WALKING BINS
PROJECT REPORT

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DATE OF SUBMISSION :

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LAB – 19

EXECUTIVE SUMMARY

Australia is one of the most developed countries in the world, with a population of just over 25 million which makes up for it's $1.4 Trillion Gross Domestic Product. Even with such vast resources and natural beauty, it is not unscathed from the plight of waste management. In the Australian state of Victoria, the rubbish pile is about to hit 20 million tonnes, if the Environmental Protection Agency (EPA) is to be believed. Although, there seems to be a massive scope for improvement in processing waste, if we are to effectively recycle and convert waste food into energy, an autonomous system that segregates waste is yet to be developed. Statistically, one out of every three people fail to segregate waste at a household level, giving rise to the problem of over-accumulation, segregation as well as transportation of waste.

At the moment, the Victorian Government has installed smart dustbins throughout the various cities and districts which are capable of measuring the level of trash with in-built infra-red transmitters and sensors. To further help the cause, an automated walking bin, which will see an integration of a state-of-the-art image classification algorithm to segregate waste as well as Tesla's auto-pilot software to form an automated waste segregating system, which will also dump the waste at the dumping site is proposed. It will be an all-in-one solution to our waste management problems, by managing the end-to-end lifecycle of waste, from it's creation to it's disposal.

This report includes all essential documentation that would help in the development of the Walking Bins Automated Waste Disposal System. Different phases of a project lifecycle like initiation, planning, execution, monitoring and project closure have been effectively combined with the Software Development Lifecycle (SDLC) to bring to life the different components of the Work Breakdown Structure (WBS) methodology. Stakeholders and their impact on the project, the influence of their support and non-support that can have on the project are also well documented. To calculate the costs that will be incurred during the execution and planning and the subsequent budget of the project, a costing mehodology has been used. The Risks connected to the implementation of the project have been addressed and also a risk management plan to reduce the risks has been developed.

TABLE OF CONTENTS

1.0 VERSION CONTROL

VERSION	COMMENTS	NAMES
0.1	First Draft	Shiivong, Rohan
0.2	Reviewed and Updated Second Draft	Sohail, Viraj
1.0	Supervisor Review / Release	Les
1.1	Feedback and Update	Project Team
2.0	Submitted on Moodle for Grading	Project Team

2.0 DEFINITIONS AND ACRONYMS

ACRONYM/TERM	DESCRIPTION/DEFINITION
Scope Creep	Continuous uncontrolled broadening of the scope of the project
WBS	Work Breakdown Structure
WIP	Work in Progress
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
SDLC	Software Development Lifecycle
KPI	Key Performance Indicator
AON	Activity-On-Node
AOA	Activity-On-Arrow
AS	Actual Start Date
AF	Actual Finish Date

CPM	Critical Path Method
COCOMO II	Constructive Cost Model II
SLOC	Source Lines of Code
TRIPLE CONSTRAINTS	Time, Scope and Cost
MOM	Minutes of Meeting
ROI	Return on Investment
POC	Proof of Concept
ADM	Arrow Diagram Method
PDM	Precedence Diagram Method
FPC	Function Point Calculator
AUD	Australian Dollars

3.0 INTRODUCTION

3.1 OVERVIEW

The report aims to develop an autonomous waste management system in the state of Victoria which sees an integration of a state-of-the-art Image Classification Machine Learning Algorithm with the auto-pilot sofware capabilities which is provided by a leading self-driven car vendor such as Tesla which would facilitate a way easier system for waste collection and disposal and also be environment-friendly at the same time. This project will eliminate the people's general habits of not wanting to segregate waste at a household level and also reduce the operational costs related to waste management. The current system has seen many failures over the years, contributing to a huge loss in terms of monetary value as well as environmental impacts to the government and the people of Victoria respectively. Hence, this project promises to replace the old, traditional system with a newer, improved one.

3.2 PURPOSE

There are two primary purposes of this report, one of them is to educate the reader about the problems faced by the government with the current waste management processes that are in effect in the state of Victoria. The other talks about the development of a revolutionary new waste management system which will make a huge impact in waste collection and disposal, in ways never seen before. Although, the system faced many technical and functional issues, we were able to tackle them using an Agile methodology approach.

4.0 BACKGROUND / CONTEXT

The Victorian Auditor-General's Office (VAGO) concluded in it's June 2019 report that Victorian agencies which are responsible for managing waste sector are not responding strategically to waste and it's recovery issues. As a result, a significant amount of waste, roughly 12.9 million tons eventually end up in landfills which pose health and fire risks to the community and the environment (Greaves, 2019). Not long ago in the state of Victoria, smart dustbins were introduced, which had the capability of measuring the level of trash in the can with the help of sensors and transmitters. But it still required human effort to dispose the waste at the dumping site. Implementing Walking Bins system would be beneficial for the environment for the number of reasons stated above and also that it spares people the time to think and worry about how to segregate waste. Also, outsourcing the development of the auto-pilot system will eventually save time and money and would give a better solution in technical perspective. Scope of the project is to develop a suitable solution which will eventually eliminate the problems faced by the current waste management system in the state of Victoria.

5.0 PROOF OF CONCEPT

So, what is a Proof of Concept (POC)?

A Proof of Concept (POC) is an exercise that focusses on determining whether an idea can be transformed into a reality. A POC is meant to determine the feasibility of the idea or to verify that the idea will function as intended. A POC is not designed to analyze the market demand nor is it planned to determine the best production process. Rather, the emphasis is on evaluating the feasibility of the idea to explore the viability of the idea created or produced.

Why is it necessary to build a POC?

Before you ask the employer for an investment and support for your new idea, you have to show that it's worth it. To order for the organization to devote resources to develop the new product or service, it must be clear that it has a potential for high Return on Investment (ROI). Some of the other advantages of developing a POC plan are :

- Scalability – You will have to show the feasibility of the idea when you create the POC and then proceed to find out how the idea will spread across the project.

- Identifying Bottlenecks – Building a POC helps identify bottlenecks faced by the concept both in implementation and scaling. Instead of finding these bottlenecks when trying to put in place a new product, POC helps to prepare, recognize and overcome challenges in the development phase. (Hemmer, 2017)

In our assignment, the focus is on a business case to establish various waste management systems to support a variety of waste management concerns. However, the implementation strategy for developing the proposed waste management system is not discussed. The proof of concept plan that we have come up with will explain how the planned product or service would meet project priorities, goals and other business requirements.

The POC can be found attached in the Appendix section A of this Project Report.

6.0 PROJECT CONTROLS

Following sections are list of Project Controls that are explained in detail.

6.1 STAKEHOLDER MANAGEMENT AND COMMUNICATION

6.1.1 DEFINITION AND IMPORTANCE

According to Project Management Institute (PMI, 1996), “the term Stakeholder is used to describe individuals, groups and organizations who are actively involved in the project or whose interests maybe positively or negatively affected as a result of project execution or successful project completion”. Identifying external stakeholders indirectly impacting the projects such as Department of Environment, Land, Water and Planning and Waste and Resource Recovery Groups, and internal stakeholders such as Victorian Government (project sponsor), steering committee, IT team, Installation team, Waste Collection Department and business process owners directly influencing the project is very relevant.

The Project Manager must oversee the internal and external stakeholders and ensure the project’s progress. Stakeholders have more power and authority to plan and track the project than the others involved. Stakeholder Analysis is an important process for determining approaches to maximize positive impacts and reduce negative impacts on the project.

According to the PMBOK Guide, the Stakeholder Analysis includes the following steps :

- Identifying and Classifying Key Stakeholders into External and Internal Stakeholder.
- Manage Problems and Disagreements that occur during the Discussions.
- Assessing each Stakeholders Influence and Power and how they affect the Project.
- Maintain a Stakeholder Communication Plan.
- Analysis of each Stakeholders needs and expectations.

Internal Stakeholders – Project Sponsor (Victorian Government), IT Team, Steering Committee, Business Process Owners, Council, Waste Collection Department, Installation Team

- The impact of internal stakeholders is greater on the project than that of external stakeholders as they have a direct impact on the planning and execution of the project.
- The Victorian Government will provide necessary resources for a successful completion of the project, which will help the people of Victoria in a greener tomorrow. Thus, the project sponsor plays an important role in ensuring the monetary approvals for key decisions.
- The Steering Committee will comprise of the Victorian Government, Tesla, Waste Collection Department and the IT Team. The Steering Committee’s power and effect is strong because they are very relevant for the progress of Walking Bins project.

External Stakeholders – Department of Environment, Land, Water and Planning, Producer and Waste and Resource Recovery Groups.

- External stakeholders have an indirect impact on the project and the influence relative with internal stakeholders is comparatively lower.
- Waste and Resource Recovery Groups help to keep track of the bins which are spread across different locations throughout the city.
- Department of Environment, Land, Water and Planning – They come into play when there is a huge waste spillage and the enforcement officers will help in investigating the incident and take appropriate and needful action. This ensures a healthy environment, that supports a live-able and prosperous Victoria, now and always. (Victoria, 2019)

6.1.2 STAKEHOLDER MAP

A Stakeholder Map gives an insight into identification of internal and external stakeholders in the project and their impact and influence on the project. The Figure 1 shown below classifies stakeholders as internal and external in-line with the scope of the project.

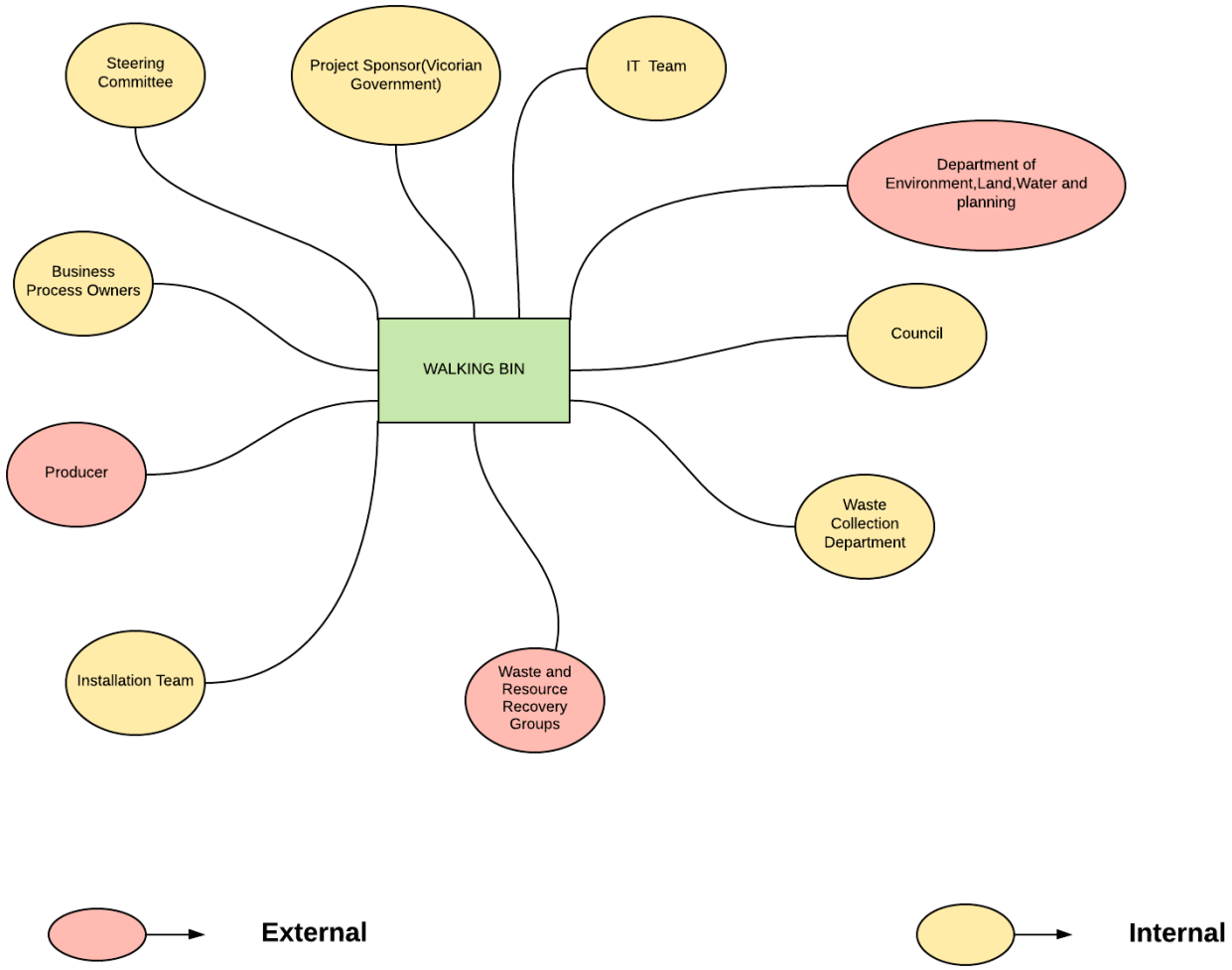


Figure 1 – Stakeholder Map for Walking Bins

6.1.3 STAKEHOLDER MATRIX

The Table 1 below is the Stakeholder Matrix for Walking Bins system, it identifies key stakeholders and documents their impacts and influence on the project.

NAME	CONTACT PERSON	IMPACT	INFLUENCE	WHAT IS IMPORTANT TO THE STAKEHOLDER?	HOW COULD STAKEHOLDER CONTRIBUTE TO THE PROJECT	HOW COULD STAKEHOLDER BLOCK THE PROJECT	STRATEGY FOR ENGAGING STAKEHOLDER
Victorian Government (Project Sponsor)	The Hon Richard Wynne 1311386	High	High	The proposed waste management system is efficiently implemented and successful waste disposal is achieved	Can help with sponsorship. Can aid in getting required permissions for efficient implementation.	By banning the implementation of the project and rejecting the required permissions	Timely updates about the progress of the development .
Steering Committee	John Bradley 0396378765	High	High	The waste management system should function as per the requirements defined in the scope of the project	The Steering Committee comprises the Victorian Government, the Waste Collection Department and the department of environment, land, water and planning	By not performing their duties and putting the project at stake.	Conducting regular meetings to discuss overall status of project, milestones achieved and monitor the progress against the project plan.
Producer	Anna Suryawanthi 0424541542	Medium	Low	The waste is collected on time and disposed off safely.	Dumping the waste in our smart bins	By not approving the use of our new system	Training a set of households with prototype of the system

Waste collection Department	Jill Mathew	High	Low	The waste is dropped off to the dumping sites smoothly	Proper timely collection of waste from dumping sites.	Rejecting the system.	Giving appropriate training necessary for the system
IT Team	Nicollo William 0424999221	High	High	The instruction are given correctly to the collectors and producers about the system.	Develop an ideal smart bin development plan taking into consideration different factors like budget, time constraints and requirements.	Not meeting the requirements and developing unsatisfactory product.	Making the team develop a proper plan plus ensure it is being followed
Installation team	Steve Rogers 0424777111	Low	High	Appropriate guidance to install the system at different sites.	Proper installation of trucks and bins	Faulty installation	Give them a brief introduction and training regarding installation
Business Process Owners	James Fernandes	High	High	The particular stream of the AMS functionality that is handled by the business process owner	They determine and implement the Key Performance Indicators(KPIs) and also negotiate with other process owners regarding inter-process conflicts.	They are critical to the project and hence a refusal to perform their duties to leave the project at stake.	Conduct meetings to provide regular status updates and discuss improvements needed to the system.
Council	Linola Martis 0424559410	High	Medium	Getting accurate data of different dumping sites and bin installation spots.	Timely monitoring of the system	Stop the funding of the project.	Timely meetings

Environment protection authority	Ramsen Snow 0424887110	Low	High	Rules are followed.	Enforce the law.	Make more stringent laws.	At every step ensuring the laws are followed by communicating with the authority
Waste and Resource Recovery Groups	Parth Oberoi 0426514244	High	Medium	Getting accurate data to function	Optimise recycling of waste.	Not making timely collection of waste.	Asking them the necessary steps to ensure waste is recycled efficiently
Department of Environment, land, water and planning	Vivienne Clare 136186	Low	Medium	Abiding by the law	Enforce the law	Make laws more difficult to be followed by the system	At every step ensuring the laws are followed by communicating with the authority

Table 1 – Stakeholder Matrix for Walking Bins

6.1.4 IMPORTANCE – INFLUENCE MATRIX

Based on the stakeholder map and stakeholder matrix, we plot a graph of influence and importance of key stakeholders (both internal and external) for management and monitoring of the Walking Bins system. Figure 2 shown below gives the importance influence matrix in stakeholder analysis of Walking Bins system.

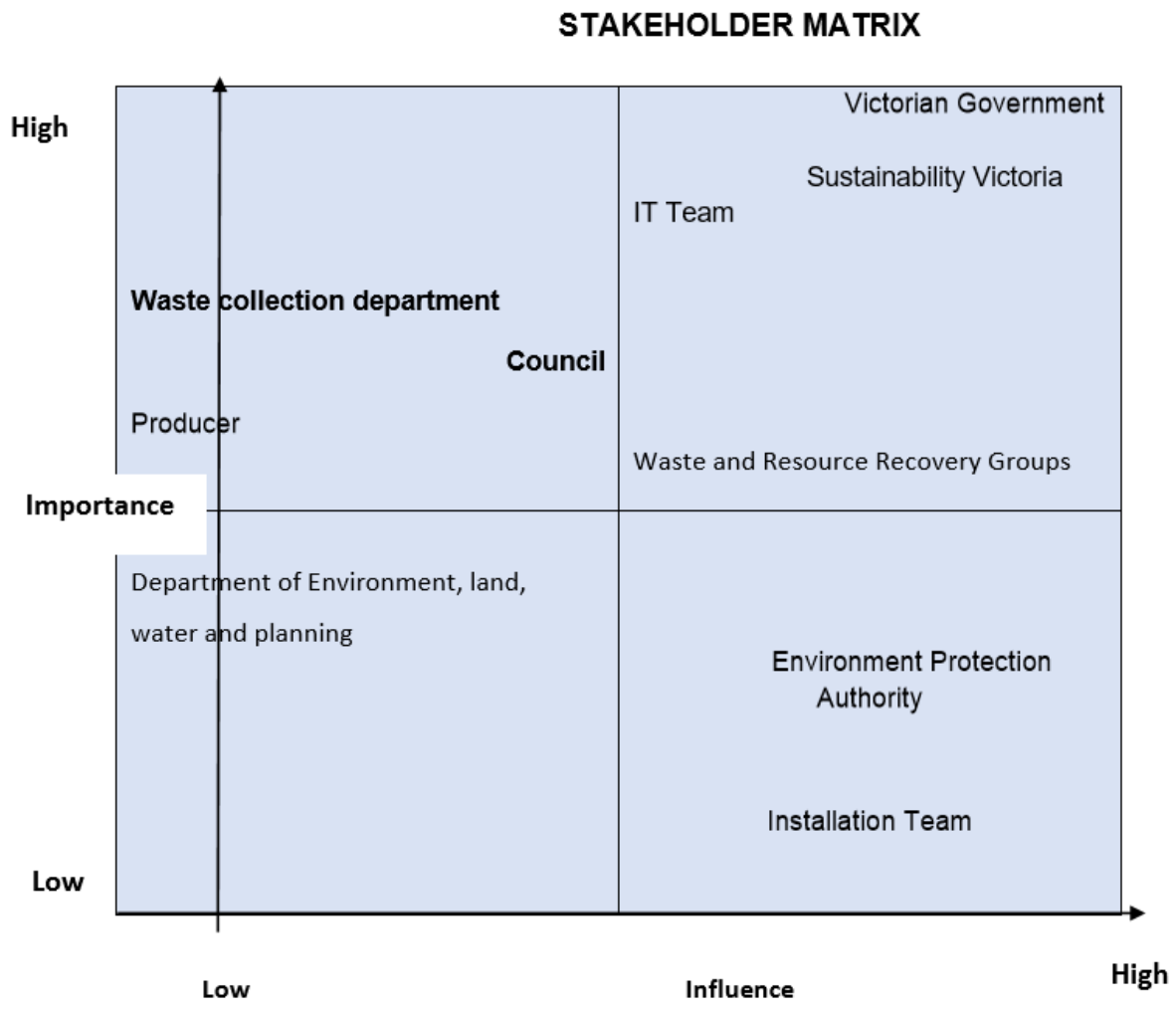


Figure 2 – Importance - Influence Matrix for Walking Bins

6.1.5 COMMUNICATION PLAN

So, what is a Communication Plan?

A Project Communication Plan is a basic tool that allows us to connect with the project partners, project team, manager etc. It provides clear guidelines for how data is to be communicated as well as who is accountable for each task interaction or needs to be looped in.

Why is it so important in a project?

It plays an essential role in the project by doing the following:

- Improving Group Sessions Efficiency.

- Anyone can look up the written document for reference.
- Ensuring that the plan tends to comply with the goals.
- Set clear guidelines about how and when to post information.
- Improved project awareness and ranking. (Gantt, 2018)

The table below gives the stakeholder communication plan for Walking Bins system.

What	Who	When	How	Whom (Audience)
Key Decisions	Project Sponsor/ Steering Committee	As required	By email using a standard template	Project Manager/PMO Team
Progress Report/ Status Report	Project Manager	Weekly	By email using a standard template	Project Sponsor/ Steering Committee
User – Acceptance Testing Documents	Producers of waste	Testing Phase	By email attaching a testing template	Technical Team Lead
Process Documents, KPI and Meeting Schedule	Business Process Owner	Weekly	By email/telephone	Project Team
Waste management system updates	Victorian Government/ Sustainability Victoria	Weekly	By email	Project Team
Updated General Ledger	Victorian Government	Daily	By email	All Stakeholders
Regular Reports	Council	Daily	By email	Project Supervisor
Software Upgrade and maintenance plan	IT Team	Quarterly	By email	Project Manager
Cost Reports	PMO Team	Monthly	Be email	Project Sponsor/ Steering Committee

Table 2 – Stakeholder Communication Plan for Waling Bins

6.1.6 TEAM COMMUNICATION PLAN

The following table gives us the Team Communication Plan which talks about the timeframe of the proceedings of the project. For e.g. Weekly meetings, Key problems identification, Process Improvement ideas.

What	Who	When	How	Whom (Audience)
Meeting Schedule	Project Manager – Sohail Sankanur	Weekly	By messaging	Team Members
Agenda of meeting and weekly deliverables	Team members	Weekly	By messaging	Team Members
Minutes of Meeting	Team member – Rohan Chutke	Weekly	By messaging	Project team
Obstacles encountered	Team member – Viraj Mahadik, Shiivong Birla	When encountered	By email/ messaging	Project team
Project Deliverables	Project Team	Weekly	Trello	Project Supervisor – Les Nicopoulos
Feedback Corrections	Project Team	Weekly	Team meeting	Team members

Table 3 – Team Communication Plan for Walking Bins

6.1.7 SUMMARY

For the project to be successful, identification of key stakeholders is a must. They tend to have high political influence and strong enough, individually to bring the work to a halt or to move mountains to make the project a success.

6.2 SCOPE MANAGEMENT PLANNING

6.2.1 DEFINITION

Scope issues in the project are the number one reason for project failures. To manage scope, we devise a scope management plan. It is the element of project management plan explaining how to identify, create, track, regulate and check the range of the scope.

The core of the scope management plan is project scope statement. Nonetheless, the other elements accompanying the scope declaration provide the framework that is essential to handling and monitoring scope of the project effectively. A good scope management plan will have the following sections :

- Scope Requirements (both Functional and Non-Functional)
- WBS Baseline
- Control Scope
- System Functionalities (Bernie Roseke, 2016)

First of all ,the Scope Management Plan is established as it is difficult to estimate both schedule and budget as these two factors rely on scope. Management of scope should include the procedures of coping with adjustments during the project, thus ensuring that the plan arrives within the projected time and budget.

6.2.2 SCOPE REQUIREMENTS

A proper process for scope identification would provide for the identification of requirements. This is where we consult with stakeholders if needed and recognize and evaluate, all the specific requirements that the project should follow.

a. Requirement Elicitation Technique

There are numerous ways in which requirements can be gathered viz. surveys, interviews, questionnaires, conferences. The table below gives the participants, techniques that were undertaken for requirement gathering and the reasons for selecting the particular techniques.

PARTICIPANTS	REQUIREMENTS GATHERING TECHNIQUE	REASONS FOR SELECTING TECHNIQUE
Victorian Public	Questionnaires/Surveys	As people in Victoria are from all over the world, the best approach would be collective information via questionnaires and surveys. It would also help gather a consensus regarding any waste related issue in Victoria.
Steering Committee	Interview/Brainstorming	The Steering committee has all the top-level executives as its members. They would therefore have an in- depth knowledge of all the processes and conducting interviews or having brainstorming sessions will help gather crucial information that will help in the system development.
Department of Environment, Land, Water and Planning	Interview	The Walking Bins will be providing data to other vendor like Tesla, hence interviewing executives from Department will help us with policies and rules to be followed while developing the system and also get help in terms of budget from known their sponsors.

Table 4 – Requirement Elicitation Technique for Walking Bins

b. Walking Bins System Requirements

After gathering requirements through various participants using different requirement gathering techniques, following functional / non-functional requirements are recognized :

Functional Requirements :

- The system will accept any sort of waste from the producer, store it in a local storage until the bigger segregator vehicle / machine arrives.
- The system will be able to measure the level of trash autonomously. If the trash is up-to the brim, no more trash can be accepted from the producer.
- The waste that is now collected by the segregator truck, will have to go through the image classification algorithm and other sensors which will segregate the waste into different categories e.g. metal, organic, dry, wet etc.
- Once the segregator is also brimming with trash, the vehicle will initiate dumping sequence whereby it will begin it's journey to the waste disposal site by the auto-pilot software.

Non-Functional :

- Walking Bins system should be able to store and handle huge volumes of data, for e.g. the details of all the producers in the suburb, their past waste management records, location of all the local waste disposal sites etc.
- For the hardware intensive Image Classification task, there should be enough RAM available for the machine to make quick and accurate predictions.
- Support for migrating data from one computer storage system to another in case of hardware failure.
- Backup mechanism should be in place in case there is an operational failure, which would render the machine useless.

6.2.3 WBS BASELINE

A framework of Work Breakdown structure (WBS) is a key deliverable task that organizes the work of the team into manageable part. The Project Management Body of Knowledge (PMBOK) defines the structure of WBS as a deliverable hierarchical breakdown of the work to be carried out by the project team. The layout of the WBS clearly divides the context into manageable chunks that the project team may grasp because each tier of the framework of WBS offers more clarity and description. In addition, the WBS will serve as a guide in the scheduling and costing of the project.

The Figure 3 below depicts WBS with all the levels defined for Walking Bins.

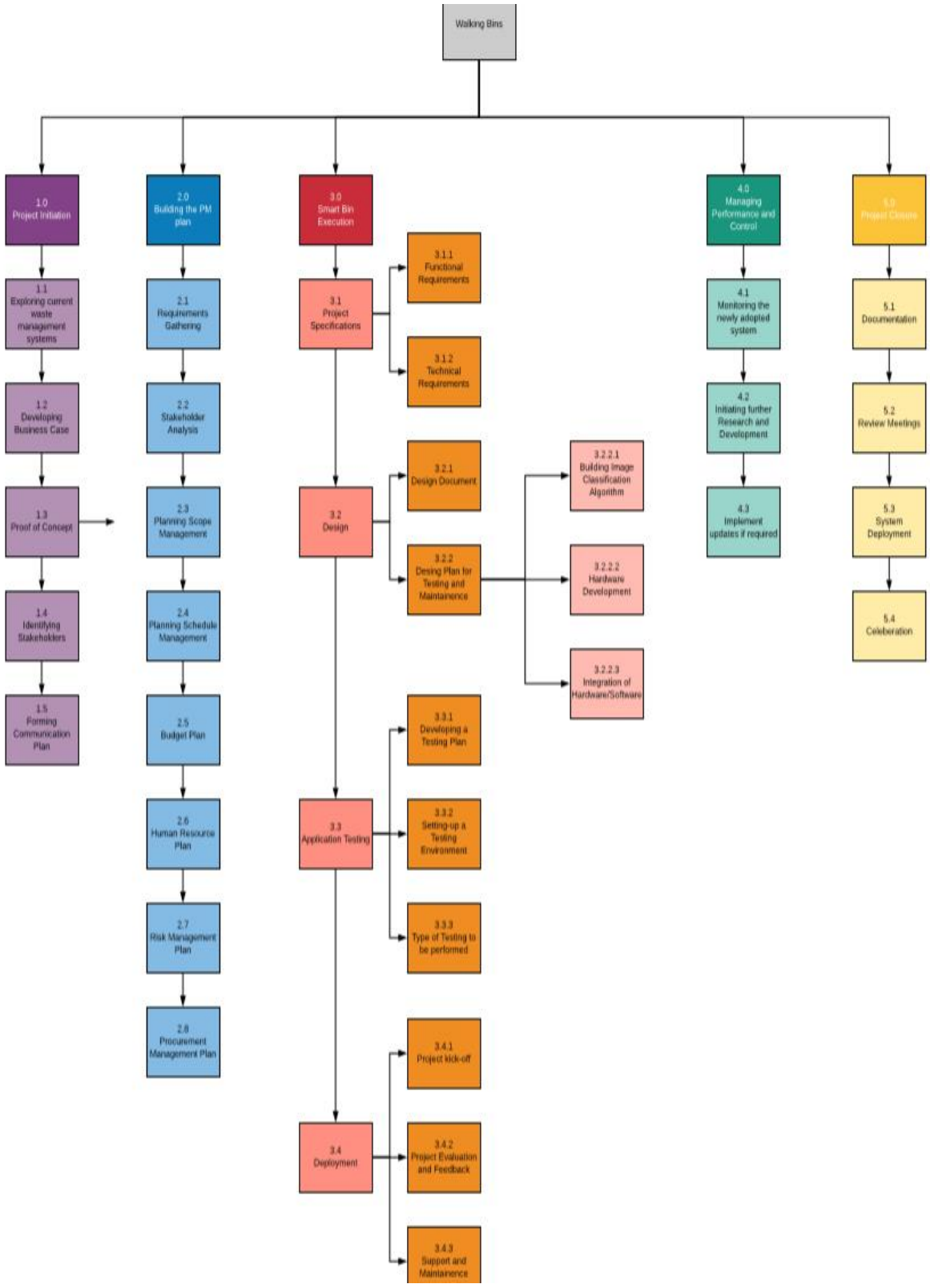


Figure 3 – Work Breakdown Structure for Walking Bins

6.2.4 CONTROL SCOPE

Control Scope is the last step of Scope Management knowledge area. It is a process of controlling a state of scope and quality of service as well as handling changes made to the standard of scope. After the scope is finalized in the plan, it needs to be monitored throughout the project to see if constructive actions can result in project deliverables being completed successfully.

To control scope :

- Scope definition must be clear.
- Work must be completed.
- Measure performance against scope baseline.
- Impact of changes should be evaluated.

The Figure below illustrates the change of control processes.

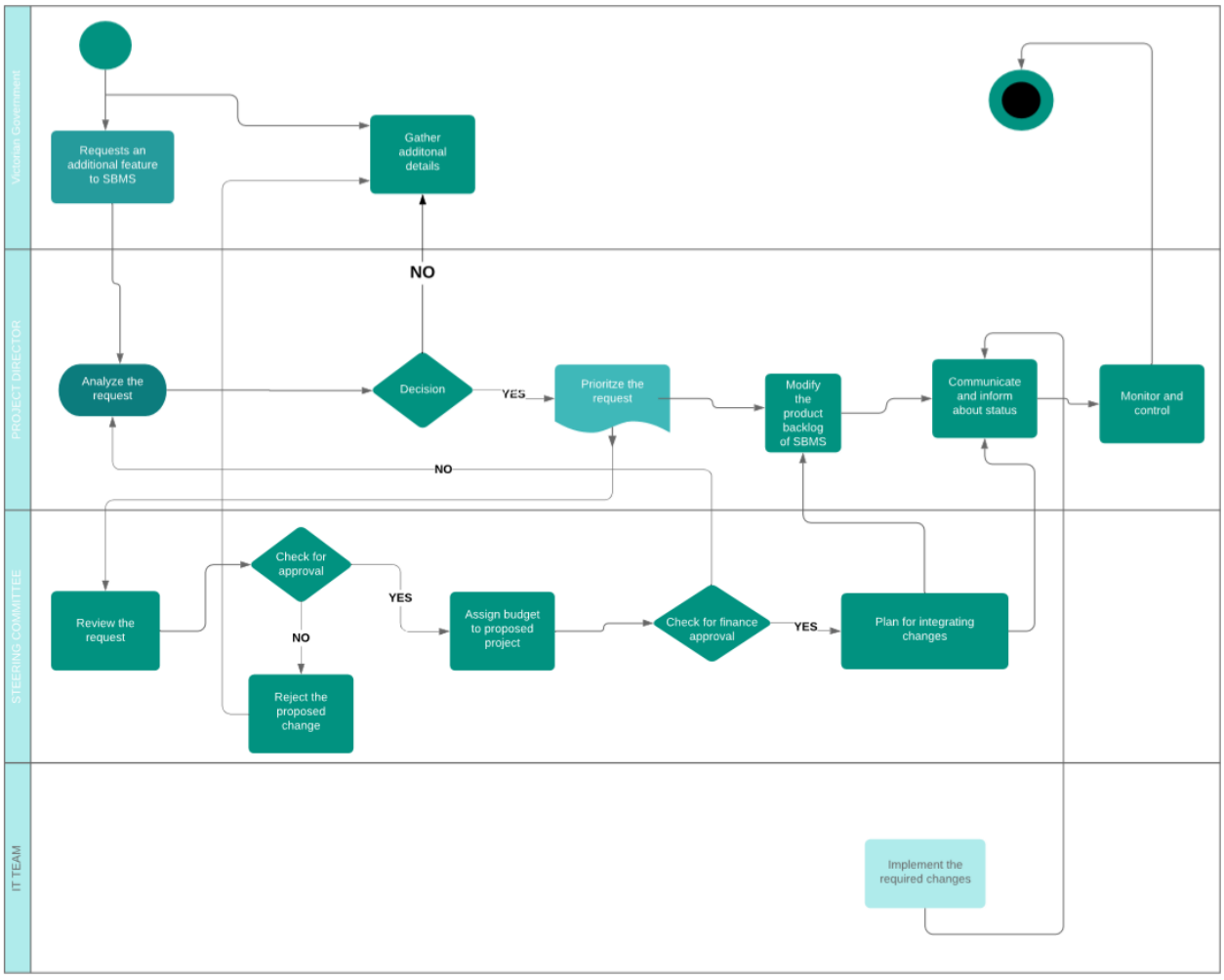


Figure 4 – Change Control Process for Walking Bins

The table below is the Scope Control table for Walking Bins which tells us about the participants and their descriptions.

Participants	Description
Victorian Government	• All the necessary details regarding the project are collected and the changes required are requested.
Project Director	• The change request made are prioritized and updated in the product backlog by the project director. • Communication of the requested update and necessary changes. • Monitors and controls the activities and processes • Ensures the project is implemented in the defined scope and unnecessary changes are not implemented.
Steering Committee	• The steering committee reviews the necessary changes suggested and approves the budget for implementation. • It also reviews and suggests the plan for incorporating the necessary changes
IT Team	• It implements the approved changes and communicates the status of implementation to the project director about the updated system.

Table 5 – Scope Control Table for Walking Bins

6.2.5 SUMMARY

Scope Management Plan is needed as it is one of the Triple Constraints and can have detrimental impact on the expense and timeline of the project if not properly managed. In addition to identifying and reporting the scope, procedures must also be in effect to manage and monitor any unnecessary changes to the scope.

6.3 SCHEDULE BASELINE

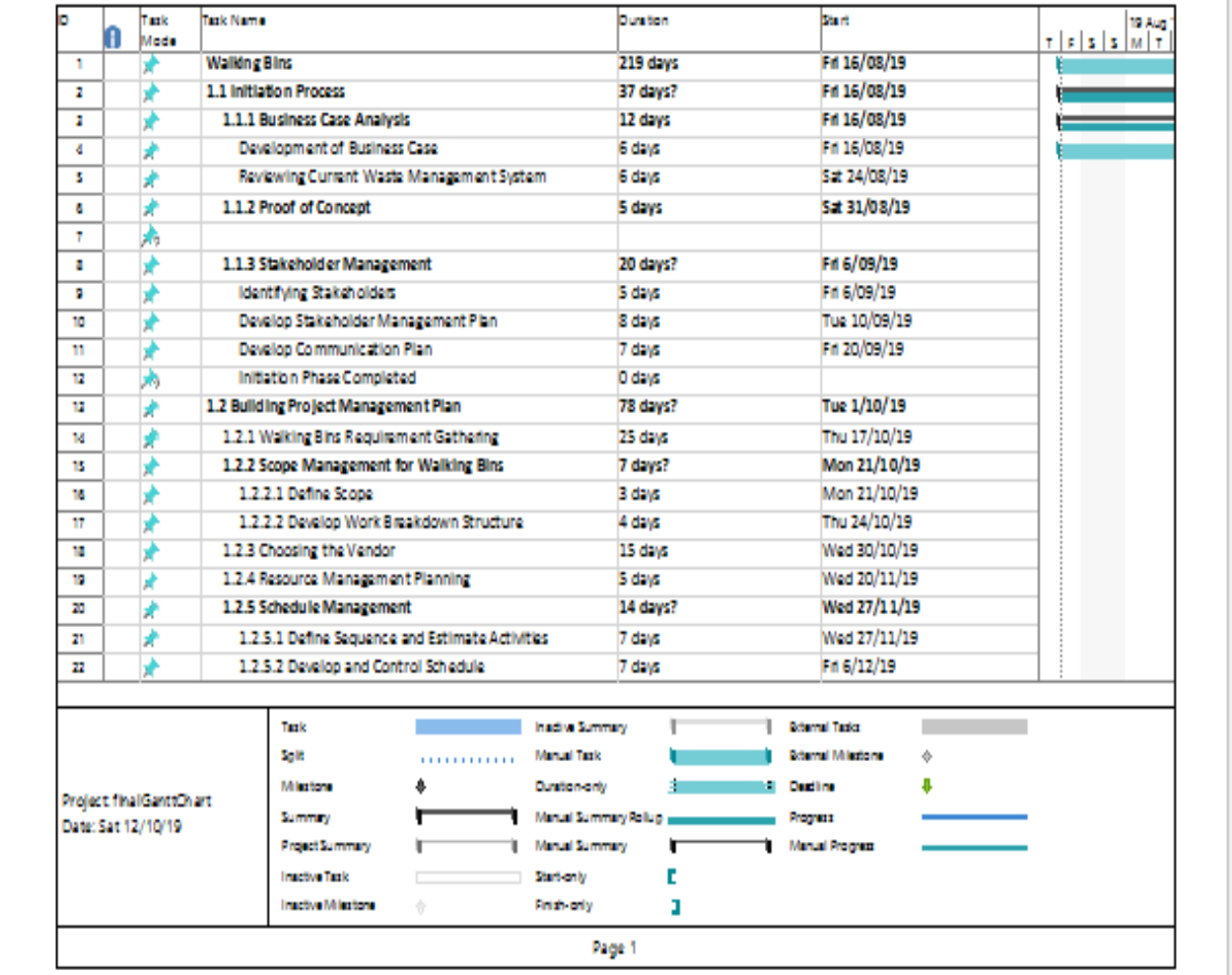
6.3.1 PURPOSE OF SCHEDULE MANAGEMENT

According to PMI, due to poor project performance, 9.9% of every dollar invested in a project is wasted. If projects run over budget, we need to take a deeper look at how we are planning our tasks and managing resources. A well-designed plan or schedule is key to having a successful project. The work schedule should be focused on WBS, detailing all the projects activities and goals. The schedule puts all activities in a series of date-related events or in some instances the starting and finishing times for each. The schedule provides a framework for the whole project to direct the work being done and to measure the progress of the project against a fixed schedule. (Weedmark, 2019)

6.3.2 SCHEDULE BASELINE

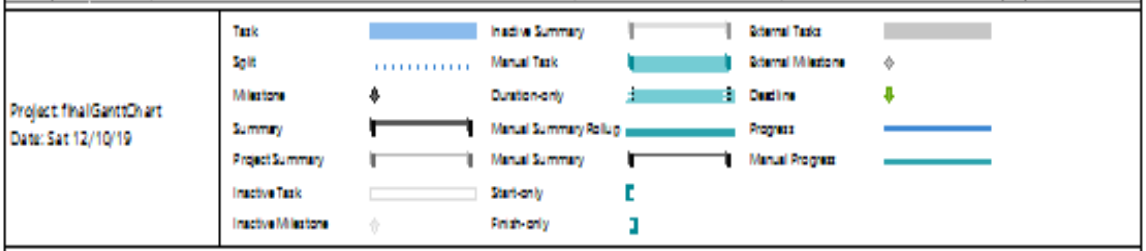
Schedule baseline entails defining necessary resources and predicting the time taken for each task, which would in -turn enhance decision making processes, increase productivity, efficient planning of projects, decrease workplace pressure by managing unnecessary workload and allow project managers to track the project progress effectively.

The Figure 5 generated below, gives the detailed scheduling of tasks carried out through the entirety of the project.

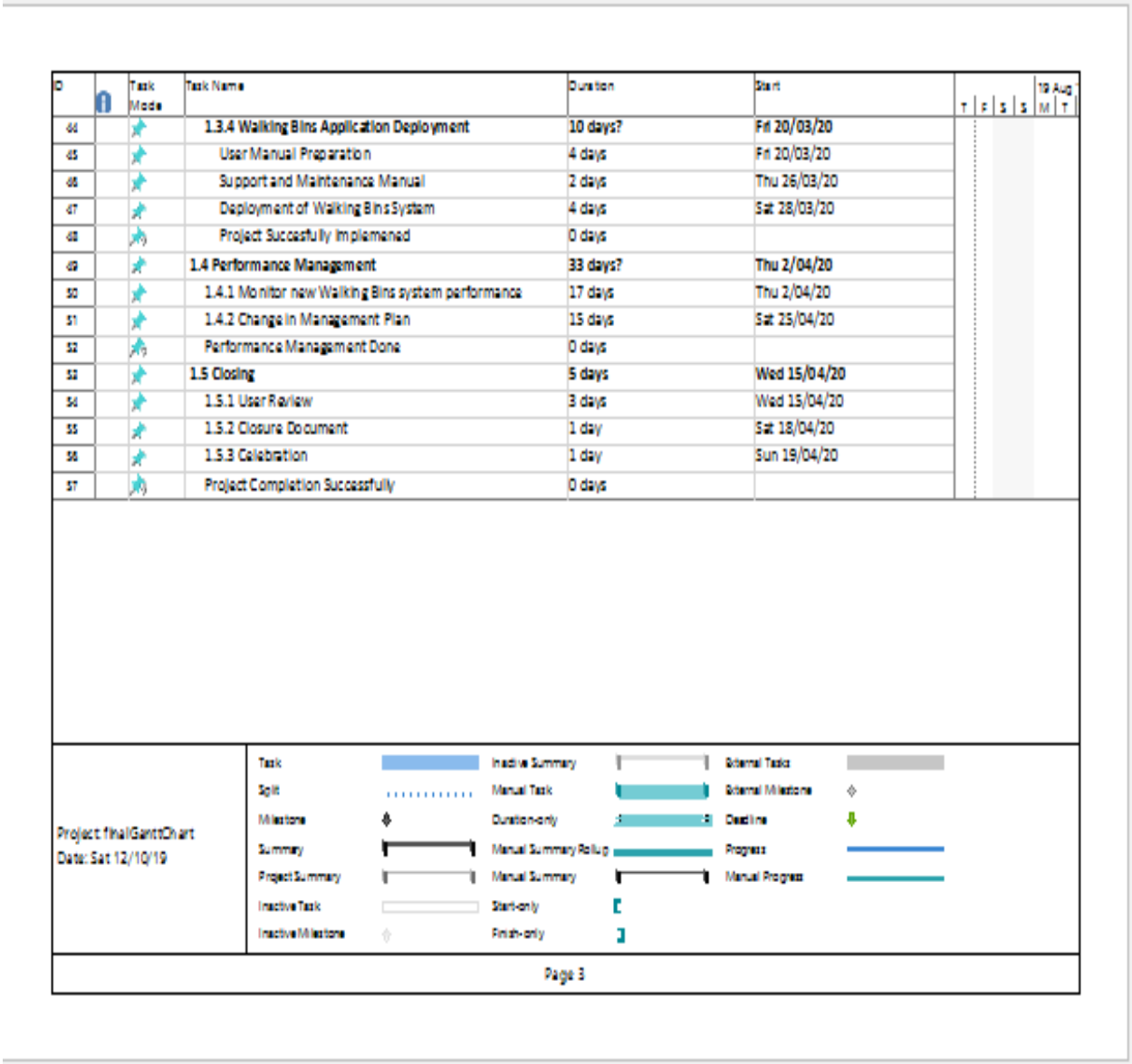


ID	Task Mode	Task Name	Duration	Start
1		Walking Bins	219 days	Fri 16/08/19
2		1.1 Initiation Process	37 days?	Fri 16/08/19
3		1.1.1 Business Case Analysis	12 days	Fri 16/08/19
4		Development of Business Case	6 days	Fri 16/08/19
5		Reviewing Current Waste Management System	6 days	Sat 24/08/19
6		1.1.2 Proof of Concept	5 days	Sat 31/08/19
7				
8		1.1.3 Stakeholder Management	20 days?	Fri 6/09/19
9		Identifying Stakeholders	5 days	Fri 6/09/19
10		Develop Stakeholder Management Plan	8 days	Tue 10/09/19
11		Develop Communication Plan	7 days	Fri 20/09/19
12		Initiation Phase Completed	0 days	
13		1.2 Building Project Management Plan	78 days?	Tue 1/10/19
14		1.2.1 Walking Bins Requirement Gathering	25 days	Thu 17/10/19
15		1.2.2 Scope Management for Walking Bins	7 days?	Mon 21/10/19
16		1.2.2.1 Define Scope	3 days	Mon 21/10/19
17		1.2.2.2 Develop Work Breakdown Structure	4 days	Thu 24/10/19
18		1.2.3 Choosing the Vendor	15 days	Wed 30/10/19
19		1.2.4 Resource Management Planning	5 days	Wed 20/11/19
20		1.2.5 Schedule Management	14 days?	Wed 27/11/19
21		1.2.5.1 Define Sequence and Estimate Activities	7 days	Wed 27/11/19
22		1.2.5.2 Develop and Control Schedule	7 days	Fri 6/12/19

ID	Task Mode	Task Name	Duration	Start
23		1.2.6 Walking Bins Cost Management	12 days?	Tue 17/12/19
24		1.2.6.1 Estimate Cost and determine budget	6 days	Tue 17/12/19
25		1.2.6.2 Control Costs	6 days	Wed 25/12/19
26		1.2.7 Risk Management	1 day	Thu 2/01/20
27		Project Planning Done	0 days	
28		1.3 Walking Bins Implementation	66 days?	Fri 3/01/20
29		1.3.1 Walking Bins Design	16 days?	Fri 3/01/20
30		1.3.1.1 Developing a system design document for Walking Bins	12 days	Fri 3/01/20
31		1.3.1.2 Designing plan for Testing and Maintanance	4 days	Tue 21/01/20
32		1.3.2 Walking Bins System Development	20 days?	Sat 25/01/20
33		1.3.2.1 Vendor Activity	15 days?	Sat 25/01/20
34		Setting up Development Environment	2 days	Sat 25/01/20
35		Setup Image Classification functionality	5 days	Tue 28/01/20
36		Develop Waste Segregation System	3 days	Tue 4/02/20
37		Integrating system with vendor	5 days	Fri 7/02/20
38		1.3.2.2 Source Systems Data Migration	5 days	Fri 14/02/20
39		1.3.2 Walking Bins Systems Testing	15 days?	Fri 21/02/20
40		Test Plan Development	5 days	Fri 21/02/20
41		Test Environment Setup	2 days	Fri 28/02/20
42		User Acceptance Testing/Integration Testing/Unit Testin	8 days	Tue 3/03/20
43		1.3.3 Software Training	5 days	Fri 13/03/20



Page 2



ID	Task Mode	Task Name	Duration	Start
44		**1.3.4 Walking Bins Application Deployment**	**10 days?**	**Fri 20/03/20**
45		User Manual Preparation	4 days	Fri 20/03/20
46		Support and Maintenance Manual	2 days	Thu 26/03/20
47		Deployment of Walking Bins System	4 days	Sat 28/03/20
48		Project Successfully Implemented	0 days	
49		**1.4 Performance Management**	**33 days?**	**Thu 2/04/20**
50		1.4.1 Monitor new Walking Bins system performance	17 days	Thu 2/04/20
51		1.4.2 Change in Management Plan	15 days	Sat 25/04/20
52		Performance Management Done	0 days	
53		**1.5 Closing**	**5 days**	**Wed 15/04/20**
54		1.5.1 User Review	3 days	Wed 15/04/20
55		1.5.2 Closure Document	1 day	Sat 18/04/20
56		1.5.3 Celebration	1 day	Sun 19/04/20
57		Project Completion Successfully	0 days	

T F S S M T — 19 Aug

Project: finalGanttChart
Date: Sat 12/10/19

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

Page 3

Figure – 5 Gantt Chart for Walking Bins

6.3.3 SUMMARY

Monitoring the schedule often plays a pivotal role in the Schedule Management, which includes planning and monitoring the necessary changes to the plan. Effectively implementing a plan for the project and observing the same would help in the project being successfully implemented.

6.4 NETWORK DIAGRAM

6.4.1 DEFINITION AND IMPORTANCE

So, what is a Network diagram in Project Management?

A Network Diagram is a visual representation of all of a projects activities, roles and workflow. With a set of boxes and arrows, it often appeals to one like a map. It is used to diagram the task timeline and the workflow from one task to another, and to chart it's progress through each point, up-to and including completion.

Not only does a Network Diagram help a project manager to monitor components of a project and communicate it's status with others easily but shows the visual representation of information can increase comprehension and loyalty. A Network Diagram can also boost performance and efficiency while reducing stress between the team members of the project.

There are two types of Network Diagrams in project management, namely :

- Arrow Diagram Method (ADM) also known as Arrow Network or Activity on Arrow (AOA)
- Precedence Diagram Method (PDM) also known as Node Network or Activity on Node (AON)

6.4.2 DEVELOPED NETWORK DIAGRAM

The Figure 6 below, shows a complete Network Diagram which represents logical relationships between activities and their sequences in our project.

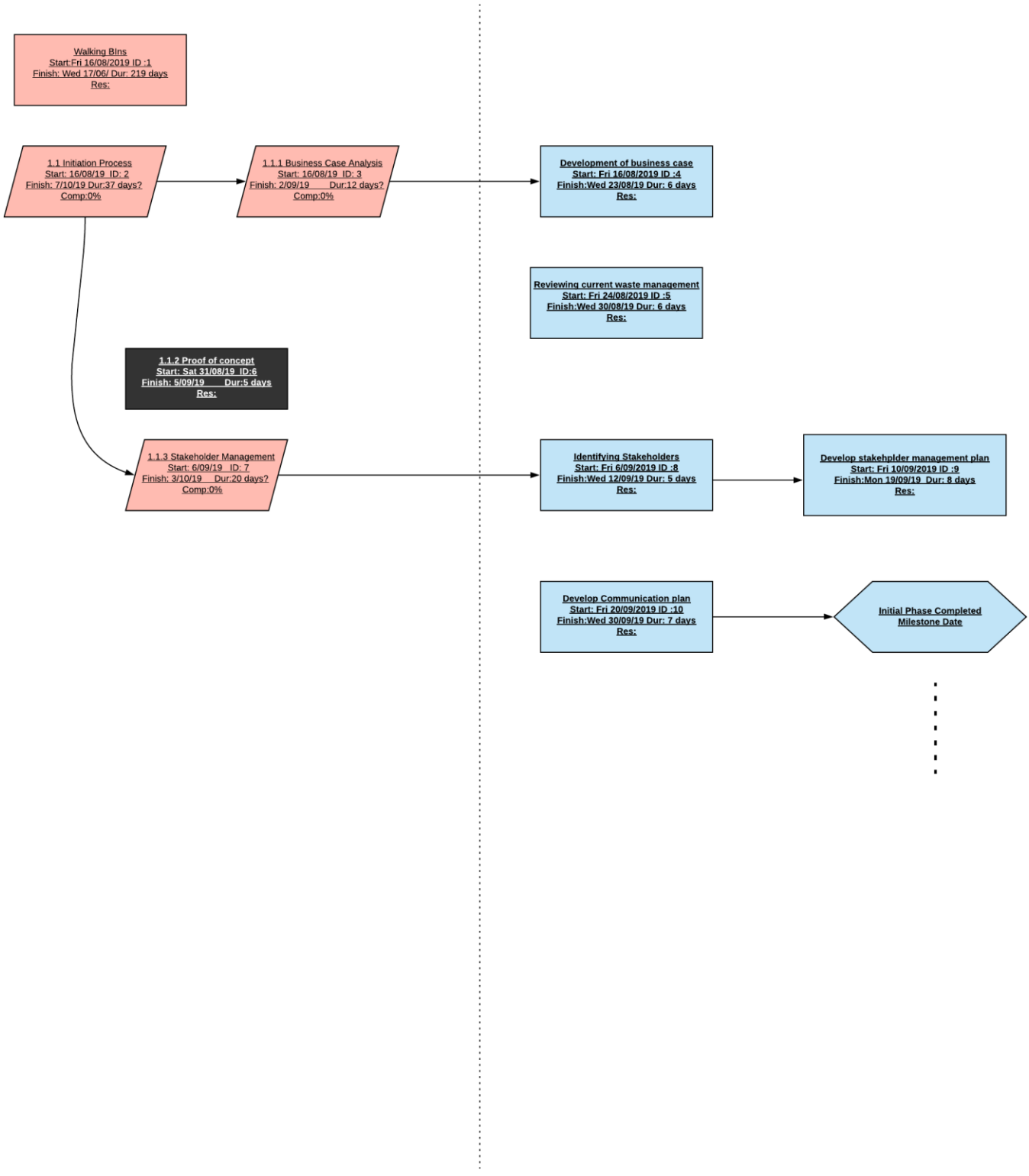


Figure – 6 Network Diagram for Walking Bins

6.4.3 IDENTIFICATION OF CRITICAL PATH

A Critical Path, according to PMBOK, identifies the longest path in the Network Diagram depending on activity start and end time. Tasks are classified as essential tasks as vital routes.

The important activities included in the Walking Bins project are shown in the following diagram.

Name	Start	Finish	% Complete	Remaining Work	Resource Names
Walking Bins	Fri 16/08/2019	Wed 17/06/2019	0	219 days	Viraj, Rohan, Shiivong, Sohail
Initiation Process	Fri 16/08/2019	Mon 7/10/19	0	37 days	Viraj, Rohan, Shiivong, Sohail
Business Care Analysis	Fri 16/08/2019	Mon 2/09/19	0	12 days	Shiiwong, Sohail
Stakeholder Management	Fri 6/09/19	Thu 3/10/19	0	20 days	Viraj, Rohan
Building Project Management Plan	Fri 4/10/19	Tue 21/01/20	0	78 days	Viraj, Rohan, Shiivong, Sohail
Scope Management for Walking Bins	Fri 8/11/19	Mon 18/11/19	0	7 days	Rohan, Shiivong
Schedule Management	Tue 17/12/19	Fri 3/01/20	0	14 days	Viraj,Sohail
Walking Bins Cost Management	Sat 4/01/20	Mon 20/01/20	0	12 days	Viraj, Shiivong
Walking Bins Implementation	Sun 19/01/20	Fri 17/04/20	0	66 days	Viraj, Rohan, Shiivong, Sohail
Walking Bins Design	Sun 19/01/20	Fri 7/02/20	0	16 days	Rohan, Shiiwong
Walking Bins System Development	Sat 8/02/20	Thu 5/03/20	0	20 days	Viraj, Rohan, Shiivong, Sohail
Vendor Activity	Sat 8/02/2019	Thu 27/02/20	0	15 days	Viraj,Sohail
Walking Bins Systems Testing	Fri 6/03/20	Thu 26/03/20	0	15 days	Viraj, Rohan, Shiivong, Sohail
Walking Bins Application Development	Fri 27/03/20	Thu 9/04/20	0	10 days	Shiiwong, Sohail
Performance Management	Thu 9/04/20	Mon 25/05/20	0	33 days	Viraj, Rohan
Closing	Fri 22/05/20	Thu 28/05/20	0	5 days	Viraj, Rohan, Shiivong, Sohail

Figure – 7 Critical Tasks for Walking Bins

6.4.4 SUMMARY

Network Diagram is used to evaluate key constraints in project management viz time. Identifying important project tasks and connecting different activities is helpful. Network Diagram is therefore an essential tool for IT projects and quality management.

6.5 COST MANAGEMENT

6.5.1 DEFINITION AND IMPORTANCE

Cost Management is a mechanism in which expenses are calculated, distributed and managed in a project, allowing project managers to predict future costs and reduce it's chances of going beyond budget. Projected Costs are calculated during the project planning phase and must be approved before the start of the project.

During the implementation of the project plan, costs are reported and monitored so that the things remain within the cost management plan. After completion of the project estimated costs vs actual costs will be compared, offering benchmarks for future cost control plans and project budgets. (Wrike, 2019)

We have made a few assumptions while determining our costs for Walking Bins project :

- The salary of every employee involved in the project are industry based.
- Number of working days per week are assumed to be 5.
- The cost-estimation method used for Walking Bins is Function Point Calculator (FPC).
- All cost figures are in Australian Dollars (AUD).

6.5.2 COST BASELINE

Cost Baseline involves various costs incurred during the lifecycle of the project, for e.g. while design, development, testing and deployment etc. The expenditure related to software majorly belong to the licensing costs and standard 10% of initial budget for reserves.

The Figure 8 below, gives cost estimates for Walking Bins system.

WBS Component	Cost per Unit / Hour (AU$)	#Units / #Hours / # installments	Total (AU$)	WBS Component Total	Percentage of Total Budget
1. Project Management				**$ 184,320.00**	**28%**
1.1 Project Manager	80	128 hours x 6 = 768	61,440		
1.2 Team Members (x3)	40	128 hours x 6 = 768 3072	122,880		
2. Design				**$ 156,250.00**	**23.87%**
2.1 Hardware Analysis				**$ 140,000.00**	
2.1.1 Computer Peripherals	1,000	35	35,000		
2.1.2 Automobiles	50,000	1	50,000		
2.1.3 Servers	20,000	2	40,000		
2.1.4 Raw Materials	5,000	1	5,000		
2.2 Software Analysis				**$ 16,250.00**	
2.2.1 Licensed Software	150	35	5,250		
2.2.2 Software Customisation	100	20	2,000		
2.2.3 Software Development	300	30	9,000		
3. Design & Development				**$ 35,840.00**	**5.48%**
3.1 Project Architects Salaries	35	128 Hours x 4 = 512	35,840		
Total expenditure for 2 Architects		1024			
4. Application Testing				**$ 23,740.00**	**3.63%**
4.1 Testing Engineers Salaries	30	128 Hours x 3 = 384 768	23,040		
4.2 Integration testing	10	25	250		
4.3 Unit Testing	25	10	250		
4.4 User Acceptance Testing	20	10	200		
5. Implementation & Deployment				**$ 91,200.00**	**13.93%**
5.1 Training	30	80 hours x 1 = 80	2400		
5.2 Hardware Installation Costs	25	120 hrs x 4 = 480	12000		
5.3 Support and Maintenance	40	160 hrs x 12 = 1920	76800		
6. Misc. Expenses				**$ 7,000.00**	**1.07%**
Initial Budget				**$ 500,000.00**	
7. Reserves (10% of initial budget)				**$ 50,000.00**	**8%**
Total Budget				**$ 654,600.00**	

Figure – 8 Cost Baseline for Walking Bins

6.5.3 COSTING METHODS

There are three techniques for calculating costs :

- Constructive Cost Model II (COCOMO II)
- Function Point Calculator
- Source Lines of Code (SLOC)

We have chosen Function Point Calculator for costing, for a number of reasons :

- The software is free and readily available.
- If the scope changes in between the project, it is very easy to report the impact of the change using FPC.
- It is flexible to use FPC during any stage of the Software Development Lifecycle (SDLC).

The Figure 9 below shows the calculation of cost estimates using Function Point Calculator.

Function Point Calculator

Main
Description
Details
Uses
Calculator
Help

Step 1:

Fill in the following table with the estimates that pertain to the software you are developing.

Help		Simple	Average	Complex
?	Number of User Inputs	3	5	6
?	Number of User Outputs	5	6	7
?	Number of User Inquiries	4	6	5
?	Number of Files	8	9	14
?	Number of External Interfaces	5	7	11

Description
Details
Uses
Calculator
Help

Step2:

Please answer the following questions:

Assign a value of importance to each question. The range is from 0 to 5. Zero being of low importance to five being of high importance.

		0 1 2 3 4 5
1.	Does the system require reliable backup and recovery?	○ ○ ○ ○ ○ ◉
2.	Are data communications required?	○ ○ ○ ◉ ○ ○
3.	Are there distributed processing functions?	○ ○ ○ ◉ ○ ○
4.	Is performance critical?	○ ○ ○ ○ ○ ◉
5.	Will the system run in an existing, heavily utilized operational environment?	○ ○ ○ ○ ◉ ○
6.	Does the system require on-line data entry?	○ ○ ○ ◉ ○ ○
7.	Does the on-line data entry require the input transaction to be built over multiple screens or operations?	○ ○ ○ ○ ◉ ○

		0 1 2 3 4 5
8.	Are the master files updated on-line?	○ ○ ○ ◉ ○ ○
9.	Are the inputs, outputs, files, or inquiries complex?	○ ○ ◉ ○ ○ ○
10.	Is the internal processing complex?	○ ○ ○ ◉ ○ ○
11.	Is the code designed to be reusable?	○ ○ ○ ○ ◉ ○
12.	Are conversion and installation included in the design?	○ ○ ◉ ○ ○ ○
13.	Is the system designed for multiple installations in different organizations?	○ ◉ ○ ○ ○ ○
14.	Is the application designed to facilitate change and ease of use by the user?	○ ○ ○ ○ ◉ ○

You can clear your answers at anytime by clicking on this button.

Reset Answers

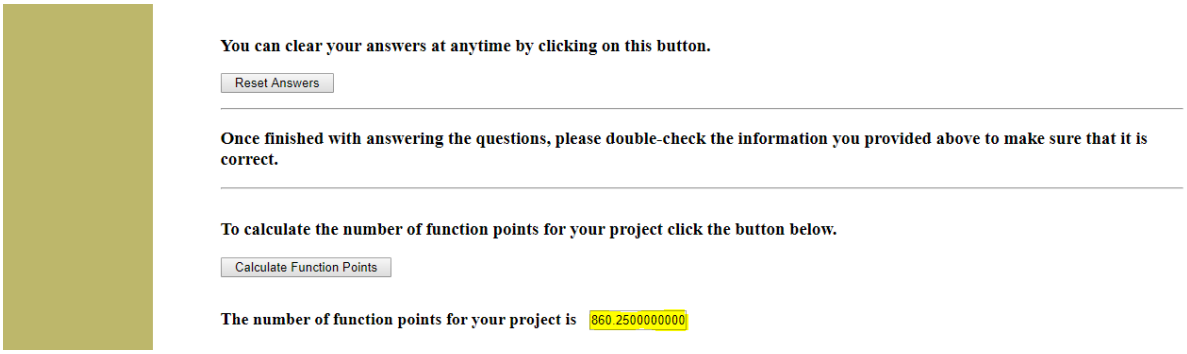


Figure – 8 Function Point Calculator for Walking Bins

6.5.4 SUMMARY

To sum up, we may conclude that Cost Control is essential and central to any method of project management controlling an IT project cost would give business priorities numerous advantages. To ensure that the project plan does not go over budget, the project team must monitor and control the cost of the project constantly to incorporate any scope changes during the project lifecycle.

6.6 RISK MANAGEMENT

6.6.1 DEFINITION AND IMPORTANCE

One of the first things you think about when starting a new project is : What can go wrong? Some risks cannot be completely avoided, but can be mitigated. There are numerous ways to get a slight glimpse of potential risks that could impact projects timeline, performance and budget, also known as Triple Constraints. Hence, it is very crucial to identify and keep a track of the potential risks of the project. For this, we need a Risk Management Plan.

Risk Management Plan is nothing but a process of identifying, analyzing and responding to any risk that arise during projects lifecycle to help the project stay on track and achieve it's goal. Risk Management is not only reactive; It should be a part of the planning process to determine the risk that could occur in the project and how to mitigate it if it actually occurs. (Ray, 2017)

6.6.2 RISK REGISTER

Risk Register is an approach to prioritize, rank, mitigate and track the status of potential risks identified during the course of the project. The risks identified are logged on the register and the actions that are required to be taken to respond to the corresponding risk. The Risk Register contains the following fields :

- Risk Number – Gives a unique identifier for the risk.
- Risk Name – Gives the risk name.
- Risk Description – Gives the detailed description of the risk.
- Likelihood – The chances of occurrence of risk.
- Impact – Effect of risk on the project.
- Total Risk Score – Product of likelihood and impact.
- Risk Class – Severity of the risk.
- Risk Control Measure – The measures undertaken to control the risk occurrences.
- Risk Monitoring measures – Monitoring measures taken to identify the problems and provide an immediate solution.
- Impact to Triple Constraint – Effect of risk on time, budget and quality.
- Risk Owner – The person in charge for risk occurrence.

The Table 6 below gives the Risk Register for Walking Bins system.

Risk No	Risk Name	Risk Description	Likelihood	Impact on Project	Total Risk score
1	Lack of support from top level management	No proper authority control to guide the staff and failure to provide resources and budget timely.	6	7	42
2	Lack of communication with stakeholders	Failure of communication of stakeholders with the team regarding the requirements of the project	6	9	54
3	Improper technical training	End users should be well aware of the new system to be adopted and also are expected to adapt to new system.	5	7	35
4	Server Crashes	Speed of operation is highly affected due to server downtime due to inefficiencies of hardware and software functionalities	4	5	20
5	User resistance by the customer towards accepting the new adopted system	Users are always reluctant to welcome changes and will resist to get used to the new system.	6	7	42
6	Change in political policies	Change in government policies might lead to significant delays in the project completion	6	8	48

Risk No	Risk Class	Risk Control Measure	Risk Monitoring measures	Impact on the triple constraint	Risk Owner
1	High	Keeping top level management in loop and clearly discuss the need of resources and budget.	Regular meetings with the top level management to discuss the same and documenting every stage of the process.	Lack of involvement of top management will lead to time and cost constraints due to incapability of taking right decisions, thus affecting the quality of the project.	Project Director
2	High	Instead of using waterfall methodology, using agile methodology as it is possible to implement changes based on the reviews of the stakeholders.	Setting up a meeting with stakeholders after every iteration of the project.	There are high chances of scope creep as budget of the project continually increases.	Project Manager/ Project Director
3	Medium	Sufficient training should be given to the staff members to newly adopted system.	Proper guidance and training facilities should be provided to all staff members.	Training costs are high and also the time invested to train staff members is more.	Training Team
4	Low	Continually updating servers and implementing multiple servers for back up in case of failures.	Monitoring the utilization of resources and keeping a support team for server crash downs.	Extra costs are involved for maintaining multiple servers	Support Team/ Vendor
5	High	Advertising the benefits of the new waste management system and providing user manuals.	Cost benefiting as number of bins to be maintained would be less.	Increases the costs of the project.	Entire Project Team
6	High	Keeping up to date with the government rules and policies	Constantly updating the project according the Victorian government needs.	Increase in the scope of the project, as project needs to implement changes.	Project Team

Table – 7 Risk Register for Walking Bins

The following table gives the Probability Impact Matrix – Legend

Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain (A)	23	59	65	63	65
Likely (B)	24	44	57	62	62
Possible (C)	5	35	44	43	65
Unlikely (D)	6	16	38	36	42
Rare (E)	8	9	12	15	39

Table – 8 Probability Impact Matrix Legend

6.6.3 SUMMARY

The cornerstone of Risk Management is analyzing the potential risks that may arrive unannounced, evaluating it's impact on Triple Constraints of the project and balancing it out against the projects overall risk appetite. Documenting risks is underrated and should be given more importance for risks that may arise in the future.

7.0 CONCLUSION / FINAL SUMMARY

A project's effective output relies on proper project planning. According to the PMBOK guide, there are 11 project controls that must be considered when implementing a project. However, after implementing this project, we recognized that planning and control as a source of tasks plays a major role. Although proper control is cost dependent and time intensive, the ROI that one earns from comprehensive checks and routine audits is worth the initial investment.

The number of benefits of Walking Bins will help to build a system which would not only helpful for overcome the shortcomings of the previously waste management systems, but also in it's endeavors to keep the environment clean and green. Every step that we followed from the PMBOK, be it the Stakeholder Management, Risk Management or Schedule Management, were imperative to a successful project implementation.

In Closing, we can say that, we can take maximum advantage of the project software by fully integrating project controls in our project management.

8.0 REFERENCES

Bernie Roseke, P. P. (2016, Oct 19). *Components of a Scope Management Plan*. Retrieved from Project Engineer: projectengineer.net/components-of-a-scope-management-plan

Gantt, T. (2018, June 26). *Creating a Project Management Communication Plan*. Retrieved from teamgantt: teamgantt.com/lbog/project-management-communication-plan

Greaves, A. (2019). *Recovering and Reprocessing Resources from Waste.* Melbourne: Victorian Government Printer.

Hemmer, M. (2017, May 22). *Why Building a Proof of Concept is Necessary*. Retrieved from blog.onefire: blog.onefire.com/why-building-a-proof-of-concept-is-necessary

Ray, S. (2017, Oct 19). *The Risk Management Process in Project Management*. Retrieved from projectmanager: projectmanager.com/blog/risk-management-process-steps

Victoria, E. (2019, May 19). *Get Involved*. Retrieved from EPA Victoria: epa.vic.gov.au/get-involved/report-litter

Weedmark, D. (2019, Sep 6). *Why is Project Scheduling Important?* Retrieved from bizfluent: bizfluent.com/about-6680670-project-scheduling-important-.html

Wrike. (2019, May 10). *What is Cost Management in Project Management?* Retrieved from Wrike: wrike.com/project-management-guide/faq/what-is-cost-management-in-project-management

9.0 APPENDICES

9.1 APPENDIX – A (PROOF OF CONCEPT)

Proof of concept

Background:

A proof of concept is not intended to explore market demand for the idea, nor is it intended to determine the best production process. Rather, its focus is to test whether the idea is viable -- giving those involved in the proof-of-concept exercise the opportunity to explore the idea's potential to be developed or built. The proof of concept is designed to demonstrate the product's feasibility i.e. that the product has some practical potential and is worth putting money into.

In your assignment a business case to establish various waste management systems to support a range of waste management issues has already been agreed to. What has not been agreed to is what type of waste management system is to be developed.

In software development, for example, a proof of concept would show whether an idea is feasible from a technology standpoint. As such, POC is a useful tool for assessing user requirements and determining the activities you want your specific user groups/community to perform.

Developing a proof of concept generally requires some investment of time or other resources to demonstrate the product's potential and could be in the form of a rudimentary prototype.

For this exercise your team are not required to develop an actual prototype as such, but you will need to demonstrate on paper how this prototype could look and work; showing links to other interconnected systems if necessary.

Going through this process enables companies to determine an idea's viability before putting production-level resources behind an untested idea.

The value of proof of concept

Developing a proof of concept can help a product owner to identify potential technical and logistical issues that might interfere with success. It also provides the opportunity for an organization to solicit internal feedback about a promising product or service, while reducing unnecessary risk and exposure and providing the opportunity for stakeholders to assess design choices early in the development cycle.

In software development proof of concept can be a vital tool to demonstrate the software's capabilities and fit with the clients' requirements. For example, design the workflow of the data through the integration process and demonstrate the integration for top management. Then create a report describing the concepts outcome and potential usage of the system.

The individual or team going through this process can then use a successful proof of concept to convince stakeholders, managers or investors that the idea is worth pursuing further.

Steps to write a proof of concept

Many industries, including the software, hardware, drug discovery, manufacturing, science and engineering sectors, use the proof-of-concept process to pursue ideas before approving them for further testing and, eventually, full-scale production.

A proof-of-concept plan could address how the proposed product or service will support organisational goals, objectives or other business requirements, although that step is not the primary objective of the POC.

Proof of Concept

NB: In this proof of concept you are not required to develop a prototype. You are just required to describe how the system will be developed and what it will look like using the following template.

1. What waste management issue are you wanting to manage and explain the importance of the waste issue? (For this question research must be presented to support your decision.)

Victoria's rubbish pile is about to hit 20 million tonnes, according to EPA in Victoria. Although waste management system in Victoria is very well established, there still is massive scope for processing waste when it comes to effective recycling and conversion of waste food into energy.

Out of every 3 people, one person fails to segregate waste on a household level. We are trying to solve the problem of over-accumulation, segregation as well as transportation of waste, trying to make the whole process autonomous. The Victorian Government currently has smart dustbins where they measure the filling of the dustbin, but there isn't any mechanism to automatically segregate the waste or to dispose the trash on it's own. We propose a walking dustbin, which at a certain point in the night, will dump trash on it's own. It's like a Tesla garbage truck.

WHY SEGREGATE IT WHEN YOU COULD JUST THROW IT?

2. Outline what system/product you want to develop to support the waste issue you have identified in 1. above.

The product in our mind is that of an autonomous dustbin, which not only measures the level of waste, segregate it using image classification machine learning algorithms, but also transport it to the dump site, all on it's own. Using IOT devices and computer software such as zigbee transmitters, we will measure the depth of the dustbin.

Another set of IOT devices, will make use of a state-of-the-art machine learning image classification algorithm which will be used to segregate waste such as glass, paper, plastic,

metal and organic waste. This mechanism will be installed within the dustbin and would be activated once the trash is collected at the top of the bin.

The smart dustbin, will have an auto-pilot system which it will use to commute to and fro from the waste disposal site. We have partnered with Tesla for this, as they're the best in the business.

3. Explain the usefulness of the system to the stakeholders. (NB: remember the KISS principle.)

The Stakeholders are the Victorian Government and all the people in Victoria themselves. The Victorian government will likely save millions of dollars in waste management and the public will save a lot of time. Whereas there will be a drastic drop in carbon footprint as well, benefiting both the government and environment.

4. a. Identify and describe the software development lifecycle (in brief) you will use and explain why your team chose this lifecycle.

We would go with the Rapid Prototyping approach for this, as this idea is still rudimentary and on paper, whereas it has not been tested in a real life scenario. In Rapid Prototyping, we will strive to build the proposed software system which does all the things mentioned above and install it on to our garbage truck. If the system is able to do almost all the things (say, 80%) it is designed to, then we could implement it on a larger scale. This is exactly what Rapid Prototyping aims at achieving when it comes to software development.

b. At each phase on the SDLC explain what part of the system will be developed. (In brief)

Phase 1 – Develop the same smart dustbin which measures depth and creates clusters for waste segregation.

Phase 2 – Develop waste segregation image classification software and put them to test.

Phase 3 – Build an auto-pilot software system, using Deep Learning to make the dustbin completely autonomous.

5. Describe how the waste issue you have identified for your project (from 1. Above) will be managed by the new system/product. (This can be as simple as numbered points clearly outlined.)

The project which we are designing involves intelligent segregation of waste. The main problem in waste management is not the waste itself, but the people. People do not think while they are about to throw rubbish in the dustbin. Thus, this leads to waste being mixed. When a person throws waste there is a high possibility that the waste is not thrown in the right dustbin and another problem is when a lot of garbage is being thrown by a person then there is high tendency of the waste being mixed. Our project would eliminate the people problem from the equation and segregate based on highly complex and intelligent algorithms.

9.2 APPENDIX – B (MINUTES OF THE MEETING)

Please refer to the following link on Trello : https://trello.com/c/c7atZjzt/10-minutes

9.3 APPENDIX – C (AGENDA OF THE MEETING)

Please refer to the following link on Trello : https://trello.com/c/ja7Ab0UO/9-agenda

9.4 APPENDIX – D (TIMESHEETS)

Please refer to the following link on Trello : https://trello.com/c/rMiCiNSh/11-timesheets

9.5 APPENDIX – E (INITIAL GANTT CHART)

Please refer to the following link on Trello : https://trello.com/c/aeHukrsE/5-les