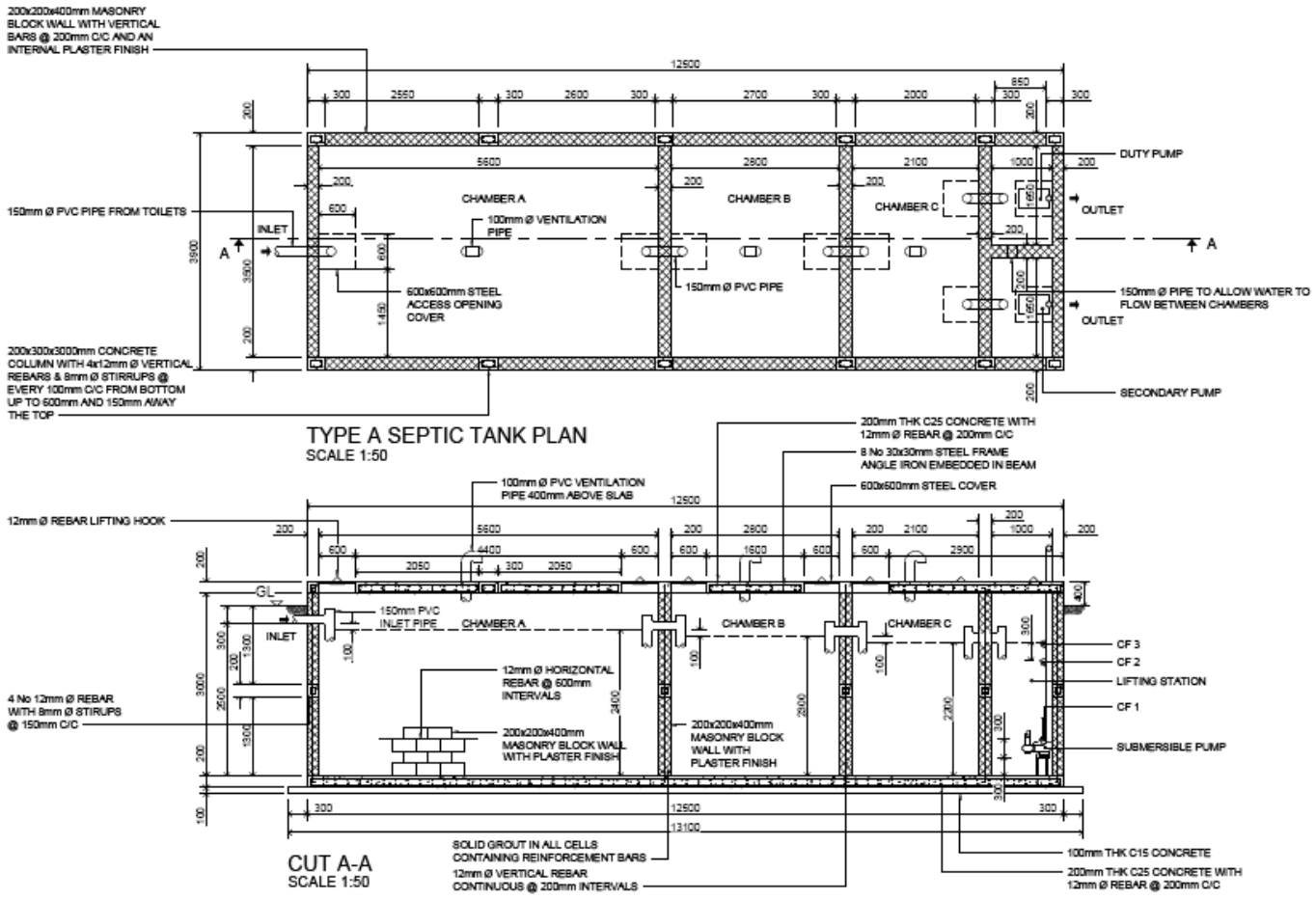
8.4. Appendix 4: Locations of various septic tanks



8.5. Appendix 5: Typical layout plan and sectional views of CAS Plant



8.6. Appendix 6: Typical Drawings for RCC Septic Tank



8.7. Appendix 7: Sample Non-Conformance (NCR) Letter

the Republic of South Sudan

بعثة الأمم المتحدة في السودان
جنوب السودان

UNMISS

ENGINEERING SECTION
NON-CONFORMANCE REPORT (NCR)

DATE: CONTRACTOR:

CONTRACT NO: UNMISS/CON/.... LOCATION:

NCR No:

NON-CONFORMANCE ITEM: (Short Description, Location Details, Sketch if applicable)

REMEDIAL ACTION REQUIRED:

UNMISS REPRESENTATIVE: ---------- SIGNATURE: ----------

CONTRACTOR'S REPRESENTATIVE: ---------- SIGNATURE: ----------

Address: UN House Site, P.O. Box 29, Juba South Sudan

8.8. Appendix 8: Sample Site Inspection Form

UNMISS
ENGINEERING SECTION
PROJECT INSPECTION FORM
ES: F0011

DATE OF INSPECTION:

CONTRACT NO.:

TASK ODERD NO.:

REF.:

- INSPECTED WORKS:

1. Construction work ---------- APPROVED YES NO
2. Plumbing works ---------- APPROVED YESI NO
3. Electrical works ---------- APPROVED YES NO
4. Tiling works ---------- APPROVED YES NO
5. Painting works ---------- APPROVED YES NO
6. Finishing works ---------- APPROVED YES NO
7. Site cleaning ---------- APPROVED YES ☐ NO ☐

- REJECTION DETAILS -REMEDIES REQUIRED:

- SKETCH (IF APPLICABLE):

INSPECTED BY UNSMISS REPRESENTATIVE: NAME: SIGNATURE:

COTRACTOR PROJECT MANAGER: NAME: SIGNATURE:

UNMISS/ENG/Project File

8.9. Appendix 9: Letter from Linguistic Reviewer

21st May, 2021,
Kathmandu, Nepal.

Academic Advisor
Master's Degree in Project Management (MPM)
University for International Cooperation (UCI)

Re: Project Management Plan (Centralized Wastewater Treatment System) of Final Graduation Project Submitted by Hark Bahadur Chand in Partial Fulfillment of the requirements for Masters in Project Management (MPM) Degree.

Dear Sir,
I hereby confirm that this dissertation entitled PMP for the construction of Centralized Wastewater treatment System has been thoroughly reviewed and meets expected literary and linguistics standard of a student studying for a degree at the Masters Level.

.....
Mr. Anil Kumar Shrestha.

8.10. Appendix 10: Certificate of Linguistic Reviewer

KATHMANDU UNIVERSITY
SCHOOL OF EDUCATION
P.O. Box 6250, Kathmandu, Nepal
TEL: 5548104, (Balkumari, Lalitpur) FAX: 977-1-5533814
TEL: 011-661399 (Dhulikhel) FAX: 977-11-661443
Website: ku.edu.np E-mail: kusoed@ku.edu.np

School of Education

Date: January 27, 2013

To Whom It May Concern

This is to notify that ***Mr. Anil Kumar Shrestha*** is a regular student of Kathmandu University, School of Education. He was enrolled in M.Ed in English Language Teaching (ELT) in February batch 2009. He has completed all the requirements for the degree of M. Ed. in ELT from this University in August 2012.

I wish him success in every walk of future endeavours.

Prof. Tanka Nath Sharma, PhD
Dean