

# Group Assignment Cover Sheet

Never Stand Still

Faculty of Engineering

School of Mechanical and Manufacturing Engineering

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Course code: GSOE 9820 \_\_\_\_\_

Course name: Project Management, Term 2 2021

Date submitted: 31 July 2021

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## Team Attribution Survey and Signature Table

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## Grading procedure:

1. The report is marked according to the marking guide giving raw grade **R**.
2. The team's demonstrator will check, modify if necessary, and approve the team attribution survey.
3. The approved contribution of a group member is **C**.
4. Each group member receives a final grade **F = R x C x N** (where **N** is number of group members).
5. You will be individually notified of **F** and **R**.

## Change Summary

ID	Changes
1	Added a Contents.
2	Added titles for charts and tables and referenced them in the text.
3	Added numbering to WBS chart.
4	Added an activity 1.3.3 external recruitment.
5	Added the grid of the level of power of the stakeholders and the ability to change the outcome (influence).
6	The budget for the project was increased from \$250,000 to \$350,000.
7	Added PM technique for estimating budgets.
8	The duration of the project was reduced from 1 year to 9 months.
9	Chart fitted to A4 paper.
10	Added recruitment process.
11	Added to the risk description of activity 2.2.1 in the risk register and changed the risk level.
12	Increase in the amount of the contingency budget corresponding to the risks of activity 2.2.1.

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# 1. Project Charter

Identification	
Name	UNSW Parking System
Description	Update the software and hardware system of UNSW Parking system, including sensors, computers, database, UI and algorithm
Sponsor	UNSW
Project Team	Group 24:Jiaqi Li, Haowen Zhao, Jieping Wu, Jie Chen, Chi Zhang
Start Date	Q1 2022
End Date	Q3 2022

Purpose
1 To meet the UNSW 2025 strategy, establish a software and hardware parking system of UNSW
2 To alleviate the difficulty for students and staff returning to UNSW after the COVID-19

Team and Strategy
The key professors and staff with experience and ability in many areas such as software engineering , IT and finance and consulting of UNSW will be the members of the Project Team.
More information of Project Team will be attached in the appendix.

Objectives
The objective of the project is to update the formal UNSW Parking System with digital management system and functions including paying online, checking for vacancies and costs based on the different roles of users, and gaining parking permit online.
New UNSW Parking System will connect to the database of UNSW staff and students and the staff and students can manage the bill and parking permit information in the UNSW related Websites or app.
The project will alleviate the difficulty for students and staff returning to UNSW after the COVID-19 and demonstrate alignment with UNSW 2025 Strategy.

Requirements
The project:
1 will deliver software system including database management system, UI and algorithm and hardware system including sensors and computers including server and entrance and exit computers.
2 Will use existing facilities and services of original UNSW Parking System.
3 Or include the required new equipment and services if the existing facilities and services cannot meet the need.
4 the cost will be less than 350,000 AUD including contingencies.
5 Need to demonstrate alignment with UNSW 2025 Strategy.

Key Stakeholders
Sponsor
UNSW Facility Managers
External Design and Construction Teams
UNSW Students/Staff
UNSW Visitors
UNSW Parking Lot Provider
Local community

## 2. Scope Statement

This project is to optimize UNSW's parking system under \$350,000 within 9 months. To implement this service, a software is developed which allows students and staff to use it to check vacancies (monitored and identified by cameras) and pay online via the internet. Entrances and exits record the length of parking and fees. Collection and analysis of data information on users and cars. Finally, the parking system will be optimized and delivered progressively through the possibility of integration with other platforms, the popularization of the use and functionality of it for students and staff, and the involvement of user feedback.

### 2.1 Acceptance Criteria

When UNSW and engineers finish all the tests of the Parking system and release the official version, the project will be considered complete.

The test contains API & Hardware Connection Test, Function Test and User Interface Test and the standard are followings:

- (1) The rate of failure cases must be lower than 3%.
- (2) The gross error does not exist.
- (3) The number of errors is lower than 20.
- (4) All the errors are corrected.

### 2.2 Deliverables

The main deliverable of the project is a fully functional parking system, including software, hardware system, UI and database management system.

The UNSW's parking system contains following major sub-deliverables:

### 2.3 Software system

The software system includes two parts: Database Management system, algorithm, and UI.

The database management system will contain the database and it can modify the information of users

automatically when users operate. In addition, the system can also search the vacancies, automatic record fees, check parking records, search vehicle information.

The algorithm contains the information about how the database management system and UI realise the functions. The UI of the parking system consist of web and app. The Webpage can be entered by scanning QR code in the parking lot or users can enter app directly. The UI offers functions including registering, logging, checking vacancies, checking the parking fees, paying online, and finding the position of the user's vehicle.

## **2.4 Hardware System**

The hardware system consists of sensors and computers.

The sensors are cameras that can discriminate vehicles' number and the data will be transmitted into the computers that can process database and control Parking system in the parks.

The computers contain two parts, a server and the entrance or exit computers. The server computer stores the database and process the data from the cameras or internet and transmit to the entrance and exit computers. The entrance computers will process the vehicles' number and admit the vehicles into parking lot. The exit computers will process the vehicles' number, check whether the fees are clear and decide if the vehicles can leave parking lot.

## **2.5 User Documentation and Training**

The user documentation contains the necessary information about how to operate, maintain software and hardware systems and extend software and hardware systems. The training will make the technicians and operators know the algorithms, the usage of software systems of UNSW Parking System.

## **2.6 Exclusions**

The maintenance and update of software system after 9 months.

The maintenance and update of hardware system.

Enough parking space for students and staff.

## **2.7 Constraints**

This project, UNSW Parking system, will cost \$350,000 within 9 months, including all the items except the purchase of cameras and computers. The fund of project is provided by UNSW.

## **2.8 Assumptions**

UNSW Parking System Project will start under the assumption that the hardware including computers and sensors and the office are provided. If the sensors in the UNSW parking lot before do not meet the criterion, UNSW need offer the sensors that can discriminate vehicles' number. In addition, all the materials are given on time, and the Parking lot staff are willing to contribute to the new UNSW Parking System.

### 3. WBS

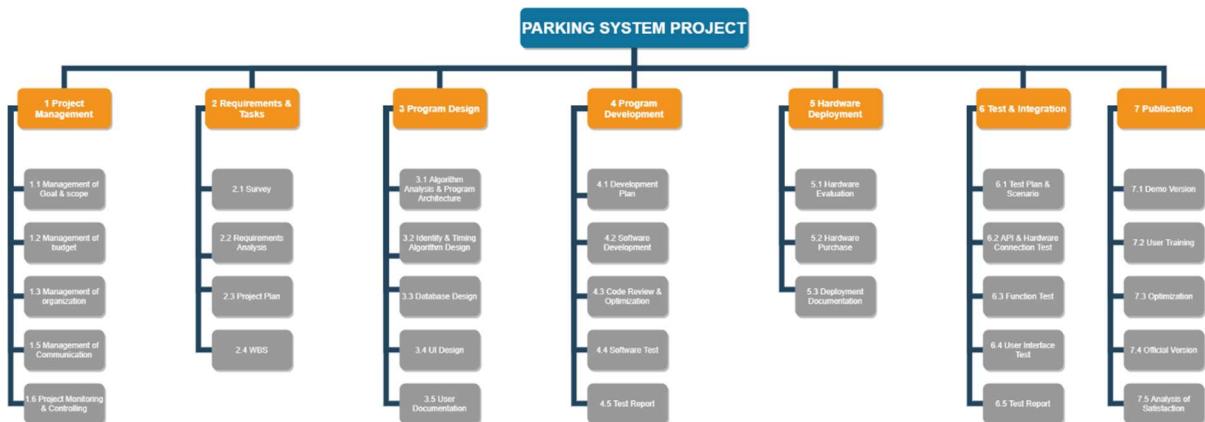


Figure 3.1 WBS

TABLE 3.1 WORK PACKAGE & ACTIVITY

Work Package	Activity
1.1 Management of Goal & Scope	1.1.1 Setting Project Goal
	1.1.2 Planning Project Scope
1.2 Management of Budget	1.2.1 Estimate Budget
	1.2.2 Distribute Budget
1.3 Management of Organization	1.3.1 Divide Organization
	1.3.2 Assign Organization Functions
	1.3.3 External Recruitment
1.4 Management of Communication	1.4.1 Choose communication tools
	1.4.2 Manage Communication
1.5 Project Controlling & Monitoring	1.5.1 Monitor Project
	1.5.2 Control Project
2.1 Survey	2.1.1 Make a questionnaire for potential users
	2.1.2 Make a market research
2.2 Requirements Analysis	2.2.1 Analyse project requirements
2.3 Project Plan	2.3.1 Making Schedule
	2.3.2 Estimate Cost
2.4 WBS	2.4.1 Define work packages
	2.4.2 Define activities
3.1 Algorithm Analysis & Program Architecture	3.1.1 Choose algorithms
	3.1.2 Determine the program architecture
3.2 Algorithm Design	3.2.1 Design algorithm
	3.2.2 Optimize algorithm
3.3 Database Design	3.3.1 Choose a database
	3.3.2 Build up architecture of database systems
3.4 UI Design	3.4.1 Design UI

3.5 User Documentation	3.5.1 Write User Document
4.1 Development Plan	4.1.1 Make a plan for development
4.2 Software Development	4.2.1 Develop Mobile Software
	4.2.2 Develop Web Software
4.3 Code Review & Optimization	4.3.1 Review codes
	4.3.2 Optimize codes
4.4 Software Test	4.4.1 Test Mobile Software
	4.4.2 Test Web Software
4.5 Test report	4.5.1 Write Mobile Software Reports
	4.5.2 Write Web Software Reports
5.1 Hardware Evaluation	5.1.1 Selecting the best performing hardware
5.2 Hardware Purchase	5.2.1 Confirm Bill of Material
	5.2.2 Purchase Hardware
5.3 Hardware Deployment	5.3.1 Install Hardware
	5.3.2 Check Hardware
6.1 Test Plan & Scenario	6.1.1 Make a plan of test
6.2 API & Hardware Connection Test	6.2.1 Test API & connection
6.3 Function Test	6.3.1 Test every single function of software
	6.3.2 Test the connection between all functions
6.4 User Interface Test	6.4.1 Test UI of Mobile Software
	6.4.2 Test UI of Web Software
6.5 Test report	6.5.1 Conclusion Test Report
7.1 Demo version	7.1.1 Release demo version
7.2 User training	7.2.1 Make a tutorial for users
7.3 Optimization	7.3.1 Boost the speed of program
	7.3.2 Make software easy to use
7.4 Official Version	7.4.1 Release official version
7.5 Analysis of Satisfaction	7.5.1 Make a questionnaire
	7.5.2 Analyse the feedback from users

## 4. Stakeholder Management

### 4.1 Overview

Stakeholder is a key component of UNSW Parking System project management. It is necessary to pay attention to the interests of stakeholders. These stakeholders play a vital role in the operation and profit, survival, and development of the project. Ignoring the existence of any stakeholders may have serious consequences for the whole project.

## 4.2 Management Method

According to Directions of influence, one of methods in the data representation technique [1], we can classify stakeholders and draw up the participation plan, and with the result of ranking the priorities and interests of stakeholders can be confirmed to generate a reasonable communication plan with all of stakeholders.

## 4.3 Identified Stakeholder

TABLE 4.1 IDENTIFIED STAKEHOLDER

Rank	Stakeholders	Interest
Primary	Sponsor	Give guidance and suggestions to the project, gain support for the project by presenting it to the rest of the organization
Primary	UNSW Facility Managers	Maintain and manage the whole parking system including mobile APPs and desktop client
Primary	External Design and Construction Teams	Responsible for the overall design of the system and the implementation of specific function
Secondary	UNSW Students/Staff	Allow UNSW students and staff have a better parking experience, in the aspect of finding parking lot and paying for parking
Secondary	UNSW Visitors	Provide visitors with the stable parking lot for a period, help to locate their parking lots
Secondary	UNSW Parking Lot Provider	Provide spaces for users to park their vehicles
Tertiary	Local community	To relieve the parking pressure of the surrounding residents

## 4.4 Stakeholders Engagement

There are five positions for these stakeholders: Unaware, Resistant, Neutral, Supportive and Leading. For the main stakeholders, we should spare no effort to ensure their participation, but for others we only need to keep them in touch.

The engagement level of stakeholders is showed at Table 4.2 by Stakeholder Engagement Assessment Matrix [2].

TABLE 4.2 THE ENGAGEMENT LEVEL OF STAKEHOLDERS

Stakeholder	Unaware	Resistant	Neutral	Supportive	Leading
Sponsor				CD	
UNSW Facility Managers				C	D
External Design and Construction Teams			C		D

UNSW Students/Staff			C	D	
UNSW Visitors			C	D	
UNSW Parking Lot Provider			C	D	
Local community	C		D		

C: Represents the current engagement level of each stakeholder.

D: Indicates the level that the project team has assessed as essential to ensure project success (desired).

## 4.5 Power Influence Grid

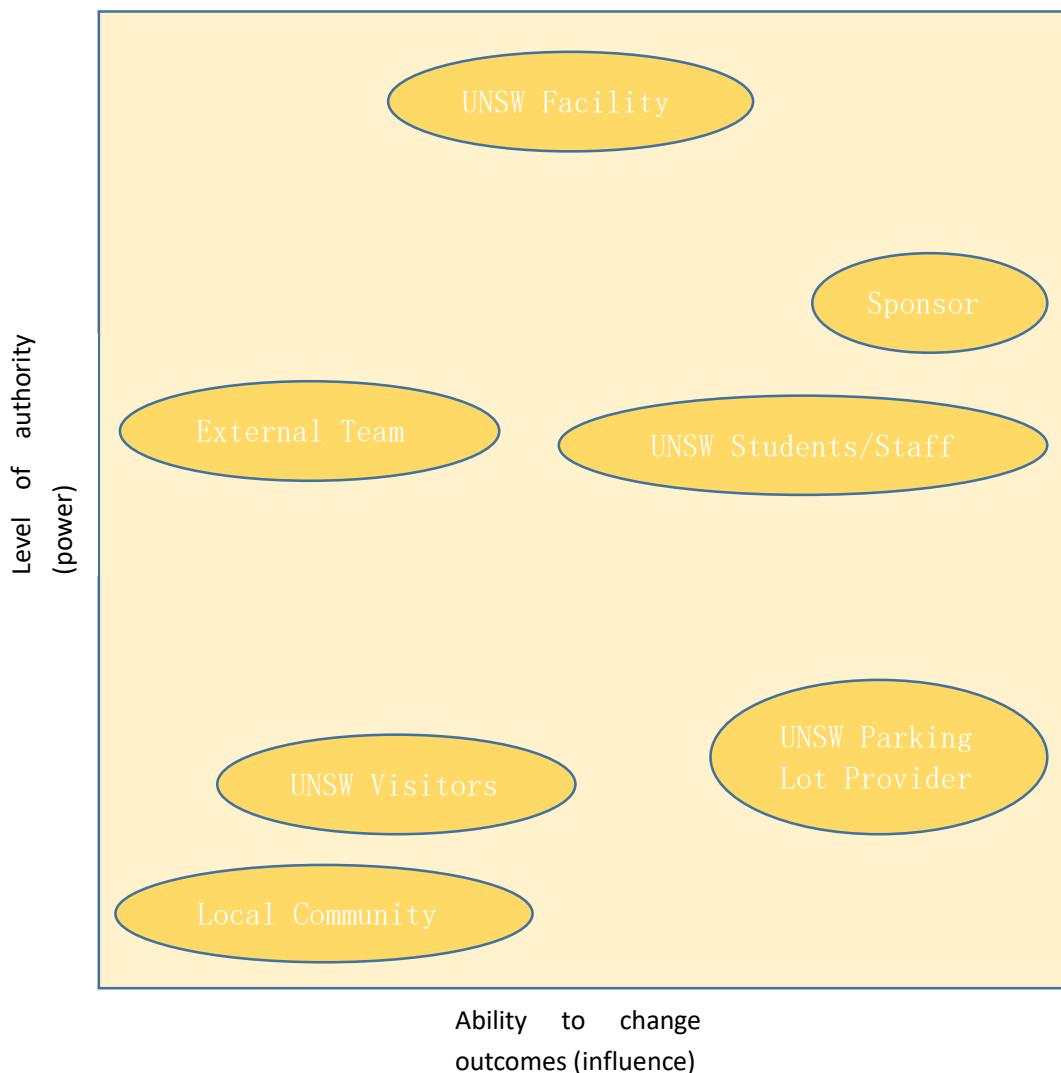


Figure 4.1 Power Influence Grid

## 5. Communications Plan

### 5.1 Overview

The aim of communications plan is to develop appropriate methods and plans for project communication activities. Based on the information needs of each stakeholder or group of stakeholders, the available organizational assets, and the needs of specific projects, provide relevant information to relevant parties, guide relevant parties to participate, and prepare a written communication plan in a timely manner for this project.

### 5.2 Communications Tools and Techniques

Communication tools:

- Conferences, face-to-face conversation, online meeting, telephone, Email, websites and other technologies. Consider urgency, availability, ease of use, sensitivity, and confidentiality to select choose the proper tool.

Communication techniques:

- Interactive communication: Real-time multiway exchange of information between two or more parties.
- Push communication: Sends or publishes information to a specific recipient that needs to receive information.
- Pull communication: Suitable for a large number of complex information or a large number of information audience.

TABLE 5.1 COMMUNICATIONS TOOLS AND TECHNIQUES

Communication Type	Receive	Owner	Medium	Content
<b>Daily Report</b>	Team leaders	External Design and Construction Teams	Email, websites	The process of a particular project
<b>Weekly Report</b>	Sponsor, UNSW Facility Managers	Team leaders	Face-to-face/online meeting	The process of the whole project
<b>Monthly Report</b>	School Board	Sponsor, UNSW Facility Managers	Email	The process of the whole project
<b>Public Report</b>	UNSW Staff/Students	Sponsor, UNSW Facility Managers	Email, social media, website	The process of the whole project
<b>Emergency</b>	Sponsor, UNSW Facility Managers	Incident Leader	Telephone, face-to-face/online meeting	The damage and impact for the project, possible solutions and consequences
<b>Milestone Events</b>	The public	School of MME	Social media, website	The phased progress of the project

## **6. Cost Estimates**

The management of cost and time plays an important role in a project. For this project, we estimated cost and time to make sure the project will be finished in time and within \$350,000 by using parametric estimate. After the estimation, the total cost of this project should be \$326,091 including \$26,668 Contingency Reserve Budget. The detail of overall cost shows in Table 6.1. The volunteer in Table 6.1 means our group members, so the cost of volunteer is 0. The distribution of budget shows in Table 6.2. In Table 6.3, it shows the budget cost of each month and the total budget cost in that month (The Contingency Reserve Budget is counted in December 2022). The salary of each employee get from UNSW Human Resources<sup>[3]</sup>.

## 6.1 The Detail of Total Cost

TABLE 6.1 OVERALL COST

Project Management											Program Design										
Description: Make a preparation for this project											Description: Design the algorithm, database, UI										
ID	Activity	Labour			Equipment			Cost (\$)	Labour			Equipment			Cost (\$)						
		Expert	Worker	Volunteer	Salary (\$)	Hardware	Cost (\$)		Expert	Worker	Volunteer	Salary (\$)	Hardware	Cost (\$)							
1.1.1	Setting Project Goal	0	0	0	32	5	0	0	0	0	0	0	0	0	0	1662	0	0	1662		
1.1.2	Planning Project Scope	0	0	0	0	24	5	0	0	0	0	0	0	0	0	3324	0	0	3324		
1.2.1	Estimate Budget	0	0	0	0	16	1	0	0	0	0	0	0	0	0	3324	0	0	3324		
1.2.2	Distribute Budget	0	0	0	0	48	1	0	0	0	0	0	0	0	0	2493	0	0	2493		
1.3.1	Divide Organization	0	0	0	0	64	1	0	0	0	0	0	0	0	0	2982	0	0	2982		
1.3.2	Assign Organization Functions	0	0	0	0	64	1	0	0	0	0	0	0	0	0						
1.3.2	External Recruitment	0	0	0	0	128	5	0	Advertise-ment	3000	3000	0	0	0	0	7952	0	0	7952		
1.4.1	Choose communication tools	0	0	0	0	32	1	0	0	0	0	0	0	0	0	9945	0	0	9945		
1.4.2	Manage Communication	0	0	0	0	96	5	0	0	0	0	0	0	0	0	0	0	0	0		
1.5.1	Monitor Project	0	0	0	0	954 (3hrs/D)	1	28620	0	0	0	28620	0	0	0						
1.5.2	Control Project	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Requirements and Tasks																					
Description: Make some surveys and create a plan for this project																					
Total Cost (\$): 0											Program Development										
ID	Activity	Labour			Equipment			Cost (\$)	Labour			Equipment			Cost (\$)						
		Expert	Worker	Volunteer	Salary (\$)	Hardware	Cost (\$)		Expert	Worker	Volunteer	Salary (\$)	Hardware	Cost (\$)							
2.1.1	Make a questionnaire for potential customers	0	0	0	0	32	5	0	0	0	0	0	0	0	0	2469	0	0	2469		
2.2.2	Make a market research	0	0	0	0	80	5	0	0	0	0	0	0	0	0	61456	0	0	61456		
2.2.1	Analyse project requirements	0	0	0	0	80	1	0	0	0	0	0	0	0	0	4690	0	0	4690		
2.3.1	Making Schedual	0	0	0	0	8	1	0	0	0	0	0	0	0	0	2894.4	0	0	2894.4		
2.3.2	Estimate Cost	0	0	0	0	8	1	0	0	0	0	0	0	0	0	2894.4	0	0	2894.4		
2.4.1	Define work packages	0	0	0	0	16	5	0	0	0	0	0	0	0	0	1146	0	0	1146		
2.4.2	Define activities	0	0	0	0	24	5	0	0	0	0	0	0	0	0	1146	0	0	1146		
Hardware Deployment																					
Description: Choose and purchase hardware																					
Total Cost (\$): 58051											Test and Integration										
ID	Activity	Labour			Equipment			Cost (\$)	Labour			Equipment			Cost (\$)						
		Expert	Worker	Volunteer	Salary (\$)	Hardware	Cost (\$)		Expert	Worker	Volunteer	Salary (\$)	Hardware	Cost (\$)							
5.1.1	Test Hardware System	0	0	38	1	0	0	1146	0	0	0	0	0	0	0	1719	0	0	1719		
5.2.1	Confirm Bill of Material	0	0	0	0	38	5	0	0	0	0	0	0	0	0	1719	0	0	1719		
5.2.2	Purchase Hardwares	0	0	0	0	38	5	0	20 x License plate detection camera	1423.7/ea	47284	0	30 x Retractable Bollard	627/ea	0	0	0	0	0	0	0
5.3.1	Install Hardware	0	0	57	3	0	0	4810.5	0	0	0	4810.5	0	0	0	0	2292	0	0	2292	
5.3.2	Debug Hardware	0	0	57	3	0	0	4810.5	0	0	0	4810.5	0	0	0	0	2292	0	0	2292	
Publication																					
Description: Release parking APP and collect feedback from users																					
Total Cost (\$): 56948											Test software function and UI										
ID	Activity	Labour			Equipment			Cost (\$)	Labour			Equipment			Cost (\$)						
		Expert	Worker	Volunteer	Salary (\$)	Hardware	Cost (\$)		Expert	Worker	Volunteer	Salary (\$)	Hardware	Cost (\$)							
7.1.1	Release demo version	0	0	38	2	0	0	4690	0	0	0	4690	0	0	0	1719	0	0	1719		
7.2.1	Make a tutorial for users	0	0	56	10	0	0	17970	0	0	0	17970	0	0	0	0	2292	0	0	2292	
7.3.1	Boost the speed of program	0	0	56	8	0	0	16458	0	0	0	16458	0	0	0	0	1719	0	0	1719	
7.3.2	Make software easy to use	0	0	24	2	0	0	1146	0	0	0	1146	0	0	0	0	2292	0	0	2292	
7.4.1	Release official version	0	0	24	6	0	0	8884	0	0	0	8884	0	0	0	0	2292	0	0	2292	
7.5.1	Make a questionnaire	0	0	24	2	0	0	3120	0	0	0	3120	0	0	0	0	1719	0	0	1719	
7.5.2	Analyse the feedback from users	24	3	0	0	0	0	4680	0	0	0	4680	0	0	0	0	0	0	0	0	0

## 6.2 Budget Distribution

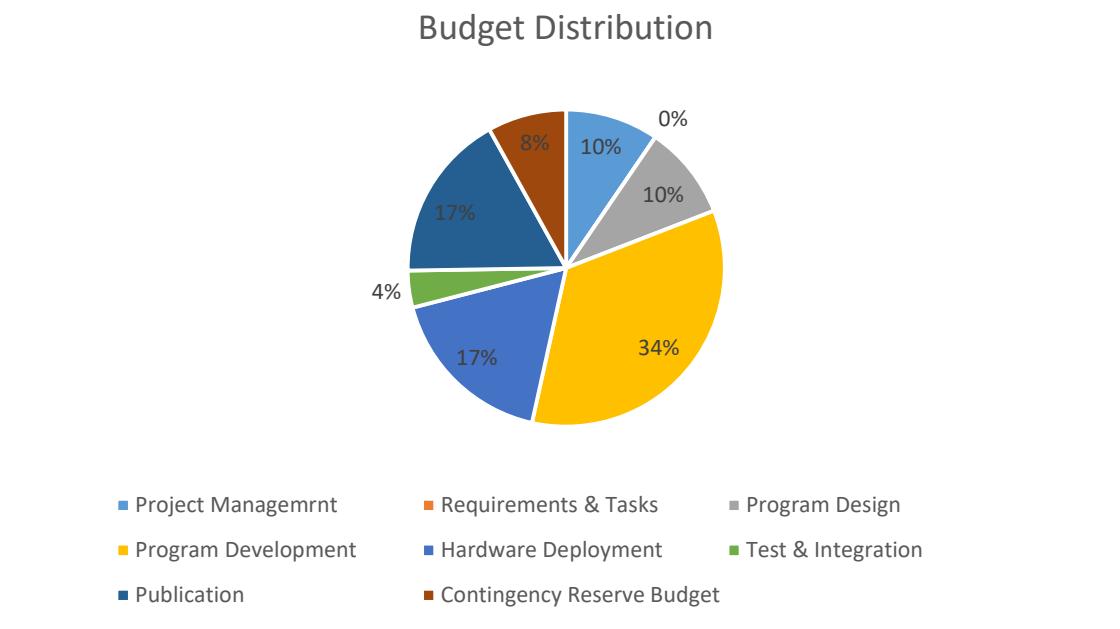


Figure 6.1 Budget Distribution

## 6.3 Budget In terms of Time

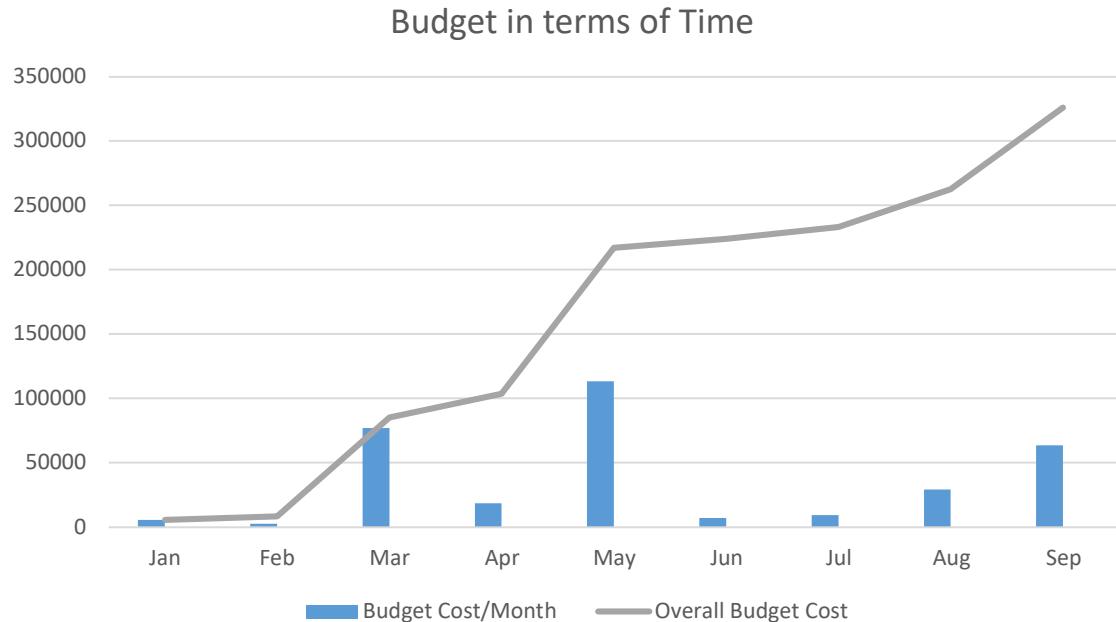


Figure 6.2 Budget in terms of Time

## 7. Schedule

The project schedule is based on Gantt Chart showed in Figure 7.1.

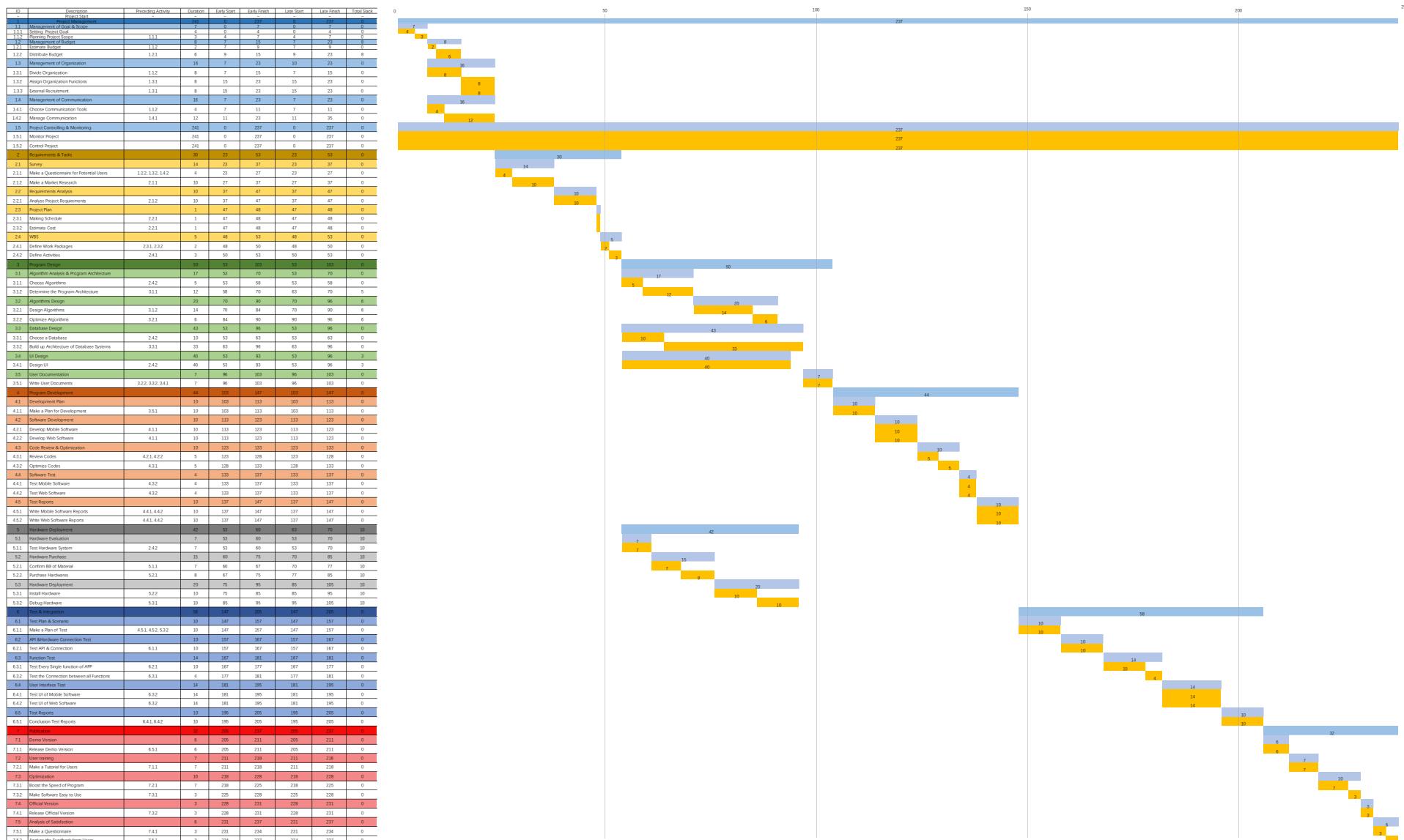


Figure 7.1 Project Schedule

The network diagram showed in Figure 7.2 is based on Activity on Node (AON), the critical path is highlighted in orange and the total duration of the project is 237 days.

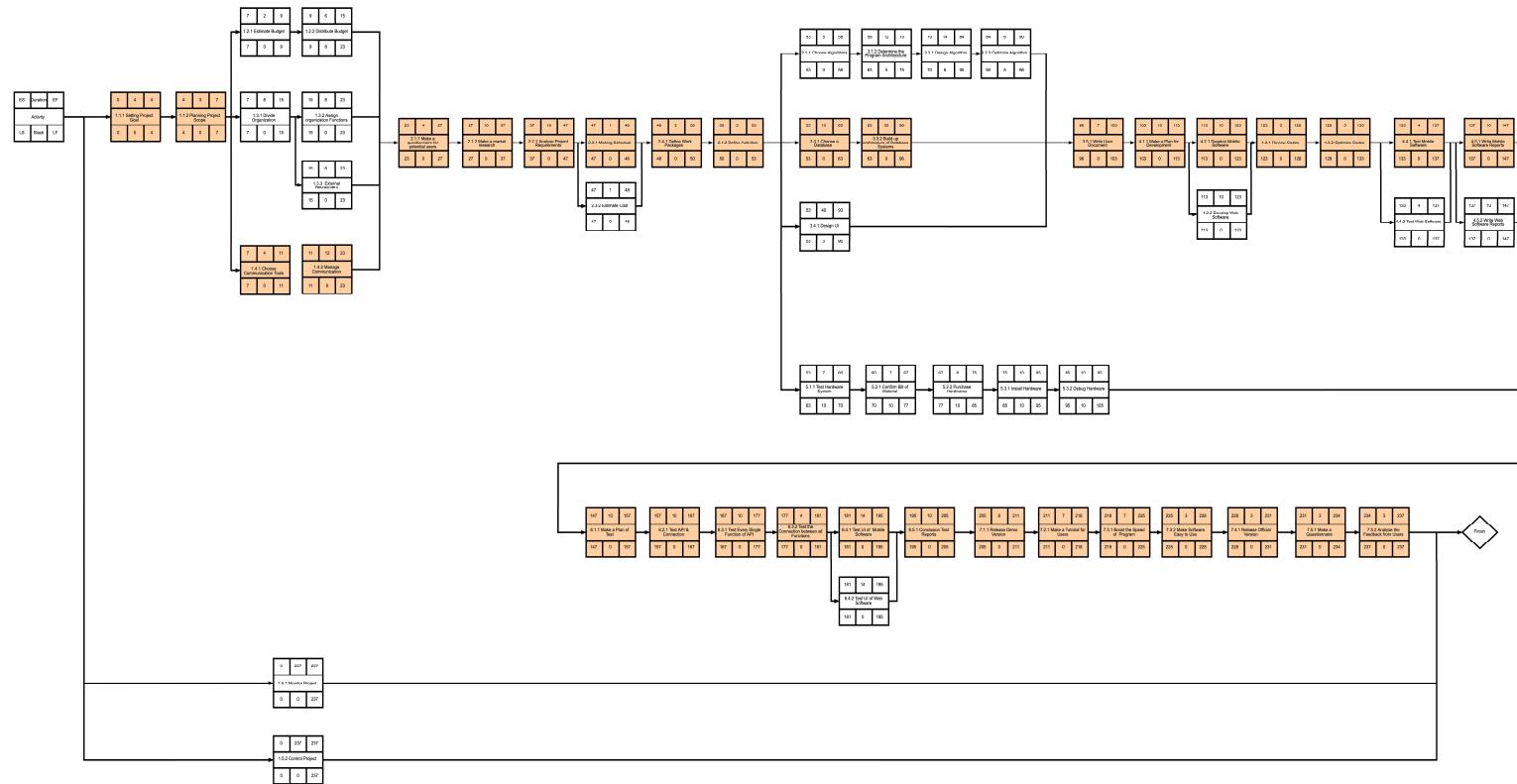


Figure 7.2 Network Diagram

## 8. Human Resource Plan

### 8.1 Overview

In this project, we will hire staff by 2 methods. First method is hiring staff from UNSW, the second method is hiring external staff online by using advertisement. The reason for applying above 2 methods is about 2 aspects. Firstly, staff from UNSW will benefit from this project and it is helpful for UNSW 2025. Secondly, employees which is from somewhere except UNSW will have a chance to work for UNSW, moreover, these employees can help UNSW to propagandize what is UNSW 2025.

To do this, this project needs part-time workers, full-time workers, and volunteers. In this project, program developers will have a full-time job, the rest of labors will be casual staff or volunteer. More details show in following tables or graphs. The project organization chart shows in Graph 8.1. The position and salary shows in Table 8.2. Table 8.3 shows the role and responsibilities (RACI).

### 8.2 Project Organization Chart

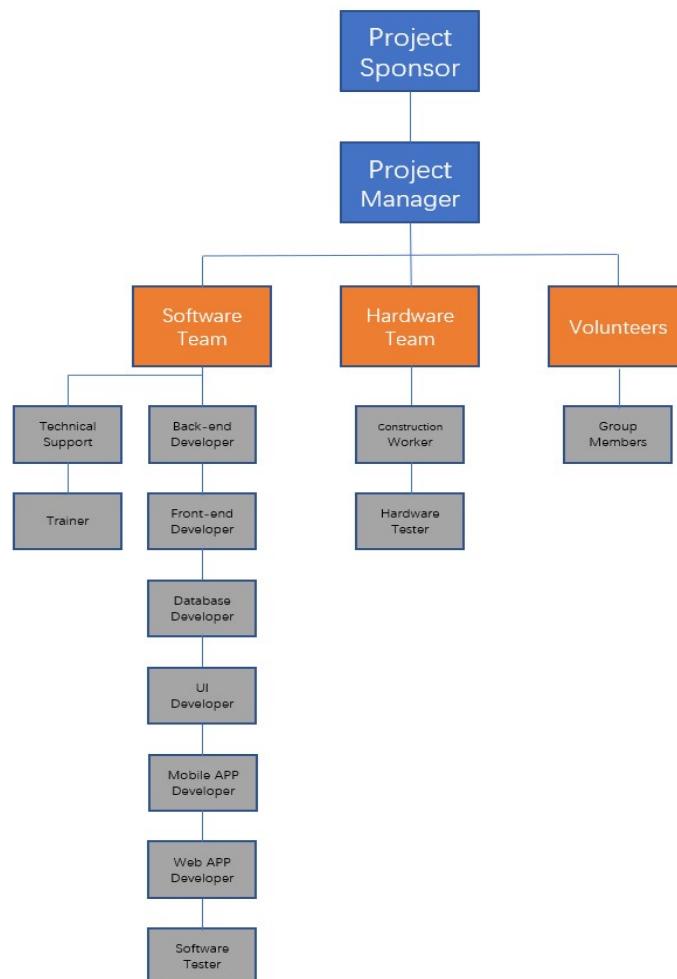


Figure 8.1 Project organization Chart

## 8.3 Position and Salary

TABLE 8.1 POSITION AND SALARY

Position	Numbers	Type	Responsibility	Level	Step	Salary/Year \$/yr
Back-end Developer	1	Full-Time	+Design Algorithm. *Develop Back-end Program.	4	2	79,042
Front-end Developer	1	Full-Time	*Develop Front-end Program	5	5	94,953
Database Developer	1	Full-Time	*Design Database. *Build up Database	5	5	94,953
UI Developer	1	Full-Time	+Design UI	5	5	94,953
Mobile APP Developer	10	Full-Time	*Develop Mobile APP	9	1	140,038
Web APP Developer	10	Full-Time	*Develop Web APP	5	1	83,920
Software Tester	2	Part-Time	+Test Software *Write Test Report	1	1	55,000
Construction Worker	3	Part-Time	* Install Hardware	1	1	55,000
Hardware Tester	3	Part-Time	*Test Hardware	1	1	55,000
Group Members	5	Volunteer	*Project Preparation *Make Survey *Purchase Hardware *Recruitment	\	\	0
Trainer	10	Part-Time	*Make Tutorials for Users	2	\	58,678
Technical Support	1	Part-Time	*Make Work Plan	7	\	124,396

## 8.4 Role and Responsibilities (RACI)

TABLE 8.2 ROLE AND RESPONSIBILITIES

Task	Project Team					
	Software Developer	Software Tester	Construction Worker	Hardware Tester	Volunteer	Project Manager
Management of Goal & Scope					R	A,C
Management of Budget					R	A,C
Management of Organization					R	A,C
Management of Communication					R	A,C
Project Controlling & Monitoring						A,C
Survey					R	A,C
Requirements Analysis					R	A,C
Project Plan					R	A,C
WBS					R,A	C
Algorithm Analysis & Program Architecture	R,A				I	I
Algorithm Design	R,A				I	I
Database Design	R,A				I	I
UI Design	R,A				I	I
User Documentation	A				R	I
Development Plan	R,A					I
Software Development	R,A					I
Code Review & Optimization	R,A					R
Software Test	I,C	R				I
Test report	I,C	R				I
Hardware Evaluation				R		A
Hardware Purchase					R	A
Hardware Deployment			R			A
Test Plan & Scenario						A
API & Hardware Connection Test	A,C	R	R			I
Function Test	A,C	R				I
User Interface Test	A,C	R				I
Test report	A,C	R				I
Demo version	R,A					I
User training	R,A					I
Optimization	R,A					I
Official Version	R,A					I
Analysis of Satisfaction	R,A					I

## **9. Risk Management Plan**

### **9.1 Overview**

For most projects, it is not uncommon to exceed the planned time and budget. PMBOK (PMI, 2017) mentions all projects are risky since they are unique undertakings with varying degrees of complexity that aim to deliver benefits. Therefore, it is essential that project risks are identified, analyzed, addressed and monitored. This Risk Management Plan will follow the process recommended in the PMBOK to outline how risks will be assessed and managed for the UNSW Parking System.

### **9.2 Risk Management Planning**

This plan manages risk activities in conjunction with the project life-cycle time plan and budget plan, identifying and generating a list of risks that may arise as **activities** are carried out during the project cycle. Risks are assessed against a risk severity matrix in terms of both likelihood and severity, and the owners and impacts of the risks are considered. Then, risk activities are responded to and solutions and contingency plans are proposed to mitigate the risks. Meanwhile, prepare a contingency budget for risks. Contingency budget shows in Table 9.3.

### **9.3 Risk Identification**

According to the WBS risk identification activities are carried out and the PMBOK (PMI, 2017)<sup>[5]</sup> mentions that risk data can be collected through techniques such as brainstorming, checklists and interviews. The project manager, project team members, project sponsors and users are all participants in the risk identification exercise. The number and level of risks may change as the project progresses and a risk management plan can help the project to respond to risks in a proactive manner. A risk register is generated to record details of risks show in Table 9.2.

### **9.4 Risk Assessment**

Refer to risk analysis in the PMBOK (PMI, 2017)<sup>[6]</sup>. Assess the probability of occurrence and impact of individual project risks and other characteristics based on the perception of risk by the project team and other interested parties, focusing on high level risks. Generate a risk matrix reflecting the hierarchy of risk activities based on the probability of occurrence and severity of the risk in order to further develop risk response measures.

### **9.5 Risk Likelihood**

The likelihood of the risk occurring is divided into five levels as below:

1. Rare : very unlikely to happen, almost never.

2. Unlikely : a slight chance of occurrence, with rare exceptional circumstances.
3. Possible : the potential for some risk to occur is not a small probability.
4. Likely : very likely to happen, occurs in more cases than not.
5. Almost Certain : the prediction is almost certain to happen, with a high probability.

## 9.6 Risk Severity

1. Insignificant : insignificant risk, little or no damage or impact.
2. Minor : minor impact, easy to deal with.
3. Moderate : some impact on project schedule and budget, requires proactive response.
4. Major : more serious impact, greater loss if not dealt with proactively.
5. Catastrophic : significant impact and loss, resulting in the project not proceeding successfully.

## 9.7 Risk Matrix

A matrix is generated from the likelihood and severity of the risk. Risk matrix shows in Table 9.1. The product of likelihood and severity represents the level of risk (1-25) and is divided into 4 levels: Low Risk(0-4), Moderate Risk(5-9), High Risk(10-14) and Extremely High Risk(15-25).

TABLE 9.1 RISK MATRIX

Likelihood		Severity				
		Insignificant	Minor	Moderate	Major	Catastrophic
		1	2	3	4	5
Severity	Almost Certain	5	5	10	15	20
	Likely	4	4	8	12	16
	Possible	3	3	6	9	12
	Unlikely	2	2	4	6	8
	Rare	1	1	2	3	4

## **9.8 Risk Response Development**

After completing the analysis of the risk, the person responsible for the risk should develop an effective and appropriate risk response. Consider the following four alternative strategies:

1. Avoid : project teams take action to eliminate risks and avoid being affected by them.
2. Transfer : transferring responsibility for risk to a third party.
3. Mitigate : measures to reduce the likelihood and impact of risks.
4. Accept : accepting the existence of risk but not taking proactive action.

Reference to planning risk response in the PMBOK(PMI, 2017)<sup>[7]</sup>.

## **9.9 Risk Response Control**

Risk response controls include implementing the risk response strategy that has been developed, monitoring and reporting on the risk process, initiating contingency plans and allocating contingency funds and schedules, monitoring changes to the project and preventing new risks.

TABLE 9.2 RISK REGISTER

Activity ID	Risk Description	Owner	Impact	Likelihood	Severity	Level of Risk	Risk Response	Mitigation	Contingency
1.4.1 1.4.2	Conflicts in communication and cooperation between teams or with UNSW	Project Team	Project delays and impact on project quality	3	2	6	Accept	The project manager coordinates the relationship between members and communication with UNSW	The project manager makes decisions on behalf of the members
2.2.1	The requirements have changed in some places ( time reduction, budget changes, increased functionality, etc. )	Project Sponsor	Project delays and increased costs	3	4	12	Avoid	Add time buffers and activate contingency funding	Escalate to the project sponsor and change the project plan urgently
3.2.1 3.2.2 3.3.2 3.4.1 4.3.1 4.3.2	Code loss due to human or uncontrollable reasons (computer failure, power failure, etc.)	Project Team	Project delays	2	5	10	Transfer	Add time buffers Use the last backup code file	Rewrite the code
4.2.1 4.2.2	Software is not compatible between different systems	Project Team	Project delays and impact on project quality	3	4	12	Mitigate	Add time buffers Debugging software to be compatible with different systems	Debugging software to be compatible with different systems
4.4.1 4.4.2	Software bugs caused the system to crash	Project Team	Project delays and impact on project quality	3	4	12	Mitigate	Add time buffers Rerun the software and rewrite the code that caused the crash	Rewrite the code Increase software test cycle and maintain it regularly
5.2.2 5.3.2	Hardware quality problems or other reasons cause it to not work properly  Data cannot be collected,	Project Team	Project delays and increased costs	3	5	15	Transfer	Add time buffers Hardware maintenance	Replace with new hardware and call in contingency funding

	transmitted or feed back								
5.2.2	Hardware shortages, such as shortage of materials for the production of hardware components, shortage of chips, lack of hardware production due to economic disputes between manufacturers, etc.	Project Team	Project delays and increased costs	2	5	10	Transfer	Add time buffers Find replacement hardware products and replace them	Escalate to the project sponsor Wait for the hardware product and adjust the schedule
5.3.1	Hardware damage due to improper installation or shipping	Project Team	Project delays and increased costs	2	4	8	Transfer	Add time buffers Hardware maintenance	Escalate to the project sponsor Replace with new hardware
	Bad weather encountered during installation	Project Team	Project delays	3	3	6	Accept	Add time buffers	Escalate to the project sponsor Adjust the schedule
6.2.1 6.3.1 6.3.2 6.4.1 6.4.2	Failure occurred during the test (intersystem connection problem, data transmission error, data loss, bad hardware contact, Interface display error etc.)	Project Team	Project delays and impact on project quality	3	5	15	Mitigate	Add time buffers Optimize software and hardware and increase test times	Escalate to the project sponsor Change software programs and replace hardware
7.2.1	The user cannot operate the software or the user does not know how to operate the software	Project Team	Project delays and damaged reputation	4	3	12	Accept	Examine the software and teach users in detail how to use it	Conduct software training sessions for test users Change the software to make it easier to use
7.4.1	Information security after the parking system is put into use	Project Sponsor	Damaged reputation	3	4	12	Avoid	Store only the necessary information about the user and maintain system security regularly	Optimize security systems against viruses and vulnerabilities
7.5.1	Users do not accept or	Project Team	Damaged	4	4	16	Accept	Teach users how to use the software	Adjust functions and optimize

7.5.2	comment on the new parking system		reputation					in detail and record their comments	parking system according to user comments
Activity ID	Opportunity Description	Owner	Impact	Likelihood	Severity	Level of Opportunity	Risk Response	Comments	
5.2.2	Hardware is cheaper than expected, e.g. when you catch a sale or get a discount for buying multiple pieces	Project Team	Reduced project cost	2	3	6	Accept	Less likely to occur, accepted but not acted upon	
4.2.1 4.2.2	Software system development went better than expected	Project Team	Reduced project duration	2	3	6	Accept	Less likely to occur, accepted but not acted upon	
7.5.1 7.5.2	User satisfaction is higher than expected	Project Team	Reduced project duration	3	3	9	Enhance	Expect to occur and try to increase the probability of occurrence, which is good for reputation and reduces project duration	

TABLE 9.3 CONTINGENCY RESERVE BUDGET

Activity ID	Baseline (\$)	Contingency Reserve (\$)	Overall Cost (\$)	Comments
2.2.1	0	3000	3000	Due to changes in requirements, projects may be delayed and budgets increased, requiring changes and planning of project plans
3.2.1	3324	1000	4324	Due to code failures or loss, projects may be delayed and need to be rechecked and rewritten
3.2.2	2493	950	3443	Due to code failures or loss, projects may be delayed and need to be rechecked and rewritten
3.3.2	7952	780	8732	Due to code failures or loss, projects may be delayed and need to be rechecked and rewritten
3.4.1	9945	1046	10991	Due to code failures or loss, projects may be delayed and need to be rechecked and rewritten
4.3.1	1146	300	1446	Due to code failures or loss, projects may be delayed and need to be rechecked and rewritten
4.3.2	4690	500	5190	Due to code failures or loss, projects may be delayed and need to be rechecked and rewritten

4.2.1	61456	2003	63459	Due to software faults, projects may be delayed and require changes and testing of the software system
4.2.2	37280	1530	38810	Due to software faults, projects may be delayed and require changes and testing of the software system
4.4.1	2292	500	2792	Due to software faults, projects may be delayed and require changes and testing of the software system
4.4.2	2292	500	2792	Due to software faults, projects may be delayed and require changes and testing of the software system
5.2.2	23642	4050	27692	Due to the quality of the hardware not working well, the hardware may need to be replaced or repaired, increasing the budget and possibly delaying the project
5.3.2	4810.5	2039	6849.5	Due to the quality of the hardware not working well, the hardware may need to be replaced or repaired, increasing the budget and possibly delaying the project
5.2.2	23642	4050	27692	Hardware shortages for some reason and hardware prices may increase from estimated costs Projects may be delayed due to unavailability of hardware or the need to re-select new hardware products
5.3.1	4810.5	1000	5810.5	Due to damaged hardware that needs to be replaced or repaired, the price of the hardware may increase compared to the estimated cost and the project may be delayed
6.2.1	1719	84	1803	Due to problems with system testing, projects may be delayed and need to be re-tested after re-debugging
6.3.1	1719	84	1803	Due to problems with system testing, projects may be delayed and need to be re-tested after re-debugging
6.3.2	965	84	1049	Due to problems with system testing, projects may be delayed and need to be re-tested after re-debugging
6.4.1	2292	84	2376	Due to problems with system testing, projects may be delayed and need to be re-tested after re-debugging
6.4.2	2292	84	2376	Due to problems with system testing, projects may be delayed and need to be re-tested after re-debugging
7.4.1	8884	3000	11884	Due to information security issues caused by data collection, the system needs to be regularly maintained and optimized against viruses and external attacks
Total Contingency Reserve (\$)	26668			

## **10. Conclusion**

In conclusion, this project could finish the parking system on time within \$350,000. The new parking system can achieve these successes:

For the budget:

2022 Q1 cost \$85,053.5.

2022 Q2 cost \$138,915.5.

2022 Q3 cost \$102,122.

Overall cost is \$326,091 including \$26,668 Contingency Reserve Budget.

For stakeholders with the UNSW 2025 Strategy:

- Users can have a better parking experience than it was before.
- Users can check the rest parking lots online.
- Users can save the checkout time by using online paying.
- UNSW can avoid losing money through computerized costing.
- UNSW can develop digital campus.
- UNSW can reduce the cost of parking lots management.
- Improved vehicle safety for users.
- The satisfaction of students and staff can be improved.
- Saving the cost of Human Resources for UNSW.

## **11. Reference**

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## 12.Appendix

### 12.1 Budget Time Phase

TABLE 12.1 BUDGET TIME PHASE

Activities	Budget (\$)	Duration (Days)	2022											
			2022Q1			2022Q2			2022Q3			2022Q4		
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.1.1	0	4	\$0											
1.1.2	0	3	\$0											
1.2.1	0	2	\$0											
1.2.2	0	6	\$0											
1.3.1	0	8	\$0											
1.3.2	0	8	\$0											
1.3.3	3000	16	\$3,000											
1.4.1	0	4	\$0											
1.4.2	0	12	\$0	\$0										
1.5.1	11700	237	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300			
1.5.2	11700	237	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300	\$1,300			
2.1.1	0	4	\$0											
2.2.2	0	10		\$0										
2.2.1	0	10		\$0										
2.3.1	0	1		\$0										
2.3.2	0	1		\$0										
2.4.1	0	2		\$0										
2.4.2	0	3		\$0										
3.1.1	1662	5			\$1,662									
3.1.2	3324	12				\$3,324								
3.2.1	3324	14					\$3,000							
3.2.2	2493	6						\$324						
3.3.1	2982	10							\$2,493					
3.3.2	7952	33								\$2,982				
3.4.1	9945	40									\$7,000			
3.5.1	0	7										\$952		
4.1.1	2469	10										\$4,900		
4.2.1	61456	10											\$2,000	
4.2.2	37280	10												\$61,456
4.3.1	1146	5												\$37,280
4.3.2	4690	5												
4.4.1	2292	14												\$1,146
4.4.2	2292	14												
4.5.1	1146	10												\$1,146
4.5.2	1146	10												
5.1.1	1146	7												\$1,146
5.2.1	0	7												
5.2.2	47284	8												\$0
5.3.1	48105	10												\$47,284
5.3.2	48105	10												\$2,810.50
6.1.1	1719	10												\$2,000
6.2.1	1719	10												
6.3.1	1719	10												
6.3.2	965	4												\$965
6.4.1	2292	14												
6.4.2	2292	14												
6.5.1	1719	10												
7.1.1	4690	6												
7.2.1	17970	7												
7.3.1	16458	7												
7.3.2	1146	3												
7.4.1	8884	3												
7.5.1	3120	3												
7.5.2	4680	3												
Reserve	\$24,668													\$26,668
Total (Quarterly)			\$85,053.50			\$138,915.50			\$102,122					
<b>Total</b>														<b>\$326,091</b>