Group Assignment Cover Sheet

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Course code: GSOE 9820_____ **Course name: Project Management,** Term 1 2022

Date submitted: 29 MARCH 2022

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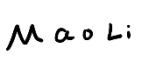
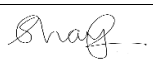
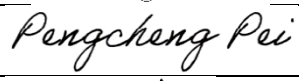
Li	Mao	z5346632	16.67 %	
Dasgupta	Shayon	z5379001	16.67%	
Pei	Pengcheng	z5405730	16.67%	
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Grading procedure:

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 $F = R \times C \times N$ *(where N is number of group members).*
5. You will be individually notified of *F* and *R*.

GSOE9820: PROJECT MANAGEMENT

ROBOTICS AND AI FOR TfNSW

Project Management Plan

Submitted By: Group 4

Group Member	zID	Key Contributions
Ho Wan Hou	z5315885	Cost Management, contingency reserve
John Van Pham	z3216645	Project Charter, Scope, Report Compilation and Review, Coordinator
Mao Li	z5346632	Risk Management, RBS, Risk Chart
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PROJECT CHARTER

Background

Transport for New South Wales (TfNSW) has long-term plans to enhance transport through the adoption of innovation in technology. The roadmap labelled 'Future Transport Strategy 2056' [1] includes various strategic objectives in line with this vision for technology and innovation in road infrastructure / transport.

This project focuses on one of the key areas identified in this roadmap, the implementation of Connected and Autonomous Vehicles (CAVs) on NSW roads and is the focus over the next five years, outlined in the 'Connected and Automated Vehicles Plan' [2]. CAVs enable a network of vehicles to operate effectively and efficiently with some of the potential benefits including reduced road fatality, improved journey times, and better transport access for customers and the community.

To enable the adoption of CAVs on NSW roads, projects must be undertaken to provide the foundation for future developments. TfNSW is responsible for commissioning various projects in line with the immediate CAV plans [2], and also the longer term 2056 Strategy [1]. It has commissioned this project to collect and analyse data necessary for the future planning and development of NSW road infrastructure. The outcomes will also highlight areas where technology, in particular AI-based technology can contribute to improved services to the community in areas such as network management / optimisation, incident response, and positioning.

Purpose Statement

To enable adoption of CAV and other AI-based technologies in NSW roads for safe and efficient movement of people and goods, delivering improved services for customers and the community.

Project Objectives

To achieve the goals outlined in the background above, various objectives have been identified for this project.

- Provide TfNSW with an in-depth understanding of the current compatibility of NSW road infrastructure for CAV use.
- Identify short-term enhancements required so that TfNSW can plan for future road infrastructure development.
- Identify and recommend where the CAV data can be used for TfNSW's development of other AI based technologies in the areas of network management / optimisation, incident response, and positioning.

Key Stakeholders

- Chris Bennetts – Project Sponsor (TfNSW: Technology and Innovation)
    - Responsible for general project oversight and advice
    - The project outcomes enable Chris Bennetts to implement the TfNSW CAV and Technology strategies in line with their immediate and long-term goals
- Joost de Kock – Steering Committee (TfNSW: Customer Strategy and Technology)
    - Head of the division of TfNSW that is sponsoring and providing the $2.0m funding
    - The project's results provides the information required for Joost de Kock to better implement TfNSW strategy
- Camilla Drover – Steering Committee (TfNSW Infrastructure and Place)
    - Head of TfNSW Infrastructure with the authority to implement the recommendations outlined in the outcomes of this project.
    - The project results provide the necessary foundation for Camilla Drover to improve road infrastructure for CAV use.
- Thomas Anderson – Project Manager

Project Success Criteria

- Long-term road infrastructure projects enter planning phases based on the project outcomes.
- Short-term road infrastructure modifications are commissioned based on the identifications made in the project.
- AI-based technology research projects are commissioned based on the CAV data and the project recommendations.
- CAVs operate successfully on the modified NSW road infrastructure.

Project Execution

The project management plan should be executed as per the baselines outlined in this report for the following knowledge areas:

1. Scope
2. Stakeholder Management
3. Schedule Management
4. Cost Management
5. Risk Management
6. Communication Management
7. Human Resource Management

The baselines should be carefully reviewed by the Project Team before commencement of the project so that there is a clear understanding of the expected outcomes. This ensures that during execution the Project Team is better prepared to identify project divergence and address this in a timely manner.

The knowledge areas above should be monitored on a fortnightly basis and compared against the baselines outlined in this report. Where the execution differs from the baseline, the plans should be revised to match the current state of the project and the projected trend. Additionally, the project should be monitored for risk events, and in such case that an event occurs, the Project Team should follow the strategies outlined in the Risk Management section of this report.

The Risk Register should be updated for new risks if these are found during the execution of the project.

1. SCOPE

1.1. Scope Statement

This project will retrofit and trial 12 CAVs on NSW roads for a budget of $2.0m in two years for TfNSW. The trials must run between 1st July 2023 – 30th June 2024. AI, Sensor, and Software systems will be installed for data collection. The data collected will be used to produce an assessment of the compatibility of NSW road infrastructure for CAV operations, including the short-term enhancements required. Recommendations will be provided on how the CAV data can contribute to the development of AI-based technology in the areas of network management / optimisation, incident response, and positioning.

The project excludes traffic management services including signage and monitoring. The project is exempt from schedule constraints if extended Covid lockdowns occur. Existing TfNSW vehicles will be used for the trial.

Please see the Work Breakdown Structure (WBS) on the following pages for a breakdown of the complete scope. The WBS forms the Scope baseline.

1.2. Collect Requirements

The baseline project requirements have been determined from various sources. The 'Connected and Automated Vehicles Plan' document [2] presents the context to why the project is conducted and how it relates to the organisation's overall strategy. By collaborating with TfNSW through the Project Sponsor, Chris Bennetts, and using his Project Brief [4], the strategy has been converted to project requirements.

The requirements below must be addressed to successfully support TfNSW strategy for adoption of CAVs and other AI-based technology:

1. To retrofit and trial CAVs on NSW roads to assess the compatibility of the road infrastructure
2. To identify short-term infrastructure enhancements that are required to support the adoption of CAVs
3. To make recommendations on how the CAV data can contribute to the next generation of AI-based technologies of interest to TfNSW, which are: network management / optimisation, incident response, and positioning.
4. Budget is $2.0m, Project duration: 2 years, Trials held between 1st July 2023 to 30th June 2024

1.3. Project Deliverables

The main deliverables for the project are listed below. For a detailed scope breakdown see the Work Breakdown Structure (WBS) presented in the following sections.

1. Assessment and Recommendations for NSW Road Infrastructure – Report, Presentation, and Workshop
2. Recommendations for CAV data and AI-based Technology – Report, Presentation, and Workshop
3. CAV Trials Data – provided for the basis of TfNSW's plans in AI-based technology

1.4. Project Exclusions / Assumptions

1. The project will retrofit existing TfNSW vehicles for the trial rather than procure from an external source.
2. The vehicle will not be left in its 'CAV' state for TfNSW at the completion of the project. The CAVs will be disassembled, and the parts disposed or sold. The vehicles will then be returned to TfNSW.
3. The project scope does not include services for road management such as traffic management, signage, and monitoring.
4. The project schedule does not account for extended Covid lockdowns which will hamper the ability to collect data in the allocated dates.

1.5. Scope Validation

Scope validation involves formal acceptance of the deliverables by the Stakeholders. The deliverables of the projects are listed in 1.3 above. The various methods listed below refer to those described in PMBOK [3].

1. Internal Inspection – the Project Team will review the deliverables before formalising the publication to TfNSW. This will be through a process which examines and validates the scope / deliverables have been fulfilled.
2. Internal Decision Making – in the event of disagreement with scope validation, the Project Team will vote before formalising the handover to TfNSW.
3. External Acceptance - the scope delivery is formally accepted when the Sponsor and Steering Committee sign the acceptance document. The acceptance document will include a list of the Project Deliverables which can be individually accepted by the committee. As the deliverables are not easily measurable, the scope will include routine progress reports so that TfNSW preview the documents before finalisation.

1.6. Control Scope

The scope must be monitored for the duration of the project and compared to project baselines. The methods from PMBOK [3] are mentioned below.

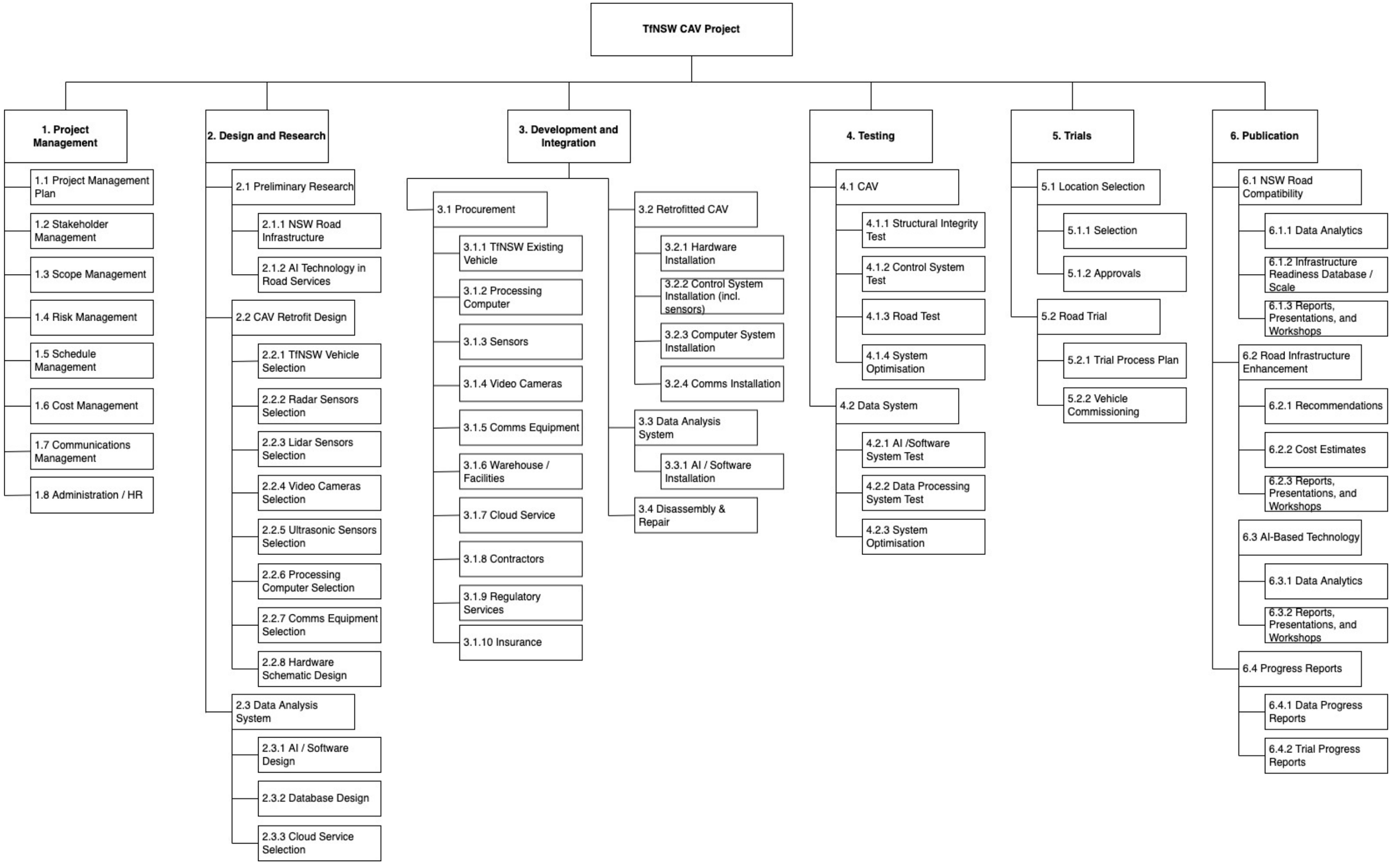
1. Variance and Trend Analysis – The scope progress should be compared routinely to the baseline to measure for scope variance. Analysis should be carried out to forecast the future scope delivery trend.
2. Change Request – If the Variance and Trend Analysis indicates the scope is not being completed according to the baseline, then a Change Request should be proposed. This must be approved after seeking Expert Judgement from the Sponsor and will result in an update to the Project Management Plan

1.7. Work Breakdown Structure (WBS)

The input to the WBS includes the Scope Statement and Requirements listed in the Project Charter. The WBS forms the Scope Baseline. Various techniques from PMBOK [3] were used in its development including:

1. Expert Judgement – The Project Sponsor was engaged in weekly meetings to define the scope and deliverables according to organisational strategy/objectives. The Sponsor also advised on the validity of the WBS for capturing the completeness of the scope and ensuring it addressed TfNSW's requirements.
2. Decomposition – In addition to the formal deliverables, group brainstorming and Sponsor guidance was used to identity additional internal deliverables needed to support the formal deliverables. Together these formed the main deliverables. The main deliverables were decomposed until they were of sufficient simplicity that each 'Work Package' could be costed, scheduled, and managed by a single person. Each Work Package has a unique identifier.

Work Breakdown Structure



2. STAKEHOLDER MANAGEMENT

2.1. Stakeholder Identification

The stakeholders relevant to the project were identified through review of the Project Requirements [4], Strategy Document 'Connected and Automated Vehicles Plan' [2], and TfNSW Leadership Organisational Chart presented in the Project Sponsor's Presentation [5]. The Project Team also leveraged the judgement of the Project Sponsor, for further guidance on the key stakeholders within TfNSW. The stakeholders are presented in the register below. Refer to Section 6 for the communication plan for each of the stakeholders.

(I = Interest, P = Power)

Name	Category	Classification	Benefits / Expectations
Chris Bennetts TfNSW Technology and Innovation	Project Sponsor	Primary (I = 5, P = 5)	1. Successful CAV trials on NSW roads 2. Project Team produces the necessary information to support adoption of CAVs on NSW roads 3. Project Team produces the necessary information to plan for future AI-based technologies. 4. Project deliverables expedites the adoption of technology and innovation resulting in improved services for the community.
Thomas Anderson Project Manager	PM Team	Primary (I = 5, P = 4)	1. Successful delivery of the project objectives 2. Enhance opportunities for future collaboration with TfNSW.
Joost de Kock TfNSW: Customer Strategy and Technology (Division Head)	Steering Committee	Primary (I = 4, P = 5)	The project deliverables will expedite the adoption of technology for improved services to TfNSW customers.
Camilla Drover TfNSW: Infrastructure and Place (Division Head)	Steering Committee	Primary (I = 3, P = 5)	The project deliverables enable the planning for NSW road infrastructure enhancements in line with the 5-year CAV plan.
Daniela Fontana TfNSW: State Transit	Steering Committee	Primary (I = 3, P = 4)	The project data informs about the impact of CAVs and AI-technology on public transport and public commuters.
Simone Roberts TfNSW: Advanced Analytics and Insights	Steering Committee	Primary (I = 4, P = 5)	The project data is of sufficient volume and quality to use as the basis for future planning of AI-based technology projects.
Project Team	PM Team	Primary (I = 5, P = 3)	Successful support of the Project Manager for project delivery.
Contractors	External	Secondary (I = 2, P = 2)	Provide a service aligned with the expectations of the Project Team.
Suppliers	External	Secondary (I = 2, P = 2)	Provide equipment of high quality matching the required specifications.
Local Mayor	External	Secondary (I = 3, P = 4)	The local council improves its chances of being an early adopter of CAVs in future, resulting in better services for their community as soon as possible.

Name	Category	Classification	Benefits / Expectations
Stephanie Anne Cooke NSW Emergency Service Minister	External	Tertiary (I = 2, P = 2)	The project outcomes indicate and recommend how AI-based technologies can improve emergency services resulting in improved response.
Taxpayer	External	Tertiary (I = 1, P = 1)	The projects outcomes lead to plans which utilise taxpayer money for direct community benefits related to the road network.
Local Community	External	Tertiary (I = 1, P = 1)	The project leads to programs which support a wide range of flexible, affordable journey options and connections between people and communities.
Public Commuters	External	Tertiary (I = 1, P = 1)	The project leads to improved transport services with better flexibility, reliability, safety, and commute times.

2.2. Stakeholder Strategy

The current and desired engagement levels of the stakeholders are analysed. From this the communication plan is tailored to individual stakeholders. Each stakeholder's interest and power are also listed above.

Stakeholder	Unaware	Resistant	Neutral	Supportive	Leading
Chris Bennetts					C, D
Thomas Anderson					C, D
Joost de Kock				C	D
Camilla Drover			C	D	
Daniela Fontana			C	D	
Simone Roberts				C	D
Project Team					C, D
Contractors		C		D	
Suppliers		C	D		
Local Mayor			C	D	
Stephanie Anne Cooke		C	D		
Taxpayer	C		D		
Local Community	C		D		
Public commuters	C			D	

C = Current Position, D = Desired Position

3. SCHEDULE MANAGEMENT

In order to ensure the timely completion of any project a project schedule is necessary. The Critical Path method [3] has been selected as the scheduling method for this project. The activities derived from the project scope and project deliverables has been determined through expert judgement and meetings with the project team [3]. The duration of the respective activities has been determined using expert judgement, team meetings and the bottom-up approach [3][5].

The Project schedule is represented in the following formats:

1. Activity List
2. Gantt Chart
3. Project Schedule Network Diagram

3.1. Activity List

The activity list includes the schedule activities required for the project [3]. It includes an activity identifier and the work packages associated with it.

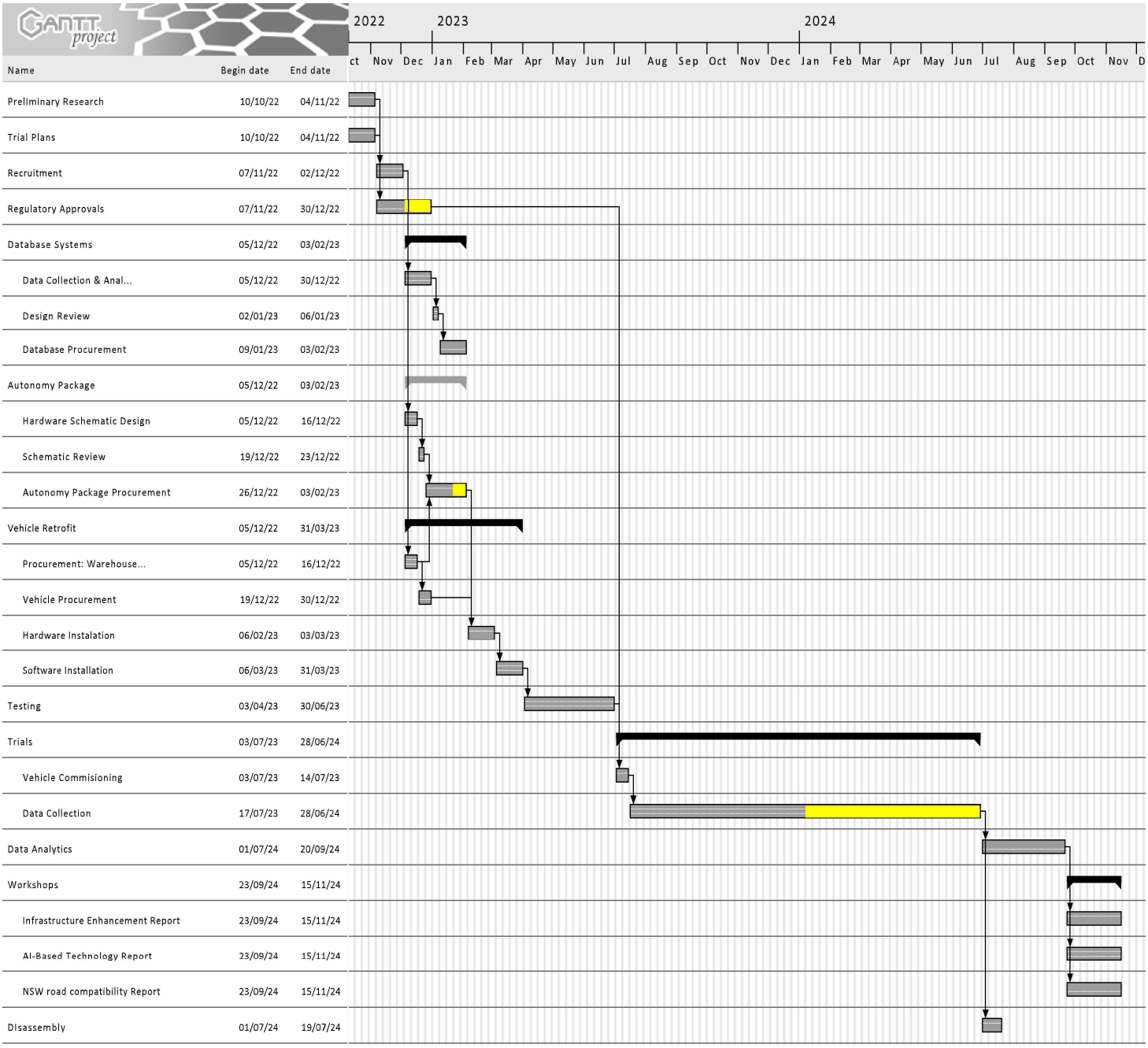
Activity ID	Activity	WPID	Work Package
1	**General Project Management Activities**	1.1	Project Management Plan
		1.2	Stakeholder Management
		1.3	Scope Management
		1.4	Risk Management
		1.5	Schedule Management
		1.6	Cost Management
		1.7	Communications Management
		1.8	Administration / HR
2	**Preliminary Research**	2.1.1	Research: NSW Road Infrastructure
		2.1.2	Research: AI Technology in Road Services
		2.2.1	CAV Retrofit Design: TfNSW Vehicle Selection
		2.2.2	CAV Retrofit Design: Radar Sensors Selection
		2.2.3	CAV Retrofit Design: Lidar Sensors Selection
		2.2.4	CAV Retrofit Design: Video Cameras Selection
		2.2.5	CAV Retrofit Design: Ultrasonic Sensors Selection
		2.2.6	CAV Retrofit Design: Processing Computer Selection
		2.3.3	Data Collection System: Sensors Selection
		2.3.4	Data Collection System: Communication Equipment Selection
		2.3.5	Data Collection System: Cloud Service Selection

Activity ID	Activity	WPID	Work Package
3	**Trial Plans**	5.1.1	Location Selection: Assessment and Selection
		5.2.1	Road Trial: Trial Process Plan
4	**Regulatory Approvals**	3.1.9	Procurement: Regulatory Services
		5.1.2	Location Selection: Approvals
5	**Recruitment**	3.1.8	Procurement: Contractors
6	**Database Systems**		
6.1	Data Collection and Analysis Systems Design	2.3.1	Data Collection System: AI / Software Design
		2.3.2	Data Collection System: Database Design
6.2	Design Review	1.4	Risk Management
		2.3.1	Data Collection System: AI / Software Design
		2.3.2	Data Collection System: Database Design
6.3	Database Procurement	3.1.7	Procurement: Cloud Service
		3.3.1	Data Collection System: AI / Software Installation
7	**Autonomy Package**		
7.1	Hardware Schematic Design	2.2.8	Hardware Schematic Design
7.2	Schematic Review	2.2.8	Hardware Schematic Design
		1.4	Risk Management
7.3	Autonomy Package Procurement	3.1.2	Procurement: Processing Computer
		3.1.3	Procurement: Sensors
		3.1.4	Procurement: Video Cameras
		3.1.5	Procurement: Comms Equipment
8	**Vehicle Retrofit**		
8.1	Procurement: Warehouse/ Installation Facility	3.1.6	Procurement: Warehouse / Facilities
8.2	Vehicle Procurement	3.1.1	Procurement: TfNSW Existing Vehicle
8.3	Hardware Installation	3.2.1	Retrofitted CAV: Hardware Installation
		3.2.2	Retrofitted CAV: Control System Installation
		3.2.4	Data Collection System: Comms Installation
8.4	Software Installation	3.2.3	Retrofitted CAV: Computer System Installation
		3.3.1	Data Collection System: AI / Software Installation

Activity ID	Activity	WPID	Work Package
9	**Internal Testing and Optimizations**	4.1.1	CAV: Structural Integrity Test
		4.1.2	CAV: Control System Test
		4.1.3	CAV: Road Test
		4.1.4	CAV: System Optimisation
		4.2.1	Data System: AI / Software System Test
		4.2.2	Data System: Data Processing System Test
		4.2.3	Data System: Optimisation
10	**Trials**		
10.1	Vehicle Commissioning	5.2.2	Road Trial: Vehicle Commissioning
10.2	Data Collection	6.1.1	NSW Road Compatibility: Data Analytics
		6.3.2	AI-Based Technology: Data Analytics
		6.4.1	Progress Reports: Data Progress Reports
		6.4.2	Progress Reports: Trial Progress Reports
11	**Data Analytics**	6.1.1	NSW Road Compatibility: Data Analytics
		6.3.2	AI-Based Technology: Data Analytics
12	**Workshops**	6.1.2	NSW Road Compatibility: Infrastructure Readiness Database / Scale
		6.1.3	NSW Road Compatibility: Reports, Presentations, and Workshops
		6.2.1	Road Infrastructure Enhancement: Recommendations
		6.2.2	Road Infrastructure Enhancement: Cost Estimates
		6.3.3	AI-Based Technology: Reports, Presentations, and Workshops
13	**Disassembly**	3.4	Disassembly and Repair

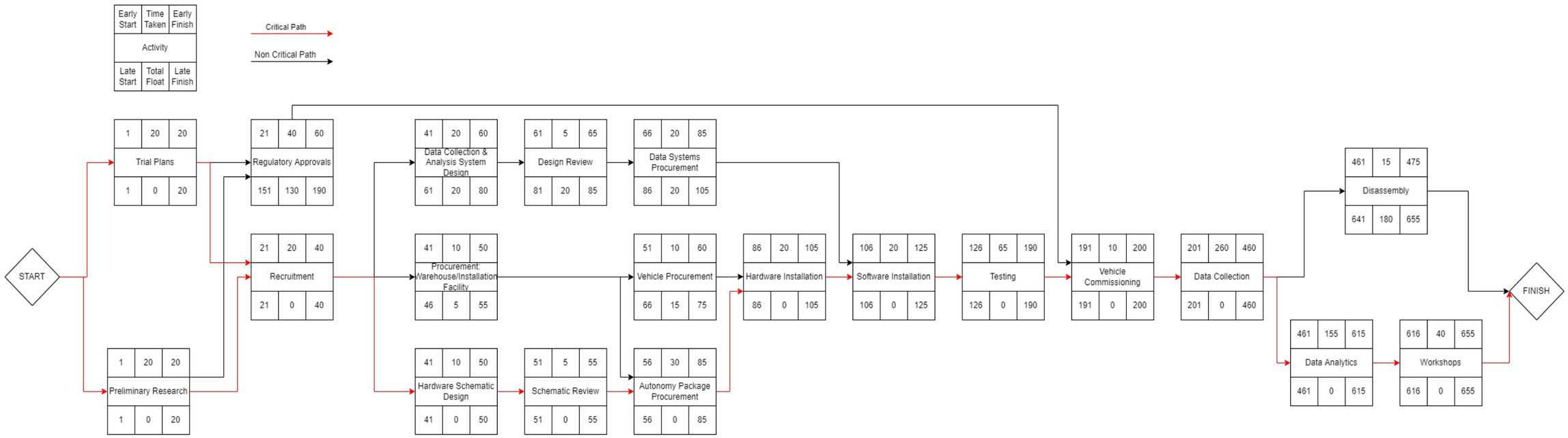
3.2. Gantt Chart

Time Buffers as part of risk management [3] (represented in yellow) have been added to certain activities to compensate for unplanned delays in the project schedule. The project starts on 10th October 2022 and ends on 15th November 2024.



3.3. Project Schedule Network Diagram

The network diagram represents the schedule in the Activity on Node (AON) format, the critical path is highlighted in red and the total duration of the project is 655 days.



4. COST MANAGEMENT

4.1. Overview of Cost Estimates

A bottom-up estimation is used to determine the overall cost of the project. Lowest level work packages from the WBS are broken down into activities illustrated in 3.1 Activity List. The cost of individual activities is budgeted using various estimating techniques from PMBOK [3].

Expert judgement is applied in estimating the cost for procuring autonomy packages and components for the CAVs. The project management team does not have prior experience in retrofitting a CAV, therefore, by referring to publications on related topics [6] a more accurate estimate was determined.

The cost of warehouse is determined by using expert judgement [7] and parametric estimation. This allows the project team to estimate the cost based on the desired size of the warehouse.

A bottom-up approach is used for budgeting the contingency reserve. The contingency reserve is approximately 19% of the whole project budget which is $345,141. Details on contingency reserves are shown in 5.2 Risk Register.

Activity ID	Activities	Responsible Parties	HR Cost	Non-HR Cost	Work Package Cost Estimates	Risk No.	Contingency Reserves	Cost Baseline
1	**General Project Management Activities**	Project Manager	240,000		240,000			240,000
2	**Preliminary Research**	Senior Engineering Consultant	11,034		11,034			11,034
3	**Trial Plans**	*PM Team	24,615		24,615			24,615
4	**Regulatory Approvals**	*PM Team	24,615		24,615			24,615
5	**Recruitment**	*PM Team	24,615		24,615	1.5	8,851	33,466
6	**Database Systems**							-
6.1	Data Collection and Analysis Systems	Data Scientist, Software Engineer	16,398		16,398			16,398
6.2	Design Review	Senior Engineering Consultant	2,759		2,759			2,759
6.3	Database Procurement	*PM Team	24,615	187,000	211,615	3.1	66,000	277,615
7	**Autonomy Package**							-
7.1	Hardware Schematic	Mechatronics Engineer	3,448		3,448			3,448
7.2	Schematic Review	Senior Engineering Consultant	2,759		2,759			2,759
7.3	Autonomy Package Procurement	*PM Team	24,615	120,000	144,615	1.1, 3.3	26,000	170,615
8	**Vehicle Retrofit**				-			-
8.1	Procurement: Warehouse	*PM Team	12,308	238,125	250,433	3.1	95,250	345,683
8.2	Vehicle Procurement	*PM Team	12,308	315,360	327,668	3.1	131,760	459,428
8.3	Hardware Installation	Mechatronics Engineer, Mechanic, Electrical Engineer	18,667		18,667			18,667
8.4	Software Installation	Software Engineer	7,663		7,663			7,663
9	**Internal Testing and Optimizations**	Mechatronics Engineer, Software Engineer, Mechanic, Electrical Engineer	85,571		85,571			85,571
10	**Trials**				-			-
10.1	Vehicle Commisioning	*PM Team	12,308		12,308			12,308
10.2	Data Collection	Data Scientist, *PM Team	216,782		216,782	3.2	17,280	234,062
11	**Data Analytics**	Data Scientist	52,414		52,414			52,414
12	**Workshops**	Data Scientist, *PM Team	34,943		34,943			34,943
13	**Disassembly**	Mechatronics Engineer, Software Engineer, Mechanic, Electrical Engineer	19,747		19,747			19,747
	Total		632,184	860,485	1,492,669		345,141	1,837,809

*HR cost for PM team is calculated on a pro rata basis

4.2.Salary Breakdown

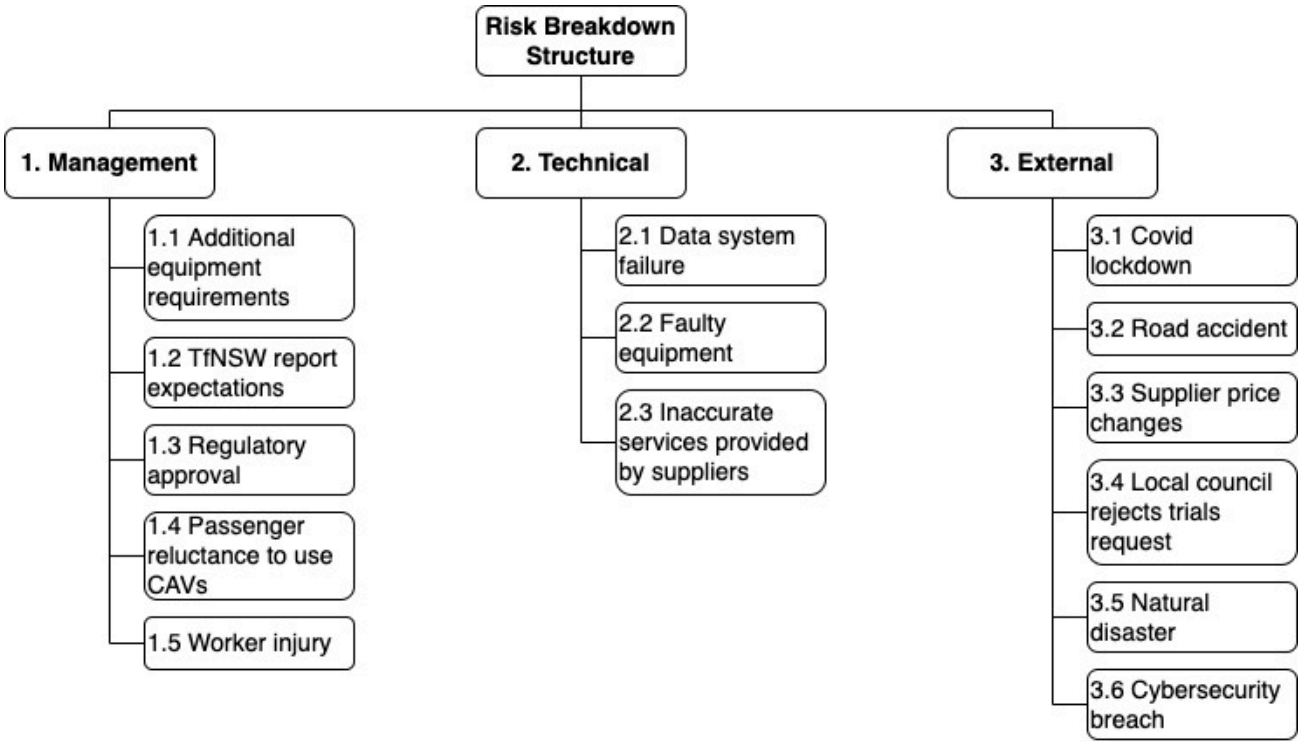
Annual Salary based on Glassdoor and recruitment websites. Refer to Section 7 - Human Resources, for position descriptions.

Position	**Annual Salary (AU$)**
Software Engineer	100,000
Data Scientist x 2	114,000 (each)
Electrical Engineer	86,000
Mechatronics Engineer	90,000
Mechanic	67,600
Consultant	144,000
Project Manager	120,000
Project Team Member x 2	80,000 (each)

5. RISK MANAGEMENT

5.1. Risk Identification and Categorisation

Risks were identified through various methods from PMBOK [3] including leveraging the Sponsor's Expert Judgement during meetings and their presentation [5], analysing the TfNSW CAV plan [2], analysing the Project Brief [4], and project team brainstorming. To complement the methods above, the Risk Breakdown Structure (RBS) was used to categorise and foster risk ideas. The risks identified are presented below. The Risk Register in the next section outlines the strategies to address these risks.



5.2. Risk Register

The Risk Register on the next page presents the management strategy for each of the risks. The risks are also evaluated to produce a score (the multiplication of factors relating to probability, severity, and ease of detection). This score helped prioritise the selection of risk strategies. It also provides an indication for areas to monitor during project execution phases.

5.3. Opportunities

Similar to techniques used to identify and manage risks, project opportunities are also identified and managed as shown below.

Opp. ID	Identified Opportunity	Strategy	Benefit
1	The early trials data may reveal how the trials can be improved to collect more meaningful data.	Enhance – increase the chance of this occurring by analyzing data periodically for indications where the trial can be improved.	TfNSW receives more meaningful information from the conclusions of the report which results in better targeted projects in the future.
2	The trials could discover how TfNSW can improve their current services.	Accept – communicate this information to TfNSW if it becomes available.	TfNSW can provide immediate improved services to their customers.
3	The trials could indicate safety concerns with the current road infrastructure.	Accept – communicate the safety concerns to TfNSW if issues are found.	TfNSW can put measures in place to immediately improve the safety of road users and commuters.

Risk Register

					Risk Responses			Risk Evaluation			
Risk ID	**Risk Description**	**Category**	**Owner**	**WPs**	**Strategy**	**Risk Response / Action**	**Risk Contingency**	**Probability**	**Severity**	**Ease of Detection**	**Total Score**
1.1	The design phase reveals additional equipment that is required and results in unplanned for budget pressure.	Management	Project Manager, Mechatronics Engineer	1.6, 1.8, 3.1	Mitigate	Human Resources: hire experienced design contractors so that this is not a repeat occurrence.	Cost: Allocate $20,000 as contingency to budget for additional equipment.	4	4	2	32
1.2	TfNSW receives a different report to what they expected and therefore the information provided is not useful to support their strategy.	Management	Project Manager	1.2, 1.3, 1.7, 6.1.3, 6.2.3, 6.3.2, 6.4.2	Avoid	Stakeholders / Communication: steering committee stakeholders to receive progress reports. Scope: scope to include progress reports.		4	5	4	80
1.3	Regulatory approval is not granted on first attempt and delays the schedule.	Management	Project Manager	1.5, 3.1.9	Mitigate	Schedule: apply for regulatory approval as early as possible.	Schedule: Assign time float of up to 4 weeks to resolve regulatory approval concerns.	4	4	1	16
1.4	Passengers are reluctant to use the CAVs and therefore the trial is unable to collect sufficient/quality data.	Management	Project Manager, Project Team	1.7, 5.2	Mitigate	Communication: run community awareness programs, survey passengers for feedback and adjust trial plan accordingly.		3	3	5	45
1.5	A worker is injured during the project resulting in delays and legal issues.	Management	Project Manager, Project Team	1.6, 1.7, 1.8, 3.1.10, 3.2, 3.3, 3.4, 4, 5	Mitigate, Transfer	Communication: conduct safety inductions. Cost: Purchase workers compensation insurance to transfer financial risk. Premium rates are estimated to be 1.4% of total HR cost.	Human Resources: ensure there is a chain of command so someone else can take-over if someone is injured.	2	3	1	6
2.1	Data collection system breaks down leading to loss of trials data.	Technical	Project Manager, Project Team, Software Engineer	1.3, 1.5, 1.7, 2.3, 5.2, 6.4.1	Mitigate	Scope: include monitoring and compilation of data reports weekly	Communication: immediate communication with software engineer to repair issue. Schedule: add float to trials.	3	5	5	75
2.2	Faulty or late supply by supplier resulting in project delay	Technical	Project Manager, Project Team, Suppliers	1.5, 1.8, 3.1	Mitigate, Transfer	Human Resources: purchase from reputable suppliers Contract: the contract is written so that delay caused by faulty or late delivery is compensated by the supplier.	Schedule: Assign 2 weeks as time float in schedule for re-delivery of equipment.	2	5	1	10
2.3	Suppliers/Contractors delivery product/services that does not match the requirements	Technical	Project Manager, Project Team, Suppliers, Contractors	1.7, 1.8, 2.2, 2.3, 3.1	Avoid	Human Resources: hire experienced personnel. Communication: frequent communication between the Project Team and Suppliers/Contractors		4	5	5	100

					Risk Responses			Risk Evaluation			
Risk ID	**Risk Description**	**Category**	**Owner**	**WPs**	**Strategy**	**Risk Response / Action**	**Risk Contingency**	**Probability**	**Severity**	**Ease of Detection**	**Total Score**
3.1	Covid lockdown reduces the available window for trials to collect information	External	Project Manager, TfNSW	1.3, 1.7, 5, 6	Mitigate, Transfer	Communication: inform TfNSW that a lockdown is out of the project's control, but that float is added in the schedule to reduce the consequence of this as reasonably possible (transfer/share risk with TfNSW) Schedule: run road trial as early as possible. Scope: Covid lockdown exclusions should be included in the scope.	Schedule: include float in schedule for trial overrun Cost: $293,010 and 6 months as contingency is made available. The contingency reserve includes additional rental cost on vehicles, warehouse, and database.	3	5	1	15
3.2	In the trials, the CAV is involved in a road accident	External	Project Manager, Project Team	1.6, 1.7, 1.8, 3.1.10, 5.2	Mitigate, Transfer	Human Resources: trials process plan to include operator training for TfNSW drivers Cost: $17,280 is allocated to purchase comprehensive car insurance for 12 CAVs to transfer financial risk.	Human Resources: revise training procedures Communication: organise repair work immediately, inform key stakeholders	2	5	1	10
3.3	Suppliers change their prices during the project resulting in budget pressure	External	Project Manager, Project Team	1.6, 3.1	Transfer, Accept	Enter contracts with suppliers and include acceptable price fluctuation in the contract.	Cost: Set the acceptable price fluctuation to be 5%. Allocate $6,000 (5% of Autonomy Package Procurement) as contingency reserve.	2	4	1	8
3.4	Local council does not approve the CAV to operate in their location	External	Project Manager, Project Team	1.3, 1.7, 5.1	Avoid	Communication: contact councils early for approval Scope: have a backup location ready		3	5	1	15
3.5	Natural disaster occurs in the location of the trial	External	Project Manager	1.3, 1.7, 5.1, 5.2.1	Accept	Scope: have more than one location ready, trials process plan should include backup location.	Communication: communicate with all relevant stakeholders about change of trials location.	1	5	1	5
3.6	There is a cybersecurity attack which results in TfNSW passenger privacy issues.	External	Project Manager	1.2, 1.7, 4.2	Mitigate	Scope: include testing of the systems before commencement of trials.	Communication: immediate communication with Sponsor if a breach occurs.	1	5	5	25

6. COMMUNICATION MANAGEMENT

6.1. Overview

The implementation of the project not only requires the cooperation between various departments, but also needs to establish regular communication with the stakeholders. Therefore, communication management is an integral part of the project. It is also crucial for implementing the risk management strategies listed in 5.2 Risk Register.

6.2. Communication Methods and Goals

Various methods from PMBOK [3] were used to produce the communication plan. Different communication methods have different effectiveness, therefore selecting the right method according to the stakeholders plays an important role. The stakeholder classifications have been analysed and are used to guide communication management. The target audience and frequency of communication is also reflective of the risk control measures. Using the correct technology for the target audience was also considered.

The table below shows the details of stakeholder communication.

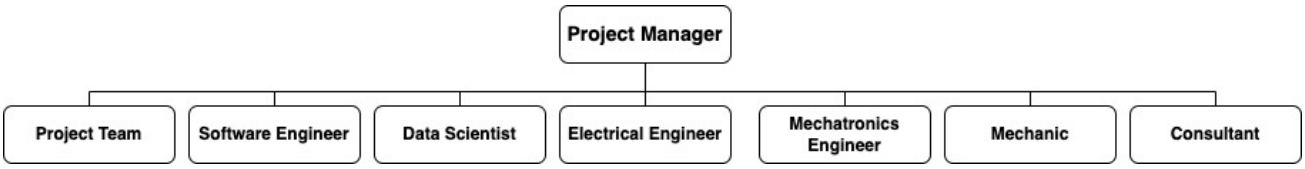
Stakeholder	**Frequency**	**Medium**	**Objectives**	**Deliverable**
Chris Bennetts	Monthly	- Email - F2F - Online Meetings	- Project progress updates - Risk awareness - Project summaries	- Meeting minutes - Reports - Presentations - Progress reports
Thomas Anderson	Daily	- Email - F2F - Online Meetings	Effective and careful management/execution of project	Meeting minutes
Joost de Nock	Quarterly	- F2F - Online Meetings	Big-picture summary of project progress and outcomes	- Meeting minutes - Reports - Presentations - Progress reports
Camilla Drover	Quarterly	- F2F - Online Meetings	Big-picture summary of project progress and outcomes	- Meeting minutes - Reports - Presentations - Progress reports
Daniela Fontana	Quarterly	- F2F - Online Meetings	Big-picture summary of project progress and outcomes	- Meeting minutes - Reports - Presentations - Progress reports
Simone Roberts	Quarterly	- F2F - Online Meetings	Big-picture summary of project progress and outcomes	- Meeting minutes - Reports - Presentations - Progress reports
Project Team	Daily	- Email - F2F - Online Meetings	Effective and careful management/execution of project	Meeting minutes

Stakeholder	Frequency	Medium	Objectives	Deliverable
Contractors	Daily / Weekly	- Email - F2F - Online Meetings	- Ensuring project team requirements are clearly communicated - Effective monitoring of progress and quality - Ensure timely response to risk events - Safety	- Contracts - Meeting minutes
Suppliers	Daily / Weekly	- Email - F2F - Online Meetings	- Ensuring requirements are clear - Keeping track of order progress - Safety	- Purchase Orders - Meeting minutes
Stephanie Anne Cooke	Bi-Annually	- F2F - Online Meetings	Big-picture summary of project outcomes	Meeting minutes
Taxpayer	Twice	Email	- Introduce the project and get feedback - Present project results	Marketing material
Local Community	Twice	- Marketing Fliers - Online Surveys	- Introduce the project and get feedback - Present project results	Marketing material
Public Commuters	Quarterly	- Marketing Fliers - Online Surveys	- Introduce the project and get feedback from surveys - Encourage participation in trials	- Marketing material - Surveys
Local Mayor	Quarterly	Email	- Obtain council approval - Provide summaries of project	Meeting minutes

7. HUMAN RESOURCE MANAGEMENT

7.1. Organisational Diagram

The organisational diagram presents the individuals required to produce the extent of scope in the WBS. Note that these members are not necessarily working for the entire duration of the project.



7.2. Roles and Responsibilities

The required human resources are identified by a bottom-up estimation [3] through review of the WBS, schedule and cost requirements / limitations. Sponsor demonstrations [5] also provided a high-level guidance of the requirements. The salaries are presented in the Cost Management Plan, Section 4.

Position	Responsibilities	Requirements
Project Manager	• Develop, organise and monitor/update detailed project documents like the schedule and budget • Anticipate risks and employ effective risk management strategies • Manage external vendors and contractors by assigning tasks, communicating requirements, and tracking deliverables • Acquire, manage, and utilise the human resources required to carry out this project	• Tertiary Degree in Project Management or equivalent experience • 10 years' experience managing projects of similar magnitude and technical complexity • Familiarity with project management tools, methodologies • Strong interpersonal, written, and verbal communication skills
Project Team (2 People)	• Manage external contractors/suppliers • Compiling progress reports, final publications and prepare materials for workshops • Execute procurement • Handle recruitment activities • Supervise trials	• Bachelor's Degree in engineering field • 3 years' experience on technology projects • Strong interpersonal, written, and verbal communication skills
Software Engineer (Contractor)	• Developing high quality, secure and stable code for data collection system and CAV's computer system • Ensuring that the code meets the design requirements and conform to a standard coding style • Provide software installation support • Cleaning software data and sensitive information after the end of project	• Bachelor's Degree in Computer Science or equivalent • 5 years' experience with autonomous vehicles • Excellent programming skills • Experience with machine vision and machine learning
Data Scientists (Contractor) 2 People	• Provide expert knowledge for the design of the data collection system, including data testing requirements and cloud service selection • Run and optimise the data system during testing • Data analysis during and after road trials • Give insights on publications and workshops	• Bachelor's Degree in Computer Science • 5 years' experience with data analysis projects • Experience in data analysis tools and data systems for AI-based technology
Electrical Engineer (Contractor)	• Specify the requirements for sensors and other CAV equipment • Installation of sensors, cameras, control system. • Disassembly support	• Bachelor's Degree in Electrical Engineering • 5 years' experience in industry • Familiarity with engineering tools • Hands-on experience with CAVs • Strong knowledge of CAV sensors and equipment

Position	Responsibilities	Requirements
Mechatronics Engineer (Contractor)	• Specify the requirements of sensors and other hardware for CAV • Check the wiring of TfNSW vehicles and schematic of sensors and control system • Hardware installation and disassembly support	• Bachelor's Degree in Mechatronics Engineering • 5 years' experience in industry • Strong mathematical background and knowledge of radar and image processing, robust filtering for signal analysis
Mechanic (Contractor)	• Hardware installation • Disassembly and repair	• Relevant Mechanic's Certification • Familiarity with engineering tools • Hands-on experience with retrofitting vehicles • Demonstrated experience in the repair and operation of mechanical systems
Consultant (Contractor)	• Research CAVs and prepare responses to inquiries about project • Engineering decisions in accordance with CAV retrofit design and regulation pertaining to the project management • Oversee structural design and technical reviews	• Bachelor's Degree or equivalent • 5 – 10 years demonstrable experience with CAVs and AI Technologies • Experience supporting the procurement, design, installation, and testing of CAVs • Strong interpersonal and written and verbal communication skills

7.3. RACI Matrix

The RACI matrix outlines which team members are: Responsible (R), Accountable (A), Consulted(C), Informed (I) for each of the activities. For Activities ID, see Section 3.1 of this report.

Act. ID	Activities	Project Manager	Project Team	Software Engineer	Data Scientist	Electrical Engineer	Mechatronics Engineer	Mechanic	Consultant
1	**General Project Management Activities**	R	A						
2	**Preliminary Research**	A	A						R
3	**Trial Plans**	R	R						C
4	**Recruitment**	A	R						I
5	**Regulatory Approvals**	R	R	I	I	I	I	I	I
6	**Database Systems**								
6.1	Data Collection & Analysis System Design	I	I	C	R	I	I		C
6.2	Design Review	I	I	I	A	I	I		R
6.3	Database Procurement	A	R	I	C	I	I		C
7	**Autonomy Package**								
7.1	Hardware Schematic Design	I	I	I	I	I	R		C
7.2	Schematic Review	I	I	I	I	I	A		R
7.3	Autonomy Package Procurement	A	R	I	I	C	C	I	C

Act. ID	Activities	Project Manager	Project Team	Software Engineer	Data Scientist	Electrical Engineer	Mechatronics Engineer	Mechanic	Consultant
8	**Vehicle Retrofit**								
8.1	Procurement: Warehouse	A	R	I	I	I	I	I	I
8.2	Vehicle Procurement	A	R	I	I	I	I	C	I
8.3	Hardware Installation	I	I	I	I	R	A	I	C
8.4	Software Installation	I	I	R	I	I	I	I	I
9	**Testing**	A	A	R	I	R	R	R	C
10	**Trials**								
10.1	Vehicle Commissioning	R	R	I	I	I	I	I	I
10.2	Data Collection	A	A	I	R	I	I	I	I
11	**Data Analysis**	A	A	I	R	I	I	I	I
12	**Workshops**								
12.1	Infrastructure Enhancement Report	R	R	I	A	I	I	I	I
12.2	AI-Based Technology Report	R	R	C	A	I	I	I	I
12.3	NSW Road Compatibility Report	R	R	I	A	I	I	I	I
13	**Disassembly**	I	I	R	I	R	R	R	I

8. REFERENCES

[1] “Future Transport Strategy 2056”, Transport for NSW, Sydney, Australia, 2020.

[2] “Connected and Automated Vehicles Plan”, Transport for NSW, Sydney, Australia.

[3] “A Guide to the Project Management Body of Knowledge (PMBOK Guide)”, 6th ed., Newtown Square, Pennsylvania, USA: Project Management Institute, 2017.

[4] “Transport Project – GSOE9820 22T1”, Goh, D., Sydney, Australia 2022.

[5] “Discussions of the Connected Autonomous Vehicles (CAV) Project for Transport for NSW”, Goh, D., Online, 2022.

[6] Connected Places Catapult, "Market Forecast For Connected and Autonomous Vehicles", UK, 2020.

[7] Colliers, "Industrial second Half 2021", AU, 2021.