UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)

FINAL GRADUATION PROJECT

A Project Management Plan for the Water Warriors Educational Toolkit Project

STUDENT'S NAME

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This Final Graduation Project was approved by the University as
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Master in Project Management (MPM) Degree

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DEDICATION

The development of this Final Graduation Project, for a Project Management Plan for the NIHERST Water Warriors Educational Toolkit project is dedicated to the organisations that are working towards achieving the goals of the local policy for an integrated water resource management approach in Trinidad and Tobago. In a broader sense, it is dedicated to the rivers of this twin island nation of Trinidad and Tobago that one day should have the legal rights of a person in the courts of law. I exist if my rivers exist.

ACKNOWLEDGMENTS

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ABBREVIATIONS AND ACRONYMS

AARP – Adopt-A-River Programme

COMDESI - Community Design & Innovation

CSW - Community Science Week

EEFs – Enterprise Environmental Factors

EU - European Union

FGP – Final Graduation Project

GWP-C - Global Water Partnership-Caribbean

ICGEB - International Centre for Genetic Engineering and Biotechnology

IEEE - Institute of Electrical and Electronic Engineers

INVOCAB - Improving Innovation Capacities in the Caribbean

IPMA - International Project Management Association

IWRM - Integrated Water Resources Management

MOE - Ministry of Education

MS – Microsoft

NASA - The National Aeronautics and Space Administration

NIHERST - National Institute of Higher Education, Research, Science & Technology

No. – Number

NYSC – National Youth Science Camp

OAS – Organisation of American States

OPAs - Organisational Process Assets

PMBOK – Project Management Body Of Knowledge

PM – Project Manager

PMI – Project Management Institute

PMP - Project Management Plan

PPP - Public-Private Partnerships

R & D - Research and Development

SEA – Secondary Entrance Assessment

STI - Science, Technology, and Innovation

STKF - Sci-TechKnoFest

UCI - Universidad para la Cooperacion Internacional

UNESCO - United Nations Educational, Scientific and Cultural Organization

WBS - Work Breakdown Structure

WRA – Water Resources Agency

EXECUTIVE SUMMARY (ABSTRACT)

In the twin island Republic of Trinidad and Tobago; the field of water resource management is an emerging, but important one. With water being continuously contaminated and with the Earth's purifying systems being challenged globally, by the human society, it has become imperative to take action to look after these regulating systems. Science and technology education for students has been the key operation of the National Institute of Higher Education, Research, Science & Technology (NIHERST). This organisation has been in existence since 1984, and has been actively engaged with the local student population across both islands.

The work of the organisation is broad; it covers several areas in the scientific and technological academia. Further, it runs the only public science centre in the region, and is therefore attractive to regional visitors. Additionally, the tasks which the institute conducts include a number of projects which are specifically geared to the promotion of water resource management. It includes educational based training segments, and pilot studies based on the implementation of rain water harvesting systems (RWHSs). The RWHSs were the first to be put into practise on the island of Trinidad, at public schools and community centres, in rural communities. NIHERST, together with its sponsor, the Water Resources Agency (WRA) collaboratively developed a project management plan (PMP) for the NIHERST-WRA Water Warrior Educational Toolkit Project. The WRA has been engaged in awareness building in the area of water resource management.

At this time, NIHERST does not have a suitable management function for projects. It however utilizes project management concepts, and templates, but not in a fully developed methodology. It has been installing software, and training project managers and teams in using the software. As such, this PMP has been built as a pilot study for the organization and can be used as an example for future projects. Currently, with a troubled economic situation, grant funding will be that much more significant to the organization, and therefore successful project management outcomes are important for demonstrating capability in the area of project management.

The general objective was to develop a complete project management plan (PMP) framed within the standards of the Project Management Institute, for the Final Graduation Project. This PMP will be relevant to the National Institute of Higher Education, Research, Science and Technology (NIHERST) and the Water Resources Agency (WRA) Water Warrior Educational Toolkit Project, and developed for the initiation and planning phases of the project life cycle. The PMP would function as a pilot study for other water-based projects at NIHERST. The specific objectives were: to create a project management plan and a project charter, to plan, and authorize and initiate the project; to develop the scope management plan, requirements documentation, requirements traceability matrix,

project scope statement, and scope baseline for the project; to plan, and develop the schedule, and to define, sequence, and estimate activities for the project; to develop the cost management plan, cost estimates, basis of estimates, cost baseline, and project funding requirements; to create the quality management plan, and quality metrics for the project; to build the resource management plan, team charter, resource requirements, basis of estimates, and resource breakdown structure; to create the communications management plan; to develop a risk management plan, register, and report for the project; to create the procurement management plan, strategy, bid documents, statement of work, source selection criteria, make-or-buy decisions, and independent cost estimates; and to develop the stakeholder register and the stakeholder engagement plan for the project.

The methodologies for the creation of the Project Management Plan (PMP) for this project involved the use of analytical, quantitative, qualitative, and descriptive research methods. The analytical research method was used to investigate the inputs for the development of each knowledge area for the PMP. The quantitative research method was conducted to make estimates for timelines, and milestones, and for the cost and resource estimates for the PMP. Another method used was the qualitative research method; it was used as part of the risk analysis in the development of the PMP. Finally, the descriptive method most often used the past experience, and records of the organisation to integrate into the PMP, such as from lessons learnt, and from interviews with project managers, and team members.

The final graduation project resulted in a project management plan for the Water Warriors Educational Toolkit project, which would be a baseline, used to enter the execution, monitoring and finally closing phases of the project. The plan has been guided by the ten (10) knowledge areas contained in the PMBOK Guide 6th edition. The plan is a pilot project management plan, because this format and approach has not been used at the National Institute of Higher Education, Research, Science & Technology. It is recommended that sustainability initiatives be incorporated into the plan, and be reported on.

Sustainability initiatives such as determining, selecting and incorporating green criteria in the procurement knowledge area processes is one such green initiative. The integrated water resource management policy which has objectives to achieve healthy freshwater bodies in itself works in tandem with green project management initiatives such as the Water Warriors Educational Toolkit project. The objectives of the Water Warriors Educational Toolkit project aims to teach students how they can improve their conception, practices of water conservation, and preservation, in addition to the sustainability practices recommended for the project's execution phase.

1 INTRODUCTION

1.1 Background

This project builds on the basis of a school based intervention project offered by the National Institute of Higher Education, Research, Science & Technology (NIHERST), and which is sponsored by the Water Resources Agency (WRA) of Trinidad and Tobago. The institute, NIHERST, has the relevant experience which the sponsor recognizes, and hopes to get its programme expanded to further reaches of the local water resources community. Further, NIHERST was the first institute to locally implement Rain Water Harvesting Systems on the island of Trinidad, hence leading the way in this aspect, as it pertains to water resource management initiatives.

The institute

The National Institute of Higher Education, Research, Science and Technology (NIHERST) was established as a statutory body by Republic of Trinidad and Tobago, act No. 20 of 1984, now Chapter 39:58. Its main functionality is science popularization, especially geared toward students.

The sponsor

The WRA is a department of the Water Sewerage Authority of Trinidad and Tobago. The main function of the WRA or its mission is to effectively manage the country's water resources through conservation, development, and protection for sustainable use, while also doing so in an integrated way, which is cost effective.

Water resource management

At this time, the managing institute, NIHERST, will leverage on its experience in projects mostly aimed at school-aged students below the age of seventeen (17), with the support of the WRA, as sponsor. It is significant to state that Trinidad and

Tobago is at the point where it is actually implementing the concept of Integrated Water Resources Management (IWRM) into the culture of responsible organizations, through a National IWRM policy. The project in WRA's perspective is going to fall under its Adopt-A-River Programme (AARP). The AARP promotes the principles of the IWRM concept, it seeks to educate, through public, private, or public-private partnerships, sustainable and holistic projects which would improve rivers, and by extension other bodies of water, and watershed health.

1.2 Statement of the problem

In light of Trinidad and Tobago's initiatives under its newest National Integrated Water Resource Management policy, signing on to international agreements, and regarding the work of the Water Resources Agency (WRA) of Trinidad and Tobago, this collaborative project called the Water Warriors Educational Toolkit Project intends to build awareness amongst school aged students. Local waterways are constantly being threatened and impacted by human actions, and WRA's Adopt a River Programme is about the implementation of enterprises that promote river, canal, and stream health, whilst NIHERST has a myriad of experience with school-based interventions, and hence both organisations will collaborate to create beneficial outcomes via these school-based interventions. The WRA has worked with community groups through its projects to measure water quality, and to teach students and members of the community how to measure it using water quality testing kits, and is also about the significance of water health. This project will perform a similar role, and will leverage on the abilities of NIHERST from its experience with school-based intervention projects.

The overall intentions are to enlighten students, to make them aware of their human actions and impacts, and of the need for healthy river, canal, and stream health. Additionally, these activities will be developed with local content, and will aim to form a real life bond between culture and natural surroundings. These human impacts span from personal actions like littering and dumping of large

appliances, to waste generated from companies such as organic waste from the beverage industry which can rapidly deplete the oxygen in waterways, improper and illegal disposal of waste oil directly into canals from garages, fatty residues from the manufacturing industry, and more. With this in mind it is noteworthy that students are taught about good stewardship, river recovery, and resilience. It is therefore, based on necessity, that students understand how to interact with nature, and form connections with it.

The Final Graduation Project will develop a PMP to implement a school-based intervention to share knowledge, and practical activities with students. The PMP will be the framework by which the project can be successfully managed, implemented, and concluded through the project management life cycles. The life cycle is made up of five (5) processes, they are: initiate, plan, execute, monitor and control, and close. The project will utilize the ten (10) project management knowledge areas, in order to successfully achieve the objectives set out. This practice of utilizing a PMP is not fully integrated into the functions of the organization, at this time. Further, organizations must now seek all avenues for new knowledge, and move forward whilst taking vibrant action, to improve how they operate, and successfully implement projects which can make a change internally through its processes, and externally by meeting its objectives.

Utilizing the PMP approach will bring a streamlined method to achieve the objectives, by integrating the project, planning the scope, and showing a clear idea of the project's scope to the relevant stakeholders. It will schedule the project, such that time can be adequately managed. It will plan the budget for the project, and cater for risks, and other unexpected occurrences, without having to pad the budget. Quality, while not a significant area for this type of project, will still be considered in terms of the toolkit and its usability in particular. An important area is human resource management, team members must be informed and consistently involved, this needs sufficient communication of the elements within the project, and a team charter, to be guided. A team charter will also help with conflict

management, and clear lines of responsibility. Communication management is of the greatest importance, if highly regarded, it will prevent unnecessary conflict, and misinterpretation amongst the internal team, and the stakeholders (both internal and external). Risk management will be implemented, and continuously updated so that risks, which are no longer applicable, will be removed, and new ones added. Risks may also come in the form of opportunities, and these will be noted, and capitalized on, if feasible. Procurement management will be utilized in this project, as many of the products and services will be externally sourced, and this will be done in conjunction with the organization's internal procurement department. Finally, stakeholder management is as important as communication management. The stakeholder database will need to be updated with changes that pertain to the stakeholder, and this must be done as a part of the actual management of the project, and therefore, should be scheduled.

1.3 Purpose

The development of a complete and formalized PMP for this project is a new step for the organization. It would assist in rationalization of the project and function as a complete pilot study. At this time, the organization is implementing the software, MS Project for project managers and team members, it has initiated an online training course for application, for its employees to use this software, and has identified and shared organizational templates with staff to use for projects which they are working on. Therefore, with this in mind, the PMP for this project can function as a pilot study.

Further, if the project outcomes are achieved, then, benefits as follows may be derived:

- It can be used as a pilot study for future projects.

- The practice of including sufficient contingency into project budgets can improve responses to unexpected crises or opportunities.
- Strengthening organizational structure and administrative capacity can prevent project implementation problems.
- Effective monitoring and control can help when the organization is faced with changes in the project environment, and will help with early identification of problems and prompt positive interjection.
- Improved communication will lead to reduced conflicts amongst stakeholders.
- Better and timely stakeholder involvement, and management will gain stakeholder buy-in and input in the long-term.
- Efficacious outcomes achieved can be used to attest to the organization's ability to manage projects, and hence gain grant funding.

1.4 General objective

To develop a complete project management plan (PMP) framed within the standards of the Project Management Institute, for the Final Graduation Project. This PMP will be relevant to the National Institute of Higher Education, Research, Science and Technology (NIHERST) and the Water Resources Agency (WRA) Water Warrior Educational Toolkit Project, and developed for the initiation and planning phases of the project life cycle. The PMP would function as a pilot study for other water-based projects at NIHERST.

1.5 Specific objectives

1. To create a project management plan and a project charter, to plan, and authorize and initiate the project, using guidance from the PMBOK Guide 6th edition. The PMP will integrate the knowledge areas and provide a

roadmap for the project, and will be done within the second week of the FGP.

2. To develop the scope management plan, requirements documentation, requirements traceability matrix, project scope statement, and scope baseline for the project, using guidance from the PMBOK Guide 6th edition. This will ensure that all the required work, but only the required work is performed, it will be done within the third week of the FGP.

3. To plan and develop the schedule, and to define, sequence, and estimate activities for the project, using guidance from the PMBOK Guide 6th edition. This will therefore allow the project to be managed, and completed in a timely manner, and will be done in the fourth week of the FGP.

4. To develop the cost management plan, cost estimates, basis of estimates, cost baseline, and project funding requirements, using guidance from the PMBOK Guide 6th edition. This will ensure that the project is completed within the project's budget; it will be done within the fifth week of the FGP.

5. To create the quality management plan, and quality metrics for the project, using guidance from the PMBOK Guide 6th edition. This would make certain that the project meets its quality requirements, and will be done within the sixth week of the FGP.

6. To build the resource management plan, team charter, resource requirements, basis of estimates, and resource breakdown structure, using guidance from the PMBOK Guide 6th edition. This will identify the resources needed to successfully complete the project, and will be done within the seventh week of the FGP.

7. To create the communications management plan, using guidance from the PMBOK Guide 6th edition. This would aid in effective information exchange, with the potential stakeholders to minimize conflicts, and will be done within the eighth week of the FGP.

8. To develop a risk management plan, register, and report for the project, using guidance from the PMBOK Guide 6th edition. This will likely optimize the chances of project success, by seeking out opportunities, and taking action to reduce negative risks; it will be done within the ninth week of the FGP.

9. To create the procurement management plan, strategy, bid documents, statement of work, source selection criteria, make-or-buy decisions, and independent cost estimates, using guidance from the PMBOK Guide 6th edition. This will strategically deal with purchases for the project, in an efficient manner, and will be done within the tenth week of the FGP.

10. To develop the stakeholder register and the stakeholder engagement plan for the project, using guidance from the PMBOK Guide 6th edition. This helps to effectively engage stakeholders in making project decisions, and during execution, and will be done within the eleventh week of the FGP.

2   THEORETICAL FRAMEWORK

2.1   Company/Enterprise framework

The PMP is intended to give structure to a project conducted by NIHERST. Currently NIHERST does not fully produce projects under the project management principles stipulated in the PMBOK Guide 6th Edition. The institute itself was established as a statutory body by the Republic of Trinidad and Tobago, act No. 20 of 1984, now Chapter 39:58. NIHERST forms numerous partnerships to implement projects. It receives funding from the Government, but owing to economic hardships in the twin island Republic of Trinidad and Tobago within very recent times, it is now more concerned with seeking grant funding – both locally, and internationally. Apart from its core project management based department, it runs a National Science Centre which serves the public, and out of that, it extends its reaches to the communities throughout both islands, by going into these communities, and hosting workshops, and other outreaches. This National Science Centre also serves the wider Caribbean islands. Therefore, it is imperative that the organisation proves itself with utilizing established project management processes, hence, ensuring a better chance at obtaining and retaining grant funding.

2.1.1   Company/Enterprise background

The institute is built on the ideology of promoting science and technology. The purpose of the institute lies under the foundation of the development of a national Science, Technology, and Innovation policy (STI Policy). According to (UNESCO, n.d.), national institutes can develop STI policies, strategies, and plans by bringing to light policy options for the governance of science systems in new contexts, and supporting participatory policy formulation and/or reviews to aid science management.

As mentioned in the organisation's website, (NIHERST, n.d.), NIHERST is authorized to promote the development of science, and technology and higher education in Trinidad and Tobago, and to enhance the innovative, creative, and entrepreneurial capabilities of the general population. Further, the organisation states its main areas of work, and these are; research and intelligence gathering to shape science policy and guide the funding of research and development (R&D); promotion of innovation and commercialisation of technology in priority areas; engagement in collaborative global relationships; and creation of a culture of science, innovation and entrepreneurship. Additionally, the institute is well aware that public-private partnerships can play a dynamic role in its work.

As such, its overarching key objectives are:

- Research and intelligence gathering in support of economic diversification.
- Promoting innovation and commercialisation of technology in priority areas.
- Building collaborative global relationships.
- Fostering a culture of science, innovation and creativity.
- Positioning NIHERST as a world-class STI institute.

(NIHERST, n.d.)

The PMBOK Guide 6th Edition is a highly recognized guide which provides project managers with the knowledge to pave the path for project success. According to the PMBOK Guide 6th Edition, (PMI, 2017, pg. 1), it includes proven traditional practices that are widely applied. Further, this guide provides innovative practices that are emerging in the profession, (PMI, 2017, pg. 1). Therefore, with this in mind, the use of the guide is a good source of knowledge for developing the PMP for the NIHERST-WRA Water Warriors Educational Toolkit project. The PMP will be a pilot study for the organisation which does not use the guide formally, but

more so, in an inconsistent manner. The approach can be tailored for individual projects, depending on its complexity.

2.1.2 Mission and vision statements

The company's mission statement is:

To provide intellectual leadership and to promote research, development and quality service in the areas of science, technology and higher education.

The institute aspires to (company's vision statements):

- be a focal point for research and information dissemination on S&T and higher education.
- provide advice to the Government on policy and planning in S&T and higher education.
- consolidate and expand its science popularisation activities through the establishment of a National Science Centre of Trinidad and Tobago.
- be an active member of regional and international networks in relevant fields of endeavour in S&T and higher education.

(NIHERST, n.d.)

2.1.3 Organizational structure

The institute's organisation structure is provided below. At this time the organisation is functional rather than projectized. A few departments work solely with projects, as well as processes. These departments, therefore, depend on the other areas such as the human resource department, the procurement department, the accounts department, and others in order to conduct its projects. Within the departments which deal with projects, there are employees who function as project managers, and report to a senior head of department, however, all functions within the department relies on the external departments to perform its role. As such, the

organisational structure provided below will give a clearer understanding of what departments will be consulted during the project's phases
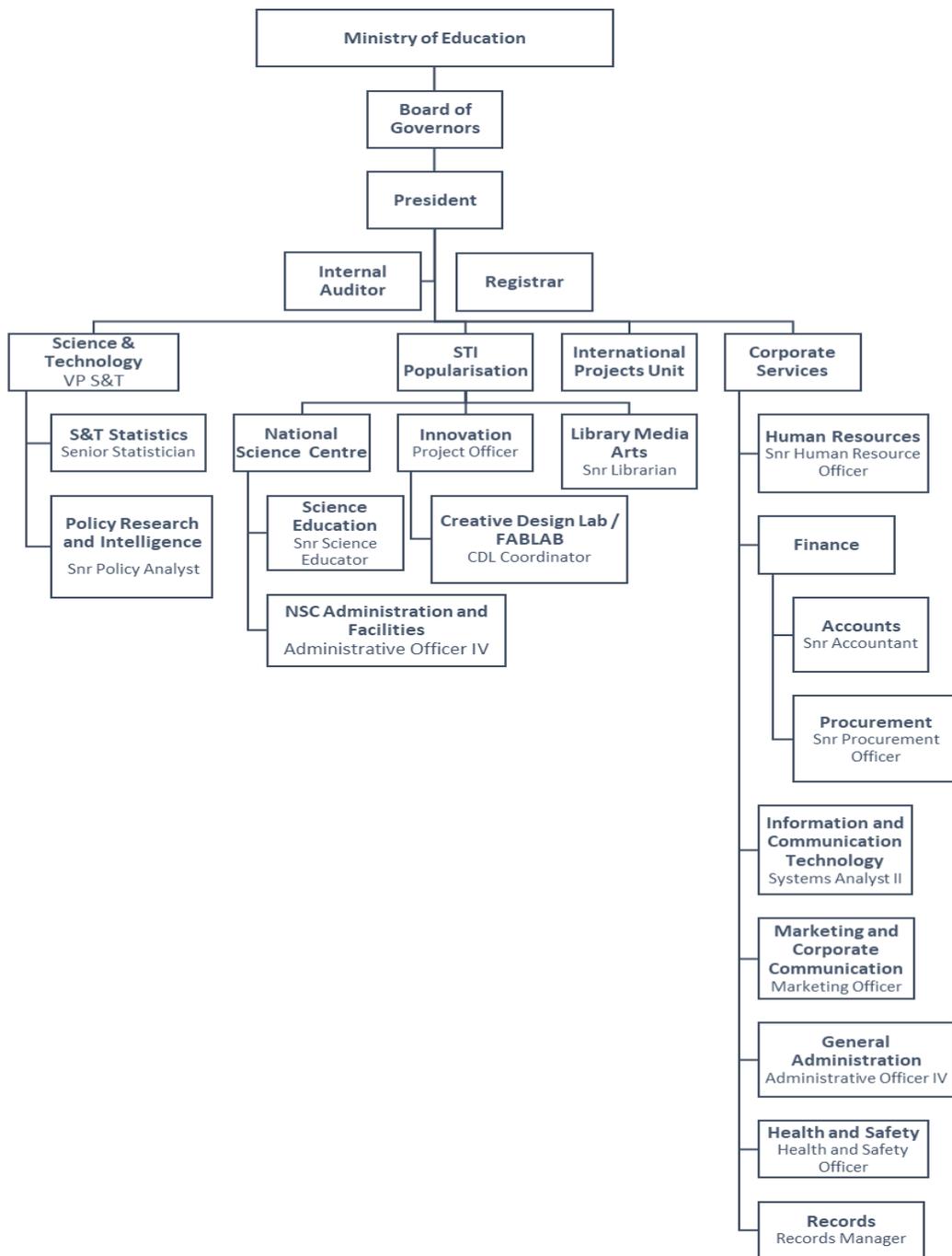
Figure 1: Organisational structure, (NIHERST, n.d)

2.1.4 Products offered

The organisation offers services to members of the public. These services are categorized as awards, camps, workshops, and clubs, amongst others.

The institute hosts school and family visits to the NIHERST/National Gas Company National Science Centre to provide knowledge and show experiences in science and technology in-house through hands-on science exhibitions, but also through workshops, seminars, competitions, vacation camps, travelling exhibitions, magazines, and biennial festivals.

It hosts public events called 'Sci-TechKnoFest' biennially, the maiden event happened in 1997, after which there were seven (7) subsequent events.

In 2003, the institute arranged a 'Community Science Week' which was a special, unique, and tailored annual event intended to make science and technology more reachable to rural communities. This event includes interactive exhibits, workshops, lectures, and entertainment geared directly to residents. At times, the event is held in the school for primary school students, and the topic covered is pulled from the school syllabus – it is often a topic which the student has difficulty in understanding. There may be public-private partnership arrangements for this type of service. A special feature of this initiative is how the institute captures special unique attributes of the rural community which was visited for inclusion on another project called the 'Science for All' documentary series which is aired on national television.

The biannual vacation camps are held for students, and targets a broad range of science concepts which are related to the local school curriculum. Then there is the 'i-STEM Science Club' which helps older students to transition to the world of working adults, in terms of technology-based concepts and subjects, such as robotics and 'gamification'.

The institute hosts two major award giving ceremonies. The first is the Prime Minister's Awards for Scientific Ingenuity which began in 2000. It has been held intermittently on 6 different occasions since. This project awards creative ideas, for

scientific innovation and invention, and scientific creative solutions for both juniors and seniors. Secondly, the awards for excellence in science and technology were held for three (3) consecutive years and began in 2012. It aimed to recognise and reward nationals for outstanding achievements in science and technology, to provide positive role models for youth to emulate, and to record scientific heritage, according to (NIHERST, n.d.). Apart from these two more historic awards, there is the globally recognised First Lego League competition which NIHERST hosts in Trinidad and Tobago for local participants.

Another service provided by the institute is library service; the NIHERST Documentation Centre offers several science related articles, books, and references to the public upon entry to the National Science Centre compound.

More modern offerings are shown in the chart below:

Chart 1: Categories of work performed by NIHERST and its relative projects, (NIHERST, n.d).

Category	Project Name
Internships and scholarships	• NASA International Internship • NYSC Scholarships • International Centre for Genetic Engineering and Biotechnology (ICGEB) opportunity
Exhibitions and Events	• Institute of Electrical and Electronic Engineers (IEEE) Trinidad and Tobago Section Exhibit • Caribbean Youth Science Forum
School Based Interventions	• Improving Innovation Capacities in the Caribbean – INVOCAB

	project. • Community Design & Innovation (COMDESI) • Seismology in schools • Youth build • Microscience TT • Water Warriors Educational Toolkit
Caribbean Icons in Science, Technology and Innovation	A Publication
Environmental Solutions Project	-For the implementation of rain water harvesting systems in rural communities via schools and community centres
Research and Intelligence Gathering	• Sectorial innovation mapping • S&T policy • STI statistics • S&T research database TT • STI conferences
Resources	• Videos (Science for All, Disaster Awareness, Natural Wonders, Icons, other) • Publications • Eco-Ribbean • Releases

	• Presentations
Other	• Science Whizz
	• Science Music Video Competition

2.2 Project Management Concepts

2.2.1 Project

According to the International Project Management Association (IPMA), there are three (3) qualities to consider when it comes to achieving excellence in projects, these are: people and purpose – the foundation for excellence, processes, and resources – reinforcement of excellence; and project results – proof of excellence, (IPMA, n.d). The PMBOK Guide 6th Edition states that 'a project is a temporary endeavour undertaken to create a unique product, service, or result,' (PMI, 2017, pg. 4). Further, a project is a temporary endeavour, with a definite beginning and end, sometimes a project will create deliverables of a social, economic, material, or environmental nature, (PMI, 2017, pg. 5). Projects drive change, and this is described as the future state, (PMI, 2017, pg. 6). Projects enable business value creation, which is described by PMI as the net quantifiable benefit derived, and may be tangible, or intangible, (PMI, 2017, pg. 7). A project is unique, and therefore, according to the PMI website, (PMI, n.d.) a project team often includes other stakeholders who do not normally work together, and may be from different organisations, across multiple geographies, hence, not making it a routine operation.

2.2.2 Project management

The creation and approval of the PMP, according to (King, S., 3 July 2017), is a significant milestone, because at this point the project team starts the work necessary for filtering the summary-level scope of the project charter into agreed-

upon requirements. The PMBOK Guide 6th Edition, states that 'project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management is accomplished through the appropriate application and integration of the project management processes identified for the project,' (PMI, 2017, pg. 10). There are benefits to effective project management, according to the PMBOK Guide 6th Edition, these are that it meets business objectives; satisfies stakeholder expectations; allows for predictability; increases chance of success; delivers the right products at the right time; resolves problems and issues; responds to risks in a timely manner; optimizes the use of organizational resources; identifies, recovers, or terminates failing projects; manages constraints; balances the influence of constraints on the project; and manages change in a better manner, (PMI, 2017, pg. 10). Additionally, the PMBOK Guide 6th Edition mentions that effective and efficient project management should be considered a strategic competency within organisations, (PMI, 2017, pg. 11). Both project and process management can be utilized to advance the work of ensuring that stakeholders are given value in the completion of a project, because both of these are complementary and therefore, can mitigate weaknesses in a functional organisation, such as NIHERST, since both roles are capable of performing horizontal management responsibilities according to (Dauphinee, J & Vercio, A., 20 Jul 2018). NIHERST is currently reviewing its strategic direction, thus, the implementation of formalized project management process can supplement the way the organisation functions. Adequate project management that has a strong foundation, according to (Government of Dubai, n.d.) is important to leverage game changing technologies and solutions, so that businesses, the economy, and governments can improve its chances of having greater success.

The PMP is made up of a few components, according to Ray, S. (24 May, 2017), these are: project phases, schedule of activities, tasks, duration, dependencies, resources, timeframes, budget, team assembly, and monitoring progress. Further,

Ray, S. (24 May, 2017) highlights the three main parts of a project plan: the activities, tasks, and resources. The project management plan, according to (PMI, 2017, pg. 34), 'is defined as the document that describes how the project will be executed, monitored, and controlled.' Developing the PMP is a process, which involves '…defining, preparing, and coordinating all plan components and consolidating them into an integrated project management plan,' (PMI, 2017, pg. 82). Further, (PMI, 2017, pg. 82) states that the outcome is the PMP, and it is a comprehensive document that defines the basis of all project work and how that work will be performed. It is important to note that the PMP includes subsidiary management plans, baselines, and other information necessary to manage the project, (PMI, 2017, pg. 86).

2.2.3 Project life cycle

Project life cycles are models, according to (Bonnal, P., Gourc, D., & Lacoste, G., 2002), further (Bonnal, P., Gourc, D., & Lacoste, G., 2002) mention that the purpose of the life cycle is to explain the real world in a simpler and understandable way, and to find something in common between all projects. Basically, according to the PMBOK Guide 6th Edition, projects can be applied to a generic life cycle, (PMI, 2017, pg. 19), see figure below taken from the PMBOK Guide 6th Edition. The PMBOK Guide 6th Edition states that 'a project life cycle is the series of phases that a project passes through from its start to its completion,' (PMI, 2017, pg. 19), further, it mentions that it is a basic framework for project management. It includes starting the project, organising and preparing, carrying out the work, and ending the project, as visually shown in the figure below.
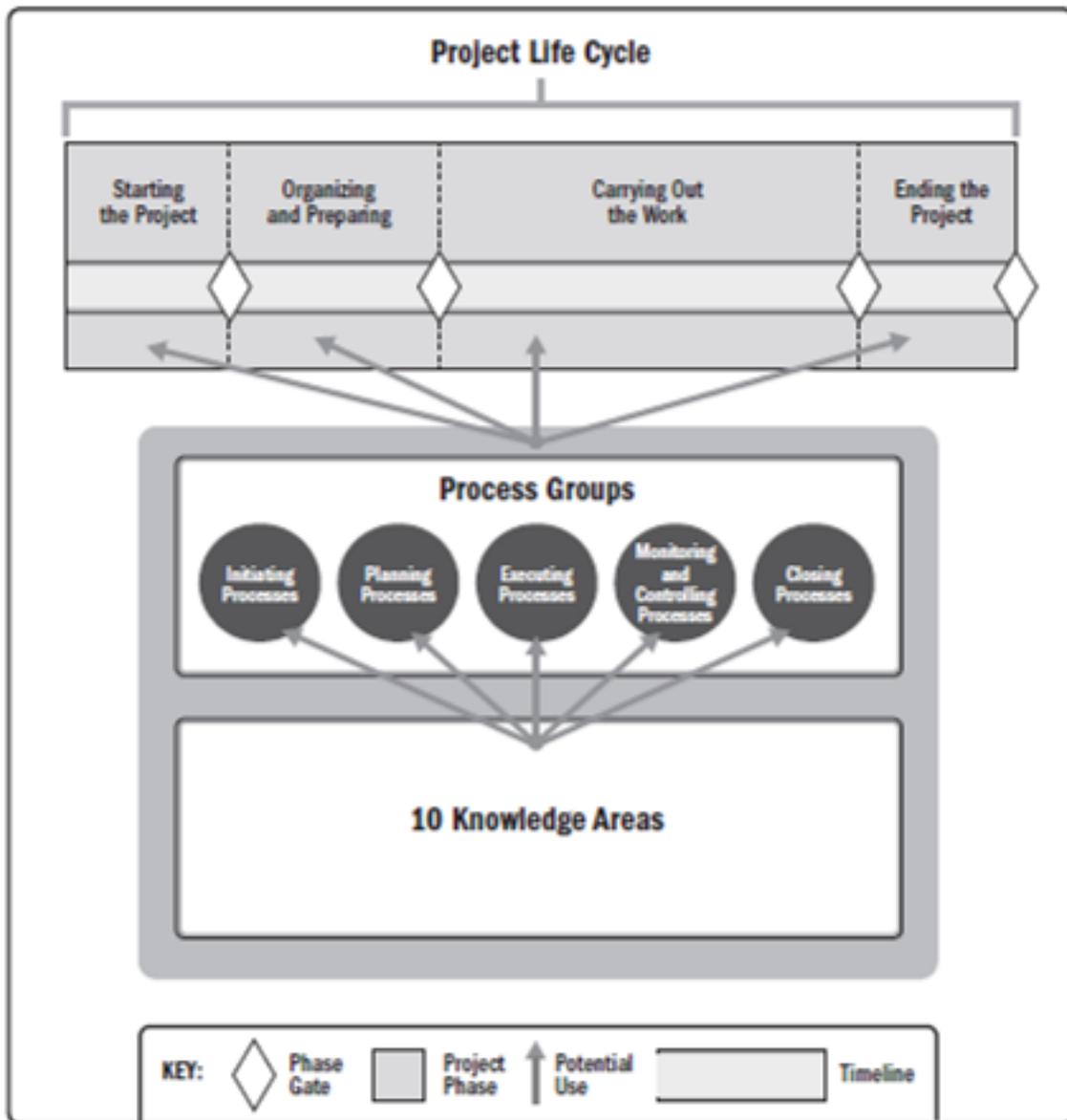
Figure 1-5. Interrelationship of *PMBOK® Guide* Key Components in Projects

Figure 2: PMBOK® Guide, Interrelationship of PMBOK Guide Key Components in Projects. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 18), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by PMI, Inc.

2.2.4 Project management processes

It is suggested by (Svetlana Cicmil, P., 2009), that to define and conceptualize project complexity, building blocks of a project needs to be clearly defined, and these include individual and group relationships, individual and group cohesion, definition of key performance indicators, and sources of project failure, (Svetlana Cicmil, P., 2009). However, (Svetlana Cicmil, P., 2009) mentions that what is referred to as the *'golden triangle'* - (project deadline, budget, and output) can cause project management processes, skills, and knowledge to be inconsistent and separated from actual practice. The PMBOK Guide 6th Edition describes very specifically the project management processes; it states that:

> the project life cycle is managed by executing a series of project management activities known as project management processes. Every project management process produces one or more outputs from one or more inputs by using appropriate project management tools and techniques. The output can be a deliverable or an outcome. Outcomes are an end result of a process. Project management processes apply globally across industries, (PMI, 2017, pg. 22).

Further to this, outputs are key, since it is the outputs which links the project management process, (PMI, 2017, pg. 22). As such, the output of one process generally results in either, an input to another process, or a deliverable of the project or project phase, (PMI, 2017, pg. 22). Processes typically fall into one of the three categories shown in the figure below.

- ◆ **Processes used once or at predefined points in the project.** The processes *Develop Project Charter and Close Project or Phase* are examples.

- ◆ **Processes that are performed periodically as needed.** The process *Acquire Resources* is performed as resources are needed. The process *Conduct Procurements* is performed prior to needing the procured item.

- ◆ **Processes that are performed continuously throughout the project.** The process *Define Activities* may occur throughout the project life cycle, especially if the project uses rolling wave planning or an adaptive development approach. Many of the monitoring and control processes are ongoing from the start of the project, until it is closed out.

Figure 3: PMBOK® Guide, Categories that process typically fall into. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 22), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

There are the project management process groups; these are logical groupings of project management processes to achieve specific project objectives, (PMI, 2017, pg. 23). It should be noted that the PMBOK Guide 6th Edition states that process groups are independent from project phases. Finally, the project management processes are composed of five groups. The process groups are initiating; planning; executing; monitoring and controlling; and closing. The figure below shows a description of each.

- ◆ **Initiating Process Group.** Those processes performed to define a new project or a new phase of an existing project by obtaining authorization to start the project or phase.

- ◆ **Planning Process Group.** Those processes required to establish the scope of the project, refine the objectives, and define the course of action required to attain the objectives that the project was undertaken to achieve.

- ◆ **Executing Process Group.** Those processes performed to complete the work defined in the project management plan to satisfy the project requirements.

- ◆ **Monitoring and Controlling Process Group.** Those processes required to track, review, and regulate the progress and performance of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes.

- ◆ **Closing Process Group.** Those processes performed to formally complete or close the project, phase, or contract.

Figure 4: PMBOK® Guide, Process Groups Description. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 23), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

2.2.5 Project management knowledge areas

The project management knowledge areas are identified areas of project management defined by knowledge requirements and described in terms of its sub sector processes, practices, inputs, outputs, tools, and techniques, (PMI, 2017, pg. 23). There are ten knowledge areas, which are elaborated on below, in accordance with the PMI Guide 6th Edition.

2.2.5.1 Project integration management

Project integration management falls into each of the project management process groups. The components for this project will be developing the project charter and developing the project management plan. The PMI provides the following definition for project integration management, '…includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups. In the project management context, integration includes characteristics of unification, consolidation, communication, and interrelationship'. Chart 2, below shows the integration knowledge area, and how it relates to the five projects management process groups.

Chart 2: Integration knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project	4.1	4.2 Develop	4.3 Direct	4.5 Monitor	4.7 Close

integration management	Develop project charter	project management plan	and manage project work 4.4 Manage project knowledge	and control project work 4.6 Perform integrated change control	project or phase

The PMBOK Guide 6th Edition describes each of the processes as excerpted and shown in the figure below:

The Project Integration Management processes are:

4.1 Develop Project Charter—The process of developing a document that formally authorizes the existence of a project and provides the project manager with the authority to apply organizational resources to project activities.

4.2 Develop Project Management Plan—The process of defining, preparing, and coordinating all plan components and consolidating them into an integrated project management plan.

4.3 Direct and Manage Project Work—The process of leading and performing the work defined in the project management plan and implementing approved changes to achieve the project's objectives.

4.4 Manage Project Knowledge—The process of using existing knowledge and creating new knowledge to achieve the project's objectives and contribute to organizational learning.

4.5 Monitor and Control Project Work—The process of tracking, reviewing, and reporting overall progress to meet the performance objectives defined in the project management plan.

4.6 Perform Integrated Change Control—The process of reviewing all change requests; approving changes and managing changes to deliverables, organizational process assets, project documents, and the project management plan; and communicating the decisions.

4.7 Close Project or Phase—The process of finalizing all activities for the project, phase, or contract.

Figure 5: PMBOK® Guide, Project Integration Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 70), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

For the two processes that will be pursued for the PMP, the outputs of 4.1 Develop project charter are: the Project Charter and the Assumption Log. And for the other process, 4.2 Develop Project Management Plan, the output is the PMP. The PMP contains the subsidiary management plans, the baselines, and other additional components. The PMBOK Guide demonstrates which project documents relate to the PMP, see figure below:

Table 4-1. Project Management Plan and Project Documents

Project Management Plan	Project Documents	
1. Scope management plan	1. Activity attributes	19. Quality control measurements
2. Requirements management plan	2. Activity list	20. Quality metrics
3. Schedule management plan	3. Assumption log	21. Quality report
4. Cost management plan	4. Basis of estimates	22. Requirements documentation
5. Quality management plan	5. Change log	23. Requirements traceability matrix
6. Resource management plan	6. Cost estimates	24. Resource breakdown structure
7. Communications management plan	7. Cost forecasts	25. Resource calendars
8. Risk management plan	8. Duration estimates	26. Resource requirements
9. Procurement management plan	9. Issue log	27. Risk register
10. Stakeholder engagement plan	10. Lessons learned register	28. Risk report
11. Change management plan	11. Milestone list	29. Schedule data
12. Configuration management plan	12. Physical resource assignments	30. Schedule forecasts
13. Scope baseline	13. Project calendars	31. Stakeholder register
14. Schedule baseline	14. Project communications	32. Team charter
15. Cost baseline	15. Project schedule	33. Test and evaluation documents
16. Performance measurement baseline	16. Project schedule network diagram	
17. Project life cycle description	17. Project scope statement	
18. Development approach	18. Project team assignments	

Figure 6: PMBOK® Guide, Project management plan and processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 89), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

2.2.5.2 Project scope management

Project scope management, according to the PMBOK Guide 6th Edition is 'the processes required to ensure that the project includes all the work required, and

only the work required, to complete the project successfully,' (PMI, 2017, Pg. 129). It falls into the planning process group, and the monitoring and controlling process group. For the purpose of the PMP, the processes which will be implemented fall within the planning process group are: 5.1 plan scope management; 5.2 collect requirements; 5.3 define scope; 5.4 create work breakdown structure (WBS). Chart 3 below shows the scope knowledge area, and how it relates to the five project management process groups:

Chart 3: scope knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Scope Management		5.1 Plan scope management 5.2 Collect requirements 5.3 Define scope 5.4 Create WBS		5.5 Validate scope 5.6 Control scope	

The PMBOK Guide 6th Edition describes each of the processes as excerpted, and shown in the figure below:

The Project Scope Management processes are:

5.1 Plan Scope Management—The process of creating a scope management plan that documents how the project and product scope will be defined, validated, and controlled.

5.2 Collect Requirements—The process of determining, documenting, and managing stakeholder needs and requirements to meet project objectives.

5.3 Define Scope—The process of developing a detailed description of the project and product.

5.4 Create WBS—The process of subdividing project deliverables and project work into smaller, more manageable components.

5.5 Validate Scope—The process of formalizing acceptance of the completed project deliverables.

5.6 Control Scope—The process of monitoring the status of the project and product scope and managing changes to the scope baseline.

Figure 7: PMBOK® Guide, Project Scope Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 129), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

For the four processes which will be formulated in the PMP, the outputs for 5.1 plan scope management are the scope management plan, and the requirements management plan. The outputs for process group 5.2 collect requirements are the requirements documentation, and the requirements traceability matrix. The output for process group 5.3 define scope is the project scope statement. And the output for process group 5.4 create WBS is the scope baseline. The scope baseline contains the approved version of a scope statement, WBS, and its associated WBS dictionary, (PMI, 2017, pg. 161).

2.2.5.3 Project schedule management

Project schedule management, according to the PMBOK Guide 6th Edition 'includes the processes required to manage the timely completion of the project,' (PMI, 2017, pg. 173). It falls into both the planning process group and the

monitoring and controlling process group. In developing this PMP, the processes to be utilized are: 6.1 plan schedule management; 6.2 define activities; 6.3 sequence activities; 6.4 estimate activity durations; and 6.5 develop schedule. Chart 4 below shows the schedule knowledge area, and how it relates to the five project management process groups:

Chart 4: Schedule knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Schedule Management		6.1 plan schedule management 6.2 define activities 6.3 sequence activities 6.4 estimate activity durations 6.5 develop schedule		6.6 Control Schedule	

The PMBOK Guide 6th Edition describes each of the processes as excerpted, and shown in the figure below:

The Project Schedule Management processes are:

6.1 Plan Schedule Management—The process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.

6.2 Define Activities—The process of identifying and documenting the specific actions to be performed to produce the project deliverables.

6.3 Sequence Activities—The process of identifying and documenting relationships among the project activities.

6.4 Estimate Activity Durations—The process of estimating the number of work periods needed to complete individual activities with the estimated resources.

6.5 Develop Schedule—The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model for project execution and monitoring and controlling.

6.6 Control Schedule—The process of monitoring the status of the project to update the project schedule and manage changes to the schedule baseline.

Figure 8: PMBOK® Guide, Project Schedule Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 173), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

The five (5) processes which will be carried out for this knowledge area for the purpose of the PMP each have outputs. The output for 6.1 plan schedule management is the schedule management plan. The outputs for the 6.2 define activities are the activity list; activity attributes; and milestone list. The output for 6.3 sequence activities is any project schedule network diagrams. The outputs for 6.4 estimate activity durations are the duration estimates; and basis of estimates. The outputs for 6.5 develop schedule are the; schedule baseline; project schedule; schedule data; and project calendars.

2.2.5.4 Project cost management

Project cost management, according to the PMBOK Guide 6th Edition, 'includes the processes involved in planning, estimating, budgeting, financing, funding,

managing, and controlling costs so that the project can be completed within the approved budget,' (PMI, 2017, pg. 231). It falls into two process groups: the planning process group, and the monitoring and controlling process group. For the PMP, the planning process group will be developed. These are 7.1 plan cost management; 7.2 estimate costs; and 7.3 determine budget. Chart 5 below shows the cost knowledge area, and how it relates to the five project management process groups:

Chart 5: Cost knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Cost Management		7.1 plan cost management 7.2 estimate costs 7.3 determine budget		7.4 Control costs	

The PMBOK Guide 6th Edition describes each of the processes as excerpted, and shown in the figure below:

managing, and controlling costs so that the project can be completed within the approved budget. The Project Cost Management processes are:

7.1 Plan Cost Management—The process of defining how the project costs will be estimated, budgeted, managed, monitored, and controlled.

7.2 Estimate Costs—The process of developing an approximation of the monetary resources needed to complete project work.

7.3 Determine Budget—The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.

7.4 Control Costs—The process of monitoring the status of the project to update the project costs and manage changes to the cost baseline.

Figure 9: PMBOK® Guide, Project Cost Management Processes. Reprinted from A Guide to the Project Management Body of Knowledge (p. 231), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

The three (3) processes which will be carried out for this knowledge area for the purpose of the PMP each have outputs. The output for 7.1 plan cost management is the cost management plan. The outputs for 7.2 estimate costs are the cost estimates; and basis of estimates. And the outputs for 7.3 determine budget are the cost baseline, and project funding requirements. The figure below shows the project budget components, it guides a visual display of the parts that make up the project budget.
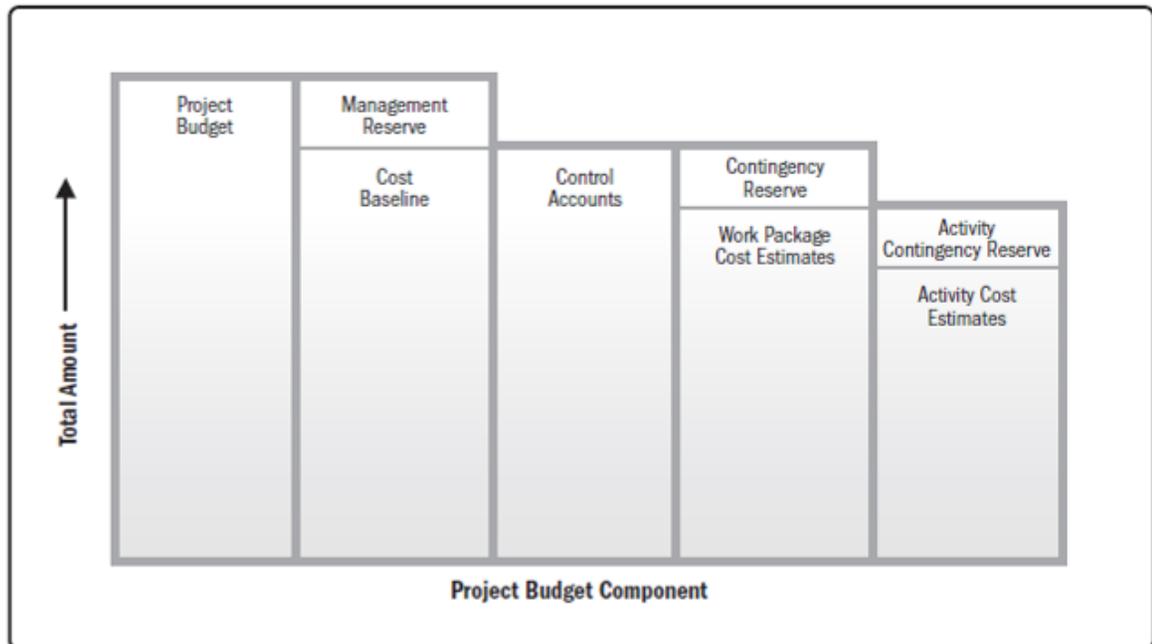
Figure 7-8. Project Budget Components

Figure 10: PMBOK® Guide Project Budget Components. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 255), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

2.2.5.5 Project quality management

Project quality management, according to the PMBOK Guide 6th Edition, 'includes the processes for incorporating the organization's quality policy regarding planning, managing, and controlling project and product quality requirements in order to meet stakeholders' objectives,' (PMI, 2017,pg 271). It falls into three of the process groups, the planning process group, the executing process group, and the monitoring and controlling process group. For the purpose of the PMP, the process within the planning process group will be developed. The process for the planning process group is 8.1 plan quality management. Chart 6 below shows the quality knowledge area, and how it relates to the five project management process groups:

Chart 6: Quality knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Quality Management		8.1 Plan quality management	8.2 Manage Quality	8.3 Control Quality	

The PMBOK Guide 6th Edition describes each of the processes as excerpted, and shown in the figure below:

The Project Quality Management processes are:

8.1 Plan Quality Management—The process of identifying quality requirements and/or standards for the project and its deliverables, and documenting how the project will demonstrate compliance with quality requirements and/ or standards.

8.2 Manage Quality—The process of translating the quality management plan into executable quality activities that incorporate the organization's quality policies into the project.

8.3 Control Quality—The process of monitoring and recording the results of executing the quality management activities to assess performance and ensure the project outputs are complete, correct, and meet customer expectations.

Figure 11: PMBOK® Guide, Project Quality Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 271), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

The process that will be developed for the PMP is the 8.1 plan quality management, the outputs for this process group are the quality management plan and quality metrics.

2.2.5.6 Project resource management

Project Resource Management, according to the PMBOK Guide 6th Edition, 'includes the processes to identify, acquire, and manage the resources needed for the successful completion of the project', (PMI, 2017, pg. 307). It falls within three (3) process groups: the planning process group, the executing process group, and the monitoring and controlling process group. For this PMP, the planning process group will be developed. The processes in the planning process group are 9.1 plan resource management and 9.2 estimate activity resources. Chart 7 below shows the resource knowledge area, and how it relates to the five project management process groups:

Chart 7: Resource knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Resource Management		9.1 Plan resource management 9.2 Estimate activity	9.3 Acquire resources 9.4 Develop	9.6 Control resources	

		resources	team		
			9.5 Manage team		

The PMBOK Guide 6th Edition describes each of the processes as excerpted, and shown in the figure below:

The Project Resource Management processes are:

9.1 Plan Resource Management—The process of defining how to estimate, acquire, manage, and utilize physical and team resources.

9.2 Estimate Activity Resources—The process of estimating team resources and the type and quantities of material, equipment, and supplies necessary to perform project work.

9.3 Acquire Resources—The process of obtaining team members, facilities, equipment, materials, supplies, and other resources necessary to complete project work.

9.4 Develop Team—The process of improving competencies, team member interaction, and the overall team environment to enhance project performance.

9.5 Manage Team—The process of tracking team member performance, providing feedback, resolving issues, and managing team changes to optimize project performance.

9.6 Control Resources—The process of ensuring that the physical resources assigned and allocated to the project are available as planned, as well as monitoring the planned versus actual use of resources, and performing corrective action as necessary.

Figure 12: PMBOK® Guide Project Resource Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 307), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

The two (2) processes that will be developed for the resource management process have both outputs. The outputs for 9.1 plan resource management are the resource management plan, and team charter. The resource management plan, may include identification of resources; acquiring resources; roles and responsibilities; project organisation charts; project team resource management;

training strategies; methods of team development; resource control methods; and recognition plan to reward team members, (PMI, 2017, pg. 318-319). The outputs for 9.2 estimate activity resources are resource requirements, basis of estimates, and resource breakdown structure.
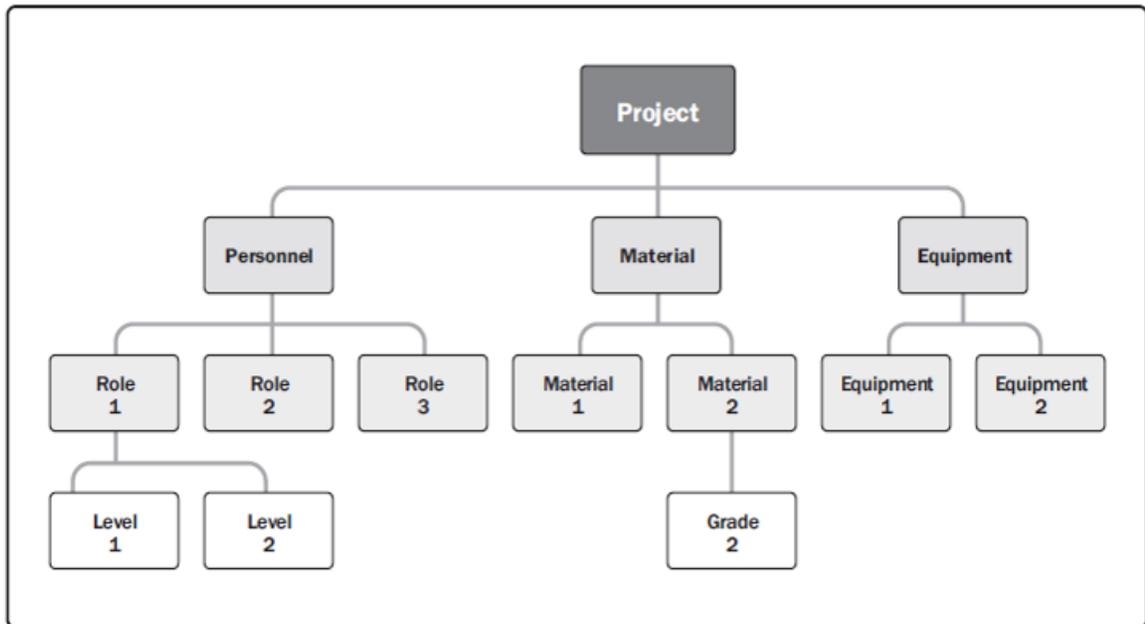
Figure 9-7. Sample Resource Breakdown Structure

Figure 13: PMBOK® Guide, Sample Resource Breakdown Structure. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 327), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

2.2.5.7 Project communications management

Project communications management, according to the PMBOK Guide 6th Edition, 'includes the processes necessary to ensure that the information needs of the project and its stakeholders are met through development of artefacts and implementation of activities designed to achieve effective information exchange,' (PMI, 2017, pg. 359). It falls into three (3) project management process groups; they are the planning process group, the executing process group and the

monitoring and controlling process group. For this knowledge area the process group which will be developed, in the planning process group is 10.1 plan communication management. Chart 8 below shows the communications knowledge area, and how it relates to the five project management process groups:

Chart 8: Communications knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Communications Management		10.1 Plan communications management	10.2 Manage communications	10.3 Monitor communications	

The PMBOK Guide 6th Edition describes each of the processes as excerpted, and shown in the figure below:

The Project Communications Management processes are:

10.1 Plan Communications Management—The process of developing an appropriate approach and plan for project communication activities based on the information needs of each stakeholder or group, available organizational assets, and the needs of the project.

10.2 Manage Communications—The process of ensuring timely and appropriate collection, creation, distribution, storage, retrieval, management, monitoring, and the ultimate disposition of project information.

10.3 Monitor Communications—The process of ensuring the information needs of the project and its stakeholders are met.

Figure 14: PMBOK® Guide, Project Communications Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 359), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by PMI, Inc.

The process that will be developed for this knowledge group, 10.1 plan communications management has one (1) output: the communications management plan. The communications management plan has the following components, (PMI, 2017, pg. 377):

- Stakeholder communication requirements;
- Information to be communicated, including language, format, content, and level of detail;
- Escalation processes;
- Reason for the distribution of that information;
- Timeframe and frequency for the distribution of required information and receipt of acknowledgment or response, if applicable;
- Person responsible for communicating the information;
- Person responsible for authorizing release of confidential information;
- Person or groups who will receive the information, including information about their needs, requirements, and expectations;
- Methods or technologies used to convey the information, such as memos, email, press releases, or social media;
- Resources allocated for communication activities, including time and budget;
- Method for updating and refining the communications management plan as the project progresses and develops, such as when the stakeholder community changes as the project moves through different phases;
- Glossary of common terminology;
- Flow charts of the information flow in the project, workflows with possible sequence of authorization, list of reports, meeting plans, etc.; and
- Constraints derived from specific legislation or regulation, technology, organizational policies, etc.

(PMI, 2017, pg. 377)

2.2.5.8 Project risk management

Project risk management, according to the PMBOK Guide 6th Edition, 'includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project,' (PMI, 2017, pg. 395). It falls into three (3) project management process groups. For the FGP, the processes within the planning process group would be developed. These processes are 11.1 plan risk management; 11.2 identify risks; 11.3 perform qualitative risk analysis; 11.4 perform quantitative risk analysis; and 11.5 plan risk responses. Chart 9 below shows the risk knowledge area, and how it relates to the five project management process groups:

Chart 9: Risk knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Risk Management		11.1 Plan risk management 11.2 Identify risks 11.3 Perform qualitative risk analysis 11.4 Perform	11.6 Implement risk responses	11.7 Monitor risks	

		quantitative risk analysis 11.5 Plan risk responses			

The PMBOK Guide 6th Edition describes each of the processes as excerpted and shown in the figure below:

The Project Risk Management processes are:

11.1 Plan Risk Management—The process of defining how to conduct risk management activities for a project.

11.2 Identify Risks—The process of identifying individual project risks as well as sources of overall project risk, and documenting their characteristics.

11.3 Perform Qualitative Risk Analysis—The process of prioritizing individual project risks for further analysis or action by assessing their probability of occurrence and impact as well as other characteristics.

11.4 Perform Quantitative Risk Analysis—The process of numerically analyzing the combined effect of identified individual project risks and other sources of uncertainty on overall project objectives.

11.5 Plan Risk Responses—The process of developing options, selecting strategies, and agreeing on actions to address overall project risk exposure, as well as to treat individual project risks.

11.6 Implement Risk Responses—The process of implementing agreed-upon risk response plans.

11.7 Monitor Risks—The process of monitoring the implementation of agreed-upon risk response plans, tracking identified risks, identifying and analyzing new risks, and evaluating risk process effectiveness throughout the project.

Figure 15: PMBOK® Guide, Project Risk Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 395), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

The processes that will be developed for the FGP planning process group each have outputs. The output for 11.1 plan risk management is the risk management plan. The outputs for 11.2 identify risks are the risk register and risk report. There are no specific outputs for 11.3 perform qualitative risk analysis, 11.4 perform quantitative risk analysis, and 11.5 plan risk responses - only updates, and change

requests, which are applicable in several knowledge areas and its processes; this will be duly noted throughout the development of the FGP.

2.2.5.9 Project procurement management

Project procurement management, according to the PMBOK Guide 6th Edition, 'includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team,' (PMI, 2017, 459). This knowledge area falls into three (3) project management process groups: the planning process group; executing process group; and the monitoring and controlling process group. For the purpose of the PMP the planning process group will be utilized. Chart 10 below shows the procurement knowledge area, and how it relates to the five project management process groups:

Chart 10: Procurement knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Procurement Management		12.1 Plan procurement management	12.2 Conduct procurements	12.3 Control procurements	

The PMBOK Guide 6th Edition describes each of the processes as excerpted, and shown in the figure below:

Project Procurement Management processes include the following:

12.1 Plan Procurement Management—The process of documenting project procurement decisions, specifying the approach, and identifying potential sellers.

12.2 Conduct Procurements—The process of obtaining seller responses, selecting a seller, and awarding a contract.

12.3 Control Procurements—The process of managing procurement relationships, monitoring contract performance, making changes and corrections as appropriate, and closing out contracts.

Figure 16: PMBOK® Guide, Project Procurement Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 459), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

The process that is applicable for the FGP is the planning process group. The process in the planning group is 12.1 plan procurement management which has several outputs; they are the procurement management plan; procurement strategy; bid documents; procurement statement of work; source selection criteria; make-or-buy decisions; and independent cost estimates. Below is a figure, taken from the PMBOK Guide 6th Edition, it is a comparison of procurement documentation.

Table 12-1. Comparison of Procurement Documentation

Procurement Management Plan	Procurement Strategy	Statement of Work	Bid Documents
How procurement work will be coordinated and integrated with other project work, particularly with resources, schedule, and budget	Procurement delivery methods	Description of the procurement item	Request for information (RFI), Request for quote (RFQ), Request for proposal (RFP)
Timetable for key procurement activities	Type of agreements	Specifications, quality requirements and performance metrics	
Procurement metrics to manage the contract	Procurement phases	Description of collateral services required	
Responsibilities of all stakeholders		Acceptance methods and criteria	
Procurement assumptions and constraints		Performance data and other reports required	
Legal jurisdiction and currency used for payment		Quality	
Information on independent estimates		Period and place of performance	
Risk management issues		Currency; payment schedule	
Prequalified sellers, if applicable		Warranty	

Figure 17: PMBOK® Guide, Comparison of Procurement Documentation. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 481), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

2.2.5.10 Project stakeholder management

Project stakeholder management, according to the PMBOK Guide 6th Edition, includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyse stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution, (PMI, 2017, pg. 503).

This knowledge area falls into four (4) of the project management process groups: the initiating process group; the planning process group; the executing process group; and the monitoring and controlling process group. For the purpose of the PMP the processes which fall into the initiating process group and the planning

process group are applicable. Chart 11 below shows the stakeholder knowledge area, and how it relates to the five project management process groups:

Chart 11: Stakeholder knowledge area, and how it relates to the five project management process groups

Knowledge Area	Project Management Process Groups				
	Initiating process group	Planning process group	Executing process group	Monitoring and controlling process group	Closing process group
Project Stakeholder Management	13.1 Identify stakeholders	13.2 Plan stakeholder engagement	13.3 Manage stakeholder engagement	13.4 Monitor stakeholder engagement	

The PMBOK Guide 6th Edition describes each of the processes as excerpted, and shown in the figure below:

The Project Stakeholder Management processes are:

13.1 **Identify Stakeholders**—The process of identifying project stakeholders regularly and analyzing and documenting relevant information regarding their interests, involvement, interdependencies, influence, and potential impact on project success.

13.2 **Plan Stakeholder Engagement**—The process of developing approaches to involve project stakeholders based on their needs, expectation, interests, and potential impact on the project.

13.3 **Manage Stakeholder Engagement**—The process of communicating and working with stakeholders to meet their needs and expectations, address issues, and foster appropriate stakeholder engagement involvement.

13.4 **Monitor Stakeholder Engagement**—The process of monitoring project stakeholder relationships and tailoring strategies for engaging stakeholders through the modification of engagement strategies and plans.

Figure 18: PMBOK® Guide, Project Stakeholder Management Processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 503), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

The processes that will be developed for the FGP planning process group each have outputs. The initiating process group and the planning process group will be utilized. The output for 13.1 identify stakeholders is the stakeholder register. The stakeholder register includes identification information, assessment information, and stakeholder classification, (PMI, 2017, pg. 514). The output for 13.2 plan stakeholder engagement is the stakeholder engagement plan. The PMBOK Guide 6th Edition states that the stakeholder engagement plan includes specific strategies or approaches for engaging individuals or groups of stakeholders, (PMI, 2017, pg. 522).

2.3 Other Applicable Theory/Concepts Related to the Project Topic and Context

2.3.1 The standard for project management

It should be recognized that the PMBOK Guide 6th Edition also includes a Part II 'The Standard for Project Management.' According to (PMI, 2017, pg. 2), the standard identifies the processes that are considered good practices on most projects, most of the time, and the inputs and outputs that are usually associated with those processes.

2.3.2 Code of ethics and professional conduct

The Code of Ethics and Professional Conduct assists Project Managers with making wise decisions in challenging situations, and especially when a Project Manager's integrity is at stake, (PMI, 2017, pg. 3).

2.3.3 European Union (EU) LIFE Programme

The EU's website for its Environment LIFE Programme shares a toolkit for the project administration of the LIFE Programme, (EU, n.d). Since this is tailored for environmentally, or green based projects, some guidance can be taken from the toolkit, but especially from the case studies for the projects which have been funded.

3 METHODOLOGICAL FRAMEWORK

3.1 Information sources

Information is readily available. According to The Guardian, a successful test run on 27 August, 1976, marked the beginning of the internet age, (Tarnoff, B., 15 Jul, 2016). The internet makes available many sources of information. Additionally, research can be conducted at the local library, or on an online library, through the internet. Field research is another research strategy which can be used. Field research, according to (Cunningham, D. H., Smith, E. O., & Pearsall, T. E., 2005, pg. 577) is the act of gathering information outside of the environment which you normally work in - that is, outside of the classroom, or office. To begin the FGP, information sources will be required to plan, create, and develop the PMP. The objectives for the PMP have already been set out, and information sources will be used to develop each. Further, (Cunningham, D. H. et al., 2007, pg. 527) mentions that research obtained from the internet, library, and through field research, are the sources of information. The Schaum's Quick Guide, (Rozakis, L., 2007, pg. 38) states that all research can be grouped into two (2) categories. Further, (Rozakis, L., 2007, pg. 38) emphasizes the importance of differentiating between the two (2), since this can affect how the research is gathered.

It should also be noted that it is important to evaluate the information gathered. Some considerations for the information gathered, according to (Cunningham, D. H. et al., 2007, pg. 539-541) are authority and source; content, reliability and validity; and timeliness and relevance.

3.3.1 Primary sources

Primary sources are those created by direct observation, (Rozakis, L., 2007, pg. 38). This means that the writer was a partaker, or witness in the event which is being described, (Rozakis, L., 2007, pg. 38). Further, (Rozakis, L., 2007, pg. 38) lists examples of primary sources of information, these are:

- Autobiographies

- Diaries

- Interviews

- Historical records and documents

- Oral histories

- Photos taken at the scene

- Maps prepared by direct observation

- Logs

- Eyewitness accounts

- Letters

- Journals

- Statistics

- Surveys

- Blogs

Primary sources can be used especially if the problem is unique, (Cunningham, D. H. et al., 2007, pg. 526). For the PMP, the primary sources of information will be important, as it is actual first-hand information which will be used in its development. As such, from the listed sources, the ones which are most applicable to the FGP are interviews; historical records and documents; oral histories; and photos taken at the scene. Primary sources are capable of providing facts, and viewpoints which may not be available elsewhere; may frequently have a certain degree of immediacy, and freshness lacking in secondary sources; it may also be subjected to the bias of the author, (Rozakis, L., 2007, pg. 38).

3.3.2 Secondary sources

Secondary sources would have been transcribed by persons with indirect knowledge, who relied on primary sources of information, or other sources of

secondary information, (Rozakis, L., 2007, pg. 38). Further, (Rozakis, L., 2007, pg. 38) lists examples of secondary sources of information, these are:

- Abstracts
- Biographies
- Books written by nonparticipants
- Encyclopaedias
- Government documents
- Interpretations
- Textbooks
- Almanacs
- Book reviews
- Critical analysis
- Explanations
- Indexes
- Literary criticism
- Web pages

Secondary sources, according to (Cunningham, D. H. et al., 2007, pg. 526) '…are those you go to for help or information rather than developing the information on your own'. For the PMP, secondary sources will be used to obtain past experiences which may apply to the current project, and textbooks or guidelines on standardization, and best practices. As such, from the listed sources, the ones which are most applicable to the FGP may be government documents; interpretations; textbooks, and explanations. Secondary sources offer a greater scope which may not be available in a primary source; it has a leaning to be less immediate than a primary source; and can be affected by author's bias, (Rozakis, L., 2007, pg. 38).

Chart 12: Information sources (Source: compiled by author, extracts from list of primary and secondary sources listed previously, from Rozakis, L., 2007, pg. 38)

Objectives	Information sources	
	Primary	Secondary
1. To create a project management plan and a project charter, to plan, and authorize and initiate the project, using guidance from the PMBOK Guide 6th edition. The PMP will integrate the knowledge areas and provide a roadmap for the project, and will be done within the second week of the FGP.	Interviews, historical records and documents, logs, oral histories, statistics, and surveys.	Abstracts, books written by nonparticipants, government documents, interpretations, textbooks, almanacs, critical analyses, explanations, literary criticism, and web pages.
2. To develop the scope	Interviews, historical	Abstracts, books written by nonparticipants, government

management plan, requirements documentation, requirements traceability matrix, project scope statement, and scope baseline for the project, using guidance from the PMBOK Guide 6th edition. This will ensure that all the required work, but only the required work is performed, it will be done within the third week of the FGP.	records and documents, logs, letters, oral histories, photos taken at the scene, statistics, surveys, and blogs.	documents, textbooks, almanacs, book reviews, critical analysis, explanations, indexes, literacy criticism, and web pages.
3. To plan and develop the schedule, and to define,	Interviews, historical records, and documents, oral	Almanacs, explanations.

sequence, and estimate activities for the project, using guidance from the PMBOK Guide 6th edition. This will therefore allow the project to be managed, and completed in a timely manner, and will be done in the fourth week of the FGP.	histories, logs, statistics, surveys, blogs	
4. To develop the cost management plan, cost estimates, basis of estimates, cost baseline, and project funding requirements, using guidance from the	Interviews, historical records, and documents, oral histories, logs, statistics, surveys, blogs	Explanations, indexes, and web pages.

PMBOK Guide 6th edition. This will ensure that the project is completed within the project's budget; it will be done within the fifth week of the FGP.		
5. To create the quality management plan and quality metrics for the project, using guidance from the PMBOK Guide 6th edition. This would make certain that the project meets its quality requirements, and will be done within the sixth week of	Interviews, historical records, and documents, logs, eyewitness accounts, letters, oral histories, photos taken at the scene, statistics, surveys, and blogs.	Book reviews, critical analyses, explanations, literacy criticism, and web pages.

the FGP.		
6. To build the resource management plan, team charter, resource requirements, basis of estimates, and resource breakdown structure, using guidance from the PMBOK Guide 6th edition. This will identify the resources needed to successfully complete the project, and will be done within the seventh week of the FGP.	Interviews, historical records and documents, logs, oral histories, statistics, and surveys.	Books written by nonparticipants, government documents, interpretations, textbooks, critical analyse, explanations, literary criticism, web pages.
7. To create the communication	Interviews, historical	Books written by nonparticipants, government documents,

s management plan, using guidance from the PMBOK Guide 6th edition. This would aid in effective information exchange, with the potential stakeholders to minimize conflicts, and will be done within the eighth week of the FGP.	records and documents, logs, letters, and oral histories.	interpretations, textbooks, critical analyse, explanations, literary criticism, web pages.
8. To develop a risk management plan, register, and report for the project, using guidance from the PMBOK Guide 6th edition. This will likely	Interviews, historical records and documents, logs, eyewitness accounts, letters, oral histories, photos taken at the scene, statistics, surveys, blogs.	Books written by nonparticipants, government documents, interpretations, textbooks, critical analyses, explanations, literary criticism, web pages.

optimize the chances of project success, by seeking out opportunities, and taking action to reduce negative risks, it will be done within the ninth week of the FGP.		
9. To create the procurement management plan, strategy, bid documents, statement of work, source selection criteria, make-or-buy decisions, and independent cost estimates, using guidance from the PMBOK Guide	Interviews, historical records and documents, logs, oral histories, photos taken at the scene, statistics, surveys, blogs.	Books written by nonparticipants, government documents, interpretations, textbooks, critical analyses, explanations, literary criticism, web pages.

6th edition. This will strategically deal with purchases for the project, in an efficient manner, and will be done within the tenth week of the FGP.		
10. To develop the stakeholder register and the stakeholder engagement plan for the project, using guidance from the PMBOK Guide 6th edition. This helps to effectively engage stakeholders in making project decisions, and during	Interviews, historical records and documents, logs, statistics, surveys, blogs.	Government documents, interpretations, textbooks, critical analyses, explanations, literary criticism, web pages.

execution, and will be done within the eleventh week of the FGP.		

1.2 Research methods

Research is a scientific and systematic search for pertinent information on a specific topic, according to Kothari, C.R. (2004). Further, Kothari, C.R. (2004) mentions that research is the art of scientific investigation. Its purpose is to find solutions to questions through scientific procedure, Kothari, C.R. (2004). Research is a way of knowing, and there are several ways, according to (Henrichsen, L., Smith, M.T., & Baker, D.S., 1997), these are intuitive; authoritative; logical; and empirical. The most common is empirical research, each of the ways which fall under empirical research are unique, some are; questioning; eliciting behaviour; observing/describing; and experimenting, (Henrichsen, L., Smith, M.T., & Baker, D.S., 1997). There are basic types of research; these are better defined as follows:

3.2.1 Analytical-Synthetic method

The synthetic (holistic) research approach takes the research question or topic from a holistic view, it is attempting to understand the parts by looking at it in whole, Henrichsen, L., Smith, M.T., & Baker, D.S. (1997). The analytic (constituent) research approach takes the topic from a constituent perspective; it is attempting to understand the whole by looking at the separate parts, Henrichsen, L., Smith, M.T., & Baker, D.S. (1997).

3.2.2 Inductive-Deductive method

Deductive reasoning is a process approach, it begins with the theory, then formulates the hypothesis, then this is followed by observation, and finally confirmation, Trochim, W. M. K. (20 Oct, 2006). As such, Trochim, W. M. K. (20 Oct, 2006) describes it as being from more general to more specific.

Inductive reasoning is a process approach as well, it begins with the observations, then it discovers patterns, and therefore makes a tentative hypothesis, which can

become a theory, Trochim, W. M. K. (20 Oct, 2006). As such, Trochim, W. M. K. (20 Oct 2006) describes it as moving from a specific to a broader generalization.

3.2.3 Experimental method

There are three (3) main types of potential plans, and formats for conducting research, Trochim, W. M. K. (20 Oct, 2006). These are qualitative; descriptive; and experimental, Trochim, W. M. K. (20 Oct, 2006). Experimental research involves control, experimental; or treatment – independent variable. It is an analytic approach. It is the heuristic or hypothesis testing or deductive approach, Trochim, W. M. K. (20 Oct, 2006). There are three (3) main types of research design: true-experimental; quasi-experimental; and pre-experimental, Trochim, W. M. K. (20 Oct, 2006).

3.2.4 Statistical method

Statistical methods may include planning, designing, collecting, analysing, and drawing meaningful interpretation and reporting of research findings, according to Ali, Z. & Bhaskar S. B. (Sept, 2016). It uses statistical tests, through the use of basic statistical tools, quantitative, and qualitative variables, measures of central tendency, sample size estimation, power analysis, statistical errors, and parametric and non-parametric tests for data analysis, Ali, Z. & Bhaskar S. B. (Sept, 2016).

3.2.5 Observation method

This is a mode of data collection, as well as the survey method, Sridhar, M. S. (2008). Observation is the act of gathering data from observations, and is termed as a participatory study, Research Methodology. (n.d.). It can be structured – conducted using specific variables, or unstructured – no pre-determined variables or objectives, Research Methodology. (n.d.).

3.2.6 Quantitative and qualitative method

Quantitative type research is a measurement of quantity, according to Kothari, C.R. (2004). Qualitative type research on the other hand, involves quality according to Kothari, C.R. (2004).

3.2.7 Descriptive method

According to Kothari, C.R. (2004), descriptive research involves enquiry type actions, for example surveying, and other 'fact-finding' methodologies. Its purpose is to enable the researcher to describe the state of affairs in that given time, Kothari, C.R. (2004).

Chart 13: Research methods (Source: author)

Objectives	Research methods						
	Analytic-Synthetic	Inductive-Deductive	Experimental	Statistical	Observation	Quantitative and Qualitative method	Descriptive method
1. To create a project management plan and a project charter, to plan, authorize and initiate the project, using guidance	The analytic method can be used to analyse business documents, agreements, enterprise environmental factors, and organisational process assets	-	-	-	-	-	The descriptive method may also be used to 'fact-find' applicable data.

from the PMBOK Guide 6th edition. The PMP will integrate the knowledge areas and provide a roadmap for the project, and will be done within the second week of the FGP.	in the creation of the project charter, and PMP.						

2. To develop the scope management plan, requirements documentation, requirements traceability matrix, project scope statement, and scope baseline for the project, using	The analytic method will be used to analyse the project charter PMP, project documents, enterprise environmental factors, and organisational process assets.	-	-	-	-	-	The descriptive method may also be used to 'fact-find' applicable data.

guidance from the PMBOK Guide 6th edition. This will ensure that all the required work, but only the required work is performed, it will be done within the third week of the FGP.						

3. To plan and develop the schedule, and to define, sequence, and estimate activities for the project, using guidance from the PMBOK Guide 6th edition. This will	The analytical method will be used to analyse the project charter, PMP, enterprise environmental factors, and organisational process assets, project documents, and agreements.	-	-	-	-	Some form of quantitative analysis can be conducted to estimate timelines, and milestones.	The descriptive method may also be used to 'fact-find' applicable data, for example calendar events.

therefore allow the project to be managed, and completed in a timely manner, and will be done in the fourth week of the FGP.							
4. To develop the cost management plan, cost estimates,	The analytical method will be used to analyse the project charter, PMP,	-	-	-	-	Involves quantitative assessment.	The descriptive method may also be used to 'fact-find' applicable

basis of estimates, cost baseline, and project funding requiremen ts, using guidance from the PMBOK Guide 6th edition. This will ensure that the project is completed within the	enterprise environmental factors, organisational process assets, project documents, business documents, and agreements.						data, for example, historical records.

project's budget; it will be done within the fifth week of the FGP.							
5. To create the quality manageme nt plan, and quality metrics for the project, using guidance from the PMBOK Guide 6th	The analytical method will be used to analyse the project charter, PMP, project documents, enterprise environmental factors, and organisational process						

edition. This would make certain that the project meets its quality requiremen ts, and will be done within the sixth week of the FGP.	assets.						
6. To build the resource manageme nt plan, team charter,	The analytical method will be used to analyse the project charter, PMP, project	-	-	-	-	Involves quantitative assessmen t	-

resource requirements, basis of estimates, and resource breakdown structure, using guidance from the PMBOK Guide 6th edition. This will identify the resources needed to successfull	documents, enterprise environmental factors, and the organisational process assets.						

y complete the project, and will be done within the seventh week of the FGP.							
7. To create the communications management plan, using guidance from the PMBOK Guide 6th edition.	The analytical method will be used to analyse the project charter, PMP (RMP + stakeholder engagement plan), project documents (requirements documentation	-	-	-	-	-	The descriptive method may also be used to 'fact-find' applicable data, for example lessons learnt with experiences like

This would aid in effective information exchange, with the potential stakeholders to minimize conflicts, and will be done within the eighth week of the FGP.	, stakeholder register), enterprise environmental factors, and organisational process assets.						inadequate communication.
8. To develop a risk manageme	The analytical method will be used to	-	-	-	-	Includes the use of both	The descriptive method may

nt plan, register, and report for the project, using guidance from the PMBOK Guide 6th edition. This will likely optimize the chances of project success, by seeking	analyse the project charter, PMP, project documents, enterprise environmental factors, organisational process assets, agreements, and procurement documentation.					qualitative and quantitative research methods.	also be used to 'fact-find' applicable data, for example, potential risk areas, and from lessons learnt logs.

out opportuniti es, and taking action to reduce negative risks, it will be done within the ninth week of the FGP.							
9. To create the procureme nt manageme nt plan, strategy,	The analytical method will be used to analyse the project charter, business documents -	-	-	-	-	-	The descriptive method may also be used to 'fact-find' applicable data, for

bid documents, statement of work, source selection criteria, make-or-buy decisions, and independent cost estimates, using guidance from the PMBOK Guide 6th	business case, and benefits management plan, project documents - milestone list, project team assignments, requirements documentation , requirements traceability matrix, resource requirements, risk register, and stakeholder register,						example, from previous lessons learnt.

edition. This will strategically deal with purchases for the project, in an efficient manner, and will be done within the tenth week of the FGP.	enterprise environmental factors, and organizational process assets						
10. To develop the stakeholder register and the	The analytical method will be used to analyse the project charter,	-	-	-	-	-	The descriptive method may also be used to 'fact-find'

stakeholder engagement plan for the project, using guidance from the PMBOK Guide 6th edition. This helps to effectively engage stakeholders in making project decisions, and during	business documents – business case, and benefits management plan, PMP – communications management plan, stakeholder engagement plan, resource management plan, and risk management plan, project documents – change log, issue log,						applicable data, for example, engagement strategies for stakeholders based on past experiences.

execution, and will be done within the eleventh week of the FGP.	requirements documentation, assumption log, project schedule, risk register and stakeholder register, agreements, enterprise environmental factors, and organisational process assets.						

1.3 Tools

Tools are used to assist in delivering successful projects which are effectively and efficiently managed, Miloševic, D. & Iewwongcharoen, B. (2004). The Merriam-Webster's collegiate dictionary (1996), provides the definition for the term tool, as referenced in Miloševic, D. & Iewwongcharoen, B. (2004) '…something (as an instrument or apparatus) used in performing an operation or necessary practice of a vocation or profession.' For the purpose of the FGP, the use of tools and techniques as stipulated in the PMBOK Guide 6th edition will be used in the development of the PMP. Finally, according to Miloševic, D. & Iewwongcharoen, B. (2004) the tools and techniques selected depends on the project's situational factors. These are the phase of the project life cycle; the project size; the strategic foci; and the project type.

Chart 14: Tools (Source: author)

Objectives	Tools
1. To create a project management plan and a project charter, to plan, and authorize and initiate the project, using guidance from the PMBOK Guide 6th edition. The PMP will integrate the knowledge areas and provide a roadmap for the project, and will be done within the second week of the FGP.	Expert judgement, data gathering – brainstorming, focus group, interviews, and checklists, interpersonal and team skills – conflict management, facilitation, and meeting managements, and meetings.
2. To develop the scope management plan, requirements documentation, requirements traceability matrix, project scope statement, and scope baseline for the project, using guidance from the PMBOK Guide 6th edition. This will ensure that all the required work, but only the required work is performed, it will be done within the third week of the FGP.	Expert judgement, data analysis – alternative analysis, and document analysis, meetings, data gathering – brainstorming, interviews, focus groups, questionnaires and surveys, and benchmarking, decision making – voting, autocratic decision making, multicriteria decision analysis, data representation – affinity diagrams, and mind mapping, interpersonal and team skills – nominal group technique, observation/conversation, and

	facilitation, context diagram, prototypes, product analysis, and decomposition.
3. To plan, and develop the schedule, and to define, sequence, and estimate activities for the project, using guidance from the PMBOK Guide 6th edition. This will therefore allow the project to be managed, and completed in a timely manner, and will be done in the fourth week of the FGP.	Expert judgement, data analysis – alternative analysis, reserve analysis, what-if scenario analysis, and simulation, meetings, decomposition, rolling wave planning, precedence diagramming method, dependency determination and integration, meetings, leads and lags, project management information system, analogous, parametric, three-point, and bottom-up estimating, decision making - voting, schedule network analysis, critical path method, resource optimization, and schedule compression.
4. To develop the cost management plan, cost estimates, basis of estimates, cost baseline, and project funding requirements, using guidance from the PMBOK Guide 6th edition. This will ensure that the project is completed within the project's	Expert judgement, data analysis – alternative analysis, reserve analysis, and cost of quality, meetings, analogous, parametric, bottom-up, three-point, estimating, project management information system, decision making - voting, cost aggregation, historical information review, funding limit

budget; it will be done within the fifth week of the FGP.	reconciliation, and financing.
5. To create the quality management plan, and quality metrics for the project, using guidance from the PMBOK Guide 6th edition. This would make certain that the project meets its quality requirements, and will be done within the sixth week of the FGP.	Expert judgement, data gathering – benchmarking, brainstorming, interviews, decision analysis – cost-benefit analysis, cost of quality, decision making – multicriteria decision analysis, data representation – flowcharts, logical data model, matrix diagrams, mind mapping, test and inspection planning, and meetings.
6. To build the resource management plan, team charter, resource requirements, basis of estimates, and resource breakdown structure, using guidance from the PMBOK Guide 6th edition. This will identify the resources needed to successfully complete the project, and will be done within the seventh week of the FGP.	Expert judgement, data representation – hierarchical charts, responsibility assignment matrix, text-oriented formats, organisational theory, meetings, estimating – bottom-up, analogous, and parametric, data analysis – alternatives analysis, and project management information system.
7. To create the communications management plan, using guidance from the PMBOK	Expert judgement, communication requirements analysis, communication - technology,

Guide 6th edition. This would aid in effective information exchange, with the potential stakeholders to minimize conflicts, and will be done within the eighth week of the FGP.	models, and methods, interpersonal and team skills – communication styles assessment, political awareness, and cultural awareness, data representation – stakeholder engagement assessment matrix, and meetings.
8. To develop a risk management plan, register, and report for the project, using guidance from the PMBOK Guide 6th edition. This will likely optimize the chances of project success, by seeking out opportunities, and taking action to reduce negative risks, it will be done within the ninth week of the FGP.	Expert judgement, data analysis – stakeholder analysis, root cause analysis, assumption, constraint analysis simulation, sensitivity analysis, decision tree analysis influence diagrams, alternative analysis, and cost-benefit analysis, risk data quality assessment, risk probability and impact assessment, assessment of other risk parameters, SWOT analysis, documentation analysis, meetings, data gathering – brainstorming, checklist, interviews, interpersonal and team skills – facilitation, prompt lists, risk categorization, data representation – probability and impact matrix, representations of uncertainty, strategies for threats, strategies for opportunities,

	contingent response strategies, strategies for overall project risk, decision making – multicriteria decision analysis.
9. To create the procurement management plan, strategy, bid documents, statement of work, source selection criteria, make-or-buy decisions, and independent cost estimates, using guidance from the PMBOK Guide 6th edition. This will strategically deal with purchases for the project, in an efficient manner, and will be done within the tenth week of the FGP.	Expert judgement, data gathering – market research, data analysis – make-or-buy analysis, source selection analysis, and meetings.
10. To develop the stakeholder register and the stakeholder engagement plan for the project, using guidance from the PMBOK Guide 6th edition. This helps to effectively engage stakeholders in making project decisions, and during execution, and will be done within the eleventh week of the FGP.	Expert judgement, data gathering – questionnaires and surveys, brainstorming, benchmarking, data analysis – stakeholder analysis, document analysis, assumption and constraint analysis and root cause analysis, decision making – prioritization/ranking, data representation – stakeholder mapping/representation, mind

	mapping, stakeholder engagement assessment matrix, and meetings.

1.4 Assumptions and constraints

According to PMI, as referenced in (Sharp, T., 2014), assumptions are 'factors that, for planning purposes, are considered to be true, real, or certain without proof or demonstration.' More so, it is moving forward without absolute information, (Sharp, T., 2014). There are types of assumptions, for example, resource, budget, and scope assumptions, as elaborated on by (Sharp, T., 2014). Further, (Sharp, T., 2014) describes an assumption as the 'flip side of a risk.' For the purpose of the FGP, assumptions have been made on scope, time, and budget.

Constraints, according to (Sharp, T., 2014) are limitations placed upon the project which the project manager and team must work within. Typically, (Sharp, T., 2014), lists three (3) common constraints; these are constraints on scope; schedule; and cost. Additionally, constraints may also include quality requirements; resources; and risk tolerances, (Sharp, T., 2014). It is important to revisit assumptions, to update, or remove them on a scheduled basis, (Sharp, T., 2014) states that 'monitoring and managing assumptions with the project team is a proactive way to ensure project success'. For the purpose of the FGP, constraints are placed on schedule, time, and cost.

Chart 15: Assumptions and constraints (Source: author)

Objectives	Assumptions	Constraints
1. To create a project management plan and a project charter, to plan, authorize and initiate the project, using guidance from the PMBOK Guide 6th edition. The PMP will integrate the knowledge areas and provide a roadmap for the project, and will be done within the second week of the FGP.	Data will be available for developing each area of the PMP.	Scope of the PMP and time to develop the PMP will be constraints.
2. To develop the scope management plan, requirements documentation, requirements traceability matrix, project scope statement, and scope baseline for the project, using guidance from the PMBOK Guide 6th edition. This will ensure that all the required work, but only the required work is performed, it will be done within the third week of the FGP.	That adequate and timely input will be received from stakeholders, that historical records will be readily available for analysis.	Time will be a constraint, the availability and accessibility of virtual meetings, for instance, can affect the data flow to develop the plans etc.
3. To plan, and develop the schedule, and to define, sequence, and estimate activities for the project, using guidance from the PMBOK Guide 6th edition. This will therefore allow the project to be managed, and completed in a timely manner, and will be done in the fourth week of the FGP.	That the company calendar will be up to date, and other information is available from staff (team) and HR.	Time will be constraint, since developing this may require extensive communication, and feedback to develop fully.
4. To develop the cost management plan, cost	That the	Information to

Objectives	Assumptions	Constraints
estimates, basis of estimates, cost baseline, and project funding requirements, using guidance from the PMBOK Guide 6th edition. This will ensure that the project is completed within the project's budget; it will be done within the fifth week of the FGP.	estimates and historical data will be accurate enough to use for current estimates.	develop the cost plan and estimates may be difficult to obtain owing to improper record management.
5. To create the quality management plan, and quality metrics for the project, using guidance from the PMBOK Guide 6th edition. This would make certain that the project meets its quality requirements, and will be done within the sixth week of the FGP.	The quality requirements will be clearly understood to develop the plan itself.	The feedback from stakeholders, based on experience, may not be forthcoming.
6. To build the resource management plan, team charter, resource requirements, basis of estimates, and resource breakdown structure, using guidance from the PMBOK Guide 6th edition. This will identify the resources needed to successfully complete the project, and will be done within the seventh week of the FGP.	That all the elements to build the resource plan, and make estimates are submitted by stakeholders as needed.	Information on resources may be unavailable.
7. To create the communications management plan, using guidance from the PMBOK Guide 6th edition. This would aid in effective information exchange, with the potential stakeholders to minimize conflicts, and will be done within the eighth week of the FGP.	That the input is received from stakeholders for; organisational	That the communication requirements are not given as needed.

Objectives	Assumptions	Constraints
	communication styles; political awareness; and cultural awareness.	
8. To develop a risk management plan, register, and report for the project, using guidance from the PMBOK Guide 6th edition. This will likely optimize the chances of project success, by seeking out opportunities, and taking action to reduce negative risks. It will be done within the ninth week of the FGP.	That both risks and opportunities will be explored.	Availability of data for analysis.
9. To create the procurement management plan, strategy, bid documents, statement of work, source selection criteria, make-or-buy decisions, and independent cost estimates, using guidance from the PMBOK Guide 6th edition. This will strategically deal with purchases for the project, in an efficient manner, and will be done within the tenth week of the FGP.	That the data used to develop the various component plans etc. are reliable.	That current data may not be available for the development of the plans etc.
10. To develop the stakeholder register and the stakeholder engagement plan for the project, using guidance from the PMBOK Guide 6th edition. This helps to effectively engage stakeholders in making project decisions, and during execution, and will be done within the eleventh week of the FGP.	That extensive investigation will be done to generate a sufficient stakeholder database.	The input for developing the stakeholder engagement plan may be limited.

1.5 Deliverables

A deliverable can be defined as something produced as a result of a process, according to Bridges, J. (28 Aug, 2017). In the PMBOK Guide 6th Edition, there are ten (10) knowledge areas, and in each there are inputs, tools and techniques, and outputs. The project management deliverables may include the project plan, reports, and minutes, Bridges, J. (28 Aug, 2017). Further, Bridges, J. (28 Aug, 2017) speaks of the importance of following the schedule in order to produce timely deliverables. For the purpose of the FGP, the deliverables are the outputs from each knowledge area, for the initiating, and planning process groups. These will collectively form the required PMP for this project.

Chart 16: Deliverables (Source author and definitions taken from the PMBOK Guide 6th Edition).

Objectives	Deliverables
1. To create a project management plan and a project charter, to plan, and authorize and initiate the project, using guidance from the PMBOK Guide 6th edition. The PMP will integrate the knowledge areas and provide a roadmap for the project, and will be done within the second week of the FGP.	Project charter document – formally authorizes the project, both in terms of the project itself, and to apply resources to project activities. Assumption log – list all assumptions and constraints throughout the project life cycle. PMP document – contains all subsidiary management plans, baselines, etc.
2. To develop the scope management plan, requirements documentation, requirements traceability matrix, project scope statement, and scope baseline for the project, using guidance from the PMBOK Guide 6th edition. This will ensure that all the required work, but only the required work is performed, it will be done within the third week of the FGP.	Scope management plan – describes how the scope will be defined, developed, monitored, controlled, and validated. Requirements management plan – describes how project and product requirements will be analysed, documented, and managed. Requirements documentation – describes how individual requirements meet business need for the project. Requirement traceability matrix – grid which links product requirements from origin to

		deliverables.
		Project scope statement – description of the project scope, major deliverables, assumptions, and constraints.
		Scope baseline – includes the project scope statement, WBS, work package, planning package, and WBS dictionary.
3.	To plan, and develop the schedule, and to define, sequence, and estimate activities for the project, using guidance from the PMBOK Guide 6th edition. This will therefore allow the project to be managed, and completed in a timely manner, and will be done in the fourth week of the FGP.	Schedule management plan – establishes the criteria and activities for developing, monitoring, and controlling the schedule. Activity list – scheduled activities for the project. Activity attributes – description of the activity Milestone list – a significant point or event in a project. Project schedule network diagrams – graphical representation of dependencies for project schedule activities. Duration estimates – quantitative assessments of the likely number of time periods required to complete an activity, phase, or the project. Basis of estimates – amount and type of additional details supporting

	the duration estimate.
	Schedule baseline – approved version of schedule model.
	Project schedule – output of the schedule model.
	Schedule data – collection of information for describing and controlling the schedule.
	Project calendar – shows working days and shifts available for scheduled activities.
4. To develop the cost management plan, cost estimates, basis of estimates, cost baseline, and project funding requirements, using guidance from the PMBOK Guide 6th edition. This will ensure that the project is completed within the project's budget; it will be done within the fifth week of the FGP.	Cost management plan – describes how the project costs will be planned, structured, and controlled. Cost estimates – quantitative assessment of likely costs to complete project work, including contingency, and management reserve. Basis of estimates – how the cost estimate was established. Cost baseline – approved version of the time-phased project budget. Project funding requirements – total and periodic funding requirements from the cost baseline.
5. To create the quality management plan, and quality metrics for the project, using	Quality management plan – describes how applicable policies, procedure, and guidelines are to be

guidance from the PMBOK Guide 6th edition. This would make certain that the project meets its quality requirements, and will be done within the sixth week of the FGP.	implemented to achieve the quality objectives. Quality metrics – describes a project or product attribute and how the control quality process is in compliance to it.
6. To build the resource management plan, team charter, resource requirements, basis of estimates, and resource breakdown structure, using guidance from the PMBOK Guide 6th edition. This will identify the resources needed to successfully complete the project, and will be done within the seventh week of the FGP.	Resource management plan – provides guidance on how project resources should be categorized, allocated, managed, and released. Team charter – establishes the team values, agreements, operating guidelines. Resource requirement - identify the types and quantities of resources required for each work package or activity in a work package and can be aggregated to determine the estimated resources for each work package, each WBS branch, and the project as a whole. Basis of estimates – provides supporting details. Resource breakdown structure – hierarchical representation of resources by category and type.
7. To create the communications management plan, using guidance from the PMBOK	Communications management plan – describes how project communication will be planned,

Guide 6th edition. This would aid in effective information exchange, with the potential stakeholders to minimize conflicts, and will be done within the eighth week of the FGP.	structured, implemented, and monitored for effectiveness.
8. To develop a risk management plan, register, and report for the project, using guidance from the PMBOK Guide 6th edition. This will likely optimize the chances of project success, by seeking out opportunities, and taking action to reduce negative risks, it will be done within the ninth week of the FGP.	Risk management plan – describes how risk management activities will be structured and performed. Risk register – captures details of identified individual project risks. Risk report – presents information on sources of overall project risk, together with summary information on identified individual project risks.
9. To create the procurement management plan, strategy, bid documents, statement of work, source selection criteria, make-or-buy decisions, and independent cost estimates, using guidance from the PMBOK Guide 6th edition. This will strategically deal with purchases for the project, in an efficient manner, and will	Procurement management plan – contains the activities to be undertaken during the procurement process. Procurement strategy – to be identified based on make-or-buy analysis, and decision is made to acquire from outside the project. Bid documents – used to solicit proposals from prospective sellers. Procurement statement of works –

be done within the tenth week of the FGP.	defines the portion of the project scope for each related contract. Source selection criteria – offer of the best quality to match the services required. Make-or-buy decisions – determination for the best decision for work, choosing either internal or external providers.
10. To develop the stakeholder register and the stakeholder engagement plan for the project, using guidance from the PMBOK Guide 6th edition. This helps to effectively engage stakeholders in making project decisions, and during execution, and will be done within the eleventh week of the FGP.	Stakeholder register – contains information about identified stakeholders.

4   RESULTS

4.1. Project Integration Management

4.1.1 Develop project charter

Project integration management is a broad knowledge area in project management, and according to the PMBOK guide 6th edition it includes the processes to identify; define; combine; unify; and coordinate the various processes and project management activities within the project management process groups.

The project charter is included separately in the appendix of the document; it authorizes the FGP for tutor and student, and further describes the Water Warriors Educational Toolkit project. This project provides a social need: it assists in knowledge sharing, awareness building, and expansion in the area of education for an integrated water resource management approach.

This project also involves an agreement which defines initial intentions for a project, according to the PMBOK Guide 6th Edition. There is a Memorandum of Understanding (MOU) outlining the partnership responsibilities between both organisations – the Water Resources Agency of Trinidad and Tobago (WRA); and the National Institute of Higher Education, Research, Science & Technology (NIHERST), see appendix 4. The enterprise environmental factors (EEFs) which may influence the development of the charter are the legal and regulatory requirement and/or constraints; marketplace conditions – in which the outputs had to be constrained to the finances promised; and the organisational culture and political climate. Whereas the organisational process assets which can influence this process are organisational standard policies, processes, and procedures; monitoring and reporting methods; templates; and the historical information and lessons learned repository.

The project charter will be reviewed by the project manager at the WRA who possess the technical knowledge in the area of an integrated water resource management approach. Two (2) meetings in the form of a focus group were held

between both partners to brainstorm ideas pertaining to the activities, and local cultural perspectives based on prior experience.

According to the PMBOK Guide 6th Edition, the outputs for this process are the project charter and assumption log. The project charter contains:

- Project purpose;
- Measurable project objectives and related success criteria;
- High-level requirements;
- High-level project description, boundaries, and key deliverables;
- Overall project risk;
- Summary milestone schedule;
- Preapproved financial resources;
- Key stakeholder list;
- Project approval requirements (i.e., what constitutes project success, who decides the project is successful, and who signs off on the project);
- Project exit criteria (i.e., what are the conditions to be met in order to close or to cancel the project or phase);
- Assigned project manager, responsibility, and authority level; and
- Name and authority of the sponsor or other person(s) authorizing the project charter.

The assumption log at this point consists of high level strategic and operational assumptions and constraints, and is used to record all assumptions and constraints throughout the project life cycle, according to the PMBOK Guide 6th Edition, see chart 17: Assumption Log below.

Chart 17: Assumption log

ID		Assumption/Constraint		Description	
- ID ==> mandatory ==> used to identify an item in the list, but you can use your own ID scheme. To start simple you can count up from	**Type** - type ==> mandatory (value range) ==> defines if the item is an assumption or constraint.	- assumption/constraint ==> mandatory ==> describes the assumption/constraint with a few words (long form description should	**Status** - status ==> mandatory (value range) ==> should indicate the status of the item (not verified yet/verified as correct/verified as incorrect/...).	- description ==> optional, but recommended ==> extended description of the item (only in simple sheet: should mention documents and artefacts which are related to the assumption/constraint and might have to be reviewed and updated if there is a change to the assumption/constraint and especially if an assumption has been verified as incorrect!).	**Comments** - Comments ==> optional ==> any additional information regarding the item, which is not a description.

one.		**go into the descriptio n field).**			
1	Assump tion	Product qu ality – the laminated activity book, and model will be sturdy enough to withstand u se, and demonstrati on, repeate dly.	Verification in process.	The laminated activity book will be used for the workshop, and can be printed per group, and left with the school after. As such, each group using the activity booklet will be using a new book, thus ensuring that repeated use will not cause it to become overused. Consider the quality of material procured. Perform test on sample prior to purchase.	This has to fall in with the resource breakdown structure.

2	Constraint	The timeframe for the workshops (post SEA students) are limited.	Verified as correct.	Robust stakeholder engagement from planning, hence, proper follow up and updated schedule, and coordination to get all stakeholders prepared for the workshop.	
3	Assumption	Students will be present in the classroom during the post SEA period.	Not verified yet.	Engaging stakeholders to ensure that they are communicating with the students to encourage them to attend class, given the normative behaviour of students during that period.	

				Students have a short timeline with which to utilize the game (on DVD) post workshop. Consideration may have to be given for NIHERST to make the game available online prior to the workshop (so that a link can be provided in the documentation - this may mean that the game has to be developed prior to the activity book for instance), as was done in the past	
4	Constraint	Schools will install the game on their library computers, and students will use it after the workshop.	Not verified yet.		Could this be done with regard to rights (i.e. who has rights to the game)

		M&E – gathering data for at least monitoring the project during implementa tion and execution would be possible, however, given the short timeline of engageme nt for the end-users		Monitor, through a pre-assessment test, and post-assessment test to determine uptake of knowledge on the day. Record the no. of students that participate.	
	Constra int				

		(1 month) - it would impossible to provide an evaluation of the project, as required in the MOU.			
	Constraint	Product - The toolkit will be applicable only in one instance. It is unlikely that the kit will be		Suggest that the DVD be available in the school's library, and placed on the school's computers.	

		reused by a second group of students in the following year(s).			
	Constraint	Engagement activity - funds to engage stakeholders are non-existent in the high-level budget; hence, communica		Other modalities of communication will be utilized.	

		tion will not be on a face-to-face basis and will have to be done using other modalities (e.g. phone and email).			

4.1.2 Develop Project Management Plan

The development of the project management plan (PMP) consists of several of the subsidiary plans, but once finalised, it is considered the baseline, and all outputs from the other processes may be edited, but only after being subjected to a formal integrated change control process. According to the PMBOK Guide 6th Edition, there are many EEF's which influence the PMP. Factors which may concern the Water Warriors Educational Toolkit project are legal and regulatory requirements and/or constraints; organizational structure, culture, management practices, sustainability; and infrastructure (e.g., existing facilities and capital equipment). Organisational process assets (OPAs) which influence the PMP are listed in the PMBOK Guide 6th edition, and are as follows:

- Organizational standard policies, processes, and procedures;
- Project management plan template, including:
- Guidelines and criteria for tailoring the organization's set of standard processes to satisfy the specific needs of the project, and
- Project closure guidelines or requirements such as the product validation and acceptance criteria.
- Change control procedures, including the steps by which official organizational standards, policies, plans, procedures, or any project documents will be modified and how any changes will be approved and validated;
- Monitoring and reporting methods, risk control procedures, and communication requirements;
- Project information from previous similar projects (e.g., scope, cost, schedule and performance measurement baselines, project calendars, project schedule network diagrams, and risk registers); and
- Historical information and lessons learned repository.

The difference between EEFs, and OPAs is that, EEFs are outside the team control, and OPAs are the company specific inputs to the knowledge areas, Ambrosy, P. (Aug 17, 2017).

In the development of the PMP, expert judgement will be sought from the partnership and sponsor organisation Project Manager (PM) in its development, in particular for the development of technical and management details; and determining resources and skill levels needed to perform project work and its prioritization for the appropriate work and time. Apart from this, one data gathering technique used was the focus group approach, this allowed for discussion regarding the project management approach and the integration of the different components. All interpersonal and team skills will be employed, the PMBOK Guide 6th edition lists conflict management; facilitation; and meeting management which will all be utilised. The project kick off meeting will occur directly after the PMP is finalised and prior to the execution phase. Meetings will be appropriately held for the development of the PMP, and the life cycle for the Water Warriors Educational Toolkit project.

The PMBOK Guides 6th edition mentions that the PMP components include subsidiary management plans; baselines; and other additional components – some of which will be used in the development of the Water Warriors Educational Toolkit project. The table below taken from the PMBOK Guide 6th Edition show a representative list of the PMP components and project documents.

Table 4-1. Project Management Plan and Project Documents

Project Management Plan	Project Documents	
1. Scope management plan	1. Activity attributes	19. Quality control measurements
2. Requirements management plan	2. Activity list	20. Quality metrics
3. Schedule management plan	3. Assumption log	21. Quality report
4. Cost management plan	4. Basis of estimates	22. Requirements documentation
5. Quality management plan	5. Change log	23. Requirements traceability matrix
6. Resource management plan	6. Cost estimates	24. Resource breakdown structure
7. Communications management plan	7. Cost forecasts	25. Resource calendars
8. Risk management plan	8. Duration estimates	26. Resource requirements
9. Procurement management plan	9. Issue log	27. Risk register
10. Stakeholder engagement plan	10. Lessons learned register	28. Risk report
11. Change management plan	11. Milestone list	29. Schedule data
12. Configuration management plan	12. Physical resource assignments	30. Schedule forecasts
13. Scope baseline	13. Project calendars	31. Stakeholder register
14. Schedule baseline	14. Project communications	32. Team charter
15. Cost baseline	15. Project schedule	33. Test and evaluation documents
16. Performance measurement baseline	16. Project schedule network diagram	
17. Project life cycle description	17. Project scope statement	
18. Development approach	18. Project team assignments	

Figure 19: PMBOK® Guide, Project management plan and processes. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 89), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

4.1.3 Direct and manage project work

This process involves executing the planned project activities to complete project deliverables and accomplish established objectives, according to the PMBOK Guide 6th edition. What was planned before, (that is the PMP) is used as an input during the 'direct and manage' project work process. During execution, expert judgement will be sought, and meetings will be held, to discuss and make decisions on important and emerging occurrences. The deliverables are, according to the PMBOK Guide 6th edition any unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project. The deliverables will be demonstrated in the scope planning processes, and through their related work breakdown structure (WBS).

Work performance data will also be an output to this process, the Water Warriors Educational Toolkit project would include key performance indicators (KPIs) for a results based monitoring framework; actual start and finish dates of scheduled activities, deliverables status, schedule progress, number of change requests, actual costs incurred, and actual durations. The issue log is an important asset throughout the project, where issues can be recorded and tracked, and will be implemented for the project. It will take the form as shown in chart 18 below.

Chart 18: Issue log

Issue Type	Who raised the issue and when	Description	Priority	Who is assigned to the issue	Target resolution date	Status	Final Solution

The integrated change control procedure will be implemented and used throughout all the phases and cycles. It includes corrective action; preventive action; defect repair; and updates. This process also often requires updates to the PMP; project documents; and the OPAs.

4.1.4 Manage project knowledge

This process uses existing knowledge and creates new knowledge to achieve the project's objectives and contribute to organisational learning, according to the PMBOK Guide 6th edition. The key thing is to ensure that the skills; experience;

and expertise of the project team and other stakeholders are used before, during, and after the project within an environment of trust, such that sharing becomes natural, according to the PMBOK Guide 6th Edition. Further, it is about knowledge sharing and knowledge integration.

There are numerous OPAs for organizational standard policies, processes, and procedures; personnel administration; and formal knowledge-sharing and information-sharing procedures.

At NIHERST there are:

Business Continuity

-NIHERST Policy Guide Version 1.0: Disaster Recovery Policy for ICT, effective date: 20 Nov, 2013.

Finances

-NIHERST Policy Guide Version 1.1: Fixed Assets, effective date: 17 April, 2013

-NIHERST Policy Guide Version 1.0: Investment Policy, effective date: 1 Dec, 2017

-NIHERST Policy Guide Version 1.0: Signing Authority Policy, effective date: 1 Dec, 2017

-NIHERST Policy Guide Version 1.0: NIHERST Credit Card Administration, effective date: 14 Mar, 2018

-NIHERST Policy Guide Version 1.0: Procurement Procedures, effective date: 7 Feb, 2011

     -Procurement process

Human Resources

-Collective Agreement

     -CA Allowance 2008-2010

     -CA Collective Agreement 2008-2010

     -MOA – PSA/NIHERST – 1 Jan 2011 – 31 Dec 2013

     -CA MOA NIHERST PSA 4% Increase dd. 20130823

-CA Salaries and COLA 2008 – 2010

-NIHERST Policy Guide Version 1.0: Conflict of Interest, effective date: 20 Nov, 2013

-Employees declaration regarding conflict of interest form

-NIHERST Policy Guide Version 1.0: Employee Emergency Loan Policy, effective date: 3 June, 2015

-NIHERST Policy Guide Version 1.0: Fraud Prevention, effective date: 22 July, 2015

-DRAFT NIHERST Manual of HR Policies and Procedures

-Performance Management in the Public Service

-Supplemental Overtime Policy

-Policy Guide Version 1.0: Transport Policy, effective date:17 April, 2013

<u>HSE Management System</u>

-Accident Investigation Reporting Form

-NIHERST HSE Training Attendance Form

-NIHERST HSE Document Circulation Form

-NIHERST HSE Management of Change Form

-NIHERST HSE Refusal to Work Form

-NIHERST Near Miss Incident Reporting Form

<u>Information Management</u>

-NIHERST Manual on Management of Intellectual Property

-NIHERST Draft Records & Information Management Policy

-NIHERST Policy Guide Version 1.0: Whistle-blower Policy, effective date: 20 November, 2013

-NIHERST Guidelines for Folder Structures

-Internal lesson learnt database for sharing data by all parties, with full access to the information.

The project specific lessons learnt register will be completed for the Water Warriors Educational Toolkit project, before the information is transferred onto the lesson learnt repository for the organisation, at project close off.

4.1.5 Monitor and control project work

This process falls under the monitoring and controlling process group. The PMBOK Guide 6th edition states that it is the process of tracking, reviewing, and reporting the overall progress to meet the performance objectives defined in the PMP. The monitoring includes collecting, measuring, and assessing measurements and trends to effect process improvements, according to the PMBOK Guide 6th edition, this monitoring will be guided by a monitoring and evaluation framework OPA specific to the Water Warriors Educational Toolkit project. Corrective and preventative action can later be taken for performance issues. The PMBOK Guide 6th edition states the following points for what this process does:

- Comparing actual project performance against the project management plan;
- Assessing performance periodically to determine whether any corrective or preventive actions are indicated, and then recommending those actions as necessary;
- Checking the status of individual project risks;
- Maintaining an accurate, timely information base concerning the project's product(s) and their associated documentation through project completion;
- Providing information to support status reporting, progress measurement, and forecasting;
- Providing forecasts to update current cost and current schedule information;
- Monitoring implementation of approved changes as they occur;

- Providing appropriate reporting on project progress and status to program management when the project is part of an overall program; and

- Ensuring that the project stays aligned with the business needs.

In the Water Warriors Educational Toolkit project, outsourcing products and services are required, and agreements in the form of purchase orders will be used; this process will be covered under the procurement knowledge area. Tools and techniques which may be used are expert judgement; data analysis techniques; decision making; and meetings. During execution work performance reports in the form of monthly reports or quarterly reports, will be done to disseminate this information to pertinent stakeholders. If changes are needed in terms of corrective or preventative action, it will be required to go through a formal integrated change control procedure.

4.1.6 Perform integrated change control

This process allows for a review of all change requests, in order to forgo the likelihood of risks, approving changes; and managing changes to deliverables, project documents, and the PMP; and communicating the decision, according to the PMBOK Guide 6th edition. The PM will be responsible for reviewing, evaluating, approving, deferring, or rejecting changes to the project and for recording and communicating such decisions, in the absence of a formal change control board (CCB). These changes, must be documented, and once documented, can either be approved, deferred, or rejected by a responsible individual, usually the project sponsor or PM as stipulated in the change management plan, according to the PMBOK Guide 6th Edition. All related PMP elements would require updates.

The Water Resources Agency does have similar school based intervention programmes, and so does NIHERST, so this partnership can allow for sharing knowledge and leveraging on positive suggestions. Expertise in technical knowledge is required, and available. Any tool which is used should support

activities which identify documents, decides on, and tracks changes, according to the PMBOK Guide 6th edition.

4.1.7 Close project or phase

This process finalizes all activities for the project, phase, or contract, according to the PMBOK Guide 6th edition. Activities and actions to satisfy completion or exit criteria; contractual agreements applicable to the project or phase; transfer of the project's products, services, or results to the next phase or to production and/or operations; collection of suggestions for improvement or updating the policies and procedures; and measuring stakeholder performance, are performed in this process, according to the PMBOK Guide 6th edition. Activities to collect project or phase records; audit project success or failure; manage knowledge sharing and transfer; identify lessons learned; and archive project information for future use by the organisation are also performed.

Tools and techniques to perform these actions will be expert judgement; data analysis; and meetings.

Finally, documentation and OPAs updates are required; final product, service, or result transition; and final reporting are the outputs.

For the development of the PMP the outputs from the initiating and planning process groups for the project integration management are required. These processes are 4.1 develop project charter; and 4.2 develop PMP. The outputs for develop project charter are the project charter which is included in the appendices; and the assumption log, and for develop PMP, the PMP itself which encompasses the project in its entirety.

4.2. Project Scope Management

Project scope may refer to both the product and project scope. According to the PMBOK Guide 6th edition, the product scope includes the features and functions

that characterise a product, service, or result, and the project scope is the work performed to deliver a product, service, or result with the specified features and functions.

The term "project scope" is sometimes viewed as including product scope, according to the PMBOK Guide 6th Edition.

4.2.1 Plan scope management

This process creates a scope management plan which documents how the project and product scope will be defined, validated, and controlled, according to the PMBOK Guide 6th edition. Information for the development of the scope management plan, and requirements management plan would be sourced from the project charter, subsidiary plans of the PMP, EEFs, and OPAs. The tools and techniques used would be expert judgement; alternatives analysis; and meetings. This process falls under the planning process group and produces two plans, mentioned above, and further described below as the outputs.

Scope management plan

This plan consists of processes for preparing a project scope statement; enabling the creation of the work breakdown structure (WBS) from the detailed project scope statement; establishing how the scope baseline will be approved and maintained; and specifying how formal acceptance of the completed project deliverable will be obtained, according to the PMBOK Guide 6th edition.

Scope Statement

Project Purpose
The Water Warriors Educational Toolkit project will help deliver knowledge to students about water conservation, protection of local waterways, and human impact, with the intention to teach sustainability concepts to students and increase their understanding of cause and effect. It is intended that delivery of this information will help students to better understand the importance of having good water quality, how they impact their local waterways, and why they should conserve water, and by understanding this, they may be motivated to make individual and personal changes.
Goals & Objectives
1. To educate students on the definition and importance of a watershed. 2. To show students how individual actions and water quality can affect the watershed in which they reside. 3. To teach students about chemical parameters through basic water quality testing. 4. To encourage and challenge students creatively, in the design of a model that can be used to purify water, made from recyclable materials – which would have contributed otherwise to a polluted watershed.
Scope Summary/Boundary Conditions
In this project, students will learn (hands-on) how to test water quality using professional water quality testing kits. The goals will be achieved through workshop activities, sharing of activity booklets and brochures, a readily available electronic game, and a competition. Local cultural, and folklore aspects will be incorporated in the content.

The boundary conditions for this project are a one-year period, with a two month execution phase; delivery at schools where nearby critically compromised watersheds exist – as a way for targeting that community within the island of Trinidad, and grouped in close proximity (i.e. between 2 – 3 of the 8 counties). Finally, this project is a collaborative effort between the National Institute of Higher Education, Research, Science & Technology (NIHERST), and its sponsor the Water Resources Agency (WRA).

Scope Details

In Scope	Out of Scope
Integration output – project charter and MOU; assumption log; and PMP.	Monitoring student's behavioural changes after the project ends.
Stakeholder Management – stakeholder register; and stakeholder engagement plan.	Students that are not 'post-Secondary Entrance Assessment (SEA)' students.
Scope Management Plan – Scope management plan; requirements management plan; requirements documentation; requirements traceability matrix; project scope statement; and scope baseline (WBS).	
Project Time Management – schedule management plan; activity lists; activity attributes; milestone lists; project schedule network diagrams; duration estimates; basis of estimates; schedule baseline; project schedule; schedule data; and calendars.	
Project cost management – cost	

management plan; cost estimates; basis of estimates; cost baselines; and project funding requirements.	
Project quality management – quality management plan and quality metrics.	
Project HR management – resource management plan; team charter; resource requirements; basis of estimates; and resource breakdown structure.	
Project communication management – communications management plan	
Project risk management – risk management plan; risk register; and risk report.	
Project procurement management – procurement management plan; procurement strategy; bid documents; procurement statement of work; source selection criteria; make it buy decisions; and independent cost estimates.	
Brochures	
Activity booklets (reusable and non-reusable)	
Water quality testing kits	
Electronic game	
Workshops	
Competition and prizes	

Requirements management plan

The requirements management plan describes how project and product requirements will be analysed, documented, and managed. Components of this plan includes how requirements activities will be planned, tracked, and reported; configuration management activities such as: how changes will be initiated; how impacts will be analysed; how they will be traced, tracked, and reported; as well as the authorization levels required to approve these changes;   requirements prioritization process; metrics that will be used and the rationale for using them; and traceability structure that reflects the requirement attributes captured on the traceability matrix, according to the PMBOK Guide 6th edition.

Overview

This plan will guide us through the following aspects of requirements management:

- Collection- gathering the basic needs of stakeholders

- Categorization – categorizing those needs

- Prioritization – prioritizing those needs and identifying "must haves"

- Tracing – tracking how those needs are addressed throughout the life of the project

- Change Management – the process by which we will change our requirements as needs change

- Verification – how we will verify that requirements have been met

This document is to be used as a tool for communications, giving all stakeholders a view on how this process is managed for the Water Warriors Educational Toolkit project.

Requirements collection

During this phase, the emphasis is on capturing as many *perceived* requirements as possible from all valid stakeholders. Not all of the needs we identify here will end up as actual "requirements," but they will be identified and understood.

Collection method 1

From the initial meetings with the sponsor's Project Manager, and her team, several requirements were discussed, in the technical areas of Water Resource Management, especially given the background of WRA's PM (Integrated Water Resource Management – IWRM) and working experience with the Adopt-A-River Programme, and its varied projects. Internal team members from the Sponsor's team are to include the technocrats in gaming, and design.

Collection Method 2

Elements about the project were discussed with the internal team members to get an idea of what experiences they could share from past school based interventions, dealing with students, and teachers, and getting around schools, as well as for transport and proximity constraints.

Collection Method 3

Contacting and having discussions with all stakeholders from the planning process group to gather input, and interest, as well as getting the necessary buy-in to execute the project. Stakeholders will be elaborated on further in that specific knowledge area.

Collection Method 4

Reviews of the OPAs, such as the lessons learnt repository, and close off reports from other similar school based interventions.

As we identify each requirement, we will document the:
- Requirement name
- Requirement description
- The stakeholder to whom it is important

- Some measure of criticality (how important it is based on a quantified view of "having it" versus "NOT having it")
- Acceptance criteria (a quantified way of understanding the specifics of the requirement. In other words, how will we know it's been fulfilled?)

Requirements Categorization

During this phase, we will logically group requirements. Requirements will be grouped into the following categories:

Categories often include:
- Functional Requirements
- Technical Requirements
- Training Requirements
- Quality Requirements
- Performance Requirements
- Support Requirements
- Maintenance Requirements

Requirements Prioritization

Our approach to prioritizing requirements will be to work with the project sponsors to make decisions.

4.2.2 Collect requirements

This process determines, documents, and manages stakeholder needs and requirements to meet objectives, according to the PMBOK Guide 6th edition. Further, requirements are the conditions, or capabilities that are required to be present in a product, service, or result to satisfy an agreement or other formally

imposed specification, according to the PMBOK Guide 6th edition. Inputs for requirements may include the project charter, subsidiary plans of the PMP, some project and business documents, agreements, EEFs, and OPAs.

To perform this process expert judgement from the sponsor's PM, and team, and internal team will be sought, especially for project requirements in previous similar projects, facilitation and conflict management. Data will be gathered from brainstorming ideas and focus groups during the planning process. Benchmarking may be performed to determine how the sponsor's conduct of similar projects was performed, via discussion. Additionally, the institute's policies and procedures, and regulatory documentation such as laws, codes, or ordinances etc., will be analysed. Finally, a prototype of the reusable activity booklet, an output of the Water Warriors Educational Toolkit project, will be created to show it to the partner organisation, and to show how it works, and the feedback will be recorded, and revision made if necessary, and reviewed again, prior to finalizing the design and procurement services for printing and collating.

The outputs from this process are the requirements documentation, and the requirements traceability matrix. The requirements documentation needs to have requirements which are measurable and testable, traceable, complete, consistent, and acceptable to key stakeholders, according to the PMBOK Guide 6th edition. Classification groups for requirements, according to the PMBOK Guide 6th edition, allow for further refinement and detail as it is being elaborated. These classifications are business issues, opportunities and reasons; stakeholder needs; solutions or functional – behaviours of the product, and non-functional – environmental conditions or qualities for effectiveness; transition and readiness; project; and quality requirements, as listed in the PMBOK Guide 6th edition.

The requirements traceability matrix is a grid that links product requirements from their origin to the deliverables that satisfy them, according to the PMBOK Guide 6th edition. It tracks the requirements throughout the lifecycle processes.

Requirements Traceability

Beginning in September, 2018 requirements will be tracked, this includes its source, project objective it supports, WBS where it is addressed, and when it is verified and validated. The requirements traceability matrix will be used to manage data on each requirement.

Because this is a small project, the PM will be responsible for the tracking of requirements, and will report any impacts to the project's requirements based on current performance to the Senior Project Manager within 24 hours of a status change.

Chart 20: Requirements Traceability Matrix

Requirements Traceability Matrix									
Project Name:	Water Warriors Educational Toolkit								
Cost Centre:	Grant Funding from the Water Resources Agency								
Project Description:	School based intervention, knowledge sharing with post SEA students on water conservations, and quality based on human impact.								
ID	**Associate ID**	**Requirements Description**	**Business Needs, Opportunities, Goals, Objectives**	**Project Objectives**	**WBS Deliverables**	**Product Design**	**Product Development**	**Test Cases**	

001	1.0 Products							
	1.1	Brochure should be 'child-friendly'	Science popularization	To show students how individual actions and water quality can affect the watershed in which they reside.	1.2.2.2.2	Review past brochures, and online content.	Liaise with graphic designers.	Share with stakeholders to obtain in final approvals, then with Graphic phic

								artist prior to printing.
	1.2	Activity booklet should be reusable, and therefore durable.	Science popularization	To educate students on the definition and importance of a watershed	1.2.2. 2.3	Review past booklets, and online content.	Liaise with graphic designers.	Share with stakeholders to obtain final approvals,

								then with Graphic artist prior to printing.
	1.3	Electronic game should contain lessons which are sustainable and forward thinking that	Science popularization	To educate students on the definition and importance of a watershed	1.2.2.2.5	Review past games, and online content.	Liaise with gamer.	Share with stakeholders to obtain in

		are readily available on the NIHERST and WRA website. Links clearly shared with students.						final approvals, before finalizing. Test the game with different users and

								record feedback.
	1.4	Memorabilia should represent sustainability and act as a reminder or representation of that.	Science popularization	n/a	1.2.2.2.6	Talk to other PM's and procurement department to see what was used before, and purchasing implications or opportunities, and from online	Follow procurement procedures to make purchases.	n/a

						research.		
002	2.0 Competition							
	2.1	Model should be intriguing and teach something related to sustainability for water management, but should also incorporate an element of individual effort, and personal	Science popularization	To encourage and challenge students creatively, in the design of a model that can be used to purify water, made from recyclable materials – which would have contributed otherwise to polluted watersheds.	1.2.2.2.7	Create a model as a prototype to see how it works, liaise with stakeholders on the prototype and get feedback. Create competition guidelines and ask stakeholder	Students will receive content as early as possible, all dates, and timelines included.	Test model, ask teachers to review.

		demonstrati on.				s to review.		
003	3.0 Water Quality Test							
	3.1	All teaching content should relate to the assessment as far as possible.	Science popularization	To teach students about chemical parameters through basic water quality testing.	1.2.2. 2.4	Liaise with the M&E assistant to ensure that the content in the assessment matches the information taught/share d.	Review assessment to ensure it meets the requirement s.	Pro of read
	3.2	Resources for demonstrati ng 7 water	Science popularization	To teach students about chemical parameters through basic water quality	1.2.2. 2.4	Resource managemen t needed. The no. of	Resources must be secured and ready for	Go thro ugh reso

		quality parameters -students are grouped into adequately numbered groups in a pre-planned way.		testing.		students per class and the no. of resources needed should match.	use.	urces, confirm availability and transport requirements, including hum

								an reso urce s.

4.2.3 Define scope

This process develops a detailed description of the project and product, according to the PMBOK Guide 6th edition. The development of the detailed scope statement is derived from the project charter; PMP; project documents such as the assumption log, requirements documents, and the risk register; EEFs; and OPAs. In the creation of defining the scope, tools and techniques for the Water Warriors Educational Toolkit project are; expert judgment; alternatives analysis; and facilitation.

The project scope statement will be developed for the Water Warriors Educational Toolkit project. It is represented in chart 19, above. It includes the product scope description; deliverables; acceptance criteria; and project exclusions. Project documents that require updates are the assumption log; requirements documentation; requirements traceability matrix; and stakeholder register.

4.2.4 Create WBS

This process to create the WBS entails subdividing the project deliverables and project work into smaller, more manageable components, according to the PMBOK Guide 6th edition. The WBS represents the total scope of work to be delivered. It is a hierarchical breakdown, of which the lowest levels are called work packages. The PMBOK Guide 6th edition states that a work package is used to group activities where work is scheduled and estimated, monitored, and controlled. It is important to note that in the context of the WBS, work refers to work products or deliverables that are the result of activity and not to the activity itself, according to the PMBOK Guide 6th edition.

There are several inputs to this process, the PMP, project documents, EEFs and OPAs. The tools and techniques used to create the WBS for the Water Warriors Educational Toolkit project were expert judgement; and decomposition. Whilst there are several methods to perform a decomposition of the project's scope – top-down or bottom-up approach. For the Water Warriors Educational Toolkit project the WBS is decomposed as shown in figure 20 below, with the deliverables for each stage of the life cycle representing the non-functional deliverables for this project, and the functional deliverables apart from those. It resembles an outline. This is a simple project, and therefore, the level of detail represents such.

1.1 Initiating process group

1.1.1 Proposal

1.1.1.1 Assumption log

1.1.2 MOU

1.1.2.1 Adopter liaison (MOU)

1.1.2.2 Liability release form (MOU)

1.1.3 Stakeholder register

1.1.3.1 School list

1.2 Planning process group   **1.3**

1.2.1 Project management plan

1.2.2 Requirements management plan

1.2.2.1 Scope management plan

1.2.2.2 Scope statement, baseline, WBS

1.2.2.2.1 GIS Maps

1.2.2.2.2 Brochure

1.2.2.2.3 Activity booklet (reusable)

1.2.2.2.4 Water testing component

1.2.2.2.5 Electronic game

1.2.2.2.6 Workshop

1.2.2.2.7 Competition

1.2.2.2.7.1 Competition Guidelines

1.2.2.2.7.2 Prizes and prize giving ceremony

(U)

1.2.2.3 Gantt Chart

1.2.2.4 Cost management plan, estimates, budget, and funding

1.2.2.5 Quality plan and metrics

1.2.2.6 Resource management plan and team charter

1.2.2.7 Resource requirement, estimates, and resource breakdown structure

1.2.2.8 Communications management plan

1.2.2.9 Risk management plan
1.2.2.9.1 Risk register and report

1.2.2.10 Procurement plan, strategy, SOW, independent cost estimates

1.2.2.11 Stakeholder engagement plan

1.3 Executing process group

1.3.1 Deliverables

1.3.1.1 Work performance data

1.3.1.2 Issue log

1.3.1.3 Lessons learnt register

1.3.2 Quality report, test, and evaluation

1.3.3 Team and resource assignment /Calendar

1.3.3.1 Team assessments

1.3.4 Communication

1.3.5 Sellers and agreements

1.4 Monitoring and controlling process group

1.4.1 Work performance report for monitoring and controlling project work, and integrated change control for integration management

1.4.2 Work performance information for stakeholder

1.4.3 Accepted deliverables, and work performance information for validating scope

1.4.4 Work performance information and schedule forecast for controlling schedule

1.4.5 Work performance information and cost forecast for controlling cost

1.4.6 Quality control measurements, verified deliverables, work performance information for controlling quality

1.4.7 Work performance information for controlling resources

1.4.8 Work performance information for monitoring communications

1.4.9 Work performance information for project risk management

1.4.10 Closed procurements and work performance information for controlling procurements
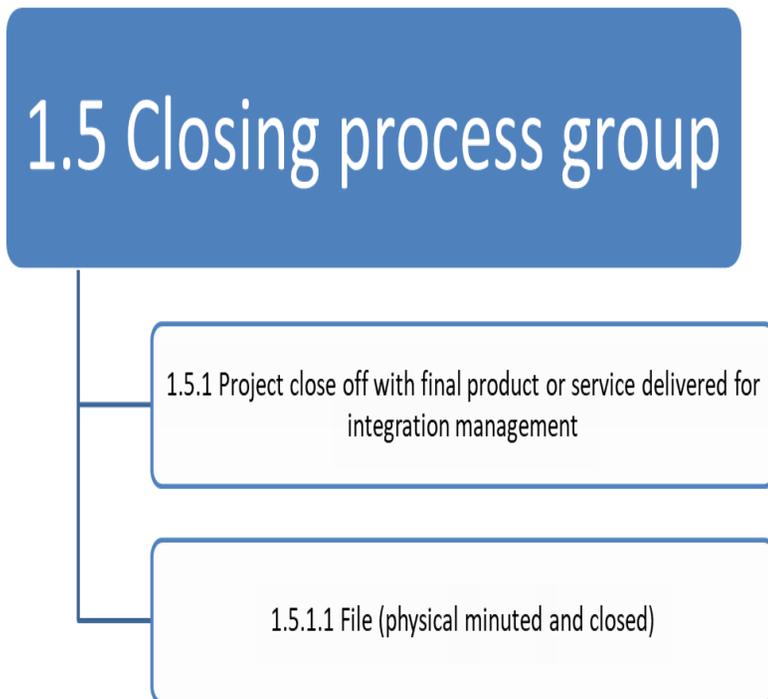
Figure 20: Work breakdown structure

4.2.5 Validate scope

This process formalizes the acceptance of the completed project deliverables, according to the PMBOK Guide 6th edition. This process falls under the monitoring and controlling process, and its outputs are the accepted deliverables, and work performance information, additionally, change requests and project document updates are part of the output as well. In this process, the outputs from the scope planning processes are validated and accepted. The PMP's scope and requirements management plan, and the scope baseline will be used in this process, as well as project documents such as the lesson learned register; quality reports; requirements documentation, and requirements traceability matrix. The tools and techniques which will be used to formalize the acceptance of the completed project deliverables are basic physical inspection, but more of a review of content, and grammatical review; and final decision making – or agreement to the final deliverables.

Once the project deliverables are completed, it is accepted through frequent stakeholder meetings and communication, and the benefits of this process can be realized. According to Kelly, S. (n.d.) both customer checks and acceptance are important activities. Further, Kelly, S. (n.d.), states that this process helps to show the customer that the project is on track and finds changes or issues during the project rather than at the end. It results in the customer either accepting the deliverable, or making requests for modifications.

For the Water Warriors Educational Toolkit project, the following workflow can be utilized:

Complete Deliverables (Direct & Manage Project Work)	
Game developer is procured	Water Quality Testing kits are obtained from internal sources

Perform Quality Control Inspection (Validate Deliverables)	
Game is rigorously tested for usability (quality)	Water Quality Testing kits are checked for expiration dates and quantity

Changes are requested and corrective action or defect repair completed	
Modifications are made to game (if applicable)	Completeness of water quality testing kits are verified and purchases made if necessary.

Perform Quality Control Inspection is repeated (Validated Deliverables)	
Modifications are made to game (if applicable)	Completeness of water quality testing kits are verified and purchases made if necessary.

Meet with the customer (Validate Scope Process)	
Ensure that teachers are satisfied with the game, and other relevant stakeholders accept it.	Ensure that the water quality testing procedures are clearly outlined and described to the teachers. If changes are required it must go through formal change control procedures before gaining approval.

Figure 21: Validate Scope Workflow.

4.2.6 Control scope

This process monitors the status of the product and project scope and manages changes to the scope baseline, according to the PMBOK Guide 6th edition. This process is performed during the monitoring and controlling process, its outputs are work performance information; change requests; PMP updates; and project document updates. This process manages actual changes when they occur and hence, prevents scope creep – the uncontrolled expansion to product or project scope without adjustments to time, cost, and resources, via a formal change control process, as stated in the PMBOK Guide 6th edition. The inputs for this process are subsidiary plans of the PMP; these are the scope, requirements, change, configuration management plans, as well as the scope and performance measurement baselines. Projects documents may also be inputs, these are the lessons learned register, requirements documentation, and the requirements traceability matrix. The PMBOK Guide 6th edition states that 'work performance data can include the number of change requests received, the number of requests accepted, and the number of deliverables verified, validated, and completed.' The OPA that will be used to monitor the Water Warriors Educational Toolkit project is a monitoring and evaluation framework. The outputs will be monitored against the objectives, and if outputs require change, they will be performed through a formal change control procedure, and documented as work performance data.

Once the scope definition is clear, and the work is completed the control process can be initiated, according to Hill, N (n.d.). Further, Hill, N (n.d.) states that there are five steps in the control scope process, which are shown in the chart below:

| Measuring performance against scope |
| Deliverables are measured against the scope baseline for meeting quality criteria |

| Determining the magnitude of variance |
| Level of variance must be determined |

| Decide whether corrective or preventative action are required | |
| Game must be checked before final approval and delivery | Water quality testing kits must be checked for quality and quantity |

| Make updates to scope baseline, PMP, or project documents as required |
| Baseline versions saved in MS Project |

| Evaluate the impact of changes |
| All requested changes require approval from a change control process |

Figure 22: Control Scope Workflow.

4.3. Project Schedule Management

The creation of a detailed plan which represents how and when the project will deliver the products, services, and results is defined in the project scope, according to the PMBOK Guide 6th edition. The PMBOK Guide 6th edition suggests that the detailed project schedule should remain flexible throughout the project to adjust for knowledge gained increased understanding of the risk, and value-added activities.

4.3.1 Plan schedule management

This process establishes the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule, according to the PMBOK Guide 6th edition. The inputs for this process are the project charter which defines the summary milestone schedule; subsidiary plans of the PMP, such as the scope management plan; development approach; EEFs; and OPAs.

The tools and techniques employed for this process for the Water Warriors Educational Toolkit project are expert judgement; and planning meetings with the internal team, and sponsor's team. The output for this process is the schedule management plan which establishes the criteria and the activities for developing, monitoring, and controlling the schedule, according to the PMBOK Guide 6th edition. Further, the PMBOK Guide states that the schedule management plan establishes the following:

- Project schedule model development
- Release and iteration length
- Level of accuracy
- Units of measure
- Organisational procedures links
- Project schedule model maintenance

- Control thresholds
- Rules for performance measurement
- Reporting format

ID	ⓘ	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names	02 Sep '18
									T | F | S | S | M | T | W | T | F
0		⇨	**Water_Warriors_Edu_T**	**209 days**	**Sat 01/09/18**	**Thu 11/07/1!**			
1		⇨	1 Develop project proposal	5 days	Mon 03/09/18	Fri 07/09/18		Sharda Mahabir,Tahira	
2		⇨	2 Amend and sign memorandum of understanding	3 days	Mon 10/09/18	Wed 12/09/18	1	Sharda Mahabir,Tahira Khan	
3		⇨	3 Generate baseline assumption log	2 days	Thu 13/09/18	Fri 14/09/18	2	Darielle Rampersad	
4		⇨	4 Populate stakeholder register	1 day	Thu 13/09/18	Thu 13/09/18	2	Rondell Liverpool	
5		⇨	5 Develop baseline project management plan	7 days	Thu 13/09/18	Fri 21/09/18	2	Tahira Khan	
6		⇨	6 Develop requirements management plan	3 days	Tue 25/09/18	Thu 27/09/18	5	Darielle Rampersad	
7		⇨	**7 Create scope management plan**	**7 days**	**Fri 28/09/18**	**Mon 08/10/18**	**6**	**Tahira Khan**	
8		⇨	7.1 Produce scope statement	1 day	Fri 28/09/18	Fri 28/09/18	6		
9		⇨	7.2 Produce scope baseline	1 day	Mon 01/10/18	Mon 01/10/18	8		
10		⇨	7.3 Generate work breakdown structure	2 days	Fri 05/10/18	Mon 08/10/18	9,23		
11		⇨	8 Develop schedule	7 days	Tue 09/10/18	Wed 17/10/18	10		

ID	ⓘ	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names	02 Sep '18
									T	F	S	S	M	T	W	T	F
12			**9 Develop cost management plan**	8 days	Thu 18/10/18	Mon 29/10/18	11	**Lovaan Superville**	
13			9.1 Produce estimate	3 days	Thu 18/10/18	Mon 22/10/18	11		
14			9.2 Develop budget and secure funding	5 days	Tue 23/10/18	Mon 29/10/18	13		
15			10 Develop quality management plan and metrics	5 days	Fri 28/09/18	Thu 04/10/18	5,6		
16			**11 Develop resource management plan**	5 days	Tue 30/10/18	Mon 05/11/18	11,14	**Darielle Rampersad**	
17			11.1 Create team cha	3 days	Tue 30/10/18	Thu 01/11/18	14		
18			11.2 Produce resource	2 days	Fri 02/11/18	Mon 05/11/18	17,19		
19			11.3 Define estimate	2 days	Tue 30/10/18	Wed 31/10/18	14		
20			11.4 Create resource breakdown structure	2 days	Thu 01/11/18	Fri 02/11/18	19		
21			12 Develop communications management plan	5 days	Tue 25/09/18	Mon 01/10/18	5		
22			**13 Develop risk management plan**	4 days	Tue 02/10/18	Fri 05/10/18	5	**Darielle Rampersad**	
23			13.1 Produce risk register	3 days	Tue 02/10/18	Thu 04/10/18	21		
24			13.2 Produce risk rep	1 day	Fri 05/10/18	Fri 05/10/18	23		
25			**14 Develop procurement**	5 days	Mon 05/11/18	Mon 12/11/18	14,20	**Rondell Liverpool**	

ID	⬤	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names	02 Sep '18 T F S S M T W T F
26			14.1 Create procurement strategy	3 days	Mon 05/11/18	Thu 08/11/18	24		
27			14.2 Create statement of work	1 day	Fri 09/11/18	Fri 09/11/18	26		
28			14.3 Produce independent cost	1 day	Mon 12/11/18	Mon 12/11/18	27		
29			15 Develop stakeholder engagement plan	5 days	Tue 25/09/18	Mon 01/10/18	5		
30			**16 Direct and manage project work**	**31 days**	**Tue 09/10/18**	**Wed 21/11/18**		**Tahira Khan**	
31			16.1 Generate GIS ma	3 days	Tue 09/10/18	Thu 11/10/18	10		
32			16.2 Produce brochur	7 days	Tue 13/11/18	Wed 21/11/18	10,28,23		
33			16.3 Produce reusable activity	7 days	Tue 13/11/18	Wed 21/11/18	10,28,23		
34			16.4 Obtain water testing kits	4 days	Tue 09/10/18	Fri 12/10/18	10		
35			16.5 Produce competition guidelines	5 days	Tue 09/10/18	Mon 15/10/18	10		
36	📝		16.6 Produce terms of reference for the electronic game	5 days	Tue 13/11/18	Mon 19/11/18	10,28,23		

ID	ⓘ	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names	T	F	S	S	M	T	W	T	F
												02 Sep '18					
37		�	**17 Collect work performance data from raw observations and measurements**	**6 days**	**Fri 05/10/18**	**Fri 12/10/18**		**Chantelle Jacob**									
38		�	17.1 Populate baseline issue log	3 days	Fri 05/10/18	Tue 09/10/18	23										
39		�	17.2 Populate baseline project specific lessons learnt register	3 days	Wed 10/10/18	Fri 12/10/18	38										
40		�a	**18 Manage stakeholder**	**80 days**	**Thu 18/10/18**	**Thu 14/02/19**		**Chantelle Jacob**									
41		�	18.1 Invite judges to select winners	3 days	Thu 18/10/18	Mon 22/10/18	35,48										
42		�	18.2 Inform winners of competition, and invite to prize giving ceremony	1 day	Tue 23/10/18	Tue 23/10/18	41										
43		�	18.3 Invite guests	5 days	Thu 07/02/19	Thu 14/02/19	49,50,51,48										
44		�a	**19 Manage project quality**	**2 days**	**Fri 05/10/18**	**Mon 08/10/18**		**Rondell Liverpool**									
45		�	19.1 Produce quality reports	2 days	Fri 05/10/18	Mon 08/10/18	15										
46		�0	20 Acquire resources	0 days	Sat 01/09/18	Sat 01/09/18			◆ 01/09								
47		�	**21 Confirm physical resource assignments**	**179 days**	**Tue 16/10/18**	**Thu 11/07/19**		**Louise Villaroel**									

ID	ⓘ	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names	02 Sep '18
									T	F	S	S	M	T	W	T	F
48			21.1 Secure venue and related services internally	2 days	Tue 16/10/18	Wed 17/10/18	35	Gail Ann Roberts-Taitt	
49			21.2 Obtain service provider for catering for prize giving ceremony	15 days	Thu 18/10/18	Thu 08/11/18	48	Snack Plates[1 Per Plate]	
50			21.3 Obtain competition prizes	30 days	Fri 09/11/18	Thu 20/12/18	49	Prizes[1 Per Unit]	
51			21.4 Obtain memorabilia	30 days	Fri 21/12/18	Thu 07/02/19	50	Memorabilia [1 Per Unit]	
52			21.5 Assign service provider to develop game	25 days	Tue 20/11/18	Thu 27/12/18	36	Game Developer[1 Per Game]	
53			21.6 Obtain service provider for the laminating of reusable activity sheets	15 days	Thu 22/11/18	Wed 12/12/18	33	Laminating Services[1 Per Unit]	
54			21.7 Obtain service provider for printing of brochures	10 days	Thu 22/11/18	Wed 05/12/18	32	Brochures[1 Per Unit]	

ID	ⓘ	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names	02 Sep '18
									T F S S M T W T F
55		⇨	21.8 Purchase DVDs for the copying of electronic game and DVD production	5 days	Fri 28/12/18	Mon 07/01/19	52	Digital Video Disc (DVDs)[1 Per Disc],Allister Brizen,Marvin Gordon	
56		⇨	21.9 Purchase white board markers	45 days	Thu 22/11/18	Wed 30/01/19	33	White Board Markers[1 Per	
57		⇨	21.10 Confirm team assignments	2 days	Fri 02/11/18	Mon 05/11/18	17	Sharda Mahabir,Kelisha	
58		⇨	21.11 Produce resource calendars	5 days	Mon 05/11/18	Mon 12/11/18	20	Allister Brizen	
59		⇨	21.12 Host workshops through planned school visits	45 days	Fri 03/05/19	Thu 11/07/19	57,58,60	Chantelle Jacob[20%],Darielle Rampersad[20%],K	
60		⇨	21.13 Deliver content and invite participants for competition	45 days	Mon 25/02/19	Fri 03/05/19	57,61	Darielle Rampersad	
61		⇨	21.14 Host prize giving ceremony	7 days	Thu 14/02/19	Mon 25/02/19	51,50,49,48,41,	Adrian Ramkissoon[25%],	
62		⇨	**22 Develop team**	**2 days**	**Tue 06/11/18**	**Thu 08/11/18**	**57**	**Lovaan Superville**	
63		⇨	22.1 Conduct team performance assessments	2 days	Tue 06/11/18	Thu 08/11/18	17		
64		⇨	**23 Manage team**	**5 days**	**Fri 09/11/18**	**Thu 15/11/18**		**Lovaan Superville**	
65		⇨	23.1 Manage project communications	5 days	Fri 09/11/18	Thu 15/11/18	21,63		

ID	ⓘ	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
66			**24 Conduct procurements**	**12 days**	**Tue 13/11/18**	**Wed 28/11/18**	**28**	**Donna Hall,Georgia Le**
67			24.1 Liaise with selected sellers	7 days	Tue 13/11/18	Wed 21/11/18	26	
68			24.2 Handle agreements	5 days	Thu 22/11/18	Wed 28/11/18	67	
69			**25 Monitor and control project work**	**4 days**	**Fri 16/11/18**	**Wed 21/11/18**		**Kelisha Ray**
70			25.1 Produce work performance report	2 days	Fri 16/11/18	Mon 19/11/18	65	
71			25.2 Perform integrated change	2 days	Tue 20/11/18	Wed 21/11/18	70	
72			**26 Monitor stakeholder**	**2 days**	**Thu 22/11/18**	**Fri 23/11/18**		**Darielle Rampersad**
73			26.1 Produce work performance information	2 days	Thu 22/11/18	Fri 23/11/18	71	
74			**27 Validate scope**	**5 days**	**Mon 26/11/18**	**Fri 30/11/18**		**Tahira Khan**
75			27.1 Accept deliverables	2 days	Thu 29/11/18	Fri 30/11/18	68,94,73	
76			27.2 Produce work performance information	2 days	Mon 26/11/18	Tue 27/11/18	73	
77			**28 Control project schedule**	**4 days**	**Wed 28/11/18**	**Mon 03/12/18**		**Lovaan Superville**

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names	02 Sep '18 T F S S M T W T F
78		28.1 Produce work performance information	2 days	Wed 28/11/18	Thu 29/11/18	76		
79		28.2 Schedule forecast	2 days	Fri 30/11/18	Mon 03/12/18	78		
80		**29 Control cost**	**4 days**	**Tue 04/12/18**	**Fri 07/12/18**		**Tahira Khan**	
81		29.1 Produce work performance data	2 days	Tue 04/12/18	Wed 05/12/18	79		
82		29.2 Cost forecast	2 days	Thu 06/12/18	Fri 07/12/18	81,84		
83		**30 Control quality**	**7 days**	**Tue 09/10/18**	**Wed 17/10/18**		**Rondell Liverpool**	
84		30.1 Make quality control measures	2 days	Tue 09/10/18	Wed 10/10/18	45		
85		30.2 Verify deliverable	3 days	Thu 11/10/18	Mon 15/10/18	84		
86		30.3 Produce work performance information	2 days	Tue 16/10/18	Wed 17/10/18	85		
87		**31 Control resources**	**2 days**	**Thu 18/10/18**	**Fri 19/10/18**		**Darielle Rampersa**	
88		31.1 Produce work performance information	2 days	Thu 18/10/18	Fri 19/10/18	86		
89		**32 Monitor communications**	**2 days**	**Mon 22/10/18**	**Tue 23/10/18**		**Darielle Rampersad**	
90		32.1 Produce work performance information	2 days	Mon 22/10/18	Tue 23/10/18	88		
91		**33 Monitor risks**	**2 days**	**Wed 24/10/18**	**Thu 25/10/18**		**Rondell Liverpool**	

ID	ⓘ	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names	02 Sep '18
									T F S S M T W T F
92			33.1 Produce work performance information	2 days	Wed 24/10/18	Thu 25/10/18	90		
93			**34 Control procuremen**	**7 days**	**Fri 26/10/18**	**Mon 05/11/18**		**Georgia Le Gendre**	
94			34.1 Close procurements	5 days	Fri 26/10/18	Thu 01/11/18	85,92		
95			34.2 Produce work performance information	2 days	Fri 02/11/18	Mon 05/11/18	94		
96			**35 Close project**	**9 days**	**Mon 25/02/19**	**Tue 12/03/19**		**Lovaan Superville**	
97			35.1 Finalise product or service	3 days	Mon 25/02/19	Thu 28/02/19	61,95		
98			35.2 Host close off meeting	1 day	Thu 28/02/19	Fri 01/03/19	97		
99			35.3 Produce close off reports	5 days	Fri 01/03/19	Tue 12/03/19	98		

	Task	▬▬▬	External Milestone	◆	Manual Summary Rollup	▬▬▬
	Split	....	Inactive Task	▭	Manual Summary	▼▬▬▼
Project: Water_Warriors_Edu_To	Milestone	◆	Inactive Milestone	◇	Start-only	[
Date: Sun 24/03/19	Summary	▼▬▬▼	Inactive Summary	▽▭▽	Finish-only	]
	Project Summary	▽▬▬▽	Manual Task	[▬▬]	Deadline	↓
	External Tasks	▬▬▬	Duration-only	▬▬▬	Progress	▬▬▬

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Figure 23: Schedule

4.3.2 Define activities

This process identifies and documents the specific actions to be performed to produce the project deliverables, according to the PMBOK Guide 6th edition. It takes the scope's WBS and transforms it into schedule activities which then provide a basis for estimating, scheduling, executing, monitoring and controlling the project work, according to the PMBOK Guide 6th edition. The outputs for this process are the activity lists and attributes, milestone list, change request if any, and updates to the PMP's schedule and cost baselines.

The inputs are subsidiary plans of the PMP; EEFs; and OPAs. The tools and techniques for defining the schedule for the Water Warriors Educational Toolkit project are expert judgement; decomposition; and meetings. The outputs for the Water Warriors Educational Toolkit project are the activity list which is the schedule activities required on the project, according to the PMBOK Guide 6th edition. Additionally, there will be activity attributes, milestone list – which will be shown in MS Project, change requests are recorded if any occurs, as well as updates of the PMP's schedule and costs baselines.

4.3.3 Sequence activities

This process identifies and documents relationships among the project activities, according to the PMBOK Guide 6th edition; it is in this process that logical relationships are determined. Inputs to this process are the subsidiary plans of the PMP – the schedule management plan; and scope baseline. Other inputs include project documents such as activity attributes; activity list; assumption log; and milestone list; EEFs; and OPAs.

Tools and techniques are the precedence diagramming method (PDM); dependency determination and integration; leads and lags; and the use of Project Management Information System (PMIS). For the Water Warriors Educational Toolkit project the PDM will be used, it includes four (4) types of dependencies or

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logical relationships, according to the PMBOK Guide 6th edition. The PMBOK Guide 6th edition states that 'A predecessor activity is an activity that logically comes before a dependent activity in a schedule. A successor activity is a dependent activity that logically comes after another activity in a schedule.' Further, the PMBOK Guide provides these descriptions for each of the four (4) relationships, and examples:

Finish-to-start (FS). A logical relationship in which a successor activity cannot start until a predecessor activity has finished.
For example, installing the operating system on a PC (successor) cannot start until the PC hardware is assembled (predecessor).

Finish-to-finish (FF). A logical relationship in which a successor activity cannot finish until a predecessor activity has finished.
For example, writing a document (predecessor) is required to finish before editing the document (successor) can finish.

Start-to-start (SS). A logical relationship in which a successor activity cannot start until a predecessor activity has started.
For example, level concrete (successor) cannot begin until pour foundation (predecessor) begins.

Start-to-finish (SF). A logical relationship in which a successor activity cannot finish until a predecessor activity has started.
For example, a new accounts payable system (successor) has to start before the old accounts payable system can be shut down (predecessor).

Lead and lags are described in the PMBOK Guide 6th edition as follows:

A lead is the amount of time a successor activity can be advanced with respect to a predecessor activity; it is often represented as a negative value for lag in scheduling software.

A lag is the amount of time a successor activity will be delayed with respect to a predecessor activity; the project management team determines the dependencies that may require a lead or a lag to accurately define the logical relationship. The use of leads and lags should not replace schedule logic, and duration estimates do not include any leads or lags, according to the PMBOK Guide 6th edition.

The PMIS which will be used for the development of the Water Warriors Educational Toolkit project is MS Project software.

A network diagram is produced as an output of this process, as well as updates to applicable project documents. The network diagram can be viewed in the MS Project file.

4.3.4 Estimate activity durations

This process estimates the number of work periods needed to complete individual activities with estimated resources, according to the PMBOK Guide 6th Edition. The inputs to this process are the schedule management plan and scope baseline of the PMP; project documents, such as: activity attributes; activity list; assumption log; lessons learned register; milestone list; project team assignments; resource breakdown structure; resource calendars; resource requirements; risk register; EEFs; and OPAs.

Specialized knowledge in topics pertaining to schedule development, management, and control, expertise in estimating; and discipline or application knowledge are used in estimating activity durations. There are also four (4) types of estimating; analogous – uses historical data from a similar activity or project; parametric – uses a statistical relationship between historical data and other variables; three-point – considers estimation uncertainty and risk, defines an approximate range for an activity's duration, it may use the triangular distribution formula; and bottom-up – aggregates the estimates of the lower level components of the WBS. For the Water Warriors Educational Toolkit Project the bottom-up technique shall be used. Data analysis techniques may include alternatives – used to compare various levels of resource capability or skills; and reserve analysis – used to determine the amount of contingency and management reserve needed for the project, according to the PMBOK Guide 6th edition. Decision making and meetings are also techniques that are part of this process.

The outputs, according to the PMBOK Guide 6th edition are the duration estimates including ranges, and probabilities; and the basis of estimates which tells how the estimates were derived; and project document updates which include activity attributes; assumption log; and lessons learned register.

4.3.5 Develop schedule

This process analyses activity sequences, durations, resource requirements, and schedule constraints to create a schedule model for project execution and monitoring and controlling, according to the PMBOK Guide 6th edition. Further, it states that 'Schedule development can require the review and revision of duration estimates, resource estimates, and schedule reserves to establish an approved project schedule that can serve as a baseline to track progress.' It includes defining milestones, identifying and sequencing activities, and estimating durations, according to the PMBOK Guide 6th edition. Inputs to this process are the schedule

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management plan; and the scope baseline of the PMP. Project documents include – activity attributes and list; assumption log; basis of estimates; duration estimates; lessons learned; milestone list; project team assignments; resource calendars; resource requirements; and risk register. It may include vendor agreements. And finally, EEFs and OPAs.

Tools and techniques used in this process are the schedule network analysis – overarching technique used to generate the project schedule model, it employs several other techniques, according to the PMBOK Guide 6th edition.

These techniques are:

- Critical path method – estimates the minimum project duration and determines the amount of schedule flexibility on the logical networks path within the schedule model.
- Resource optimization techniques – used to adjust the start and finish dates of activities to adjust planned resource use to be equal to or less than resource availability. For example, resource levelling and resource smoothing.
- Modelling techniques – what-if scenario analysis and simulation.

Lag time is a delay in time between the predecessor task and the successor task.

Lead is an overlap in time between the predecessor task and the successor task.

Schedule compression are techniques which shorten or accelerate the schedule duration without reducing the project scope in order to meet schedule constraints, imposed dates, or other schedule objectives, according to the PMBOK Guide 6th edition. There are two variations – crashing which shortens the duration and adds resources, but introduces high cost; and fast tracking is done when activities or

phases are done in sequence or performed in parallel for a portion of its duration, but introduces high risk.

MS Project - (a PMIS), will be utilised for the Water Warriors Educational Toolkit project.

Agile release planning is used because it shows the relationship among the product's vision and roadmap; release planning; and iteration planning.

Outputs for the process include the schedule baseline. In MS Project 11 baselines are allowed, 0 represent the initial baseline, it is used to track and compare project progress against the schedule baseline.

The project schedule shows linked activities with planned dates, durations, milestones, and resources, according to the PMBOK Guide 6th edition. Summary tasks may be shown with its subtasks, and numbering. In MS project (a PMIS) the bar chart (Gantt chart) is shown aside the activities. Milestone charts show major deliverables. Project schedule network diagrams show activities and relationships without the time scale – it shows the project network logic and critical path schedule activities, according to the PMBOK Guide 6th edition.

The schedule data describes and controls the schedule, according to the PMBOK Guide 6th edition. It includes schedule milestones and activities; activity attributes and documentation of assumptions and constraints, and more.

Project calendars are applied in MS Project, for the Water Warriors Educational Toolkit project the standard calendar is used, but several exception days are entered – these represents the non-working days, or partial non-working days.

Change requests, once approved must go through a formal change control procedure. Updates to the PMP, and project documents are an output of this process.

4.3.6 Control schedule

This process monitors the status of the project to update the project schedule and manages changes to the baseline, according to the PMBOK Guide 6th edition. This process is performed in the monitoring and controlling process group and occurs after the execution phase. Any change must go through the formal change control procedure. The control schedule determines the current status of the project schedule; influences the factors that create schedule changes; reconsiders necessary schedule reserves; determines if the project schedule changes; and manages actual changes as they occur, according to the PMBOK Guide 6th edition. The inputs to this process are the schedule management plan; schedule, scope, and performance measurement baselines. Project documents are also inputs to this process – the lessons learned register; project calendars; project schedule; resource calendars; and schedule data. Work performance data; and OPAs are inputs as well. Work performance data can be managed through MS project.

Tools and techniques that can be used in this process are data analysis – earned value analysis; iteration burndown chart; performance reviews; trend analysis; variance analysis; and what-if scenario analysis. Other techniques are the critical path method; resource optimization; leads and lags; and schedule compression. PMIS tools can be used, such as MS project can be used.

The outputs for this process (a part of the monitoring and controlling phase), are work performance information; change requests; updates to the PMP; and project documents updates.

4.4 Project Cost Management

The processes which are in the PMBOK Guide 6th edition involves planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget. There are four (4)

processes – plan cost management; estimate costs; determine budget; and control cost. The latter, control cost is part of the monitoring and controlling phase of project management.

4.4.1 Plan cost management

This process defines how the project costs will be estimated, budgeted, managed, monitored, and controlled, according to the PMBOK Guide 6th edition. The inputs to this process are the project charter; subsidiary plans of the PMP – the schedule and risk management plan; EEFs; and OPAs. The tools and techniques include expert judgement; data analysis (alternatives); and meetings.

The output is the cost management plan. This plan describes how the project costs will be planned, structured, and controlled, according to the PMBOK Guide 6th edition. It establishes units of measure; level of precision; level of accuracy; organizational procedures links; control thresholds; rules of performance measurement; reporting formats; and additional details.

The Cost Management Plan

The **units of measure** for the Water Warriors Educational Toolkit project for time measures are monthly salary, and overtime hours for staff. The products and service required would be based on applicable quantity.

The **Level of precision** would be that all cost estimates are rounded up.

The **Level of accuracy** would include +10%. However, contingency would be based on the identified risk, and management reserves for unknown risks.

The **Organizational procedures links** would be demonstrated by the breakdown of the WBS into activities or tasks, and the resources linked to the tasks list.

The **Control thresholds** are variance thresholds used for monitoring cost performance, and may be specified to indicate an agreed-upon amount of variation

to be allowed before some action needs to be taken. Thresholds are typically expressed as percentage deviations from the baseline plan as stated in the PMBOK Guide 6th edition, and can be demonstrated in the PMIS, MS project during execution.

Further, the PMBOK Guide states that the **Rules of performance measurement, or** earned value management (EVM) rules of performance measurement are set. For example, the cost management plan may:

-Define the points in the WBS at which measurement of control accounts will be performed;

-Establish the EVM techniques (e.g., weighted milestones, fixed-formula, percent complete, etc.) to be employed; and

-Specify tracking methodologies and the EVM computation equations for calculating projected estimate at completion (EAC) forecasts to provide a validity check on the bottom-up EAC.

The **Reporting formats** and frequency for the various cost reports are defined, according to the PMBOK Guide 6th edition. The reporting formats may be demonstrated directly from MS Project.

Additional details about cost management activities include but are not limited to:

-Strategic funding choices – funding will be by sponsor. The sponsor's funding comes from government funds, and is under the state's 'Green Fund initiative.'

The procedure to account for fluctuations in currency exchange rates would be that contingencies would have to be used, it is not expected that the currency would fluctuate beyond the estimates, since this project is not long in duration.

The procedure for project cost recording involves careful record keeping and maintenance of the cost estimate versus actual figures.

4.4.2 Estimate costs

This process develops an approximation of the cost of resources needed to complete project work, according to the PMBOK Guide 6th edition. The staff hours will be considered for overtime costs (if any), and for monthly salary. The currency used for the Water Warriors Educational Toolkit project is Trinidad and Tobago dollars. However, in the case of any online purchases, the price in United States dollars will be converted, based on the daily traded value at the local bank. Cost estimates would be made based on the suggested approach of taking a quantitative assessment of the likely costs for resources required to complete the activity, for the Water Warriors Educational Toolkit project it will be based on the previous estimates for similar resources within a relatively short time range, and which includes rounded-up figures with a +10% addition. Decisions would be made regarding make versus buy, and sharing of resources from partner organisation, and internal departments. The estimates for labour; materials; services; and contingency based on risks will be included at the activity level.

The inputs to this process are the cost and quality management plan, and the scope baseline of the PMP. The project documents that are inputs to this process are the lessons learned register; project schedule – here duration estimates affect cost estimates; resource requirements; and the risk register. EEF's such as market conditions; published commercial information and exchange rates, inflation and OPAs such as cost estimating policies and templates; and historical information and lessons learned repository are inputs to this process.

The tools and techniques which can be used in this process are expert judgement; analogous, parametric, bottom-up, or three-point estimating techniques; data analysis such as alternatives, and reserve analysis; and cost of quality. The PMIS used for the Water Warriors Educational Toolkit is MS Project, while the bottom-up and analogous approaches will be used. Finally, decision making in the estimation of costs may including voting.

The outputs of this process are the cost estimates; and basis of estimates which are listed in the PMBOK Guide 6th edition, and are as follows:

-Documentation of the basis of the estimate (i.e., how it was developed),

-Documentation of all assumptions made,

-Documentation of any known constraints,

-Documentation of identified risks included when estimating costs,

-Indication of the range of possible estimates (e.g., US$10,000 (±10%) to indicate that the item is expected to cost between a range of values), and

-Indication of the confidence level of the final estimate.

Additionally, project documents are updated as part of this process. These include the assumption log; lessons learned register; and risk register.

D	O	Resource Name	Type	Material Label	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar	Code
1		Tahira Khan	Work		T		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
2		Chantelle Jacob	Work		C		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
3		Rondell Liverpool	Work		R		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
4		Darielle Rampersad	Work		D		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
5		Marvin Gordon	Work		M		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
6		Adrian Ramkissoon	Work		A		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
7		Simone Warner-King	Work		S		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
8		Gail Ann Roberts-Taitt	Work		G		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
9		Franklyn Charles	Work		F		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
10		Digital Video Disc (DVDs)	Material	Per Disc	D			$10.00		$10.00	Prorated		
11		Prizes	Material	Per Unit	P			$3,000.00		$0.00	Prorated		
12		Snack Plates	Material	Per Plate	S			$45.00		$0.00	Prorated		
13		Memorabilia	Material	Per Unit	M			$50.00		$0.00	Prorated		
14		Game Developer	Material	Per Game	G			$10,000.00		$0.00	Prorated		
15		Laminating Services	Material	Per Unit	L			$20.00		$0.00	Prorated		
16		Brochures	Material	Per Unit	B			$12.00		$0.00	Prorated		
17		White Board Markers	Material	Per Pack of 24	W			$80.00		$0.00	Prorated		
18		Sharda Mahabir	Work		S		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
19		Kelisha Ray	Work		K		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
20		Allister Brizen	Work		A		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
21		Lovaan Superville	Work		L		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
22		Georgia Le Gendre	Work		G		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
23		Donna Hall	Work		D		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	
24		Louise Villaroel	Work		L		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard	

Figure 24: Resource sheet.

4.4.3 Determine budget

This process aggregates the estimated costs of individual activities, or work packages to establish an authorized cost baseline, according to the PMBOK Guide 6th edition. The PMBOK Guide 6th edition states that 'A project budget includes all the funds authorized to execute the project. The cost baseline is the approved version of the time-phased project budget that includes contingency reserves, but excludes management reserves.'

The inputs to this process are subsidiary plans of the PMP, these are the cost, and resource management plans, and the scope baseline. Project documents include the basis of estimates; costs estimates; project schedule; and risk register. Business documents are also considered inputs to the process, these may be the business case, and the benefits management plan. Other inputs are the agreements; EEFs (for exchange rates); and OPAs, in the Water Warriors Educational Toolkit project would come through the use of historical information.

The tools and techniques which may be used in this process are expert judgement; cost aggregation; data analysis – reserve analysis which establishes the management reserves for the project; historical information review; funding limit reconciliation; and financing.

The outputs of this process is the cost baseline which is, according to the PMBOK Guide 6th edition, the approved version of the time-phased project budget, excluding any management reserves, which can only be changed through formal change control procedures, see figure 23 below.
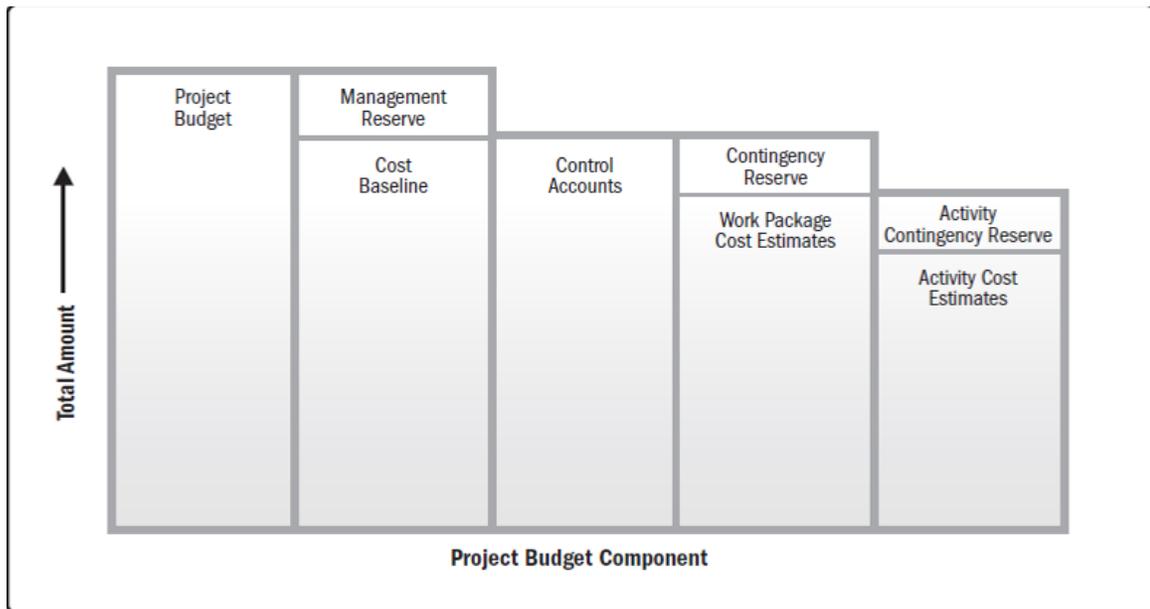
Figure 7-8. Project Budget Components

Other outputs are the project funding requirements, and project document updates. These project documents include, according to the PMBOK Guide 6th edition, cost estimates; project schedule; and risk register.

Chart 21: Budget

WBS Code	Activity	Unit	No. of Units	Estimated Activity Cost	Total (TTD)
Project Budget – funds from WRA Adopt-A-River Programme					
	Human resource (factored in for totality)	Internal			n/a
	Marketing	Free sources, e.g. talk stations/ TV. and social media			

		pages			
	Monitoring	Internal HR			
21.7	Brochures	16 pages plus cover	1000	$12.00 TTD	$12,000.00 TTD
21.6	Activity booklets	Lamination of activity sheets	54	$20.00 TTD	$1,080.00 TTD
21.9	Markers Online purchase, see link: https://www.amazon.com/Marks-Markers-Assorted-Colors-24409/dp/B000IJCDOO/ref=sr_1_3?s=office-products&ie=UTF8&qid=1532376329&sr=1-	24 per pack	17	$80.00 TTD	$1,360.00
	Water quality testing kit	Internal resource			
21.3	Competition Online purchase	Prizes	3	$3000.00 TTD	$9,000.00 TTD
21.2	Snack plates for hosting of prize giving ceremony	Per plate	100	$45.00 TTD	$4,500.00 TTD
21.5	Game	Electronic Game	1	$10,000.00 TTD	$10,000.00 TTD
	Digital Video Disc (DVD) – for games for distribution	Per Disc	50	$10.00 TTD	$500.00 TTD
21.4	Memorabilia Online purchase	Pieces	150	$50.00 TTD	$7,500.00 TTD
	Total				$45,940.00
	Contingency Reserve (based on risks - TTD)				$3,681.25
	Total project baseline (TTD)				$49,621.25
	Management reserve (TTD)				$2,481.06
	Total project budget (TTD)				$52,102.31

The contingency for this budget is based on applicable risks identified. As such, there are two (2) main risks for which a contingency cost will be

required. Firstly, additional contingency should be made for if the water quality testing kits are inadequate for the workshops in terms of needed quantities; and for purchase of new water quality testing kits, should some, or all of the kit's components be expired. Secondly, the electronic game may encounter technical issues later in the project, after the final deliverables are signed off, and the contractual agreement is closed. This means that external technical assistance may be required, hence, introducing unbudgeted cost.

The contingency for the water quality testing kits will be based on the following breakdown, which represents reduced testing capability, but is an estimate within budgeted constraints:

LaMotte Kits

-Tapwater Kit

Price: $1050 plus VAT

Therefore, $1050 X 12.5 /100 = $131.25

$1050 + $131.25 = $1181.25

Instructions/other literature would have to be copied for the distrubution.

Liminting No. of NIHERST kits from a single tapwater kit: 50

Part	Description	Qty/Parent
1381	TAPWATER TOUR COLOR CHART POSTER	1
35022	TAPWATER TOUR, INSTR. MANUAL 48 3-HOLE PUNCHED PAGES	1
35023	TAPWATER TOUR HANDOUTS SET 1 INDEX PLUS 16 MASTER SHEETS	1
34218.03	MAILER, WLT1211, 12 1/4 X 11 7/8 X 2 1/2	1
3608-SS	TAPWATER TOUR SLIP SHEET FOR COVER OF BINDER	1
33103	BAG/WHIRL-PAK/(0791)/NASCO 4OZ 10-20-40ML B00679WA	50
35053	SAFETY FIRST CARD	1
6459A-J	WIDE RANGE PH TABLETS, 100/BOX BLISTER	1
6899A-J	CHLORINE DPD 4R TABLETS,100/BX **MSDS**	1
6917A-J	HARDNESS T (H.R.) TABLETS, 100/BOX *LBL-I* BLISTER	1
3701A-H	COPPER HR TABLETS, 50/BOX BLISTER *LBL-I*	1
3725A-J	IRON (RAPID DISSOLVE) LR TBLTS 100/BOX *LBL-I* BLISTER	1
70103-NP	FLYER, TOURS	1
35024	TAPWATER TOUR DATA SHEET	1
31010-5	BINDER, WHITE CLEARVIEW 1" FOR WATERSHED TOUR #7-221WE	1
37078-A	LABEL, KIT BLUE BOX 3.25" X 1.5" WD 2 2000/ROLL PKG 1177	1
69900	FLYER, PHOTO CONTEST EDUCATION	1

Figure 26: Breakdown of contents in the water quality kit.

Date quote provided: 24 Apr, 2018

From: vishala@roseenvironmental.net

For the electronic game, twenty-five per cent (25%) of the cost to develop the game will be used as an estimate for this project. That would be 25% of $10,000.00 TTD.

4.4.4 Control costs

This process monitors the status of the project to update the project costs and manages changes to the cost baseline. This process occurs under the project's monitoring and controlling phase. The PMBOK Guide 6th edition mentions how a significant part of cost control involves analysing the

relationship between consumption of project funds and the work being accomplished for these expenditures. The PMBOK Guide 6th edition lists the following as the items for the cost control activities:

-Influencing the factors that create changes to the authorized cost baseline;

-Ensuring that all change requests are acted on in a timely manner;

-Managing the actual changes when and as they occur;

-Ensuring that cost expenditures do not exceed the authorized funding by period, by WBS component, by activity, and in total for the project;

-Monitoring cost performance to isolate and understand variances from the approved cost baseline;

-Monitoring work performance against funds expended;

-Preventing unapproved changes from being included in the reported cost or resource usage;

-Informing appropriate stakeholders of all approved changes and associated cost; and

-Bringing expected cost overruns within acceptable limits.

The inputs to this process are the subsidiary plans of the PMP, these may include the cost management plan; cost baseline; and performance measurement baseline. Other inputs are project documents – lessons learned register; project funding requirements; work performance data; and OPAs. The tools and techniques are expert judgement and data analysis. There is a number of data analysis techniques put forward in the PMBOK Guide 6th edition, see a short description below:

Earned Value Analysis (EVA) – compares the performance measurement baseline to the actual schedule and cost performance.

Variance Analysis – as used in EVM, is the explanation (cause, impact, and corrective actions) for cost ($CV = EV – AC$), schedule ($SV = EV – PV$), and variance at completion ($VAC = BAC – EAC$) variances. Variance analysis determines the cause and degree of variance relative to the cost baseline,

according to the PMBOK Guide 6th edition; this further determines whether corrective or preventative action is required.

Trend analysis - is used in this process, it examines project performance over time to determine if performance is improving or deteriorating, and techniques include charts and forecasting, according to the PMBOK Guide 6th edition.

Reserve analysis, according to the PMBOK Guide 6th edition - monitors the status of contingency and management reserves for the project to determine if it is still needed or if additional reserves need to be requested.

To-Complete Performance Index - is a measure of the cost performance that is required to be achieved with the remaining resources in order to meet a specified management goal, expressed as the ratio of the cost to finish the outstanding work to the remaining budget, as stated in the PMBOK Guide 6th edition.

A PMIS is a tool which can be used. MS Project has the capability to monitor EVM, and produce reports.

The outputs of this project are work performance information on how the project work is performing when compared to the cost baseline; cost forecasts on calculated EAC or bottom-up EAC values; change requests; updates to the subsidiary plans of the PMP – cost management plan; cost baseline; and performance measurement baseline. Finally updates to project documents such as the assumption log; basis of estimates; cost estimates; lessons learned register; and risk register.

Cost constraints and boundaries

The well-known triple constraint of a project's time; cost; and scope is an essential concept which Project Managers are familiar with. According to Lee, W. (2010) PMs refer to the triple constraint as a framework for evaluating competing demands, however Lee, W. (2010) also states that there may be challenges outside of this acquainted context and which are beyond a PM's control, Lee, W. (2010). A key area of managing a project, according to Lee, W. (2010) is balancing the competing demands for quality, scope, time, and cost, and this is associated to the resulting quality of the project's intended outputs, as well as the risks (events of uncertainty), Lee, W. (2010) mentions how one affected factor in the triple triangle may also have an effect on one of the other two factors. However, there are limitations to the triple constraint according to Lee, W. (2010), as such Lee, W. (2010) proposed the 'Management Constraint Triangle.' The 'Management Constraint Triangle' according to Lee, W. (2010) seeks the reason certain events or challenges occur and finds why it is beyond a PM's control. The three factors of the 'Management Constraint Triangle' are resources (people, system, and tools); financials (revenue, expenses, budget, and allocation); and stakeholders (sponsor, boss, client, and customer), Lee, W. (2010). Once one of these three (3) factors is affected then the effects are potentially made to the other two factors in a complex way, Lee, W. (2010).

In terms of the Water Warriors Educational Toolkit project, for the financial aspect, should the PM and team cross the cost boundaries of the project, impacts can be multifarious. If the cost boundaries are crossed, or cut, for instance, then the stakeholders and end users may be affected. For example, if the budget allocated through grant funding is reduced then the number of schools the project is intending to benefit will be have to be reduced. If the estimates are off by a significant margin, owing to inflation, then the project's management reserve will be required, but if it is beyond the five per cent (5%) allocated then there may be some seriously crippling effects on the project

results. Acknowledging constraints that are outside of the project's boundaries, according to Lee, W. (2010) helps the PM to deal with such events when they do happen. Therefore, the 'Management Constraint Triangle' can be used for the Water Warriors Educational Toolkit project by, utilizing the three factors of the 'Management Constraint Triangle:' attending internal and external meetings and conferences that pertain to water resource management; paying attention to external environmental factors and organizational changes; and networking and keeping one's knowledge in tune with current happenings as it pertains to industry best practice, according to Lee, W. (2010).

4.5 Project Quality Management

The processes of the project quality management knowledge area are plan; manage; and control quality, according to the PMBOK Guide 6th Edition. Project Quality Management includes the processes for incorporating the organization's quality policy regarding planning, managing, and controlling project and product quality requirements in order to meet stakeholders' objectives, according to the PMBOK Guide 6th edition. Of the three processes, plan quality management falls under the planning process group, whilst manage quality is under the executing process group, and control quality under the monitoring and controlling process group. As such, the outputs of the plan quality management will be developed for the FGP process as applicable.

4.5.1 Plan quality management

This process identifies quality requirements and/or standards for the project and its deliverables, and documents how the project will demonstrate compliance with quality requirements and /or standards, according to the PMBOK Guide 6th Edition. The inputs to this process are the project charter;

subsidiary plans of the PMP – requirements and risk management plan; stakeholder engagement plan; and scope baseline; project documents – assumption log; requirements documentation; and risk and stakeholder register; and EEFs and OPAs.

The tools and techniques in this process are expert judgement; data gathering techniques such as benchmarking, brainstorming, and interviews. There are several data analysis techniques, these are; cost-benefit analysis cost of quality (i.e. Prevention cost, appraisal costs, and failure costs), see figure 24 below:

Cost of Conformance

Prevention Costs
(Build a quality product)
- Training
- Document processes
- Equipment
- Time to do it right

Appraisal Costs
(Assess the quality)
- Testing
- Destructive testing loss
- Inspections

Money spent during the project **to avoid failures**

Cost of Nonconformance

Internal Failure Costs
(Failures found by the project)
- Rework
- Scrap

External Failure Costs
(Failures found by the customer)
- Liabilities
- Warranty work
- Lost business

Money spent during and after the project **because of failures**

Figure 8-5. Cost of Quality

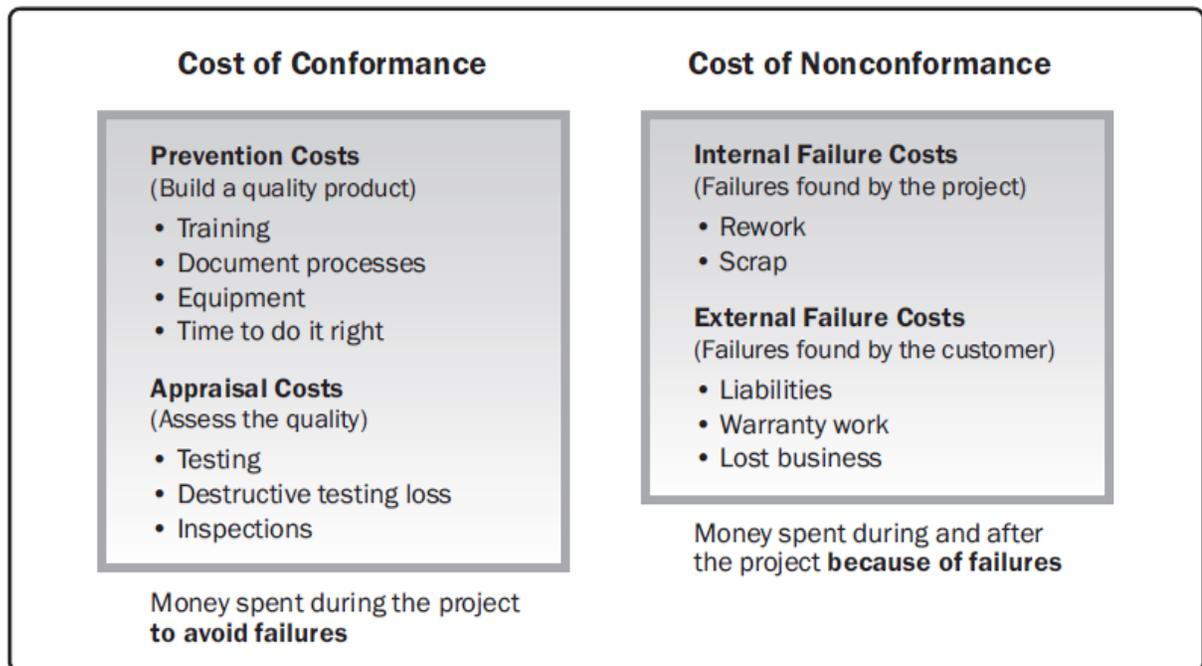Figure 27: PMBOK® Guide, Project budget components. Reprinted from: A Guide to the Project Management Body of Knowledge (p. 283), Project Management Institute, 2017, Project Management Institute. Copyright 2017 by Project Management Institute, Inc.

Further, the PMBOK Guide 6th edition outlines techniques, such as; decision making – multicriteria decision analysis; data representation – flowcharts,

logical data model, matrix diagrams, and mind-mapping; test and inspection planning; and meetings.

The outputs are the quality management plan; quality metrics; updates to the PMP's subsidiary plans – the risk management plan, and the scope baseline; and updates to project documents – lessons learned register, requirements traceability matrix, risk register, and stakeholder register.

The quality management plan describes how applicable policies, procedures, and guidelines will be implemented to achieve the quality objectives, the activities and resources necessary for the project management team to achieve quality objectives set for the project, according to the PMBOK Guide 6th edition. It includes the following components according to the PMBOK Guide 6th edition:

-Quality standards that will be used by the project;

-Quality objectives of the project;

-Quality roles and responsibilities;

-Project deliverables and processes subject to quality review;

-Quality control and quality management activities planned for the project;

-Quality tools that will be used for the project; and

-Major procedures relevant for the project, such as dealing with non-conformance, corrective actions procedures, and continuous improvement procedures.

The quality metric describes a project or product attribute and how the Control Quality process will verify compliance to it, according to the PMBOK Guide 6th edition. For the Water Warriors Educational project quality metrics may include; percentage of tasks completed on time, and tests compliance for the game component prior to service provider submission as a final deliverable, and may include other simple checks.

1.0 The Quality Management Plan

The Quality Management Plan is a significant aspect of the Project Management Plan, Rose in his book, utilized four (4) aspects regarding quality: planning; assurance; control; and improvement, and the general framework is broken down into seven (7) steps (Rose, K., 1947). It is a proactive approach to quality management. Rose describes how customers and requirements are the groundwork of the quality management plan, and represents the first two (2) steps. Customers, he says, are the base in project quality, and can be classified into three (3) groups: internal; external; and hidden, this is the first step. Further, Sirolli, in his Ted Talks video file, highly regards the potential of listening to what customers want, this, he says, is more realistic when it comes to dealing with entrepreneurs, because he says entrepreneurs are likely to come and listen and give inputs on a one-on-one basis, when they are assured of trust and confidentially and are more lured by passionate service. This is the basis for successful projects, according to Sirolli, 2012, November 26. The second step is identifying requirements, Rose uses the Full Analytical Criteria Method to do this, and then both customers and requirements are compared in a Customer-Weighted Requirements Prioritization Matrix to determine what the critical requirement for project success is. Quality plan components include: quality objectives; key project deliverables and processes to be reviewed for satisfactory quality level; quality standards; quality control and assurance activities; quality roles and responsibilities; quality tools; and plan for reporting quality control and assurance problems, according to (DoIT Project Management Advisor, 2006). Having the requirements clearly written out is critical to project success as well, according to Mulcahy, R. [RMC Learning Solutions]. (2008, July 14).

Mulcahy, describes how to go about obtaining those requirements, a process she explains must be carried out firmly and with resolute action.

1.1 Objectives

This project is a collaborative project between the sponsor Water Resource Agency (WRA) and the National Institute of Higher Education, Research, Science and Technology (NIHERST). The WRA runs a programme called Adopt-A-River which administers numerous projects, some of them with the assistance of partner organisations, such as NIHERST in this case.

- Deliverables for the project sustain best project management practices.
- Deliverables meet customer requirements and all stakeholders.
- Deliverables bring into line all the regulatory frameworks, and standards that are applicable to this project.
- Deliverables meet customer specifications.
- Deliverables incorporate the use of recyclables.

2.0 Stakeholders matrix (impact, interest, power and influence)
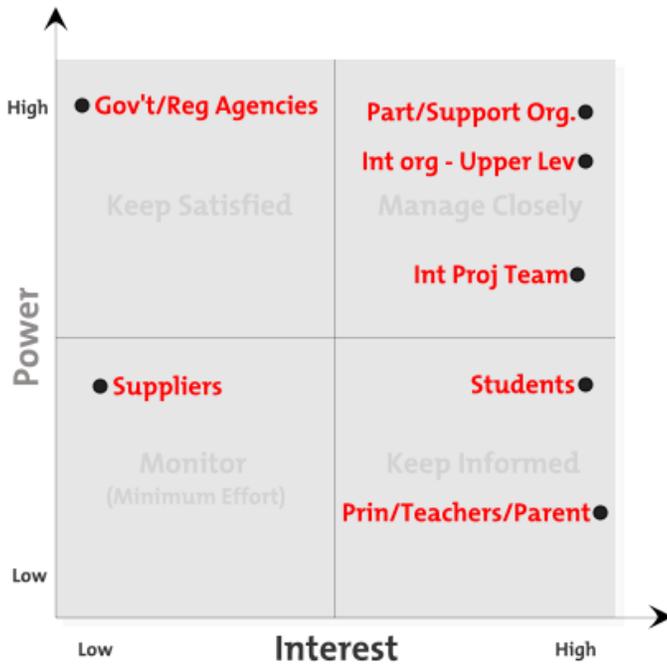
Figure 28: Stakeholder Power/Interest Matrix.

Chart 22: Stakeholder analysis

Stakeholder	Impact (low, medium, high)	Interest (low, medium, high)	Power (low, medium, high)	Influence (low, medium, high)
Partner/Support Organisation	High	High	High	High
Internal Organisation /Upper Level Management	High	High	High	High
Internal Teams for the Project	High	High	High	High
Students	Medium	High	Low	Medium
Principle/Teachers/Parents	Medium	High	Low	High
Suppliers; game	Low	Low	Low	Low

developers; stationary and publication services etc.			
Government agencies and other regulatory agencies	High	Low	High	Medium

3.0 Prioritize the stakeholders, using the "L Shape Matrix"

Project: Water Resources Agency /Science Institute Water Conservation Sensitization Project for Students.

Chart 23: Separation of Stakeholders

Internal	External	Hidden
-Partner/Support Organisation. -Internal organisation upper level management. -Internal teams for project	-Students. - Principle/Teachers/Parents. -Suppliers; game developers; stationary and publication services; etc.	-Government agencies and other regulatory agencies.

3.1 Prioritizing Customers

Here, the customers are compared to each other on a one-on-one basis. Where the first is compared to the second, from the vertical axis to the horizontal axis.

Chart 24: L-Shaped Matrix

	Partner/Support Organisation	Internal organisation upper level mgmt.	Internal teams for project	Students	Principle/Teachers/Parents	Suppliers; game developers; stationary and publication services; etc.	Government agencies and other regulatory agencies	Row Total	Relative Decimal Value
Partner/Support Organisation		1	5	1/10	1/5	10	1	17.3	0.15
Internal organisation upper level mgmt.	1		1	1/10	1/5	5	1	8.3	0.071
Internal teams for project	1/5	1		1/10	1/5	5	5	11.5	0.099
Students	10	10	10		1	10	1	42	0.36

Principle/Teachers/Parents	5	5	5	1		5	1	22	0.19
Suppliers; game developers; stationery and publication services; etc.	1/10	1/5	1/5	1/10	1/5		1/10	0.9	0.0077
Government agencies and other regulatory agencies	1	1	1/5	1	1	10		14.2	0.12
							Grand Total	116.2	

Key:

- 10 Much more important
- 5 More important
- 1 Equally important
- 1/5 Less important
- 1/10 Much less important

4.0 Identify the requirements and prioritize them using "L Shape Matrix"

➢ Age relevant

- ➢ Sustainable resources
- ➢ Directive
- ➢ Entertaining
- ➢ Sturdy
- ➢ Compliant

Chart 25: Requirements - Partner/Support Organisation

Partner/Support Organisation	Age Relevant	Sustainable Resources	Directive	Entertaining	Sturdy	Compliant	Row Total	Relative Decimal Value
Age Relevant		5	10	5	1	1	22	0.24
Sustainable Resources	1/5		1/5	1/5	1/5	1/10	0.9	0.0099
Directive	1/10	5		1/5	1/5	1/5	5.7	0.0625
Entertaining	1/5	5	5		1/5	1/10	10.5	0.12
Sturdy	1	5	5	5		1/10	16.1	0.18
Compliant	1	10	5	10	10		36	0.39
						Grand Total	91.2	

Chart 26: Requirements - Internal organisation upper level management

Internal organisation upper level management	Age Relevant	Sustainable Resources	Directive	Entertaining	Sturdy	Compliant	Row Total	Relative Decimal Value
Age Relevant		1	1	5	1	1/10	8.1	0.12
Sustainable Resources	1		1	1	1	1/10	4.1	0.058
Directive	1	1		1/5	1/5	1/5	2.6	0.037
Entertaining	1/5	1	5		1/10	1/5	6.5	0.092
Sturdy	1	1	5	10		1	18	0.26
Compliant	10	10	5	5	1		31	0.44
						Grand Total	70.3	

Chart 27: Requirements - Internal teams for project

Internal teams for project	Age Relevant	Sustainable Resources	Directive	Entertaining	Sturdy	Compliant	Row Total	Relative Decimal Value
Age Relevant		1	1	1	1/5	1/5	3.4	0.047
Sustainable Resources	1		10	5	5	1	22	0.31
Directive	1	1/10		1	1/10	1/5	2.4	0.033
Entertaining	1	1/5	1		1/5	1/5	2.6	0.036
Sturdy	5	1/5	10	5		1/5	20.4	0.28
Compliant	5	1	5	5	5		21	0.29
						Grand Total	71.8	

Chart 28: Requirements - Students

Students	Age Relevant	Sustainable Resources	Directive	Entertaining	Sturdy	Compliant	Row Total	Relative Decimal Value
Age Relevant		10	1/10	1/10	5	5	20.2	0.18
Sustainable Resources	1/10		1/10	1/10	1/5	1	1.5	0.014
Directive	10	10		1/5	10	10	40.2	0.36
Entertaining	10	10	5		5	10	40	0.36
Sturdy	1/5	5	1/10	1/5		1	6.5	0.059
Compliant	1/5	1	1/10	1/10	1		2.4	0.022
						Grand Total	110.8	

Chart 29: Requirements - Principle/Teachers/Parents

Principle/Teachers/Parents	Age Relevant	Sustainable Resources	Directive	Entertaining	Sturdy	Compliant	Row Total	Relative Decimal Value
Age Relevant		5	1	1	1	1/10	8.1	0.094
Sustainable Resources	1/5		1/5	1/5	1/5	1/10	0.9	0.010
Directive	1	5		1	1	1/10	8.1	0.094
Entertaining	1	5	1		1/5	1/10	7.3	0.084
Sturdy	1	5	1	5		1/10	12.1	0.14
Compliant	10	10	10	10	10		50	0.58
						Grand Total	86.5	

Chart 30: Requirements - Suppliers; Game Developers; Stationery and Publication Services; etc.

Suppliers; game developers; stationary and publication services; etc.	Age Relevant	Sustainable Resources	Directive	Entertaining	Sturdy	Compliant	Row Total	Relative Decimal Value
Age Relevant		1	1	1	1/10	1/10	3.2	0.030
Sustainable Resources	1		5	1	1/10	1/10	7.2	0.068
Directive	1	1/5		1/10	1/10	1/10	1.5	0.014
Entertaining	1	1	10		1/10	1/10	12.2	0.11
Sturdy	10	10	10	10		1	41	0.39
Compliant	10	10	10	10	1		41	0.39
						Grand Total	106.1	

Chart 31: Requirements - Government agencies and other regulatory agencies

Government agencies and other regulatory agencies	Age Relevant	Sustainable Resources	Directive	Entertaining	Sturdy	Compliant	Row Total	Relative Decimal Value
Age Relevant		1/5	1	1	1/5	1/10	2.5	0.028
Sustainable Resources	5		10	5	1	1/10	21.1	0.24
Directive	1	1/10		1	1/5	1/10	2.4	0.027
Entertaining	1	1/5	1		1/5	1/10	2.5	0.028
Sturdy	5	1	5	5		1/5	16.2	0.18
Compliant	10	10	10	10	5		45	0.50
						Grand Total	89.7	

5.0 Customer-Weighted Prioritization Matrix

Overall values for requirements.

Chart 32: Customer-Weighted Prioritization Matrix

Customer-Weighted Requirements Prioritization	Partner/Support Organisation (0.15)	Internal organisation upper level mgmt. (0.071)	Internal teams for project (0.099)	Students (0.36)	Principle/Teachers/Parents (0.19)	Suppliers; game developers; stationary and publication services; etc. (0.0077)	Government agencies and other regulatory agencies (0.12)	Row Total	Relative Decimal Value
Age Relevant	0.036	0.0085	0.0047	0.065	0.018	0.00023	0.0034	0.14	0.14
Sustainable Resources	0.0015	0.0041	0.031	0.0050	0.0019	0.00052	0.029	0.073	0.072

Directive	0.0094	0.0026	0.0033	0.13	0.018	0.00011	0.0032	0.17	0.17
Entertaining	0.018	0.0065	0.0036	0.13	0.016	0.00085	0.0034	0.18	0.18
Sturdy	0.027	0.018	0.028	0.021	0.027	0.0030	0.022	0.15	0.15
Compliant	**0.059**	**0.031**	**0.029**	**0.0079**	**0.11**	**0.0030**	**0.06**	**0.30**	**0.30**
							Grand Total	1.013	

The matrix shows that, by a significant margin, the highest priority for the Water Resources Agency /Science Institute Water Conservation Sensitization Project for Students is for the content to be compliant. This is important because in order to be authorized by the relevant authorities compliance is needed for the project to be executed. It is therefore good to have this incorporated into the planning stage.

6.0 Quality Management Plan

6.1 Role and Responsibilities Matrix

Chart 33: Roles and Responsibilities Chart

Role	Responsibilities
Partner/Support Organisation	Plays a role in approval of and input in deliverables, through communicating with these stakeholders in the planning stage of the project.
Internal Organisation /Upper Level Management	Ensures that a quality system is in place.
Internal Teams for the Project: The Project Manager	Ultimately responsible for the quality assurance and control activities for the deliverables arising out of the project and product.
Internal Teams for the Project: The team members	Responsible for the quality aspects of their part of the project.
Internal Teams for the Project: Individual team member	Responsible for overall quality in whatever assignments they have.
Students	Accepts or rejects the final

	deliverables. Can be positive (customer marketing) or negative (lost customers). Quality Assurance and Control should effectively eliminate this result), through communicating with these stakeholders in the planning stage of the project.
Principle/Teachers/Parents	Accept or reject the final deliverables. Can be positive (customer marketing) or negative (lost customers). Quality Assurance and Control should effectively eliminate this result), through communicating with these stakeholders in the planning stage of the project.
Suppliers; game developers; stationary and publication services etc.	Doing business with suppliers that have only positive reviews from past experiences and lessons learnt documentation is essential to achieving quality assurance.
Government agencies and other regulatory agencies	Ensures that permits are approved in accordance with regulations and other standards.

6.2 Key Factors Related to Quality

Chart 34: Key Factors Related to Quality

Factor	Factor Definition	Quality Objective
Continuous Improvements In Process.	-Wide range data collection methods. -Data distribution: regular and timely. -Spreading data collection activities over time.	Deliverables for the project sustain best project management practices.
Focus on Customer Requirements.	Quality Assurance that covers important aspects of quality and the relevant stakeholder views.	Deliverables meet customer requirements, and of all stakeholders.
Quality Improvement Culture.	Pressure to improve.	Deliverables bring into line all the regulatory frameworks, and standards that are applicable to this project.
Commitment and Understanding from Employees.	Ensure that employees within the organization work towards achieving the company's	Deliverables meet customer specifications.

	strategic direction, and by extension meeting customer specifications.	
Sustainably produced components.	Purchase components that are manufactured from post customer materials by at least 85%.	Deliverables incorporate the use of recyclables.

6.3 Metrics and Quality Baseline

Chart 35: Metrics and Quality Baseline

Factor	Metrics	Metric definition	Expected outcome/result	Measurement frequency	Responsible
Continuous Improvements In Process.	Improvement incorporated as a continuous measure throughout organisation.	The use of tools, such as, data gathering tool – checklists, questionnaires and surveys; data analysis method - root cause analysis; and testing/product evaluation to be utilized.	Quality/customer requirements met for in-house designed reusable activity booklets, computerized games, and brochures; potential customer expectations, availability and buy in obtained; if a problem arises, to find out its source; and to test the game, before being finally approved, ensure that all the customers and stakeholders are satisfied with the service of the game, and also if the reusable activity booklets are functioning as intended.	At the initiation, midpoint and close of each phase.	Internal Project Team.
Focus on	Gather all available	Itemize and prioritize customer requirements in	Ensure that all prioritized customer requirements are met.	During planning.	Internal Project Team

Custom er Require ments.	customer requirement s from lessons learnt organization al process assets and customer engagement as part of the communicat ion managemen t plan.	collaboration with the project sponsor and internal project team.			
Quality Improve	Adhere to 100%	100% required standards and regulations are	100% of required standards and regulations adhered to.	During Planning, and	Internal Project Team

ment Culture.	required standards and regulations.	identified and documented.		at the start and close of each phase.	
Commit ment and Underst anding from Employ ees.	Achieve 100% customer specification s.	Relevant customer specifications documented, in alignment to the strategic objective of fulfilling customer satisfaction, by continuous communication with stakeholders.	100% of customer specifications achieved.	Quarterly	Internal Organisation /Upper Level Management
Sustain ably produce d compon	Purchase paper and request that publications are printed	Ensure that three aspects; anything printed for distribution, any paraphernalia purchased are manufactured from	Three aspects utilize agreed upon degree of sustainable materials.	During Execution	Internal Project Team

ents.	on post customer materials by at least 85%. Purchase paraphernalia that were sustainably produced. Use no imperishable food packaging and cutlery.	recyclables. And that no imperishable food packaging and cutlery are used.			

6.4 Quality Activities Matrix

Chart 36: Quality Activities Matrix

Deliverable	Requirement	Manage and Control activities	Frequency	Responsible
Deliverables for the project sustain best project management practices.	Continuous Improvements In Process. The use of tools, such as, data gathering tool - checklists and questionnaires and surveys; data analysis method - root cause analysis; and testing/product evaluation to be utilized.	Manage: Analyse the data and make projections.	At the initiation, midpoint and close of each phase.	Project Manager
		Control: Perform small and frequent inspections based on the findings from the implementation of various tools and techniques.	At the end of each phase.	Internal Project Team
Deliverables meet customer requirements,	Focus on Customer Requirements.	Manage: Utilize the documented specifications	During planning.	Internal Project Team and Project

		in the design process.		Sponsor
and all stakeholders	Itemized and prioritize customer requirements in collaboration with the project sponsor and internal project team.	Control: Inspect/test the deliverables (in-house designed reusable activity booklets, computerized games, and brochures) by sponsor and internal project team to determine if it meets documented specifications.	At the end of production, prior to release.	Internal Project Team
Deliverables bring into line all the regulatory frameworks, and	Quality Improvement Culture. 100% of the required	Manage: Identify the required and agreed upon standards and regulations for	During Planning, and at the start and close of each phase (in the event	Internal Project Team

standards that are applicable to this project.	standards and regulations are identified and documented.	this project in order to ensure compliance, and meet deadlines.	of new standards or regulations).	
		Control: Apply for permits within the stipulated timeframe.	During planning, and prior to execution or release.	Internal Project Team
Deliverables meet customer specifications.	Commitment and Understanding from Employees. Each employee understands the strategic goal of the organization – to achieve customer satisfaction.	Manage: Communicate consistently and continuously - the organization's strategic direction; ensure that each employee understands and recognizes that direction	Quarterly communication on a continuous basis.	Internal Organisation /Upper Level Management

		and work towards achieving it.		
		Control: Ensure that deliverables embody the organization's strategic direction.	Prior to execution or release.	Internal Organisation /Upper Level Management
Deliverables incorporate the use of recyclables.	Sustainably produced components. No use of imperishable food packaging. Use of 85% post customer materials in procured goods.	Manage: Research and purchase only the agreed upon specifications for materials for the printing of brochures, activity booklets and food packaging.	During Planning	Internal Project Team – Individual member responsibility.
		Control: Inspect invoices to	During Planning.	Internal Project Team –

		ensure the correct grade and specifications are being purchased.		Individual member responsibility.

6.5 Quality Documents

Organizational Process Assets

Chart 37: Quality Documents

Category	Standards and Regulations
Standard	ISO 14001
Internal Policy	Signatory policy.
Quality Template	Checklists, L-Shaped Matrix, Test Plan, Test Documents.
Issue and defect reporting procedures and communication policies	Organizational reporting template for issues and defects, and accompanying policies.
Guidelines	For documenting lessons learnt and report templates, by phase and by quarter/annual basis.
Lessons learned repository	From similar projects.
National Policies	National Environmental Policy
Approvals/Consent	Ministry of Education Approvals/Consent for school engagement activities.

Chart 38: Tools And Techniques That Will Be Used Are As Follows:

Description	Tools and Techniques
Matrix	L-Shaped Matrix
Data gathering tool.	Checklists and questionnaires and surveys.
Data analysis method	root cause analysis
Testing	Testing/product evaluation

6.6 Continuous Improvement Plan

Continuous Improvement Plan

Quality improvement is a continuous process, Rose, K. (1947), mentions how it is a continuous and deliberate process which uses objective measurement and data. Further, he states the numerous benefits to continuous improvement, such as, improving and meeting customer satisfaction, and improving company reputation and competiveness.

Engaging in a continuous improvement plan may result in fewer defects, cost saving, time saving, positive customer marketing, incorporating newer concepts as introduced on the market by entrepreneurs and companies, Rose, K. (1947), which are all beneficial and is a step above traditional quality processes and checks.

The plan-do-check-act cycle developed by Walter Shewhart is a methodology that can be used for continuous improvement. Each step of the process, with relevance to the Adopt-A-River Programme-NIHERST Collaboration is described below:

CHART 39: Proposed Plan/Procedure to Improve

Process Description
1. **IDENTIFY** - After the team is formalized, and during the project planning, any opportunities for the team to assess checkpoints, and audits with regard to the deliverables should be identified. The Adopt-A-River Programme-NIHERST Collaboration project will need a communication plan that is dynamic, that is, it must ensure that all information is effectively communicated, so that the customer requirements are documented. To support this, all stakeholders must be identified and documented. Additionally, their buy-in and availability are also relevant for the success of a science popularization project like this. All internal team members must understand their role and be knowledgeable about how it relates to the strategic direction of the organization and the project by extension. Checklists should include all the agreed upon specifications to be utilized to control quality.
2. **PLAN** - Observing and collecting data through the tools and techniques identified is a part of ensuring quality. This means that data can be analysed to determine what needs improvement; it can also determine a level where measurement can be benchmarked. Areas of non-conformance, for example, can be documented, applicable diagrams can be utilized to find issues and uncover problems, e.g. a cause and effect diagram.
3. **EVALUATE** - Verify with relevant stakeholders the various issues earmarked for improvement before moving forward. Developing an effective and workable plan with targets set against the measured benchmarks, are taken, and utilized for increasing the level of quality in the deliverables.

4. **EXECUTE** – Taking the plan with suggested targets for improvement, and putting it into action by the creation of an action plan. Once the identified actions are deemed feasible, they should be tested before implementation, and communicated with stakeholders before being finally implemented.

5. **REVIEW** – After the approved and planned changes have been put into action, a review and evaluation is done to observe the effects on quality of the deliverables. These may have to be repeated, until the planned objectives are met. If necessary, methods may need revision, and team members may need training.

7.0 Conclusions

The quality management plan is a seven step process that has components starting with quality objectives; key project deliverables and processes to be reviewed for satisfactory quality level; quality standards; quality control and assurance activities; quality roles and responsibilities; quality tools; and ending with plan for reporting quality control and assurance problems, according to (DoIT Project Management Advisor, 2006). Each element forms the quality management plan. Tools such as the L-Shaped Matrix in its entirety identifies and prioritizes the customers and their requirements and finally analyses, through the Customer Weighted Prioritization Matrix, the rank of each requirement. The quality management plan takes into consideration customer's expectations and it uses their requirements to take a pre-emptive approach to build in quality into the planning stages, whilst using the concept of control more as an approach to net any unexpected issues, before reaching customers (DoIT Project Management Advisor, 2006).

8.0 Recommendations

- Implementation of the plan-do-check-act cycle created by Walter Shewhart is recommended for achieving continuous improvement and maintaining best project management practices. Data can be collected, collated, and analysed using the applicable tools and techniques identified.

- In accordance with the communication management plan, dynamic communication between stakeholders will promote awareness and interest in the Adopt-A-River Programme-NIHERST Collaboration Project. It will ensure that adoption of the responsibilities and actions assigned to each stakeholder is achieved. And it will boost the two-way communication process between the Internal Project Management Team and the stakeholders.

- Quality Assurance will encourage the identification and documentation of the all the regulatory frameworks, and standards that are applicable to this project. This process ensures that relevant permits are applied for well in advance, and any other request, e.g. school participatory approval/consent letters.

- Upper level management should ensure that all Internal Team Members are well aware of, and appreciate the strategic direction of the organisation; therefore, meeting customer satisfaction should be at the forefront of any successful project.

- The use of post customer materials in the purchasing, manufacturing and development of deliverables and selective perishable food packaging must be ensured, this can be in alignment to achieving National targets, such as those found in the National Environmental Policy, and ISO 14001 International standards for process improvement.

4.5.2 Manage quality

This process translates the quality management plan into executable quality activities that incorporate the organization's quality policies into the project, according to the PMBOK Guide 6th edition. It falls under the executing process group. According to the PMBOK Guide 6th edition, this process is sometimes called quality assurance, however, manage quality involves product design aspects and process improvements. The inputs to this process are the PMP's quality management plan; project documents – lessons learned register, quality control measurements, quality metrics; risk report; and OPAs.

The tools and techniques used in this process are data gathering - checklists; data analysis – alternatives, document, process, and root cause analysis; decision making – multicriteria decision; data representation - affinity diagrams, cause-and-affect diagrams, flowcharts, histograms, matrix diagrams, scatter diagrams; audits; design for X; problem solving; and quality improvement methods.

The outputs are quality reports; test and evaluation documents; change requests; PMP updates – quality management plan, scope baseline, schedule baseline; and cost baseline; and project document updates – issue log, lessons learned register, and risk register.

4.5.3 Control quality

This process monitors and records results of executing the quality management activities in order to assess performance and ensure the project outputs are complete, correct, and meet customer expectations, according to the PMBOK Guide 6th edition. The inputs to this process are the PMP's quality management plan; project documents – lessons learned register, quality metrics, test and evaluation documents; approved change requests; deliverables; work performance data; EEFs; and OPAs.

The tools and techniques for this process are; data gathering – checklists, check sheets; statistical sampling; questionnaires and surveys; data analysis – performance reviews, and root cause analysis; inspection; testing/product evaluations; data representation – cause-and-effect diagrams, control charts, histograms, and scatter diagrams; meetings for approved change requests review, and for retrospectives/lesson learned.

The outputs of the control quality process, which falls under the monitoring and controlling process group, are quality control measurements; verified deliverables; work performance information; change requests; updates to the PMP's quality management plan; and project documents updates – issue log, lessons learned register, risk register, and test and evaluation documents.

4.6 Project Resource Management

This process identifies, acquires, and manages the resources needed for the successful completion of the project, according to the PMBOK Guide 6th edition. There are six (6) processes in this knowledge area. This knowledge area distinguishes team resources and physical resources.

4.6.1 Plan resource management

This process defines how to estimate, acquire, manage, and use team and physical resources, according to the PMBOK Guide 6th edition. It is important to recognise that the PMBOK Guide states that effective resource planning should consider and plan for the availability of, or competition for, scarce resources.

The inputs to this process are the project charter; subsidiary plans of the PMP – quality management plan, and scope baseline; project documents – project schedule, requirements documentation, risk register, stakeholder register; EEFs; and OPAs. For instance, the use of NIHERST's policies for HR, asset management and related forms, Health and Safety policy and related forms, and historical records may be considered.

The tools and techniques for this process are expert judgement; data representation – hierarchical charts for positions and relationships (WBS, organizational breakdown structure (OPA), resource breakdown structure (RBS)); responsibility assignment matrix, e.g. a RACI chart; text-oriented formats; organisational theory; and meetings.

The outputs of this process are the resource management plan; team charter; and project documents updates – assumption log, and risk register.

The resource management plan

-Identification of resources

The use of the WBS would be used to derive the necessary resources needed for the project from the work packages, as well as taking consideration of the organisational breakdown structure, from which the human resources would be assigned.

-Acquiring resources

The team resources are all internal resources. The physical resources are materials, equipment etc. Use of equipment would be internal assets, for the Water Warriors Educational Toolkit project - a simple project, equipment such as the use of photocopiers, and printers would already be accessible internally. All other services and materials would be purchased externally through the organisation's procurement department.

Chart 40: Roles and Responsibilities:

Role	Authority	Responsibility	Competence
Project Manager	-Determines selection of a method for completing an activity -Makes decisions, signs approvals. - Responds to project variances.	-Project management duties.	-Knowledge of project management knowledge areas, phases and processes.
Research Assistant	-Applies project resources -Accepts deliverables - Influences others to carry out the work of the project - Responds to project variances.	-Assists with executing deliverables.	-Knowledge of project management knowledge areas, phases and processes.
Project Assistant	-Applies project resources -Accepts deliverables influence others to carry out the work of the project	-Assists with executing deliverables.	-Knowledge of project management knowledge areas, phases and processes.

	- responds to project variances.		
Project Assistant	-Applies project resources -Accepts deliverables - Influences others to carry out the work of the project - Responds to project variances.	-Assists with executing deliverables.	-Knowledge of project management knowledge areas, phases and processes.
Senior Project Officer	-Determines selection of a method for completing an activity -Makes decisions, sign approvals - Responds to project variances. -Assists with executing deliverables.	-Project management duties.	-Knowledge of project management knowledge areas, phases and processes.
Project Assistant	-Applies project resources -Accepts deliverables - Influences	-Assists with executing deliverables.	-Knowledge of project management knowledge areas, phases and

	others to carry out the work of the project - Responds to project variances.		processes.
Administrative Assistant, Procurement	-Handles procurement processes.	-Assists with purchasing.	-Knowledge of procurement procedures and OPA's – policies, procedures, and forms.
Administrative Assistant, Facilities	-Handles internal procedures.	-Assists with internal bookings, and use of facilities.	-Administrative, and strong communication skills. -Problem solving.
Outreach Assistant	-Assigns resources, and manages meetings.	-Assists with executing deliverables.	-Personal competencies in leadership and classroom behaviours.
Technical Assistant	- Helps formulate quality acceptance criteria	-Assists with specific work packages.	-Technically competent
Production Assistant	- Helps formulate quality acceptance criteria	-Assists with specific work packages.	-Technically competent

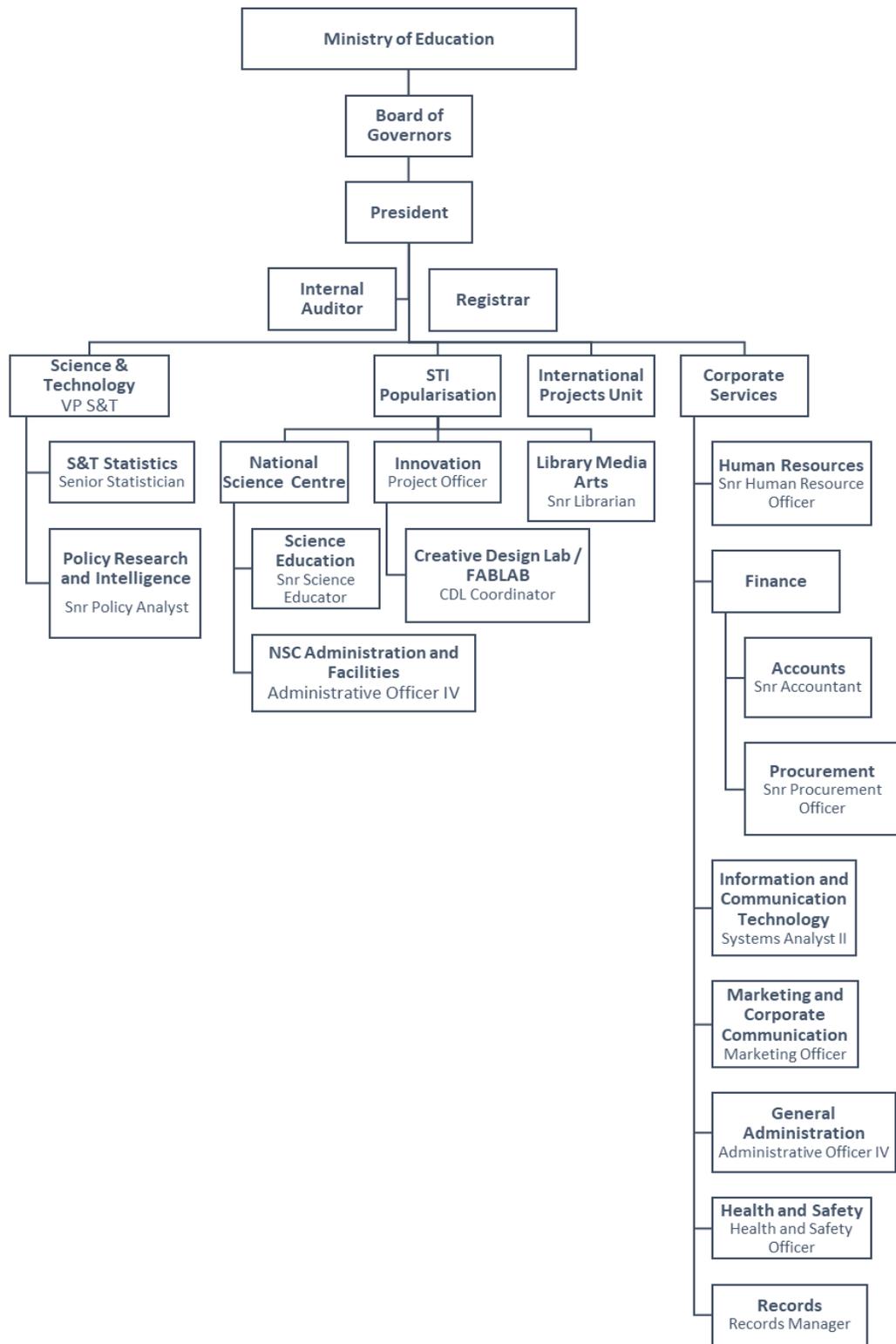| Administrative Assistant, Procurement	-Handles procurement processes.	-Assists with purchasing.	-Knowledge of procurement procedures and OPAs – policies, procedures, and forms.
Administrative Assistant, Procurement	-Handles procurement processes.	-Assists with purchasing.	-Knowledge of procurement procedures and OPAs – policies, procedures, and forms.

Figure 29: Project organization chart.

-Project team resource management

Staff for the Water Warriors Educational Toolkit project would be internally available, and would either be employed on a permanent or contracted basis. They are part of the establishment, and would not be released after the project closes, rather, they would be assigned to other projects, as the case may be.

-Training

Training would be done from the Human Resource Department, however, during annual performance appraisal for employees; their supervisor would discuss training needs. Owing to financial constraints, given the economic depression in the Republic of Trinidad and Tobago, free sources of training would be utilised, for instance inter-ministerial training.

-Team development

Team development will be gained through training in leadership, and other project management duties, and other applicable training sessions.

-Resource control

Inventory will be managed, released and secured by the PM. The procuring of services and materials for the project would be obtained from external sellers.

-Recognition plan

Recognition has been normatively awarded for years of service, beginning at the 10 year milestone. Increments in salary are granted on an annual basis. Promotion is based on position availability.

The PM will be responsible for having a project close off ceremony to celebrate project success.

The team charter, according to the PMBOK Guide 6th edition contains the following:

-Team values,

-Communication guidelines,

-Decision-making criteria and process,

-Conflict resolution process,

-Meeting guidelines, and

-Team agreements.

It is best developed collectively by the team, and PM.

Team Charter – Water Warriors Educational Toolkit project

Values statement

This team value statement is a compilation of values from the team member's perspectives, according to Knutson, J. (1997). Further, Knutson, J. (1997) suggest that the team charter may include colleagues with admirable values; the characteristics these people possess; traits that are not liked; the values of the company; qualities that are likable amongst colleagues; aspects they admire in themselves; and aspects they wish to improve on personally. The mission statement, according to Knutson, J. (1997) is the vision of what the team is trying to accomplish, but not necessarily the project deliverables, where each team member brings some aspect and use it to develop the mission statement. The mission statement might include several statements, according to Knutson, J. (1997). The goal statement is another area, as mentioned in the article 'developing a team charter' Knutson, J. (1997). The goal statement has both short-term and long-term goals for the team. According to Knutson, J. (1997) there appears to be an element of fun in short term and long term goals. The final aspect of a team charter is the operating agreement. In this area, the team decides how they will work together, what rules applies, what are the current issues that the team is

dealing with, and how it can be improved, according to Knutson, J. (1997). With all these elements – the positioning, values, mission statement, goal statement and operating agreement are all elements that comprise the team charter; it is formulated by meeting with the team.

4.6.2 Estimate activity resources

This process estimates team resources and the types and quantities of materials, equipment, and supplies necessary to perform project work, according to the PMBOK Guide 6th edition. This process is associated with the estimate costs process. For the Water Warriors Educational Project, estimates were based on information from past projects, as stated before, and estimates derived from sellers, where past knowledge was unavailable. The inputs to this process are the subsidiary plans of the PMP – resource management plan, and scope baseline; project documents – activity attributes, activity list, assumption log, cost estimates, resource calendars, and risk register; EEFs and OPAs.

The tools and techniques which may be used in this process are; expert judgement; bottom-up, analogous, and parametric estimating; data analysis (alternatives); PMIS; and meetings.

The outputs of this process are resource requirements; basis of estimates; RBS; and project documents updates – activity attributes, assumption log, and lessons learned register.

The resource requirements identify the type and quantities of resources required for each work package or activity in a work package, and can be aggregated to determine the estimated resources for each work package, each WBS branch, and the project as a whole, according to the PMBOK Guide 6th edition, see chart 21, and figure 22.

The basis of estimates is the amount and type of additional details which supports the resource estimates, according to the PMBK Guide 6th edition. For the Water Warriors Educational Project, methods included the bottom-up and analogous estimating techniques. The resource used to develop the estimate pulled data from previous similar projects, assumptions associated with the estimate, known constraints, range of estimates, confidence level of the estimate, and documentation of identified risks influencing the estimate, as recommended in the PMBOK Guide 6th edition. Where applicable an online URL was inserted in the budget, see chart 21.

The resource breakdown structure shows a hierarchical representation of resources by category and type.
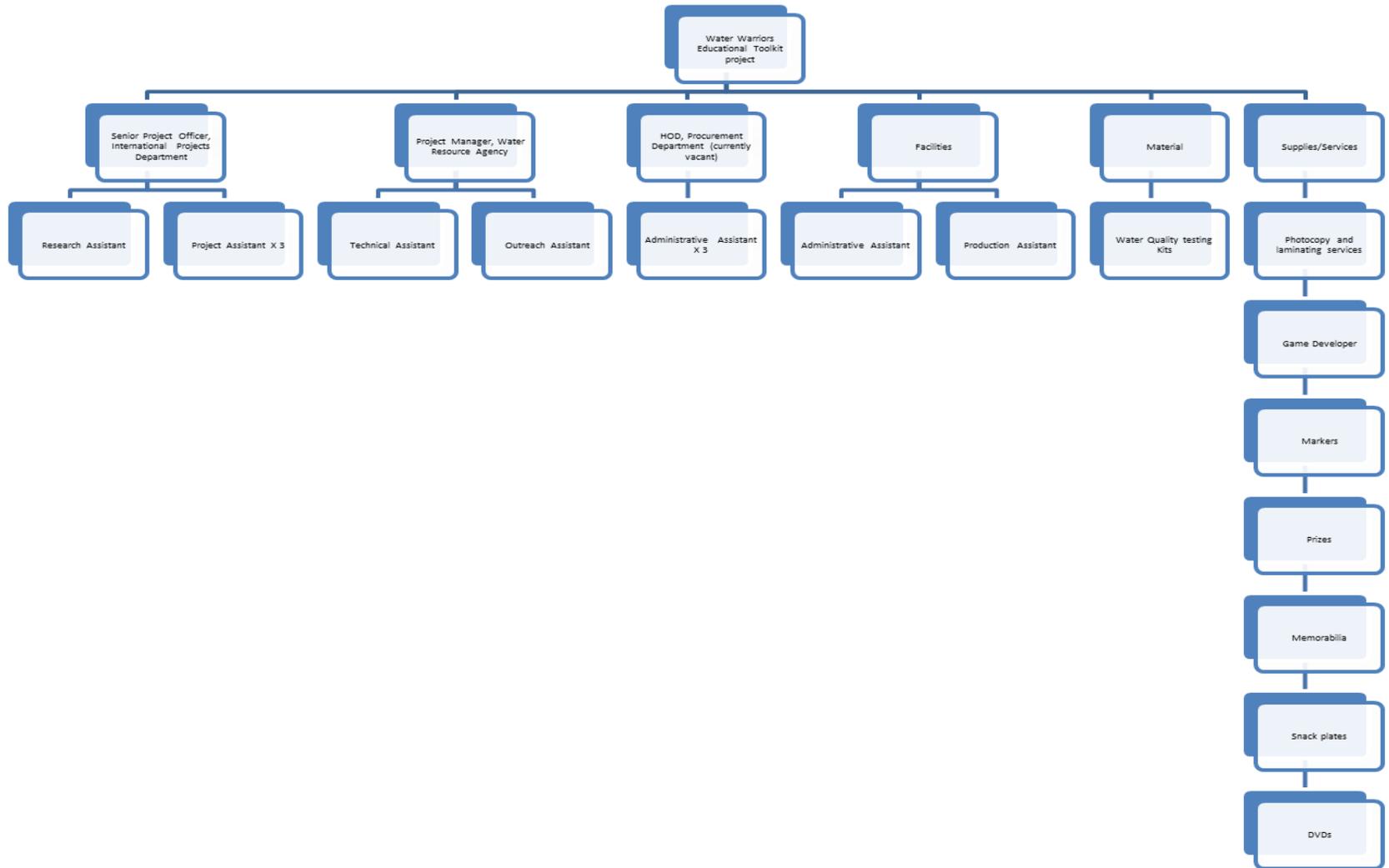
Figure 30: Resource breakdown structure.

4.6.3 Acquire resources

This process obtains team members, facilities, equipment, materials, supplies, and other resources necessary to complete project work, according to the PMBOK Guide 6th edition. Further, the PMBOK Guide 6th edition separates resources into two categories – internal (assigned); and external (acquired). This process falls under the executing process group, and issues should always be considered. The inputs to this process are subsidiary plans for the PMP – resource and procurement management plan, and cost baseline; project documents – project schedule, resource calendar, resource requirements, and stakeholder register; EEFs; and OPAs.

The tools and techniques which may be used are decision making for instance, multicriteria decision analysis tools where criteria such as the following are considered, as listed and described in the PMBOK Guide 6th edition:

-Availability. Verify that the resource is available to work on the project within the time period needed.

-Cost. Verify if the cost of adding the resource is within the prescribed budget.

-Ability. Verify that the team member provides the capability needed by the project. Some selection criteria that are unique for team resources are:

-Experience. Verify that the team member has the relevant experience that will contribute to the project success.

-Knowledge. Consider if the team member has relevant knowledge of the customer, similar implemented projects, and nuances of the project environment.

-Skills. Determine if the team member has the relevant skills to use a project tool.

-Attitude. Determine if the team member has the ability to work with others as a cohesive team.

-International factors. Consider team member location, time zone, and communication capabilities.

Other techniques are interpersonal and team skills such as negotiation, the PMBOK Guide 6th edition list colleagues with whom the PM may be required to negotiate with, they are:

-Functional managers

-Other project management teams within the performing organization

-External organisations and suppliers.

There is the pre-assignment technique in which resources are determined in advanced, according to the PMBOK Guide 6th edition. And finally, virtual teams carry the possibility of saving time of having to meet face to face, according to the PMBOK Guide 6th edition. Rather teams are able to meet using communication technology which may include email, audio conferencing, social media, web-based meetings, and video conferencing.

The outputs of this process are documentation of physical resource assignments; project team assignments; resource calendars; change requests; PMP updates to the resource management plan, and cost baseline; project documents updates to the lessons learned register, project schedule, RBS, resource requirements, risk register, and stakeholder register; EEFs for resource availability and use and OPAs updates.

4.6.4 Develop team

This process improves competencies, team member interaction, and the overall team environment to enhance project performance, according to the PMBOK Guide 6th edition. Further, the PMBOK Guide 6th edition emphasises the importance of teamwork, and effective project teams, therefore, making it a significant aspect of this knowledge area. The Tuckman ladder is mentioned in the PMBOK Guide 6th edition, it says that it is a model used to describe five (5) stages of team development; forming; storming; norming; performing; and adjourning. This process falls under the executing process group.

The inputs to this process are the PMP's resource management plan; project documents – lessons learned register, project schedule, project team assignments, resource calendars, and team charter; EEFs and OPAs. There are many tools and techniques described in the PMBOK Guide 6th edition; these are colocation; virtual teams; communication technology (e.g. shared portal, video conferencing, audio conferencing, and email/chat); interpersonal and team skills (e.g. conflict management, influencing, motivation, negotiation, and team building); recognition and rewards; training; individual and team assessments; and meetings.

The outputs to this process are team performance assessments; change requests; PMP updates to the resource management plan; project documents updates – lesson learned register, project schedule, project team assignments, resource calendars, and team charter; EEF updates; and OPA updates.

4.6.5 Manage team

This process tracks team member performance, provides feedback, resolves issues, and manages team changes to optimize project performance, according to the PMBOK Guide 6th edition. The inputs to this process are the PMP's resource management plan; project documents – issue log, lessons learned register, project team assignments, and team charter; work performance reports; team performance assessments; EEF's; and OPA's.

The tools and techniques that are used in this process are interpersonal and team skills such as conflict management techniques; decision making; emotional intelligence; influencing; and leadership; and PMIS. The outputs of this process are change requests; PMP updates to the resource plan, schedule baseline, and cost baseline; and project documents updates to the issue log, lessons learned register and project team assignments; EEFs and OPAs. This process is a part of the executing process group.

4.6.6 Control resources

This process ensures that the physical resources assigned and allocated to the project are available as planned, as well as monitoring the planned versus actual utilization of resources and taking corrective action as necessary, according to the PMBOK Guide 6th edition. This process is a part of the monitoring and controlling process group, the PMBOK Guide 6th edition also states that this process should be performed continuously in all project phases and throughout the project life cycle. This process is concerned with physical resources, since team members are addressed in the manage team process, according to the PMBOK Guide 6th edition. The inputs to this process are the PMP's resource management plan; project documents such as issue log, lessons learned register, physical resource assignments, project schedule, RBS, resource requirements, and risk register; work performance data; agreements; and OPAs.

The tools and techniques used in this process may include data analysis (e.g. alternatives analysis, cost benefit analysis, performance reviews, and trend analysis. The technique of problem solving which includes methodical steps to solve problems which identifies the problem, defines the problem, investigates and collects data, analyses to find the root cause of the problem, solves, and checks the solution to determine if it has been fixed, according to the PMBOK Guide 6th edition. Other techniques are interpersonal and team skills such as negotiation and influencing. And a tool used in this process is the PMIS.

The outputs of this process are work performance information; change requests; updates to the resource management plan, schedule baseline, and cost baseline of the PMP; and updates to project documents such as the assumption log, issue log, lessons learned register, physical resource assignments, RBS, and risk register.

4.7 Project communications management

This area of the PMBOK Guide 6th edition acknowledges the needs of stakeholders, and indicates approaches as to how effective information exchange can be achieved, according to the PMBOK Guide 6th edition. There are three processes: plan communications management; manage communications; and monitor communications. The PMBOK Guide 6th edition lists three (3) types of mechanisms by which information is exchanged, they are written form; spoken; formal or informal; through gestures; through media; and choice of words.

Further, apart from the importance of these processes in the project management field, the PMBOK Guide 6th edition speaks about how misunderstandings can be reduced, though not eliminated through using the 5Cs of written communication. The 5Cs are as follows:

- Correct grammar and spelling.
- Concise expression and elimination of excess words.
- Clear purpose and expression directed to the needs of the reader.
- Coherent logical flow of ideas.
- Controlling flow of words and ideas.

These may be supported by communication skills, such as listening actively; awareness of cultural and personal differences; identifying, setting, and managing stakeholder expectations; and enhancement of skills, according to the PMBOK Guide 6th edition.

4.7.1 Plan communications management

This process develops an appropriate approach, and plan for project communications activities based on the information needs of each stakeholder or group, available organizational assets, and the needs of the project, according to the PMBOK Guide 6th edition. Further, this process emphasises the need to

determine the methods of storage, retrieval, and ultimate disposition of information, according to the PMBOK Guide 6th edition.

The inputs to this process are the project charter; subsidiary plans of the PMP – resource management plan, and stakeholder engagement plan; project documents – requirements documentation and stakeholder register; EEFs; and OPAs.

The tools and techniques which may be used in this process include expert judgement; communication requirement analysis; communication technology; communication models; and communication methods. The communication methods are interactive communication, push communication, pull communication, interpersonal communication, small group communication, public communication, mass communication, networks and social computing communication, and several others, as stated in the PMBOK Guide 6th edition.

Communication models include the simple, two party, basic sender/receiver communication models which have a sequence of encode – transmit message – decode. Secondly, there is the sample interactive communication model which is has two parties, the steps in this model are acknowledge, and feedback/response; and cross cultural communication model, according to the PMBOK Guide 6th edition.

Additionally, there is interpersonal and team skills which include communication styles assessment, political awareness, and cultural awareness, as outlined in the PMBOK Guide 6th edition. Another technique recommended in the PMBOK Guide 6th edition is meetings on how to provide updates; this is usually documented in the communication plan. Finally, a technique used in this process is data representation, the PMBOK Guide 6th edition recommends the stakeholder engagement assessment matrix.

The outputs of this process are the communications management plan; updates to the subsidiary plans of the PMP – the stakeholder engagement plan in this process, and updates to the project documents such as the project schedule, and stakeholder register, according to the PMBOK Guide 6th edition.

The communication management plan

The communication management plan describes how project communications will be planned, structured, implemented, and monitored for effectiveness, according to the PMBOK Guide 6th edition. Further, it can include guidelines and templates for project status meetings, project team meetings, e-meetings, and email messages, according to the PMBOK Guide 6th edition.

The Water Warriors Educational Toolkit project is a relatively simple project; the main stakeholders that will be involved are the end users (the teachers, principals and students); the sponsor; and the project management team.

The communication management plan as listed in the PMBOK Guide 6th edition contains the following:
- Stakeholder communication requirements;
- Information to be communicated, including language, format, content, and level of detail;
- Escalation processes;
- Reason for the distribution of that information;
- Timeframe and frequency for the distribution of required information and receipt of acknowledgment or response, if applicable;
- Person responsible for communicating the information;
- Person responsible for authorizing release of confidential information;

- Person or groups who will receive the information, including information about their needs, requirements, and expectations;

- Methods or technologies used to convey the information, such as memos, email, press releases, or social media;

- Resources allocated for communication activities, including time and budget;

- Method for updating and refining the communications management plan as the project progresses and develops, such as when the stakeholder community changes as the project moves through different phases;

- Glossary of common terminology;

- Flow charts of the information flow in the project, workflows with possible sequence of authorization, list of reports, meeting plans, etc.; and

- Constraints derived from specific legislation or regulation, technology, organizational policies, etc.

Chart 41: Communication Plan

Sender	Receiver	Contents	Frequency	Communication code	Language
Tahira Khan	Sharda Mahabir, Kelisha Ray	Gather input for proposal. Agree to the contents and sign off on the MOU. To conform team assignments.	1x per week	E1	
Tahira Khan	Darielle Rampersad	Inform about the role of creation of the assumption log; requirements management plan; resource management plan; risk management plan;	1x per week	I1	
Tahira Khan	Rondell Liverpool	Inform about the role of create of the stakeholder register; procurement plan and related activities; management of project quality for outputs.	1x per week	I1	
Tahira Khan	Partnership team	Gathering requirements, and sharing details while developing the PMP, and its subsidiary plans.	1x per week	E1	
Tahira	Team members	Communicate with team members; keep	1x per week	I2	

Khan		team informed of any changes.			
Chantelle Jacob	Partnership team, and end users (i.e. students and teachers)	Gather information for monitoring and evaluation purposes.	Once	I1	
Chantelle Jacob	Winners, teachers, students	Inform winners of the competition, and invite relevant teachers and students to the opening ceremony. Keep stakeholders updated, share invitations via email.	Once	E2	
Rondell Liverpool	Tahira Khan	To share data from the control quality, and monitor risk processes for reporting purposes, etc.	1x per week	I1	
Darielle Rampersad	Tahira Khan	To share data from the monitoring stakeholder, control resource, and monitor communications processes for reporting etc.	Once	I1	
Tahira Khan	Marvin Gordon	To request photo/video services for the prize giving ceremony.	Once	I1	

Tahira Khan	Adrian Ramkissoon	To request technical support for prize giving ceremony.	Once	I1	
Tahira Khan	Simone Warner-King	To request ITC assistance for prize giving ceremony.	Once	I1	
Tahira Khan	Gail Ann Roberts-Taitt	Liaise with Gail Ann Roberts-Taitt to book room for prize giving ceremony internally.	Once	I1	
Tahira Khan	Franklyn Charles, and Supervisor/Coordinator	Inform about dates for transport requirements.	Once	I1	
Sharda Mahabir	Tahira Khan	Send edited MOU and proposal.	1x per week	E1	
Tahira Khan	Allister Brizen, Darielle Rampersad	To assign role to develop resource calendar for the project.	Once	E1	
Tahira Khan	Allister Brizen, game developer	Liaise with Allister Brizen to determine what input to request for the development of the game.	Various times per day	E2	

Lovaan Superville	Team members	Share knowledge to develop team member capacity, and mange team; to inform team of any changes of the project schedule; and to close the project by liaising with all stakeholders.	1x per week	I2	
Georgia Le Gendre	Tahira Khan	To gather any requirements to conduct procurements, and share information from the control procurements process.	1x per week	I1	
Donna Hall	Tahira Khan	To gather any requirements to conduct procurements.	1x per week	I1	
Louise Villaroel	External sellers	Liaise with external sellers to confirm physical resource assignments.	1x per week	E2	
Tahira Khan	Internal team and external team	To assign role to host workshops through planned school visits.	Various times per day	I2	
Tahira Khan	Darielle Rampersad	To assign role to deliver content and invite participants for competition.	1x per week	I1	
Tahira Khan	Gail Ann Roberts-Taitt; Adrian	To assign role for hosting prize giving ceremony.	1x per week	I1	

	Ramkissoon; Simone Warner-King				
Tahira Khan	Kelisha Ray	To assign role to monitor and control project work during workshops with regard to the water testing component.	1x per week	E1	
Tahira Khan	Lovaan Superville	To share confirmation of scope validity.	Once	I1	
Tahira Khan	Procurement department	To monitor actual expenditure vs. planned expenditure.	1x per week	I1	

Communication Plan - Communication codes

Communication code	Properties	Medium	Quality control	Level of detail	Storage	Status
E1	External Formal Written	Letter E-mail Meeting with minutes	Yes	High	≥ 2 years	Red
E2	External Formal Verbal	In person Phone	No	Medium		Orange
I1	Internal Informal Written	E-mail Meeting with minutes Database Presentation	No	High	≥ 1 year	Blue
I2	Internal Informal Verbal	In person Phone Instant messaging	No	Low		Green

4.7.2 Manage communications

This process ensures timely and appropriate collection, distribution, storage, retrieval, management, monitoring, and the ultimate disposition of project information, according to the PMBOK Guide 6th edition. Further, the PMBOK Guide 6th edition, recommends the following techniques and considerations for effective communications management:

- Sender-receiver models
- Choice of media
- Writing style
- Meeting management
- Presentations
- Facilitation
- Active listening

This process falls under the executing process group.

The inputs to this process are the subsidiary plans of the PMP which are the resource management plan, communications management plan, and the stakeholder engagement plan. The project documents are the change log; issue log; lessons learned register; quality report; risk report; and stakeholder register. Additionally, there are work performance reports, for example status reports and progress reports which are inputs to the manage communications process, according to the PMBOK Guide 6th edition. Finally EEFs and OPAs are inputs as well.

The tools and techniques used in this process are outlined in the PMBOK Guide 6th edition; these include communication technology; communications methods; communication skills. The communication skills include communication competence; feedback; nonverbal; and in presentations. Additionally, there is PMIS which includes electronic project management tools; electronic communications management; and social media management; project reporting; interpersonal and

team skills (active listening, conflict management; cultural awareness; meeting management; networking; and political awareness); and meetings.

The outputs of this process are project communications; updates to the communications management plan, and stakeholder engagement plan of the PMP; updates to project documents – the issue log, lessons learned register, project schedule, risk register, and stakeholder register; and the OPAs.

4.7.3 Monitor communications

The monitor communication process is under the monitoring and controlling process group. This process ensures the information needs of the project and its stakeholder are met, according to the PMBOK Guide 6th edition. The inputs to this process are the subsidiary plans of the PMP; these are the resource management plan; communications management plan; and the stakeholder engagement plan. The project documents that are inputs include the issue log; lessons learned register; and project communications. Additionally, other inputs are work performance data; EEFs and OPAs.

The tools and techniques used in this process, according to the PMBOK Guide 6th edition are expert judgement; PMIS; data representation – stakeholder assessment matrix; interpersonal and team skills; and meetings. The outputs of this process, according to the PMBOK Guide 6th edition are work performance information; change requests; updates to the communications management plan, and stakeholder engagement plan of the PMP; updates to project documents – the issue log, lessons learned register, and stakeholder register.

4.8 Project risk management
Project risk management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project, according to the PMBOK Guide 6th edition. There are

seven (7) processes in this knowledge area. Further, the guide states that the aim of this process is to exploit or enhance positive risks (opportunities) while avoiding or mitigating negative risks (threats).

The way risks are managed depends on the project size; complexity; importance; and its development approach, according to the PMBOK Guide 6th edition. The Water Warriors Educational Toolkit project requires a simplified risk process.

4.8.1 Plan risk management

This process defines how to conduct risk management activities for a project, according to the PMBOK Guide 6th edition. This process falls under the planning process group. The inputs to this process are the project charter; all the subsidiary plans of the PMP; the stakeholder register; EEFs; and OPAs.

The tools and techniques which may be used in this process are expert judgement; stakeholder analysis which determines risk appetite; and meetings.

The main output of this process is the risk management plan. This plan includes several elements. The risk management plan for the Water Warriors Educational Toolkit project will be based on the guidance of the PMBOK Guide 6th Edition.

The risk management plan

-Risk strategy

The general approach to managing risk for the Water Warriors Educational Toolkit project is the qualitative approach. This project seeks to share knowledge through interactive methodologies in a classroom setting about water conservation and protection.

-Methodology

The specific approaches, tools, and data sources which can be used for the Water Warriors Educational Toolkit Project are the Risk Breakdown Structure (RBS);

probability and impact scales; probability and impact matrix; and risk register. The risk register will be developed in the following process.

-Roles and responsibilities

The Water Warriors Educational Toolkit project risk management process will be managed by a single team member – Darielle Rampersad. She will be the risk manager, and will be required to liaise with the rest of the team, that is the Project Manager from the sponsor organisation, and the Project Manager from the partner organisation, and to gather expert judgement where possible whilst developing the approaches, tools, and data sources for this project. The outputs for the PMP will include the Risk Breakdown Structure (RBS); probability and impact scales; probability and impact matrix; and risk register.

-Funding

The protocol for the risks identified in this process which requires risk responses and which results in costs outside of the budget estimate will be used to develop an estimate for the contingency budget, whilst a management reserve, separate from the budget and contingency estimates will be included for unknown risks. Budget padding will not be encouraged in this project.

-Timing

The project risk management processes will follow the guidance provided in the PMBOK Guide 6th edition. So the processes will be planned, executed, and monitored until the project is closed off.

-Risk categories

A RBS will be used to categorise, and identify risks. For the Water Warriors Educational Toolkit a tailored RBS will be developed. Additionally, risk can be

categorised, this often help teams to generate more inclusive lists of risks for a project. The risk categories described in Warner. R. (2013) are project management risks (size and complexity); leading and organisational risks (leadership abilities); technical risks; commercial risks (economic areas); and project environment risks (conditions and restrictions). Further, Warner. R. (2013) mentions three (3) types of risks which can occur after project execution; these are market risks; reputational risks; and security risks.

Chart 42: Risk Breakdown Structure

RBS Level 0	RBS Level 1	RBS Level 2
0 All sources of project risk	1.0 Project management risks (size and complexity);	1.1 Insufficient data collected from previous projects, such as lessons learned.
		1.2 Lack of available organisational process assets identified in a systematic way.
		1.3 Project management processes not used extensively.
		1.4 Team lacks motivation, no reward system in place.
		1.5 Team lacks clear guidance.
	2.0 Leading and organisational risks (leadership abilities);	2.1 Insufficient communication between Project Manager, and

		project management team.
		2.2 Low levels of influencing between heads and teams.
		2.3 Low levels of training available to staff. Hence, a lack of ability to perform tasks.
		2.4 Unresolved conflicts.
		2.5 Political and cultural bias hidden. Decisions made without consideration to biases.
		2.6 EEFs and OPAs not recognised extensively, and utilised in project decisions.
	3.0 Technical risks;	3.1 Game development testing.
		3.2 Water quality testing kits.
	4.0 Commercial risks (economic areas);	4.1 Funding withheld.
	5.0 Project environment risks (conditions and restrictions).	5.1 Estimated resources unavailable.
		5.2 Resources expired.
		5.3 Low attendance - stakeholders unavailable.

		5.4 Marketing team cannot assist.
		5.5 Lack of support - external or internal human resources unavailable.
		5.6 Staff changes - resignations.
	6.0 Market risks;	6.1 Game unusable because of technical issues.
	7.0 Reputational risks;	7.1 Stakeholder disgruntle owing to lack of communication between PM/team and teachers, principals, students.
	8.0 Security risks	8.1 Hacker attack on electronic game (available on website).

-Stakeholder risk appetite

The risk appetites of key stakeholders for the Water Warriors Educational Toolkit Project are related to the project objectives, as measurable risk thresholds. Risk appetite is a classification of how much risk are specific stakeholders, or the overall organisation, willing to accept while pursuing project objectives, according to Moura, H. (Dec, 2015). Further, Moura, H. (Dec, 2015) lists common approaches which describe stakeholders' risk appetite, these are averse; minimal; cautious; neutral; or seeker. Each is explained by Moura, H. (Dec, 2015), and are as follows:

- Risk adverse stakeholders' are not willing to accept any risk exposure.
- Minimal risk stakeholders believe that the less risk the better.
- Risk cautious stakeholders favour safer options, even if it sacrifices benefits.
- Risk neutral stakeholder will assess available project options, balancing existing risks with potential rewards.
- Risk seekers are actively pursuing high value rewards, at the expense of high risk exposure.

The Water Warriors Educational Toolkit project faces the triple constraints of time, budget, and scope, therefore, given these constraints it is likely that the key stakeholders would be risk cautious. Therefore, the stakeholders would in fact take into consideration the safer options in decision making, and data analysis.

-Definitions of risk probability and impacts

Qualitative risk analysis rates risk on a qualitative scale, according to Warner. R. (2013). It rates the probability and impact of risks and opportunities; identifies the top risks; helps in decision making with regard to defining actions; and it can also determine if a project would go forward or not, Warner. R. (2013). The probability of a risk event has a range of 0% (does not occur) to 100% (occurs certainly), according to Warner. R. (2013). Expert judgement can be quite helpful in this process. The impact, according to Warner. R. (2013) describes the possible damage or benefits when a risk or opportunity occurs, Warner. R. (2013) explains that impacts may have an influence on costs; time; quality; and performance.

The PMBOK Guide 6th edition lists the alternative strategies for dealing with threats, opportunities, and overall risks. The strategies for threats are escalate when outside the scope of the project; avoid is where the team acts to eliminate the threat or protect the project from its impact; transfer involves shifting ownership of the threat to a third party; mitigate is action taken to reduce the probability of

occurrence and or impact; and acceptance acknowledges the threat however no action is taken, according to the PMBOK Guide 6th edition.

-Probability and impact matrix

Once the qualitative process has been completed for a project, a PM has the option to determine if quantitative risk analysis is required. For the Water Warriors Educational Toolkit project, the process will go directly to response planning, Warner. R. (2013) suggests that a project with a small budget and duration, coupled with a PM with little experience should move directly to response planning.

-Reporting formats

The risk register and risk score for the project will be developed under the qualitative analysis process.

-Tracking

Auditing will be performed as required; additionally the project risk process will be monitored within its phase.

4.8.2 Identify risks

This process identifies individual project risks as well as sources of overall project risk and documents its characteristics. The inputs to this process are the subsidiary plans of the PMP, in this process; the PMBOK Guide 6th edition outlines the requirement management plan; schedule management plan; cost management plan; quality management plan; resource management plan; risk management plan; scope baseline; schedule baseline; and cost baseline. The project documents which are inputs to this process according to the PMBOK Guide 6th edition are the assumption log; cost estimates; duration estimates; issue log; lessons learned register; requirements documentation; resource requirements; and stakeholder

register. Additionally, other inputs include agreements; procurement documentation; EEFs; and OPAs.

The tools and techniques which may be used in this process include expert judgement; data gathering techniques such as brainstorming, checklists, and interviews. Other inputs include data analysis techniques outlined are root cause analysis, assumption and constraint analysis, SWOT analysis, and document analysis. Further inputs are meetings; facilitation; prompt lists which are PESTLE (political, economic, social, technological, legal, environmental), TECOP (technical, environmental, commercial, operational, political), or VUCA (volatility, uncertainty, complexity, ambiguity), according to the PMBOK Guide 6th edition.

The outputs of this process are the risk register; risk report; and updates to project documents such as the assumption log, issue log, and lesson learned register. The risk register, according to the PMBOK Guide 6th Edition at the identify risks level includes a list of identified risks; potential risk owners; and list of potential responses. The risk report according to the PMBOK Guide 6th edition includes sources of overall project risk, indicating which are the most important drivers of overall project risk exposure; and summary information on identified individual project risks, such as number of identified threats and opportunities, distribution of risks across risk categories, metrics and trends, etc., according to the PMBOK Guide 6th edition. Finally, updates to the assumption log; issue log; and lessons learned register may be required.

Chart 43: Risk Register

#	Risk	Description	Category	Cause	Probability	Impact	P X I	Proposed Responses	Owner	Status
1	Stakeholder engagement	Stakeholders not engaged from early on in the project. This may lead to lack of buy-in, and influence on student attendance, and workshop coordination.	Leading and organisational risks (leadership abilities)	Communication plan not created, or properly utilized.	3	4	12	Mitigate. Create and actively manage a communication plan. Assign a resource with good communication skills.	Darielle Rampersad	
2	Technical end-user difficultie	End-users encounter difficulties in playing the	Technical risk	Quality tests not perfor	4	5	20	Mitigate. Perform extensive quality	Rondell Liverpool, Louise	

	s in game	game		med prior to final hando ver from develo per. Procur ement not adequ ately manag ed.				testing, together with the developer, and end user, before hand over.	Villaroel	
3	Inadequ ate resource s	Water quality testing kits quantity insufficient, or	Project environm ent risks (condition	Resour ce plan not adequ	5	5	25	Mitigate. Confirm availability, quality, and	Darielle Ramper sad	

		expired.	s and restrictions)	ately formulated, or utilized.				quantity well in advance.		
4	Insufficient support team	The support team unavailable to conduct workshops.	Project environment risks (conditions and restrictions)	Scheduling conflicts, team resignations	5	4	20	Mitigate. Identify alternative resource plans.	Lovaan Superville	
5	Low levels of training available to staff. Hence a	Staff not trained the use of tools and techniques which may be utilised during	Project environment risks (conditions and restriction	Lack of available funds	5	2	10	Mitigate. Take advantage of free training, and internal	Lovaan Superville	

	lack of ability to perform tasks.	the project.	s)					training.		
6	Funding not released on time	Funding managed by the sponsor organisation, funds withheld, or unavailable.	Commercial risk	Sponsor organisation relationship with its Board of Governors dealing with conflicts.	4	5	20	Escalate. Communicate effectively and efficiently with sponsor.	Lovaan Supervil le	

| 7 | Online resources not arriving on time | Online resources arriving late. | Project environment risks (conditions and restrictions) | Procurement policy and guidelines not followed by the PM, and team. Goods ordered late. | 4 | 5 | 20 | Mitigate. Follow the procurement policy and guidance. | Rondell Liverpool, Donna Hall, Georgia Le Gendre | |
| 8 | Stakeholder disgruntl | Stakeholder disgruntle owing to lack | Reputational risks; | Communication | 2 | 4 | 8 | Mitigate. Create and actively | Darielle Rampersad | |

				plan not utilized by team member, or was inadequately developed.				manage a communication plan. Assign a resource with good communication skills.		
e	of communication between PM/team and teachers, principals, students.									
9	Booklet and activity sheets content unsuitable.	Level of information may be higher than the student ability to comprehend,	Reputational risks	Expert judgement /review not performed	2	5	10	Mitigate. Ask for guidance and input from experts.	Tahira Khan	

		or contains errors							

4.8.3 Perform qualitative risk analysis

This process prioritizes individual project risks for further analysis or action by assessing its probability of occurrence and impact, as well as other characteristics, according to the PMBOK Guide 6th edition. The PMBOK Guide 6th edition suggests that care must be taken since risks are based on perception, and it is therefore important to identify bias and correct it. The inputs to this process are risk management plan of the PMP; project documents such as the assumption log, risk register, and stakeholder register; EEFs; and OPAs.

The tools and techniques to this process are expert judgement; and structured or semi-structured interviews. Further, data analysis techniques such as risk data quality assessment, risk probability and impact assessment, and assessment of other risk parameters (urgency, proximity, dormancy, manageability, controllability, detectability, connectivity, strategic impact, and propinquity) may be used, according to the PMBOK Guide 6th edition. There are several other tools and techniques mentioned in the PMBOK Guide 6th edition, these are facilitation; risk categorization; data representation which may include probability and impact matrix for two-way parameters, and hierarchical charts such as a bubble chart for three-way parameters; and meetings (risk workshop).

The outputs of this process are updates to project documents, such as the assumption log, issue log, risk register, and risk report, according to the PMBOK Guide 6th edition.

For the Water Warriors Educational Toolkit project five (5) ratings for probability will be used.

Chart 44: Probability key

Rating	Interpretation
5 – very high	(80% - 100%)
4 – high	(50% - 80%)
3 – moderate	(30% - 50%)
2 – low	(10% - 30%)
1 – very low	Rather unlikely (0% - 10%)

The ratings for the impacts on the Water Warriors Educational Toolkit Project can be defined as shown in the following table:

Chart 45: Impact Key

Rating	Schedule	Cost	Quality
5 – very high	Delay in delivery >20% (…days)	Exceedance >20% (…$)	The result of the project is unusable
4 – High	Delay in delivery 10…20% (…days)	Exceedance 10…20% (…$)	A lower quality is not acceptable
3 – Moderate	Delay in delivery 5…10% (…days)	Exceedance 5…10% (…$)	Important areas are affected
2 - Low	Delay in delivery <5% (…days)	Exceedance <5% (…$)	Only a minor reduction of quality
1 – very low	Delay in delivery is insignificant	Exceedance is insignificant	Barely noticeable differences

Chart 46: Risk Matrix

RISK ASSESSMENT TABLE

PROBABILITY						
5		5, 9		2, 4, 6, 7	3	
4		8	1			
3				1		
2				8	5, 9	
1						
	1	2	3	4	5	
IMPACT						

Risk Key	
High	
Medium	
Low	

Chart 47: Project Risk Score

RISK SCORE FOR WATER WARRIORS EDUCATIONAL TOOLKIT PROJECT

#	Probability	Impact	P X I	Risk rank within the project
1	3	4	12	3
2	4	5	20	2
3	5	5	25	1
4	5	4	20	2
5	5	2	10	4

6	4	5	20	2
7	4	5	20	2
8	2	4	8	Not top
9	2	5	10	4
TOTAL RISK SCORE WITHIN THE PROJECT			145	

The total risk score of the project defined here can be used as a comparison in later phases of the project, or on a monthly basis, this is a way to evaluate the risk trend before and after planning of actions, according to Warner. R. (2013).

4.8.4 Perform quantitative risk analysis

This process numerically analyses the combined effect of identified individual project risks and other sources of uncertainty on overall project objectives, according to the PMBOK Guide 6th edition. This is an important process performed in the planning process, but will not be required for the Water Warriors Educational Toolkit project. However this process can be quite reliable, according to the PMBOK Guide 6th edition.

The inputs to this process are the subsidiary plans of the PMP, such as the risk management plan, scope baseline, schedule baseline, and cost baseline; project documents such as the assumption log, basis of estimates, cost estimates, cost forecasts, duration estimates, milestone list, resource requirements, risk register, risk report, and schedule forecasts; EEFs; and OPAs.

The tools and techniques available to this process are expert judgement; data gathering via interviews; facilitation; and representations of uncertainty (e.g. probability distributions). Additionally, there are some data analysis techniques that can be used, these are simulation (e.g. Monte Carlo analysis in which outputs are represented in the form of histograms, or cumulative probability distribution or S-

Curve, or criticality index); sensitivity analysis (e.g. tornado diagram); decision tree analysis (e.g. expected monetary value); and influence diagrams (e.g. use of Monte Carlo analysis).

The outputs to this process are updates to project documents such as the risk report. It may include updates of assessment of overall project risk exposure; detailed probabilistic analysis of the project; prioritized list of individual project risks; trends in quantitative risk analysis results; and recommended risks responses.

Some benefits of quantitative risk analysis, according to Goodrich, 2014, are that it quantifies possible outcomes for the project and assesses the probability of achieving specific project objectives; is a quantitative approach in the face of uncertainty; and has realistic and achievable cost, schedule, or scope targets. However, to perform quantitative risk analysis, versus performing the qualitative risk analysis, more time and specific tools are required, according to Goodrich, 2014. Therefore, if a project is small, and its risks are manageable, then quantitative risk analysis may not be necessary. Further, Wanner, 2013 states that whilst you may be better able to tackle risks by knowing where and how to invest the organisation's time and money using the quantitative approach, it is recommended to determine the effort/benefit ratio of the quantitative approach for small projects. The Water Warriors Educational Toolkit project is a small project with controllable risks, and spending more time on the qualitative risk analysis process is deemed sufficient.

4.8.5 Plan risk responses

This process falls under the planning process group but is performed throughout the project; it develops options, selects strategies, and agrees on actions to address overall project risk exposure, as well as treats individual project risks,

according to the PMBOK Guide 6th edition. Typically, risk responses should consider the following, according to the PMBOK Guide 6th edition:

- should be appropriate for the significance of the risk,
- cost-effective in meeting the challenge,
- realistic within the project context,
- agreed upon by all parties involved,
- and owned by a responsible person.

The inputs to this process are the subsidiary plans of the PMP, such as the resource management plan, risk management plan, and cost baseline; project documents such as lesson learned register, project schedule, project team assignments, resource calendars, risk register, risk report, and stakeholder register; EEFs; and OPAs.

The tools and techniques which may be used in this process are expert judgement; data gathering such as interviewing; and interpersonal and team skills (e.g. facilitation). The PMBOK Guide 6th edition lists five (5) alternative strategies for threats, these are escalate; avoid; transfer; mitigate; and accept. It also list five (5) alternative strategies for opportunities, these are escalate, exploit, share, enhance, and accept. Additionally, other inputs include contingent response strategies; strategies for overall project risk for instance avoid, exploit, transfer/share, mitigate/enhance, and accept; data analysis (alternatives analysis, and cost-benefits analysis); and decision making (multicriteria).

The outputs of this process are change requests; updates to the subsidiary plans of the PMP, such as the schedule management plan, cost management, quality management plan, resource management plan, procurement management plan, cost baseline, schedule baseline, and cost baseline. Finally, the project documents which may be updated are the assumption log, cost forecasts, lessons learned register, project schedule, project team assignments, risk register; and risk report, according to the PMBOK Guide 6th edition.

4.8.6 Implement risk responses

This process implements agreed-upon risk response plans, according to the PMBOK Guide 6th edition. This process is part of the executing process group. The inputs to this process are the risk management plan; project documents, such as the lessons learned register, risk register, and risk report; and OPAs.

The tools and techniques which may be utilized in this process are expert judgement; influencing; and PMIS. The outputs of this process are change requests; and update to project documents, such as the issue log; lessons learned register; project team assignments; risk register; and risk report.

4.8.7 Monitor risks

This process monitors the implementation of agreed-upon risk response plans, tracks identified risks, identifies and analyses new risks, and evaluates risk process effectiveness throughout the project, according to the PMBOK Guide 6th edition. This process falls under the monitoring phase, it uses performance information generated during project execution to determine effectiveness, validity, changes, new risks, appropriateness, strategy, and need for modification, according to the PMBOK Guide 6th edition. The inputs to this process are the risk management plan; project documents such as issue log, lessons learned register, risk register, and risk report; work performance data which pertains to risks; and work performance reports.

The tools and techniques which may be used in this process include data analysis techniques such as technical performance analysis, and reserve analysis; risk audits; and meetings (e.g. risk reviews). The outputs of this process are work performance information; change requests; updates to the PMP; updates to project documents such as the assumption log, issue log, lessons learned register, risk register, and risk report; and OPAs.

4.9 Project Procurement Management

This process consists of three (3) parts – plan procurement management; conduct procurements; and control procurements. The PMBOK Guide 6th edition states that this process is necessary to purchase or acquire products, services, or results needed from outside the project team. Further, the PMBOK Guide 6th edition describes the key concepts of this process as the legal obligations and penalties, authorization to sign agreements, agreements between seller and buyer, contracts, and its terms and conditions; the buyer's role; and the seller's role. At NIHERST, a centralized purchasing department exists. The PMBOK Guide 6th edition also recommends the need for tailoring considerations; these may be owing to the complexity of procurement; physical location; governance and regulatory environment; and availability of contractors.

4.9.1 Plan procurement management

This process documents project procurement decisions, specifies the approach, and identifies potential sellers, according to the PMBOK Guide 6th edition. In this process, roles and responsibilities are defined and documented in the procurement plan, according to the PMBOK Guide 6th edition. Further, this process has a high correlation with the project's schedule, and budget.

The inputs of this process are the project charter; business documents such as the business case and benefits management plan; subsidiary plans of the PMP, such as the scope, quality, and resource management plans, and the scope baseline. Additionally, several project documents are inputs to this process, these are the milestone lists; project team assignments; requirements documentation; requirements traceability matrix; resource requirements; risk register; and stakeholder register. Finally EEFs and OPAs such as preapproved seller lists; formal procurement policies, procedures, and guidelines; contract types (fixed-price contracts – firm fixed price, fixed price incentive fee, fixed price with

economic price adjustments; cost-reimbursable contracts – cost plus fixed fee, cost plus incentive fee, and cost plus award fee; and time and material contracts – hybrid, according to the PMBOK Guide 6th edition.

The tools and techniques which may be used in the process, according to the PMBOK Guide 6th edition are expert judgement; market research; and make-or-buy analysis. The PMBOK Guide 6th edition states that the make-or-buy analysis techniques such as payback period return on investment (ROI), internal rate of return (IRR), discounted cash flow, net present value (NPV), benefit/cost analysis (BCA) to make such a decision.

Further, other techniques include source selection criteria which is when the evaluation method is included in the procurement documents, so that bidders can understand how they will be evaluated, additionally, these methods may be least cost; qualifications only; quality-based/highest technical proposal score; quality and cost-based; sole source; and fixed budget. Finally, meetings with potential bidders are also another technique used to assist in formulating the procurement strategy, according to the PMBOK Guide 6th edition.

There are several outputs to the plan procurement process outlined in the PMBOK Guide 6th edition. The first output is the procurement management plan which contains activities to be undertaken during the procurement process. The PMBOK Guide 6th edition states that the procurement management plan should include schedule implications; timeline for key activities; metrics for the management of contracts; roles and responsibilities; authority; constraints and assumptions; legal jurisdiction; currency choice; estimate type; risk management issues; and prequalified sellers. Secondly, an output of this process is the procurement strategy for external procurements which includes the delivery method; contract payment types; and procurement phases. Thirdly, bid documents are outputs of this process, and are used to solicit proposals from prospective sellers, for example a bid, tender, or quotation, or proposal, according to the PMBOK Guide 6th edition. Further, bidding documents can include a request for information,

request for quotation, request for proposal, or other appropriate procurement documents, according to the PMBOK Guide 6th edition. Additionally, another output of this process is the procurement statement of work (SOW). The SOW can include specifications, quantity desired, quality levels, performance data, period of performance, work location, and other requirements, as stated in the PMBOK Guide 6th edition, it should be noted that a terms of reference (TOR) is similar to the SOW. Finally, source selection criteria; make-or-buy decisions; independent cost estimates; change requests which impact procurement processes; updates to project documents; and OPA updates on information on qualified sellers, are also outputs, according to the PMBOK Guide 6th edition. The project document updates may be to the lessons learned register; milestone list; requirements documentation; requirements traceability matrix; risk register; and the stakeholder register.

The outputs of the planning phase are listed as follows, according to the PMBOK Guide 6th edition:

Procurement management plan

Procurement strategy

Bid documents

Procurement statement of work

Source selection criteria

Make-or-buy decisions

Independent cost estimates

Change requests

Project documents updates

• Lessons learned register

• Milestone list

• Requirements documentation

• Requirements traceability matrix

• Risk register

• Stakeholder register

Organizational process assets updates

For the Water Warriors education toolkit project, a procurement management plan is as follows, under the guidance of the PMBOK Guide 6th edition:

How procurement will be coordinated with other project aspects, such as project schedule development and control processes

The procurement aspects will begin as stipulated in the baseline project schedule, but which may require updates should factors change throughout the life cycle of the project. All changes beyond the project charter will be required to go through a formal change control procedure. At NIHERST, the Procurement Department will be responsible for overseeing the request, selection, agreements, financing, and closure of all external needs for goods and services.

The following policies and OPAs will be referenced during the planning, executing, and controlling phases of this project:

- NIHERST Policy Guide Version 1.0 Signing Authority Policy, effective: 1 December, 2017.
- NIHERST Policy Guide Version 1.0 NIHERST Credit Card Administration, effective: 14 March, 2018.
- NIHERST Policy Guide Version 1.0 Procurement Procedures, effective: 7 February, 2011.
- NIHERST OPA for the Procurement Process.
- NIHERST OPA – Requisition Form
- NIHERST OPA – Online Requisition Form

The procurement process guideline provides a step by step guide for processing requests for goods and services external to the organisation. Firstly, goods and

services are requested; it is distributed as necessary; the request is processed; agreements are formulated and may take the form of contracts or purchase orders; goods and services are received, and certified invoices are processed. Such requests may be for online purchases; on demand purchases; and emergency purchases. Additionally, it clearly states that it is a grave breach of policy to split up a purchase in order to avoid going to the Management Tenders Committee, or President.

Chart 48: Timetable of Key Procurement Activities

Task Name	Duration	Start	Finish
Develop procurement management plan	5 days	Mon 05/11/18	Mon 12/11/18
Create procurement strategy	3 days	Mon 05/11/18	Thu 08/11/18
Create statement of work	1 day	Fri 09/11/18	Fri 09/11/18
Produce independent cost estimates	1 day	Mon 12/11/18	Mon 12/11/18
Develop stakeholder engagement plan	5 days	Tue 25/09/18	Mon 01/10/18
Conduct procurements	12 days	Tue 13/11/18	Wed 28/11/18
Liaise with selected sellers	7 days	Tue 13/11/18	Wed 21/11/18
Handle agreements	5 days	Thu 22/11/18	Wed 28/11/18
Control procurements	7 days	Fri 26/10/18	Mon 05/11/18
Close procurements	5 days	Fri 26/10/18	Thu 01/11/18
Produce work performance information	2 days	Fri 02/11/18	Mon 05/11/18

Procurement metrics to be used to manage contracts

Metrics can help ensure that the project contracts are managed, according to the PMBOK Guide 6th Edition. Metrics may also be used for ensuring that the project stays on schedule with regard to activities, and to compile data on the performance of sellers which may be used in future cases, on a project level, according to Project management docs, (n.d.). For the Water Warriors Educational Toolkit project, each metric will be rated on a 1-3 scale, see the following:

Chart 49: Sample Metrics Table

Vendor	Product Quality	On Time Delivery	Documentation Quality	Development Costs	Development Time	Cost per Unit	Transactional Efficiency
Vendor #1							
Vendor #2							

1 – Unsatisfactory

2 – Acceptable

3 – Exceptional

Stakeholder roles and responsibilities related to procurement, including authority and constraints of the project team when the performing organization has a procurement department.

The Project Manager and project team member will be responsible for handling the needs of the project for external purchases, whilst the budget holder and PM would have signing authority over all requisitions. This includes the management, progress, and service provided in relation to quality, and requirements of vendors by the PM, and to request timely changes in agreement, therefore, initiating several meetings between the PM and Procurement Department, according to Project management docs. (n.d.).

However, the Procurement Department will have a significant role, below are the individual positions within the Procurement Department which will assist will the processing of requisitions, as stipulated in the OPAs – its internal policies, and guidelines.

- Head of the Management Tenders Committee
- Secretary Management Tenders Committee
- Senior Procurement Officer
- Procurement Assistant
- Purchaser - Responsible for purchasing activities
- Administrative Assistant
- Administrative Clerk

Chart 50: Physical Resource Assignments For The Water Warriors Educational Toolkit Project

Task Name	Duration	Start	Finish	Resource Names
Confirm physical resource assignments	179 days	Tue 16/10/18	Thu 11/07/19	Louise Villaroel
Secure venue and related services internally	2 days	Tue 16/10/18	Wed 17/10/18	Gail Ann Roberts-Taitt
Obtain service provider for catering for prize giving ceremony	15 days	Thu 18/10/18	Thu 08/11/18	Snack Plates [1 Per Plate]
Obtain competition prizes	30 days	Fri 09/11/18	Thu 20/12/18	Prizes [1 Per Unit]
Obtain memorabilia	30 days	Fri 21/12/18	Thu 07/02/19	Memorabilia [1 Per Unit]
Assign service provider to develop game	25 days	Tue 20/11/18	Thu 27/12/18	Game Developer [1 Per Game]
Obtain service provider for the laminating of reusable activity sheets	15 days	Thu 22/11/18	Wed 12/12/18	Laminating Services [1 Per Unit]
Obtain service provider for printing of brochures	10 days	Thu 22/11/18	Wed 05/12/18	Brochures [1 Per Unit]

Purchase DVDs for the copying of electronic game and DVD production	5 days	Fri 28/12/18	Mon 07/01/19	Digital Video Disc (DVDs) [1 Per Disc],Allister Brizen, Marvin Gordon
Purchase white board markers	45 days	Thu 22/11/18	Wed 30/01/19	White Board Markers [1 Per Pack of 24]
Confirm team assignments	2 days	Fri 02/11/18	Mon 05/11/18	Sharda Mahabir, Kelisha Ray
Produce resource calendars	5 days	Mon 05/11/18	Mon 12/11/18	Allister Brizen
Host workshops through planned school visits	45 days	Fri 03/05/19	Thu 11/07/19	Chantelle Jacob[20%],Darielle Rampersad[20%],Kelisha Ray[20%],Rondell Liverpool[20%],Tahira Khan[20%]
Deliver content and invite participants for competition	45 days	Mon 25/02/19	Fri 03/05/19	Darielle Rampersad

Constraints and assumptions that could affect planned procurements

Constraint number 2 of the assumption log, see chart 17, may affect the procurement processes.

The legal jurisdiction and the currency in which payments will be made

The legal jurisdiction which may affect the procurement processes is Legal Supplement Part B–Vol. 55, No. 118, 19 October, 2016 – the provisional collection of taxes order, 2016 for online purchase tax. The 7% Online Purchase Tax (referred to as O.P.T.) has been in effect since October 20, 2016; in addition to

previously implemented duty tax at 20%; and value added tax at 12.5%. Value added tax is applicable to in country purchases; however, Government Agencies, such as NIHERST are exempted from paying VAT.

The procurement request for external purchases from online sources is subject to O.P.T, and duty tax. These purchases will be made via credit card and will be in United States dollars. For all other in-country purchases the Trinidad and Tobago dollar will be used. The Trinidad and Tobago foreign exchange rate as at 18 April 2019 is $6,7993 TTD for selling, and $6,1000 TTD for buying for $1.00 USD.

Determination of whether independent estimates will be used and whether they are needed as evaluation criteria

Independent estimates will be acquired for purchases, a minimum of three quotes are usually requested in accordance with the internal policy. Elements in the statement of work will be used as evaluation criteria.

Risk management issues including identifying requirements for performance bonds or insurance contracts to mitigate some forms of project risk

Some risks identified in the risk register may affect the procurement processes; these are risk numbers 2, 3, and 7, see risk register, chart 42.

Prequalified sellers, if any, to be used

One seller has been prequalified based on satisfactory past experience. This seller is for the development of the game – Dollar Bill Studios. This seller will be required to go through the formal procurement guidelines which are internal to the organisation.

Procurement strategy

The PMBOK Guide 6th edition states that the objective of the procurement strategy is to determine the project delivery method, the type of legally binding agreement(s), and how the procurement will advance through the procurement phases.

For the Water Warriors Educational Toolkit project the delivery method will allow only buyer/services provider with no subcontracting. The contract payment types will be specified as only fixed-price contracts, since the work is predictable and unlikely to change. The procurement phases will follow the PMBOK Guide 6th edition, where three (3) processes are utilized; the project schedule will be closely linked to the procurement processes; with consideration to milestones, and deliverables; and updating of the subsidiary plans of the PMP, and project documents.

Bid documents

The internal OPAs are the guide for all procurement matters. Bid documents for the Water Warriors Educational Toolkit project will be only in the form of quotations. This is called request for quotation (RFQ). The RFQ, according to the PMBOK Guide 6th edition is used when more information is needed on how vendors would satisfy the requirements and/or how much it will cost.

Procurement statement of work

This output, in addition to the description of the desired form of the response, and any required contractual provisions as stated in the PMBOK Guide 6th edition are all part of the buyer's request. Given the simplicity and size of the project, these need not be too elaborative, but still extensive enough to meet its requirements.

Brochures

Quantity: 1000

The brochure design will be provided by the buyer to the seller for services for the printing and binding by staple, of one thousand (1000), sixteen (16) pages – on 8.5 x 11 letter size plain paper, plus hard cover, and in full colour, booklets in portable document format (pdf) file format. The booklets should be packaged in packets of ten in shrink wrapped plastic.

Activity booklets

Quantity: 54

The activity sheets will be provided by the buyer to the seller for services for the lamination of fifty-four (54) single 8.5 x 11 letter size pages, provided by the buyer.

White board markers (online purchase)

Quantity: 17

For the online purchase of seventeen (17) packs of Avery 98188 MARK A LOT Desk-Style, Chisel Tip, Assorted (4 colours) - (Pack of 24) Dry Erase Markers.

Competition prizes (online purchase)

Quantity: 3

For the online purchase of three (3) prizes to be identified. These prizes will be suitable to a group of children between the ages of 10 – 12 years.

Snack plates

Quantity: 100

The buyer will cater services for the provision of one hundred (100) pre-packaged snack plates containing three (3) items each, and individual bottled juice on ice. The three items should include two (2) savoury items, and one (1) sweet item; of the one hundred (100) plates, seventy-five (75) should be meat, and twenty-five

(25) vegetarian. These should be delivered between the stipulated break times (to be determined).

Game

Quantity: One (1) Electronic game

The game specifications must be clearly outlined by the buyer. These will incorporate the objectives of the learning materials, and will be listed. The list will be developed under the guidance of two (2) technical persons from either party (i.e. the sponsor and the partner). The game should be copied on fifty (50) Digital video discs (DVD) by the service provider, and be uploaded to the websites of each party (i.e. the sponsor and the partner). The DVD must be printed by the service provider. The electronic game must be tested for quality by the technical team of both parties - before it is accepted by the buyer. Once approved, it will hand over, and closed. It may be revised by the seller, as required until all specifications outlined in the agreement are met.

The period of the game delivery and revision times will be made out in the contractual agreement, as would the release of payment. Should performance reporting or post-project operational support for the procured item be required, it will be handled separately.

Digital video disc (DVD)

Quantity: 50

The buyer would require fifty (50) DVDs to provide to the game developer. The quality of the DVD, and its specification would be based on expert judgement received from the identified technical persons, and further approved by the game developer, for producing copies of the game, prior to purchase. The DVDs must be received and delivered to the game developer at the same time the contractual agreement is made.

Memorabilia (online purchase)

Quantity: 150

The memorabilia must be approved by the PM. It should be related to the objectives of the project, and should be interesting, and suitable to students between the ages of 10 – 12 years. It must be received at least two (2) weeks prior to the start of the workshops.

All services and goods, with the exception of the snack plates and juices must be received at least two (2) weeks prior to the start of the workshops.

Source selection criteria

Source selection criteria may include the following elements as listed in the PMBOK Guide 6th edition:

- Capability and capacity;
- Product cost and life cycle cost;
- Delivery dates;
- Technical expertise and approach;
- Specific relevant experience;
- Adequacy of the proposed approach and work plan in responding to the SOW;
- Key staff's qualifications, availability, and competence;
- Financial stability of the firm;
- Management experience; and
- Suitability of the knowledge transfer program, including training.

These will be selected by weighted evaluation scores.

Make-or-buy decisions

Make-or-buy decisions have already been determined, and are in accordance with the project's budget.

Independent cost estimates

Whilst this project is a small project, most estimates will be utilized based on analogous estimates, and expert judgement, hence, the budget estimates were based on those types of estimates.

4.9.2 Conduct procurements

This process falls under the executing process group. It obtains seller responses, selects a seller, and awards a contract, according to the PMBOK Guide 6th edition. The inputs to this process are the subsidiary plans of the PMP, such as the scope, requirement, communication, risk, procurement, and configuration management plans; and the cost baseline. Further, project documents are also inputs to this process, such as the lessons learned register; project schedule for when contractor deliverables are due; requirements documentation; risk register; and stakeholder register, according to PMBOK Guide 6th edition. Other inputs are procurement documentation, such as bid documents; procurement statement of work; independent cost estimates; source selection criteria; seller proposals; EEFs; and OPAs.

The tools and techniques which may be used in this process are expert judgement; advertising; bidder conferences; data analysis for instance proposal evaluation; and interpersonal and team skills such as negotiation. The outputs of the conduct procurement process are selected sellers; agreements; change requests; updates to the subsidiary plans of the PMP. The subsidiary plans of the PMP include the

requirements, quality, communications, risk, procurement management plans; and the scope, schedule, and cost baselines. Additionally, project documents are also updated such as the lessons learned register; requirements documentation; requirements traceability matrix; resource calendars; risk register; and stakeholder register, according to PMBOK Guide 6th edition. Finally, OPAs are also updated in this process, and include the listings of prospective and prequalified sellers, and information on relevant experience with all sellers, as stated in the PMBOK Guide 6th edition.

4.9.3 Control procurements

This process manages procurement relationships; monitors contract performance; and makes changes and corrections as appropriate; and closes out contracts. The PMBOK Guide 6th edition mentions the importance of the legal aspect of contractual agreements; communication between all parties; and administrative activities. The inputs to this process are the subsidiary plans of the PMP, such as the requirements, risk, procurement, and change management plans, and the schedule baseline. Another input is the assumption log; lesson learned register; milestone list; quality reports; requirements documentation; requirements traceability matrix; risk register; and stakeholder register. Further, agreements; procurement documentation; approved change requests; work performance data; EEFs; and OPAs are also inputs.

The tools and techniques which may be used in this process are expert judgement; and claims administration. Another set of techniques that can be used are performance reviews; earned value analysis; and trend analysis. Further, inspection; and audits are two (2) techniques which are a part of this process.

The outputs of this process are closed procurements; work performance information; procurement documentation updates; and change requests. There may also be updates to the subsidiary plans of the PMP such as the risk,

procurement management plans, and the schedule, and cost baseline. Additionally, there may be changes to the project documents. Project documents listed in the PMBOK Guide 6th edition which may require updates are the lessons learned register; resource requirements; requirements traceability matrix; risk register; and stakeholder register. Finally, OPAs may also require updates, the PMBOK Guide 6th edition lists payment schedules and requests; seller performance evaluation documentation; prequalified seller lists updates; lessons learned repository; and procurement file as the processes which can be updated.

4.10 Project stakeholder management

This knowledge area identifies the people, groups, or organisations that could impact or be impacted by the project, it analyses stakeholder expectations, and their impact on the project and it develops appropriate management strategies for effectively engaging stakeholders in project decisions, and expectations, according to the PMBOK Guide 6th edition. This knowledge area has four (4) processes – identify stakeholders; plan stakeholder engagement; manage stakeholder engagement; and monitor stakeholder engagement, as outlined in the PMBOK Guide 6th edition. Further, the PMBOK Guide 6th edition emphasises the importance of stakeholder engagement, that is to enhance the chances of project success, and states that it should start soon after the project charter is approved. It should be broad enough to include all stakeholders; that it should be updated at specified times, yet often; that it may include co-creation; and deals with both the positive and negative aspects, according to the PMBOK Guide 6th edition. Additionally, tailoring may involve stakeholder diversity; complexity of stakeholder relationships; and communication technology.

4.10.1 Identify stakeholders

This process identifies project stakeholders regularly and analyses, and documents relevant information regarding their interests; involvement; interdependencies; influences; and potential; impacts on project success, according to the PMBOK Guide 6th edition. The inputs to this process are the project charter; business documents such as the business case and benefits management plan; the subsidiary plans of the PMP once developed, such as the communications management plan and stakeholder engagement plan; project documents in later phases such as the change log, issue log, and requirements documentation; agreements; EEFs; and OPAs, according to the PMBOK Guide 6th edition.

The tools and techniques which may be used in this process are expert judgement; data gathering techniques such as questionnaires and surveys, brainstorming and brain writing; data analysis techniques such as stakeholder analysis (interest, legal or moral rights, ownership, knowledge, and contribution), and document analysis; and meetings. Additionally, stakeholder mapping/representation categorises stakeholders, and uses popular methods such as the power/interest grid, power/influence grid, or impact/influence grid, and would be useful for the Water Warriors Educational Toolkit project owing to its small size, and simple structures. The PMBOK Guide 6th edition states the following meanings:

Power - level of authority

Interest - level of concern about the project's outcomes

Influence - ability to influence the outcomes of the project

Further to this method are more widely held methods like the stakeholder cube – a three (3)-dimensional model; salience model (useful for large complex communities

of stakeholders) – stakeholders classified based on their power, legitimacy, and urgency; directions of influence – stakeholder classified as upward, downward, outward, and sideward; and prioritization (for larger and complex stakeholder groups).

The outputs of this process are the stakeholder register which includes identification and assessment information, and stakeholder classification; change requests; updates to the subsidiary plans of the PMP such as the requirements, communication, risk management plans, and stakeholder engagement plan; and updates to project documents such as the assumption log; issue log; and risk register.

Chart 51: Stakeholder Management Register

Title	Surname	First Name	Project Role	Importance	Influence	Score	Major Concerns	Relationship Owner
Mr	Brizan	Allister	Technical Person for Game Development	4	4	16	Interested in the game, personal drive	Sharda Mahabir
Mr	Dolabaille	Victor	Animation/Motion Graphics Illustrations Video Editing	3	4	12	Seller, interested in doing business. Familiar with the PM, and organisation, i.e. has done previous work for NIHERST	Louise Villaroel, Lovaan Superville
Mr	Etienne	Wendell	Encore Productions	1	2	2	May have some influence on the PM from sponsor's	Sharda Mahabir

							team	
Dr	Mahabir	Sharda	Project Lead at WRA	5	5	25	Has authority to drive change, cancel projects, and approve budgets etc.	WRA Steering Committee
Ms	Maharaj	Vishala	Agents for the LaMotte Water Testing Kits	2	1	2	Seller, interested in doing business.	Louise Villaroel, Lovaan Superville
Ms	Ray	Kelisha	Outreach Assistant	4	5	20	Direct assistant for the PM on the sponsor's team. Handles almost all communication with the PM	Sharda Mahabir

							from the partner organisation.	
Ms	Ross	Krystal		2	1	2	OJT with the sponsor organisation. Assists the Outreach Assistant as required.	Kelisha Ray
Mr	Seecharan	Harrilal	Requirement for approval to engage primary schools	5	4	20	Grants permission to sponsor and partner, and to perform work at Government schools.	PM

			Customer (students)	2	2	4	Must be highly influenced by the teachers, with which the PM's team will be in continuous communication with.	
			WRA Steering Committee Has the responsibility for monitoring of the Adopt a River Programme, final project approval, budgetary allocation and auditing of projects.	5	5	25	Grants all request by the Sponsor's PM. Approves project charter, releases funds.	
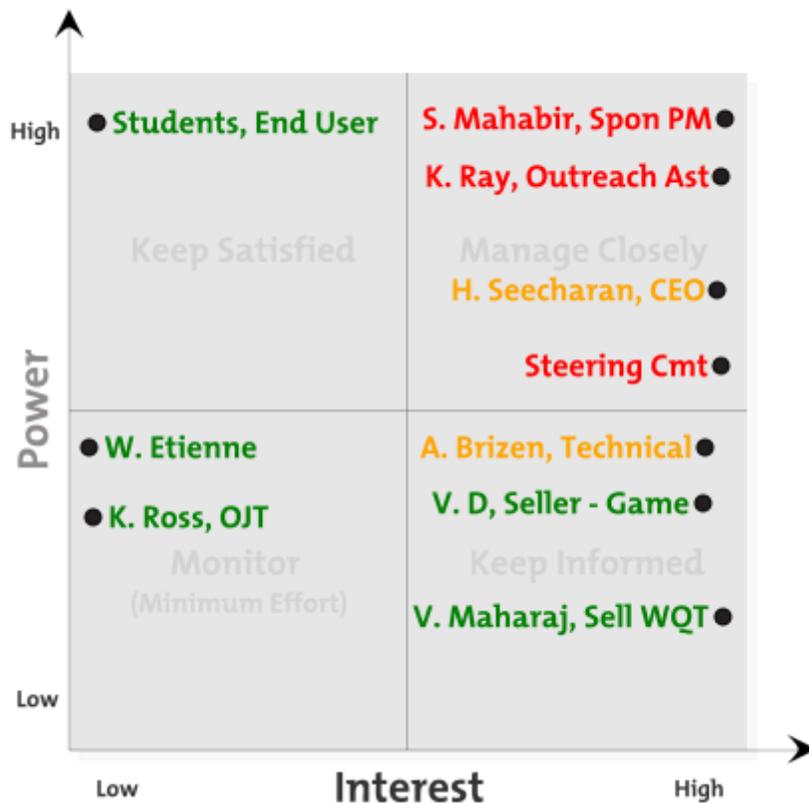
Figure 31: Power /Interest Grid.

4.10.2 Plan stakeholder engagement

This process develops approaches to involve project stakeholders based on their needs, expectations, interests, and potential impact on the project, according to the PMBOK Guide 6th edition. This requires efficient updates to fulfil its purpose, according to the PMBOK Guide 6th edition. The inputs to this process are the project charter; subsidiary plans of the PMP such as the resource, communication, and risk management plans; project documents such as the assumption, change, and issue logs, project schedule, risk and stakeholder registers; agreements; EEFs; and OPAs.

The tools and techniques which may be used in this process are expert judgement; benchmarking; data analysis techniques such as assumption and constraint analysis and root cause analysis; prioritization/ranking; data representation such as mind mapping, stakeholder engagement assessment matrix; and meetings. The PMBOK Guide 6th edition states that the classification used in a stakeholder engagement assessment matrix are unaware; resistant; neutral; supportive; and leading. Further, it indicates that the stakeholder engagement assessment matrix shows the gap between current and desired levels for each stakeholder and is used to direct the level of communications necessary to effectively engage the stakeholder.

The output of this process is the stakeholder engagement plan. This plan identifies the strategies and actions required to promote productive involvement of the stakeholders in decision making and execution, according to the PMBOK Guide 6th edition. Further, the PMBOK Guide 6th edition states that it includes specific strategies or approaches for engaging with individuals or groups of stakeholders.

4.10.3 Manage stakeholder engagement

This process communicates to and works with stakeholder to meet their needs and expectations, addresses issues, and fosters appropriate stakeholder involvement, according to the PMBOK Guide 6th edition. The inputs to this process are the subsidiary plans of the PMP such as the communication, risk, and change management plans, and the stakeholder engagement plan; project documents, such as the change, and issue logs; lessons learned and stakeholder registers; EEFs; and OPAs.

The tools and techniques which may be used in this process are expert judgement; communication skills; interpersonal and team skills such as

conflict management, cultural awareness, negotiation, observation/conversation, and political awareness; ground rules; and meetings. The outputs of this process are change requests; updates to the subsidiary plans of the PMP such as the communications management plan, and stakeholder engagement plan; and updates to project documents such as the change, and issue logs; the lesson learned and stakeholder registers.

4.10.4 Monitor stakeholder engagement

This process monitors project stakeholder relationships and tailors strategies for engaging stakeholders through modification of engagement strategies and plans, according to the PMBOK Guide 6th edition. The inputs to this process are the subsidiary plans of the PMP, such as the resource, and communications management plans, and the stakeholder engagement plan; project documents, such as the issue log, lessons learned register, project communications; risk and stakeholder registers. Further, work performance data; EEFs; and OPAs are also inputs to this process.

The tools and techniques which may be used include data analysis techniques such as alternative, root cause, and stakeholder analysis; decision making techniques such as multicriteria decision analysis, and voting; the stakeholder engagement assessment matrix; communication skills such as feedback, and presentations; and meetings. Finally, interpersonal and team skills may also be used, and these include active listening; cultural awareness; leadership; networking; and political awareness.

The outputs of the process are work performance information; change requests; updates to the subsidiary plans of the PMP such as the resource and communication management plans, and the stakeholder engagement

plan; and updates to project documents such as the issue log; and the lessons learned, risk, and stakeholder registers.

Stakeholder engagement assessment matrix

The PMBOK Guide 6th edition states that the stakeholder engagement assessment matrix supports comparison between the current engagement levels of stakeholder and the desired engagement levels required for successful project delivery. This is done through classification. These are outlined in the PMBOK Guide 6th edition as follows:

Unaware - Unaware of the project and potential impacts.

Resistant - Aware of the project and potential impacts but resistant to any changes that may occur as a result of the work or outcomes of the project. These stakeholders will be unsupportive of the work or outcomes of the project.

Neutral - Aware of the project, but neither supportive nor unsupportive.

Supportive - Aware of the project and potential impacts and supportive of the work and its outcomes.

Leading - Aware of the project and potential impacts and actively engaged in ensuring that the project is a success.

The PMBOK Guide 6th edition provides a template, and related key to assess stakeholders, such that the letter 'C' means current level, and the letter 'D' means desired level. Each stakeholder is assessed individually.

Chart 52: Stakeholder Engagement Assessment Matrix

Stakeholder	Unaware	Resistant	Neutral	Supportive	Leading
Technical Person for Game Development				C, D	
Animation/Motion Graphics Illustrations Video Editing				C, D	
Encore Productions	C			D	
Project Lead at WRA			C		D
Agents for the LaMotte Water Testing Kits				C, D	
Outreach Assistant			C	D	
Requirement for approval to engage primary schools	C			D	
Customer (students)	C			D	
WRA Steering Committee has the responsibility for monitoring of the Adopt a River		C			D

Programme, final project approval, budgetary allocation and auditing of projects.					

Key	Definition
C	Current Level
D	Desired Level

5 CONCLUSIONS

As a result of the development of the work or research objectives, the following conclusions are obtained.

This FGP introduced an improved approach to managing projects, including all water based initiatives aimed at achieving local objectives for integrated water resource management at NIHERST. A number of projects fall under an umbrella portfolio for the implementation of Rain Water Harvesting Systems (RWHS), whilst others are purely school-based interventions, like the Water Warriors Educational Toolkit project. The development of the PMP for this project was developed and guided by the PMBOK Guide 6th edition which is a fundamental resource for effective project management in any industry, and is also the PMI's flagship publication, according to PMI. (2017). Further, this PMP delved into all ten (10) knowledge areas recognised in the PMBOK Guide 6th edition, and creates a plan with outputs of the initiation and planning phases of the project management lifecycles. Additionally, this PMP can be used as a pilot project plan for other projects to leverage on.

1. The PMP was developed under a partnership agreement with the Water Resources Agency of Trinidad and Tobago. It was guided by the project charter and memorandum of agreement between both organizations; the sponsor and partner. These initial documents and stakeholder identification process are the main components guiding the rest of the plan; it contains baseline data which may be updated throughout in the following phases and processes. The PMP is collectively made up of several subsidiary plans developed under the knowledge areas defined by the PMBOK Guide 6th edition.

2. The scope management process aids as a main guide throughout the development of the PMP. It ensures that the following phases have a reference point, and should any changes be required, it should go through the organisation's change management process. However, attention must be given to the occurrence of scope creep, in order to avoid it.

3. The schedule was developed for the PMP which guides the timeline with activities. The activities were given a duration, start and finish date, and were grouped by process, phase and were numbered. The software of choice was Microsoft Project which has the ability to save the initial baseline, and make updates whilst allowing for viewing a limited number of previous baselines to compare data.

4. The cost management process and its outputs were developed based on estimates obtained from previous similar school-based intervention projects. A baseline budget estimate was developed. As the project progresses, the actual expenditure can be compared to the estimate and variances will be noted. This project budget contains both contingency reserves, and management reserve. The management reserve is external to the project budget.

5. The quality management component for the Water Warriors Educational Toolkit project is limited to the quality of the outputs of the project. The critical factors for this project are the testing of the reusable activity book for usability and functionality, and the electronic game by the technical team.

6. The resource management area considered the team from both organisations, and other requirements which are important to the project. It provides structures from which resources can be estimated, and how the roles and responsibilities of the team would be needed to fulfil the activities outlined in the project's schedule.

7. The communication management process is one of the vital areas in project management. Hence, the robust development of the communication plan for the Water Warriors Educational Toolkit project is critical for project success. Given the tight timelines for the execution phase of this project, early stakeholder intervention, and management is necessary. The stakeholders must motivate the project's end users. That means that the project team must inform teachers and principals well in advance, so that they can motivate and inform students. This will likely secure the attendance by students, since this post examination period is a time when students normally stay at home, as they await the results of their examination. Further, early stakeholder intervention is necessary since students will be focused on their examination during the planning phase of the project, and hence, teachers must prepare students. This is one way of dealing with the risks identified in this project.

8. The risk management processes are significant in a PMP plan. It identifies both risks and opportunities for the project as the case may be. The risks, or opportunities once identified is the first step in working towards a strategy for example mitigation or exploitation.

9. The procurement management plan and processes are used to ensure that the procurement aspects of the project are handled efficiency, and

effectively. It is imperative that the Project Manager and team member responsible for handling procurement liaises with the procurement department, and negotiates for the best deals when making agreements for goods and services. It is important for the Project Manager to be familiar with the organizational policy and guidelines for the procurement processes.

10. The stakeholder management process is as significant as the communication knowledge area, and works in tandem with the communication management plan. The stakeholder management plan and strategies for managing stakeholders throughout the project's phases are used to assist the Project Manager and team in gaining buy-in and support where necessary. Additionally, monitoring stakeholders who may be helpful or detrimental to the project outputs and outcomes, is also a part of this knowledge area.

6 RECOMMENDATIONS

This FGP creates a PMP for the Water Warriors Educational Toolkit project. This project promotes sustainability initiatives and works towards achieving some of the goals of the recently revamped integrated water resource management policy of Trinidad and Tobago. The PMP considers the first two of the five phases of project management, that is the initiation and planning phases. The following are the recommendations proposed for moving forward:

1. The project is to be executed, monitored and closed utilizing the baseline plans developed in the PMP in the planning phase. Whilst taking precaution against scope creep, any changes to the baseline plans must go through the organisation's change control management procedures, once the project charter has been formalized and signed off.

2. The project should seek out measures that will promote sustainability, that is reducing waste of energy and resources when possible, and these achievements should be reported on.

3. Avenues for recycling must be provided, so that students can learn first-hand and practice recycling themselves.

4. Where possible sustainable goods and services should be sought out and prioritized as criteria in the procurement processes, for instance, the use of sustainable food choices, and biodegradable goods, and packaging.

5. A powerful message should be promoted to students about sustainability, and prevention rather than cure. Telling stories to students about achievements in a simplified manner are recommended. For instance, how on 20 March, 2017 New Zealand recognized the Te Awa Tupua River as a living being with all the rights, powers, duties, and liabilities of a legal person, according to Warne, K. (n.d.). Additionally, students should be taught about mysticism and awe in the stories told about rivers, and this should include local cultural stories.

6. A lessons learned repository should be developed for the project, however at project closure, all lessons learned that are new to the organisation must be collaboratively discussed at the project close out meeting and those which are new must be entered into the organisation's lesson learned repository so that other PM's and their teams can benefit. Lessons learned may be both positive and negative aspects from the management of the project.

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8 APPENDICES

Appendix 1: FGP Charter

PROJECT CHARTER	
Formalizes the project start and confers the project manager with the authority to assign company resources to the project activities. Benefits: it provides a clear start and well defined project boundaries.	
Date	**Project Name:**
5 November, 2018	Project Management Plan for the NIHERST-WRA Water Warrior Educational Toolkit Project
Knowledge Areas / Processes	**Application Area (Sector / Activity)**
Knowledge areas: Project - integration; scope; time; cost; quality; human resources; communications; risk; procurement; and stakeholder management. **Process groups:** Initiating; and Planning.	Resource Management: Informing, and educating in the area of Water Resource Management.
Start date	**Finish date**
5 November, 2018	24 May, 2019
Project Objectives (general and specific)	

General objective:

To develop a complete project management plan (PMP) framed within the standards of the Project Management Institute, for the Final Graduation Project. This PMP will be relevant to the National Institute of Higher Education, Research, Science and Technology (NIHERST) and the Water Resources Agency (WRA) Water Warrior Educational Toolkit Project, and developed for the initiation and planning phases of the project life cycle. The PMP would function as a pilot study for other water-based projects at NIHERST.

Specific objectives:

1. To create a project management plan and a project charter, to plan, and authorize and initiate the project, using guidance from the PMBOK Guide 6th edition. The PMP will integrate the knowledge areas and provide a roadmap for the project, and will be done within the second week of the FGP.

2. To develop the scope management plan, requirements documentation, requirements traceability matrix, project scope statement, and scope baseline for the project, using guidance from the PMBOK Guide 6th edition. This will ensure that all the required work, but only the required work is performed, it will be done within the third week of the FGP.

3. To plan and develop the schedule, and to define, sequence, and estimate activities for the project, using guidance from the PMBOK Guide 6th edition. This will therefore allow the project to be managed, and completed in a timely manner, and will be done in the fourth week of the FGP.

4. To develop the cost management plan, cost estimates, basis of estimates, cost baseline, and project funding requirements, using guidance from the PMBOK Guide 6th edition. This will ensure that the project is completed within the

project's budget; it will be done within the fifth week of the FGP.

5. To create the quality management plan, and quality metrics for the project, using guidance from the PMBOK Guide 6th edition. This would make certain that the project meets its quality requirements, and will be done within the sixth week of the FGP.

6. To build the resource management plan, team charter, resource requirements, basis of estimates, and resource breakdown structure, using guidance from the PMBOK Guide 6th edition. This will identify the resources needed to successfully complete the project, and will be done within the seventh week of the FGP.

7. To create the communications management plan, using guidance from the PMBOK Guide 6th edition. This would aid in effective information exchange, with the potential stakeholders to minimize conflicts, and will be done within the eighth week of the FGP.

8. To develop a risk management plan, register, and report for the project, using guidance from the PMBOK Guide 6th edition. This will likely optimize the chances of project success, by seeking out opportunities, and taking action to reduce negative risks; it will be done within the ninth week of the FGP.

9. To create the procurement management plan, strategy, bid documents, statement of work, source selection criteria, make-or-buy decisions, and independent cost estimates, using guidance from the PMBOK Guide 6th edition. This will strategically deal with purchases for the project, in an efficient manner, and will be done within the tenth week of the FGP.

10. To develop the stakeholder register and the stakeholder engagement plan for the project, using guidance from the PMBOK Guide 6th edition. This helps to effectively engage stakeholders in making project decisions, and during

execution, and will be done within the eleventh week of the FGP.

Project purpose or justification (merit and expected results)

This FGP will develop the PMP for the NIHERST-WRA Water Warrior Educational Toolkit Project, and will act as a pilot study for the organisation, since it does not currently utilize the project management methodology fully, but more so on a partial and piecemeal approach. This PMP will assist the organisation to meet its objectivies successfully, and this can reap numerous rewards.

At this time the organisation is at point where it recognizes the need for efficient project management. Recently, it has obtained licences for the project management software, and is installing it for use by the Project Managers and Project Teams. It has also embarked on encouraging staff to take a training in the use of Microsoft Project, and staff are asked to take this training as a group to provide support to others. Thus far, a set date for training has been earmarked, on a weekly basis. This is therefore a good time to utilize the concept of project management by implementing a PMP for this project.

A synopsis of the expected benefits are that it can be used as an example for future projects. It implements good budgetary practices for projects, for example including contingency reserves for anticipated risks, and management reserves for unanticipated risks. It can strengthen organisational structure, and prevent project implementation problems. It can effectively monitor and control the project's management for the knowledge areas. It can result in reduced conflicts through improved communication. The project can have good stakeholder involvment and less opposition. And finally successful outcomes can be show organisation capability, and hence attract grant funding, for instance, from both local and international organisations.

Description of Product or Service to be generated by the Project – Project final deliverables

The specific and measurable description of the FGP PMP for the NIHERST-WRA Water Warrior Educational Toolkit Project are as follows:

- Assumption log
- Stakeholder register
- PMP
    - Requirements management plan
    - Scope management plan (scope statement, baseline), and WBS
    - Schedule (Gantt Chart)
    - Cost management plan (estimates, budget, and funding)
    - Quality management plan
    - Resource management plan (resource requirements, estimates, and resource breakdown structure), and team charter
    - Communications management plan
    - Risk management plan (risk register and report)
    - Procurement plan, strategy, statement of work, and independent cost estimates
    - Stakeholder engagement plan

Assumptions
- The project schedule, its milestones, and timelines are adequately estimated.   - The estimated costs are adequate.   - The project deliverables are sufficient for the formation of the PMP.   - The content of the deliverables are of the appropriate standard as stipulated in the PMBOK Guide 6th Edition.   - The stakeholders and resources (e.g. software) are available.

Constraints
- The FGP and course 11 occuring contemporaneously.   - Lack of experience, and assistance with using new software.   - Additional deliverables identified, hence, affecting scheduled events.

Preliminary risks
If the student does not include all the adequate deliverables then the PMP will not be fully anticipated. If the student fails to keep the pace of meeting the scheduled event and milestones then the project may become difficult to develop with shortened timelines. If the student does not anticipate risk and develop a contingency plan, then some delays can be expected. If student misinterprets the instructions, it will impact the student's quality of work. If the student fails to adequtely communicate with the tutors, and other stakeholders then

conflicts are more likely to arise and have negative impact.

Budget

Cost for student time: $220 USD at an average of 5 working days.

Cost for mailing document to UCI: $60 USD, one time delivery via DHL mail.

Milestones and dates

1	Graduation Seminar	30d	05/11/2018	14/12/2018
1.1	FGP Deliverables	30d	05/11/2018	14/12/2018
1.1.6	Annexes	25d	12/11/2018	14/12/2018
2	Tutoring Process	75d	17/12/2018	29/03/2019
2.1	Tutor	3d	17/12/2018	19/12/2018
3	Reading By Reviewers	15d	01/04/2019	19/04/2019
3.1	Reviewers Assignment Request	5d	01/04/2019	05/04/2019
3.2	Reviewers Work	10d	08/04/2019	19/04/2019
3.2.1	Reviewer	10d	08/04/2019	19/04/2019
3.2.2	Reviewer	10d	08/04/2019	19/04/2019
4	Adjustments	20d	22/04/2019	17/05/2019
5	Presentation to Board of Examiners	5d	20/05/2019	24/05/2019

Relevant historical information

The National Institute of Higher Education, Research, Science and Technology (NIHERST) was established by the Republic of Trinidad and Tobago as a statutory body by Act No. 20 of 1984, now Chapter 39:58. Currently NIHERST is a state agency under the Ministry of Education (MOE). The institute's mission statement is 'to provide intellectual leadership and to

promote research, development and quality service in the areas of Science, Technology and Higher Education' and has the vision to be the focal point and to provide advice to Government policy and planning in the area of research and development, popularise science and actively form regional and international networks in the said areas. The Institute has some key objectives, one of which is 'fostering a culture of science, innovation and creativity' within the public domain. NIHERST attempts to fulfil its mandate through its objectives and in part 'fostering this culture' by offering programmes that will have a set of focused outputs.

NIHERST promotes science and technology and functions to build capacity and science policy as a key part of its mandate. The development of the Science, Technology and Innovation policy (STI Policy) is done to improve science management at the national level according to UNESCO. Science popularization functions through educational initiatives, such as awards, earmarked days, commemorative occasions, magazines, journals, science communication, science institutions and science exhibitions. It falls under the objectives of STI policy, in accordance with UNESCO's guidelines.

The Environmental Solutions for Sustainable Communities project

The Environmental Solutions for Sustainable Communities project embarked upon by NIHERST together with the Global Water Partnership-Caribbean (GWP-C) and the Toco Foundation promotes the use of rainwater harvesting systems (RWHS). This project was conducted in water-scarce communities, and falls within the purview of this United Nations Sustainable Development Goal, goal 4, target 4.7, and the Integrated Water Resource Management Planning concept, amongst others.

A recent Rain Water Harvesting System (RWHS) project was sponsored by an organisation based in Costa Rica, that promotes public-private partnerships. In this project, a RWHS was installed in the rural community of Toco, Trinidad and Tobago by NIHERST.

There were numerous projects which came out of the Water Resource Management area, solely for constructing Rain Water Harvesting Systems. Further to these, other environmentally geared projects were; The Natural Wonders video series, part 1 & 2; Climate change DVD – 3 short videos (2011); Raging Planet Exhibit; Alternative Energy Exhibits – Solar, Wind, Wave Energy; and most recently the Deep Sea Wonders of the Caribbean video series in 2018.

Stakeholders

Direct stakeholders:

Lecturer for the Final Graduation Seminar

Tutor

Student

Reviewers

Board of Examiners

Indirect stakeholders:

Universidad para la Cooperacion Internacional (UCI)

Academic Assistant, UCI

Registry Department, UCI

Classmates, UCI

Computer store

Organisation of American States (OAS)

Project Manager: Tahira Khan	**Signature:** *Tahira Khan*
Authorized by:	**Signature:**

Appendix 2: FGP WBS

WBS_Schedule1 ☒

- 0 Final Graduation Project
- 1 Graduation Seminar
  - 1.1 FGP Deliverables
    - 1.1.1 Charter
    - 1.1.2 WBS
    - 1.1.3 Chapter I. Introduction
    - 1.1.4 Chapter II. Theoretical Framework
    - 1.1.5 Chapter III. Methodical Framework
    - 1.1.6 Annexes
      - 1.1.6.1 Bibliography
      - 1.1.6.2 Schedule
      - 1.1.6.3 Graduation Seminar Approval
  - 2.1 Tut
    - 2.1.1
    - 2.1.2

3 Reading By Reviewers

3.1 Reviewers Assignment Request

3.1.1 Assignment of Two Reviewers

3.1.2 Communication

3.1.3 FGP Submission to Reviewers

3.2 Reviewers Work

3.2.1 Reviewer

3.2.1.1 FGP Reading

3.2.1.2 Reader 1 Report

3.2.2 Reviewer

3.2.2.1 FGP Reading

3.2.2.2 Reader 2 Report

4

Appendix 3: FGP Schedule

BS_Schedule1 ▣

WBS	Name	Duration	Start	Finish
0	Final Graduation Project	135d	05/11/2018	10/05/2019
1	⊟ Graduation Seminar	30d	05/11/2018	14/12/2018
1.1	⊟ FGP Deliverables	30d	05/11/2018	14/12/2018
1.1.1	Charter	5d	05/11/2018	09/11/2018
1.1.2	WBS	5d	05/11/2018	09/11/2018
1.1.3	Chapter I. Introduction	5d	12/11/2018	16/11/2018
1.1.4	Chapter II. Theoretical Framework	5d	19/11/2018	23/11/2018
1.1.5	Chapter III. Methodical Framework	5d	26/11/2018	30/11/2018
1.1.6	⊟ Annexes	25d	12/11/2018	14/12/2018
1.1.6.1	Bibliography	5d	03/12/2018	07/12/2018
1.1.6.2	Schedule	5d	12/11/2018	16/11/2018
1.1.6.3	Graduation Seminar Approval	5d	10/12/2018	14/12/2018
2	⊟ Tutoring Process	75d	17/12/2018	29/03/2019
2.1	⊟ Tutor	3d	17/12/2018	19/12/2018
2.1.1	Tutor Assignment	1d	17/12/2018	17/12/2018
2.1.2	Communication	2d	18/12/2018	19/12/2018
2.2	Adjustments of Previous Chapters (if ne	5d	03/01/2019	09/01/2019
2.3	Chapter IV. Development (Results)	47d	10/01/2019	15/03/2019
2.4	Chapter V. Conclusions	5d	18/03/2019	22/03/2019
2.5	Chapter IV. Recommendations	5d	25/03/2019	29/03/2019
3	⊟ Reading By Reviewers	15d	01/04/2019	19/04/2019
3.1	⊟ Reviewers Assignment Request	5d	01/04/2019	05/04/2019
3.1.1	Assignment of Two Reviewers	2d	01/04/2019	02/04/2019
3.1.2	Communication	2d	03/04/2019	04/04/2019
3.1.3	FGP Submission to Reviewers	1d	05/04/2019	05/04/2019
3.2	⊟ Reviewers Work	10d	08/04/2019	19/04/2019
3.2.1	⊟ Reviewer	10d	08/04/2019	19/04/2019
3.2.1.1	FGP Reading	9d	08/04/2019	18/04/2019
3.2.1.2	Reader 1 Report	1d	19/04/2019	19/04/2019
3.2.2	⊟ Reviewer	10d	08/04/2019	19/04/2019
3.2.2.1	FGP Reading	9d	08/04/2019	18/04/2019
3.2.2.2	Reader 2 Report	1d	19/04/2019	19/04/2019
4	⊟ Adjustments	20d	22/04/2019	17/05/2019
4.1	Report For Reviewers	9d	22/04/2019	02/05/2019
4.2	FGP Update	1d	03/05/2019	03/05/2019
4.3	Second Review by Reviewers	10d	06/05/2019	17/05/2019
5	⊟ Presentation to Board of Examiners	5d	20/05/2019	24/05/2019
5.1	Final Review By Board	2d	20/05/2019	21/05/2019
5.2	FGP Grade Report	3d	22/05/2019	24/05/2019
5.3	FGP End	0d	24/05/2019	24/05/2019

Appendix 4: Memorandum of Understanding

"Water Security for Every Sector, Deliver it. Sustain it."

MEMORANDUM OF UNDERSTANDING

BETWEEN

WATER AND SEWERAGE AUTHORITY OF TRINIDAD AND TOBAGO

AND

THE NATIONAL INSTITUTE OF HIGHER EDUCATION, RESEARCH, SCIENCE AND TECHNOLOGY (NIHERST)

For the Adopt A River Programme

REPUBLIC OF TRINIDAD AND TOBAGO

MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (hereinafter referred to as 'the MOU') is made in duplicate the xxxxxxxxxxxxxxxx, BETWEEN the **WATER AND SEWERAGE AUTHORITY** of Trinidad and Tobago, a body corporate established under the Water and Sewerage Act, Chapter 54:40 of the Laws of Trinidad and Tobago with its principal offices situated at Farm Road, Valsayn, St. Joseph in the Republic of Trinidad and Tobago (hereinafter called 'the Authority') of the One Part and **THE NATIONAL INSTITUTE OF HIGHER EDUCATION, RESEARCH, SCIENCE AND TECHNOLOGY (NIHERST)** and having its office at **St Vincent Street, Port of Spain** (hereinafter called "the Adopter") of the Other Part ("the Authority" and "the Adopter" hereinafter where jointly referred to as "the Parties").

WHEREAS:

(a) The Authority has responsibility for, *inter alia*, the development and maintenance of waterworks, for administering the supply of water in the Republic of Trinidad and Tobago and the promotion of the conservation and proper use of water resources;

(b) The Adopter has expressed an interest to participate in the Authority's Adopt a River Programme (hereinafter referred to as "the Programme"); and

(c) The Authority under and by virtue of its powers under the Water and Sewerage Act Chapter 54:40 and the Waterworks and Water Conservation Act Chapter 54:41 has agreed to permit the Adopter to participate in the Adopt a River Programme as specified in Schedule 1 hereto and on the terms and conditions hereinafter expressed.

NOW THEREFORE the understanding of both Parties is detailed as follows:

1.   Definitions

1.1   For the purposes of this MOU, except where the context otherwise requires:

a) "Water Resources Agency" shall mean the Water Resources Agency of the Water and Sewerage Authority of Trinidad and Tobago.

b) "Proposal" shall mean a written document that includes the desire of the applicant to participate in the Programme, the project areas of interest and or to be targeted, the project timelines and the deliverables.

c) "Adopter" shall mean an individual, company or group that has submitted a proposal to participate in the Adopt a River Programme and said proposal has been successfully agreed upon by the Adopt a River Implementation Unit.

d) "Adopt a River Implementation Unit" will be formed from contract staff being persons appointed to manage the Adopt a River Programme under the guidance of the Adopt a River Steering Committee.

e) "Adopt a River Steering Committee" shall consist of appointed representatives from state agencies, educational institutions, non-governmental, and community based organizations. This Steering Committee shall have the responsibility for monitoring of the Adopt a River Programme, final project approval, budgetary allocation and auditing of projects.

f) "Adopt a River" is the programme wherein an organization actively participates in or funds a watershed project as outlined in Section 4.1 Part F.

g) "Effluent" shall mean liquid waste or sewage discharged into the environment which consists of harmful or toxic substances that can contaminate the natural environment.

h) "Non-point Source Pollution" shall mean pollution input from many diffuse sources.

i) "Watershed" shall mean a region drained by a stream, lake or other body of water. It is a basin-shaped area in which all water or precipitation, sediments and other materials will flow to the same outlet.

1.2 In this MOU:-

a) words in the singular include the plural, the masculine includes the feminine and neuter and vice versa, except where the context otherwise requires; and

b) Clause headings are included for convenience only and shall not be used in the interpretation of any clause.

2. Objectives

2.1 The overall objective of the 'Adopt a River' Programme is to implement approved watershed rehabilitation and conservation projects, identified by stakeholders at national and community levels, for water supply and/or water management improvement.

2.2 The specific objectives of the 'Adopt a River' programme are to:

a) Identify critical watersheds in need of improved water supply and/or management.

b) Identify watershed degradation issues, including unplanned housing/squatting and slash-and-burn agriculture, and communicate these issues to relevant Government Agencies to be addressed.

c) Engage stakeholders at the national and community levels to identify water related projects.

d) Prepare a compendium of water-related projects across watersheds.

e) Collaborate with other Government Agencies and community groups to implement projects to alleviate watershed degradation issues for lasting success.

f) Facilitate partnerships with the business community and NGOs in the implementation of identified projects.

g) Educate citizens on water pollution and mitigation measures.

h) Foster a culture change towards greater appreciation of the environment.

i) Promote a culture of volunteerism for the national good.

j) Empower water users to protect the resource and participate in its management.

k) Train trainers to promote community water resources management.

l) Partner with existing programs and water resources initiatives by other organisation/agencies.

3.   Duration

3.1   Commencement

This MOU shall be effective on the date of signing and shall remain in full force and effect for one (1) calendar year ("the Agreement Period") unless terminated earlier in accordance with the terms and conditions of this MOU.

3.2 Option to Extend

    a) Prior to the completion of the Agreement Period each Party shall have the right, by written notice to the other Party, to seek an extension of the term of this MOU for a period to be determined by mutual agreement of the Parties.

    b) This MOU may be extended only on terms and conditions mutually acceptable to both Parties and same must be in writing.

4. Responsibilities of the Parties

4.1 The responsibilities of the Adopter will include but not be limited to:-

    a) The submission of a proposal in accordance with the objectives of the Adopt a River Program and as detailed in Clause 2 above;

    b) Appointment of an liaison to act on its behalf and written notification to the Adopt a River Implementation Unit of the appointment prior to the commencement of the project;

    c) The engaging of participating volunteers within the domicile community in which the project is being undertaken;

    d) The organization and participation in a minimum of one (1) project during the term of this MOU. The Adopter will also be responsible for the provision of a written report to the Adopt a River Implementation Unit on the progress of the project on an as and when required basis;

    e) Collaboration with the Adopt a River Implementation Unit to develop the necessary tools to be utilised in the program and for the promotion of the program such as but not limited to manuals, games, etc.;

    f) Submission of all data collected throughout the duration of the project to the Adopt a River Implementation Unit, for example, research material, questionnaires, surveys, etc.;

g) The Adopter hereby acknowledges that projects should encompass a minimum of three (3) of the below-mentioned items:

(i) Public awareness/education;

(ii) Water conservation for example water reuse projects;

(iii) Water management for example reforestation and rehabilitation exercises;

(iv) Clean-up programs;

(v) Water source improvement;

(vi) Water quality monitoring programs;

(vii) School participation and competition;

(viii) Voluntary effluent clean-up.

4.2 The responsibilities of the Adopt a River Implementation Unit will include but not be limited to:-

a) The review of the proposal submitted by the Adopter;

b) Prior to the approval of the proposal the Adopt a River Implementation Unit will make such recommendations or amendments as are required for the effective progression of the projects;

c) For the purpose of public information, the Adopt a River Implementation Unit will publish relevant information about the project in a daily newspaper;

d) Collaboration with the Adopter to define the specific areas of the project as in Clause 4.1 Part F;

e) Providing assistance to and collaborating with the Adopter to develop the necessary tools to be utilised in the program and for the promotion of the program such as but not limited to manuals, games, etc.;

f) Collation of relevant information received from the Adopter in relation to the project, for example, research material, questionnaires, surveys, etc.;

g) Other responsibilities:-

i) To provide guidance to the Adopter in order to promote the success of the program;

ii) To provide background information to the Adopter on the watershed issues;

iii) To coordinate and manage the Adopt a River Programme;

iv) To communicate to the Authority regarding the status of the project;

v) To assist the Adopter where possible to facilitate meetings about the project;

vi) To monitor projects;

vii) To provide any other necessary/relevant information to the Adopter.

5.   Health, Safety, Security and the Environment

a) The Adopter will appoint a qualified representative(s) with responsibility for training all participants, particularly to ensure conformance with Occupational Safety and Health practices.

b) When persons under the age of 18 years are present during projects, the Adopter will ensure that written permission from the parents and or guardians of the minors is obtained and that there is adequate qualified supervision in order to facilitate mentoring, training, water safety and first aid.

c) The Adopter will act in and ensure compliance with all rules, regulations, policies and guidelines of the Environmental Management Act Chapter 35:05 and occupational health and safety guidelines.

d) The Adopter will notify the Adopt a River Implementation Unit in writing immediately of all accidents and or injuries occurring or sustained during the conduct of the project.

e) The Adopter will notify the Adopt a River Implementation Unit in writing no later than seven (7) calendar days of incidents of persistent pollution

and any issue that may impact the project, the environment or the Authority in any way.

f) The Adopter shall dispose of all collected trash and or waste material in accordance with the Environmental Management Act Chapter 35:05 and Environmental Management Agency guidelines.

6. Relationship

This MOU shall not be interpreted or construed to create an association, joint venture or partnership between the Parties or to impose any partnership obligation or liability upon either Party and neither Party shall have any right, power or authority to enter into any Agreement or undertaking for, or act on behalf of, or to act as or be an agent or representative of, or to otherwise bind, the other Party.

7. Intellectual Property

The Authority shall retain copyright of all documents prepared by its employees or officers, or on its behalf. The Adopter shall be entitled to use or copy such documents only for the work and purpose for which they were intended and shall require the Authority's written consent to use, copy or publish such information, such consent not to be unreasonably withheld.

8. Confidentiality

a) When a party discloses any information or object in any form under this MOU to the other party, the disclosing party shall in writing inform the receiving party of any confidentiality of intellectual property right attached to the information or object.

b) The recipient shall observe confidentiality throughout the duration of and thereafter the expiration of the Agreement for the Adopt a River Program.

9. Alternative Dispute Resolution

a) The Parties shall use their best efforts to settle amicably by direct informal negotiation any dispute, controversy or claim arising out of or relating to this MOU, including the interpretation, application or implementation of the provisions of this MOU.

b) If, after thirty (30) days from the commencement of such informal negotiations, the Parties have been unable to resolve amicably any dispute, either Party may call for the resolution of same by formal mechanisms to be held in the Republic of Trinidad and Tobago. The formal mechanisms may include, but are not restricted to mediation by an agreed independent third party or arbitration.

10. Termination

Either Party may terminate this MOU for what it considers to be just cause at any time upon two (2) calendar months prior notification in writing to the other party. In the event of such termination of this MOU, the Adopter shall be required to satisfactorily discharge all liabilities and/or obligations that it has incurred up to the date of termination.

11. Indemnity

a) The Adopter shall complete the liability release form, as hereto attached in Schedule 2 and shall further keep the Authority fully indemnified at all times against any action, claim or demand of whatever nature, including loss or damage to property and equipment of the Authority where such

claim, loss or damage arises from any gross negligence of the Adopter, its servants and/or agents.

b) The Adopter shall meet all costs related to reparative works should its actions or that of its servants and/or agents exacerbate the issues within the designated adopted river/area.

c) The Adopter shall keep the Authority fully indemnified at all times against any action, claim or demand of whatever nature, including loss or damage to property and equipment of the Adopter and Authority. Further, the Adopter shall keep the Authority full indemnified in relation to matters of an environmental nature, arising out of the exercise of rights granted under this MOU, unless the loss, injury or damage or liability is due to the negligence of the Authority, its servants and/or agents.

12. Notices

Any notice or another communication which is to be given hereunder shall be given or made in writing and shall be considered to have been so given made by personal delivery to the relevant address or by facsimile transmission containing the text of such information or other communication to the facsimile number of the Parties below.

THE AUTHORITY:

Chief Executive Officer

Water and Sewerage Authority

Farm Road

St. Joseph

Tel: 662-2302 Ext. 2500

Fax: 696-4621

THE ADOPTER:

THE NATIONAL INSTITUTE OF HIGHER EDUCATION, RESEARCH, SCIENCE AND TECHNOLOGY (NIHERST)

Address:

Tel:

Fax:

13. Amendment

a) Either Party shall notify the other of the desire to change or modify the provisions of this MOU in writing. The provisions of this MOU shall not be changed or modified other than by the mutual agreement of the Parties in writing, such agreement not to be unreasonably withheld by either Party.

b) Any and or all changes or modifications shall be proposed no fewer than fourteen (14) calendar days prior to the effective date proposed for such change and modification.

14. Assignment

Neither of the Parties shall assign or transfer this MOU or any part thereof to any other person, firm or corporation, save and except where such person, firm or corporation is wholly controlled by the Party so transferring or assigning, provided that such person, firm or corporation remains so controlled during the remainder of the term of this MOU.

15. Costs and Expenses

Each Party shall pay its respective costs and expenses in relation to the negotiation, preparation, execution and effect of this MOU.

16. Applicable Law

The respective rights, privileges, duties and obligations of the Parties under this MOU shall be determined under and governed by the Laws of the Republic of Trinidad and Tobago.

IN WITNESS whereof the parties have hereunto set their hand the day and year first written above.

SIGNED for and on behalf of the   )
WATER AND SEWERAGE AUTHORITY   **)**
by   )
its Chief Executive Officer   )
and   )
its Corporate Secretary   )
in the presence of:-   )

SIGNED for and on behalf of the   )
NIHERST   **)**
by   )
its   )
and   )
its   )
in the presence of:-   )

Schedule 1

Adoptee Contact Information

Name of Adoptee (Organization or Group)	NIHERST		
Name of Contact Person(s)	Tahira Khan		
Email Address			
Contact Info	Tel:	Fax:	Cell:

Project Details

Project Title	Water Education Toolkit
River to be adopted	All
Project Objectives	To develop a water education tool kit, consisting of educational literature, videos and games, for post-SEA students. This toolkit will be used jointly in school and children outreach exercises, including at the NIHERST Science Centre. The sub objectives include: 1. Development of a water education toolkit which will include storybooks, activity books and games. 2. Collaboration on water education content as well as outreach exercises. 3. Sharing of educational content such as videos and website content for mutual marketing benefit. 4. Possible development of a water education section in the NIHERST Science Centre.

Location	This project will be used in primary schools across the country as well as the NIHERST Science Centre
Project Rationale	NIHERST is a leading science education organization in the country and a partnership with this organization would afford a wider audience with respect to water education in the country. The Adopt A River Programme's outreach and education supports NIHERST's science education drive and hence, a partnership of this kind can only afford both parties mutual benefit. The development of a water education toolkit for post-SEA students will provide schools with activities for these students who usually do not have curriculum requirements. It would also provide them with an introduction of water education, for when the students enter secondary school.
Resources/Contribution	Testing kits, human resources, ECOFACT videos, other video content

Thematic Areas(s) covered

	'River Clean-up'
	Establishment of community clean-up teams
	Sponsorship of community competitions
X	Water quality monitoring for your organization/community/school
X	Educational and Awareness Program
	Sponsorship of school competitions
	Tree planting exercise
X	Water camps for kids
	Other: (describe)
	Other: (describe)

Proposed Activities and Timeline

Activity #1	Timeframe
Milestone:	Projected Start Date
Activity #2	
Milestone:	Projected Start Date
Activity #3	Timeframe
Milestone:	Projected Start Date

Appendix 5: Revision dictum

Maria Alexandra Mora Ramírez
Cra 13. #44-34
Apartment 805
COLOMBIA

Phone number: +57 311 835 6798

7 June 2019

Mr Ramiro Fonseca Macrini, MBA
Dean GSPM
UNIVERSITY FOR INTERNATIONAL COOPERATION

Dear Mr Fonseca Macrini:

Re: Philologist Approval for Final Graduation Project Review and Correction

I, Maria Alexandra Mora Ramírez with identity card, number 52.820.618, with an academic post graduate Master's Degree in Teaching English as a Foreign Language from the Universidad Internacional Iberoamericana, graduated in 2017, and an Undergraduate Degree in Philology and English, extended by La Universidad Nacional De Colombia, graduated in 2003, declare that I, as a professional in the field of Philology, have reviewed, and corrected Tahira Nissa Khan Final Graduation Project (FGP) entitled *'A Project Management Plan for the Water Warriors Educational Toolkit Project'* dated May 2019.

The FGP document meets the proper philological quality (correct writing, spelling and grammar) as stipulated by the University and is corresponding to a master's level work. It is a requirement of the University that the final version of the FGP document for a Master in Project Management degree, to be awarded by the University for International Cooperation (UCI) is reviewed and corrected by a professional in the field of philology.

Yours sincerely,

Maria Alexandra Mora cc 52.820 618
Maria Alexandra Mora Ramírez

Bachelor, philologist and proofreader of English style National university of Colombia

Master in Teaching English as a Foreign Language Universidad Internacional Iberoamericana

Figure 32: Philologist Approval Letter

APOSTILLE

(Convention de la Haye du 5 octobre 1961)

1. Country: United States of America
   This public document
   El presente documento público

2. has been signed by **Luis Sevillano Sánchez**
   ha sido firmado por

3. acting in the capacity of **Notario Público**
   quien actúa en calidad de

4. and bears the seal/stamp of **Notario de Puerto Rico**
   y está revestido del sello/timbre de

CERTIFIED
certificado

5. at **Mayagüez, Puerto Rico**
   en

6. on **29 de diciembre de 2017**
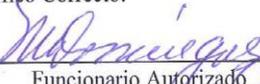   a

7. by **Secretario de Estado del Gobierno de Puerto Rico**
   por

8. No. **46922**
   bajo el número

Certifico Correcto:

Funcionario Autorizado

9. Seal/Stamp
   Sello

D00602629

10. Signature:
    Firma

Luis G. Rivera Marin
Secretario de Estado

Figure 33: Apostille

Figure 34: Ma in Teaching English as a Foreign Lang - Maria Alexandra Mora Ramirez

REPÚBLICA DE COLOMBIA
MINISTERIO DE RELACIONES EXTERIORES

APOSTILLE
(Convention de La Haye du 5 Octobre 1961)

Libertad y Orden

Pais: REPUBLICA DE COLOMBIA
(Country: - Pays:)

El presente documento público
(This public document - Le présent acte public)

Ha sido firmado por: QUIROGA CANCHARO LEIDY VIVIANA
(Has been signed by:
A été signé par:)
Actuando en calidad de: SECRETARIA EJECUTIVA
(Acting in the capacity of:
Agissant en qualité de:)
Lleva el sello/estampilla de: MINISTERIO DE EDUCACION NACIONAL
(Bears the seal/stamp of:
Est revêtu du sceau de/timbre de:)

Certificado
(Certified - Attesté)

En: BOGOTA - EN LÍNEA
(At: - A:)

El: 10/5/2017 17:31:37 p. m.
(On: - Le:)

Por: APOSTILLA Y LEGALIZACIÓN
(By: The Ministry of Foreign Affairs of Colombia - Par: Ministère des Affaires Étrangères de la Colombie)

No: A2RKF1731418130
(Under Number - Sous le numéro:)

Firmado Digitalmente por: (Digitally Signed by:)
Ministerio de Relaciones Exteriores de Colombia
ALFONSO DE JESUS VELEZ RIVAS
Reason: DOCUMENT AUTHENTICITY
BOGOTA - COLOMBIA

Firma: (Signature:)

Nombre del Titular: MARIA ALEXANDRA MORA RAMIREZ
(Name of the holder of document:
Nom du titulaire:)
Tipo de documento: DIPLOMA DE GRADO PREGRADO LICENCIADA EN
(Type of document - Type du document:) FILOLOGIA E IDIOMAS INGLES

Número de hojas apostilladas: 1
(Number of sheets: - Nombre de feuilles:)

070040005849878

39 Expedido (mm/dd/aaaa): 06/12/2003

El Ministerio de Relaciones Exteriores, no asume la responsabilidad por el contenido del documento apostillado. Artículo 3 Ley 455/98

La autenticidad de esta apostilla puede ser verificada en el Registro Electrónico que se encuentra en la siguiente página web:
The authenticity of this Apostille may be verified by accessing the e-Register on the following web site:
L'authenticité de cette Apostille peut être vérifiée en accédant l'e-Registre sur le site web suivant:

www.cancilleria.gov.co/apostilla

Figure 35: Apostille

REPUBLICA DE COLOMBIA
MINISTERIO DE EDUCACION NACIONAL

LA UNIVERSIDAD NACIONAL DE COLOMBIA

CONFIERE EL TITULO DE

Licenciada en Filologia e Idiomas
Inglés

A

Maria Alexandra Mora Ramirez

C.C. No. 52.820.618   EXPEDIDA EN *Stafé Btá*

QUIEN CUMPLIO SATISFACTORIAMENTE LOS REQUISITOS ACADEMICOS EXIGIDOS.
EN TESTIMONIO DE ELLO OTORGA EL PRESENTE

D I P L O M A

EN LA CIUDAD DE   *Bogotá, D.C.,*   *Junio*   12   DEL 2003

DECANATURA DE LA FACULTAD   RECTORÍA DE LA UNIVERSIDAD   SECRETARÍA GENERAL

REGISTRADO AL FOLIO 39   DEL LIBRO DE DIPLOMAS No. 2
DE LA SEDE DE   *Bogotá, D.C.*   FACULTAD DE *C. Humanas*
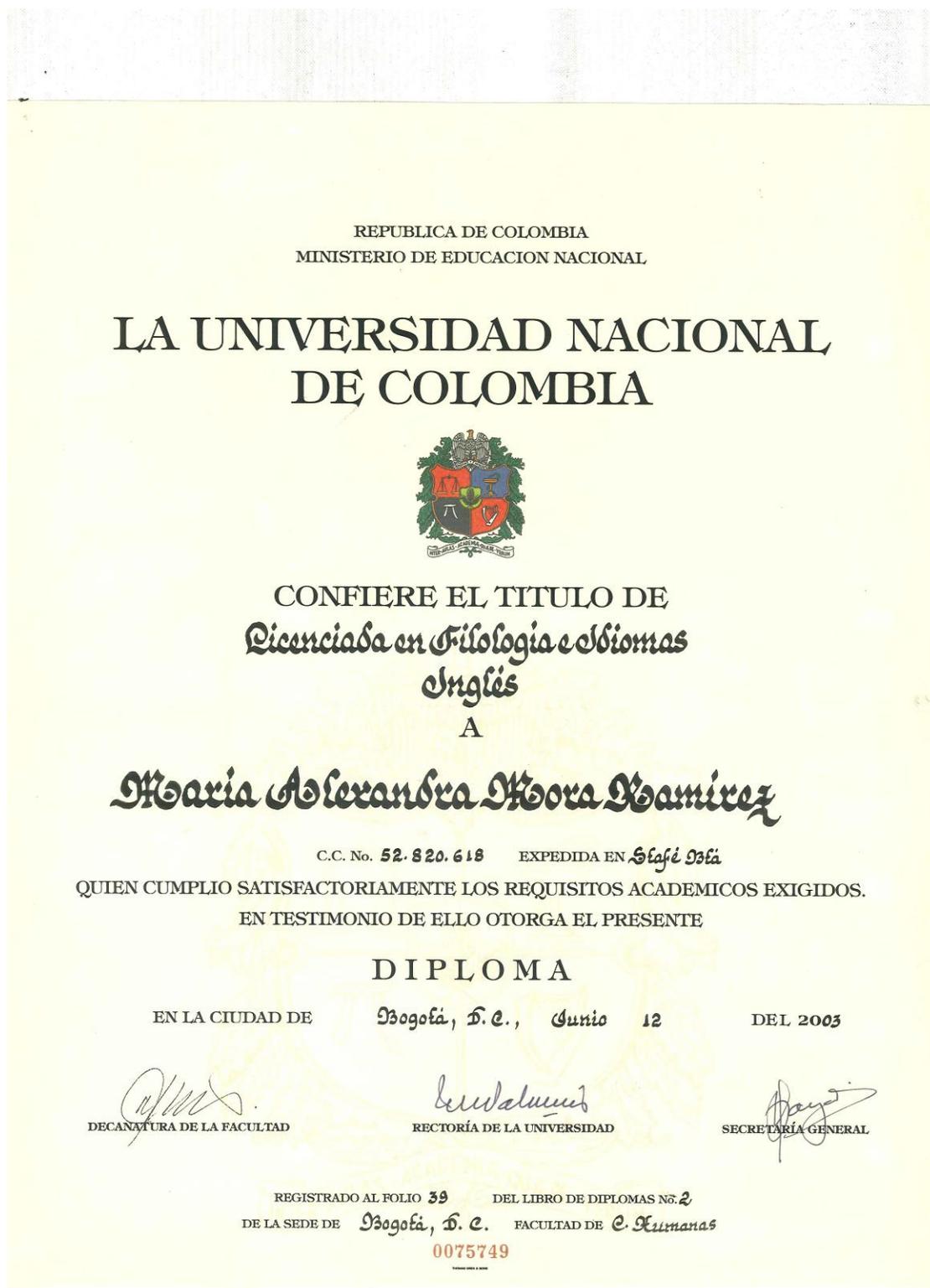
0075749

Figure 36: Undergraduate Degree in Philology and English - Maria Alexandra Mora Ramirez
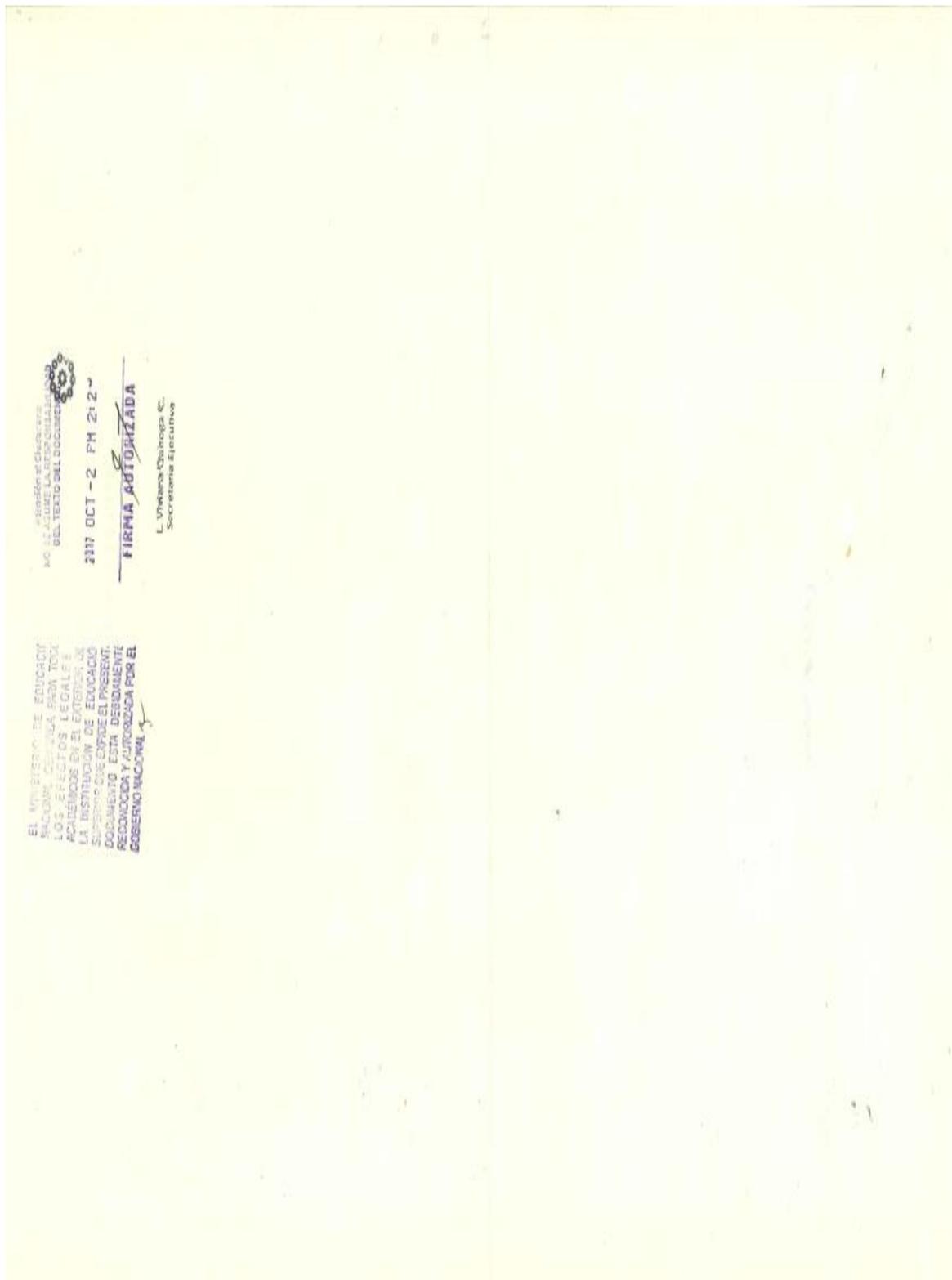
Figure 37: Certification of Undergraduate Degree - Maria Alexandra Mora Ramirez