CONTENTS

1. INTRODUCTION

Risk management is defined as the 'processes of conducting risk management planning, identification, analysis, response planning and controlling risk on a project' (PMI 2013, p. 309). Risk management is an important project management knowledge area as it aims to decrease the likelihood of negative events, increase the likelihood of positive events and manage their impact on the four primary project constraints of cost, scope, schedule and resources (Mahendra, Pitroda & Bhavsar 2013).

This report proposes to generate a risk management plan for the High Street Level Crossing Removal Project in accordance with the Victorian Government Risk Management Framework (2009) based on a critical review of advanced concepts and practices in risk assessment and project management.

2. CONTEXT FOR RISK MANAGEMENT

2.1 Project Brief

The High Street, Reservoir Level Crossing Removal Project is part of the Victorian government initiative to remove 75 dangerous and congested level crossings in Melbourne city. The project aims to remove the existing level crossing and elevate the rail line by constructing a new Reservoir station over High Street. The two main problems identified at Reservoir level crossing are the traffic congestion experienced by road users due to prioritization of rail networks and the safety hazard for pedestrians around the level crossing. Removing the level crossing is expected to improve the transport network efficiency and deliver safer travel for the public, especially pedestrians.

2.2 Project Scope

The project includes, but is not limited to, the following:

- Demolition for the removal of Reservoir level crossing.
- Demolition and construction of a new Reservoir station, including a railway, car parks, loading and unloading stations, bicycle facilities and convenience stores.

- Road and railway works.
- Construction of underpasses and overpasses for pedestrians.
- Public realm improvements.
- Relocation of telecommunications infrastructure.

3. RISK MANAGEMENT PLAN

3.1 Risk Identification

Risk identification is the first step of risk management and is defined as the process of identifying unwanted events, outcomes or threats, as well as existing and emerging opportunities (PMI 2013). Risk identification is a crucial step in the risk management process because risks that go unidentified are excluded from further steps such as analysis and evaluation implying that proper mitigation strategies may not be implemented at the right time.

According to Odimabo, Oduoza and Suresh (2018), the most common tools and techniques used to identify risks in construction projects are :

- Brainstorming - It is the process of bringing together all relevant stakeholders in the project to identify sources of potential risks and opportunities. Brainstorming is an open approach that encourages large quantities of risks to be identified in a relatively short span of time.
- Delphi Technique - It involves a panel of experts in risk management to forecast risks and conduct risk analysis using questionnaires. The technique is similar to brainstorming, but participants do not collaborate with each other.
- Interviews - Relevant stakeholder and risk management experts are interviewed to elicit information regarding risks and opportunities in a project as well as gain insight on possible mitigation and contingency strategies. Interviews are mostly conducted as a follow-up to brainstorming and the Delphi-technique.
- Experiential knowledge - It is the process of gathering information regarding past experiences in similar projects to form an analogy that provides insights for risk identification.

- Documentation Review - It is the process of reviewing project documentation to identify areas of inconsistencies.

Other tools and techniques that can be employed in risk identification include decision trees, historical research, lessons learned, checklists, workshops, SWOT analysis, simulations, cause-effect diagrams, trend analysis, sensitivity analysis, process flowcharts, feasibility studies and issue logs (Hartley 2018). At the end of the risk identification stage, a comprehensive list of risk sources is generated after all stakeholders have reviewed and documented the potential risks in the project (PMI 2013).

This report has identified the preliminary risks in the High Street level crossing removal project through 'experiential knowledge' and 'documentation review', and the results are outlined in Table 1.

Table 1. List of risks identified in High Street Level Crossing Removal Project

ID	**Risk Category**	**Risk Description**
1	Socio-Political	State and federal legislation requirements may change
2	Socio-Political	Labor party may push for schedule compression
3	Socio-Political	Change in political party may halt/ delay project
4	Socio-Political	Competing projects in other states may drive resources away from Victoria

5	Financial	Project cost estimations may be incorrect
6	Financial	Exchange rate fluctuations may occur
7	Organisational	Contract documentation may not be properly reviewed
8	Organisational	Not all risks may be thoroughly identified by project team
9	Organisational	Workforce may have low productivity
10	Organisational	Equipment and material delivery may be delayed
11	Technical	Scope may change uncontrollably
12	Technical	Drawings and specifications may not match accurately
13	Physical	Unsafe working conditions may cause injury to workforce.
14	Physical	Public health and safety may be jeopardized
15	Construction	Material and resources may be used extensively
16	Construction	Unintentional damage to existing gas or power lines may occur
17	Construction	Local fauna and flora may be disturbed
18	Construction	Emission of dust and particulates to air may occur
19	Construction	Construction noise may affect residential and retail areas

20	Construction	Greenhouse gas emissions may occur
21	Community & Stakeholders	Rail and road operations may be disrupted
22	Community & Stakeholders	Local businesses may be interrupted
23	Community & Stakeholders	Local landowner may oppose the project
24	Environmental	Severe weather conditions may arise
25	Environmental	Natural disaster may occur

3.2 Risk Analysis

Following the risk identification comes the second stage of risk analysis. During this stage, the potential risks identified are analysed in detail to reduce the level of ambiguity regarding their consequences on the project (Hartley 2018).

An excellent technique to perform qualitative and quantitative risk analysis for a construction project is probability and impact assessment. It consists of two stages:

- Risk Probability Assessment - The process of determining the likelihood of a risk occurring (PMI 2013). Risk probability can be scored by assigning a qualitative descriptor ranging from ‘rare’ to ‘certain’ and a quantitative descriptor ranging from 1 to 5 (Refer Fig. 1).
- Risk Impact Assessment - The process of estimating the severity of consequences of a risk based on its impact on project constraints like time, cost, scope and resources (PMI 2013).

Risk impact can be scored by assigning a qualitative descriptor ranging from ‘insignificant’ to ‘catastrophic’ and a quantitative descriptor ranging from 1 to 5 (Refer Fig. 2).

Figure 1. Qualifying and quantifying project risk probability

Risk probability		**Explanation**
Value	**Descriptor**	
1	Rare	A one in one hundred chance of occurring
2	Unlikely	A slight possibility of occurring
3	Moderate	Reasonable to consider it could occur
4	Likely	Most probable that it will occur
5	Certain	100 per cent chance of happening

Source: Hartley (2018)

Figure 2. Qualifying and quantifying project risk impact

Risk impact		**Explanation**
Value	**Descriptor**	
1	Insignificant	Impact would be inconsequential
2	Minor	Some noticeable impact
3	Moderate	Manageable scale of impact
4	Major	Large scale of impact
5	Catastrophic	Extreme, widespread impact

Source: Hartley (2018)

This report has analysed the risks in the High Street level crossing removal project using the probability and impact assessment technique and the results are outlined in Table 2.

3.3 Risk Evaluation

Risk evaluation is the process of determining risk management priorities and assessing appropriate response strategies by establishing quantitative and qualitative relationships between the probability and impact of risks in a project (Curtis & Carey 2012). The risk priority score can be calculated by multiplying the quantified probability and impact score or by analysing the

qualitative relationship between probability and impact as determined in the risk analysis stage. This relationship can be represented using a risk matrix, a visual tool that assists in prioritization of risks (Refer Fig 3).

Figure 3. 5x5 Risk Matrix

		Impact				
		1	**2**	**3**	**4**	**5**
Probability	**1**	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

Source : Hartley (2018)

Risks can be evaluated based on the risk priority scores and appropriate response strategies can be determined as follows (Hartley 2018):

- A *very high priority risk* (score >19) is not tolerable and warrants immediate attention. It requires a treatment plan designed by senior management that aims to avoid or change the consequences of the risk.
- A *high priority* risk (score 13-18) requires direct intervention by the project manager and a treatment plan designed to minimize the consequences of the risk.
- A *medium priority* risk (score 7-12) only requires a treatment plan if the costs are not exceedingly expensive. Otherwise, they are treated by existing SOPs.
- A *low priority* risk (score 1-6) is negligible and does not require a treatment plan. They are however included in the risk register for future monitoring.

This report has evaluated the risks in the High Street level crossing removal project using a risk matrix and the results are outlined in Table 2.

Table 2. Risk evaluation for High Street Level Crossing Removal Project

ID	Risk Description	Risk Probability	Risk Impact	Risk Priority
1	State and federal legislation requirements may change	Moderate (3)	Major (4)	Medium(12)
2	Labor party may push for schedule compression	Unlikely (2)	Major (4)	Medium (8)
3	Change in political party may halt/ delay project	Rare (1)	Major (4)	Low (4)
4	Competing projects in other states may drive resources away from Victoria	Unlikely (2)	Moderate (3)	Low (6)
5	Project cost estimations may be incorrect	Moderate (3)	Moderate (3)	Medium (9)

6	Exchange rate fluctuations may occur	Rare (1)	Major (4)	Low (4)
7	Contract documentation may not be properly reviewed	Likely (4)	Moderate (3)	High (12)
8	Not all risks may be thoroughly identified by project team	Moderate (3)	Major (4)	Medium (12)
9	Workforce may have low productivity	Unlikely (2)	Minor (2)	Low (4)
10	Equipment and material delivery may be delayed	Moderate (3)	Moderate (3)	Medium (9)
11	Scope may change uncontrollably	Likely (4)	Catastrophic (5)	Very High (25)
12	Drawings and specifications may not match accurately	Likely (4)	Moderate (3)	Medium (12)
13	Unsafe working conditions may	Likely (4)	Major (4)	High (16)

	cause injury to workforce.			
14	Public health and safety may be jeopardized	Unlikely (2)	Major (4)	Medium (8)
15	Material and resources may be used extensively	Likely (3)	Moderate (3)	Medium (9)
16	Unintentional damage to existing gas or power lines may occur	Unlikely (2)	Major (4)	Medium (8)
17	Local fauna and flora may be disturbed	Likely (4)	Minor (2)	Medium (8)
18	Emission of dust and particulates to air may occur	Likely (4)	Moderate (3)	Medium (12)
19	Construction noise may affect residential and retail areas	Certain (5)	Moderate (3)	High (15)
20	Greenhouse gas emissions may occur	Certain (4)	Major (4)	High (16)

21	Rail and road operations may be disrupted	Certain (5)	Moderate (4)	Very High (20)
22	Local businesses may be interrupted	Certain (5)	Minor (2)	Medium (10)
23	Local landowner may oppose the project	Possible (3)	Minor (2)	Low (6)
24	Severe weather conditions may arise	Unlikely (2)	Major (4)	Medium (8)
25	Natural disaster may occur	Rare (1)	Catastrophic (5)	Low (5)

3.4 Risk Treatment

Risk treatment is the process of designing specific strategies to reduce or eliminate threats and enhance opportunities in a project (PMI 2013).

According to Hartley (2018), the four strategies that effectively manage risks are:

- Risk Avoidance - The strategy in which the project team aims to eliminate the risk entirely or protect the project from its consequences.
- Risk Transference - The strategy in which the project team transfers the risk, its liability and ownership of response to a third party who is better equipped to deal with the consequences of the risk.

- Risk Mitigation - The strategy in which the project team acts to lower the probability of occurrence or impact of a risk to an acceptable threshold limit.
- Risk Acceptance - The strategy in which the project team is aware of a risk but does not take any action to address it unless the risk actually occurs. This strategy is adopted when it is not appropriate or cost-effective to deal with it in any other way.

This report has proposed risk treatment strategies for the risks identified in the High Street level crossing removal project and the results are outlined in Table 3.

Table 3. Proposed risk treatment for High Street Level Crossing Removal Project

ID	**Risk Description**	**Risk Priority**	**Risk Treatment**
1	State and federal legislation requirements may change	Medium(12)	Early engagement of statutory authorities to establish proper communication
2	Labor party may push for schedule compression	Medium(8)	Establish good project governance framework
3	Change in political party may halt/ delay project	Low (4)	Build strong business case; Identify exit strategies

4	Competing projects in other states may drive resources away from Victoria	Low (6)	Early market engagement
5	Project cost estimations may be incorrect	Medium (9)	Recruit QS through a quality assurance process
6	Exchange rate fluctuations may occur	Low (4)	Closely monitor cash-flow reserves
7	Contract documentation may not be properly reviewed	High (12)	Hire capable and experienced resource to review document
8	Not all risks may be thoroughly identified by project team	Medium (12)	Conduct regular risk workshops ; Gather sufficient information from stakeholders
9	Workforce may have low productivity	Low (4)	Provide performance support technology
10	Equipment and material delivery may be delayed	Medium (9)	Maintain good inventory management system; Establish positive supplier-customer relationship
11	Scope may change uncontrollably	Very High (25)	All proposed changes should be in writing and authorised

12	Drawings and specifications may not match accurately	Medium (12)	Seek internal representatives to carry out checks for inconsistencies
13	Unsafe working conditions may cause injury to workforce.	High (16)	Ensure contractors use proactive safety management strategies and zero harm approach
14	Public health and safety may be jeopardized	Medium (8)	Provide adequate signs and fences around construction site; Prevent unauthorised access
15	Material and resources may be used extensively	Medium (9)	Waste recycling and reduction should be in accordance with Environmental Management Plan
16	Unintentional damage to existing gas or power lines may occur	Medium (8)	Ensure contractor locates these services prior to commencement of works and notes this information on construction drawings
17	Local fauna and flora may be disturbed	Medium (8)	Environment Effects Statement must be prepared to the satisfaction of the Minister of Planning and should outline recommendations to mitigate impacts on fauna and flora.
18	Emission of dust and particulates to air may occur	Medium (12)	Air quality measures in accordance with project Environmental Management Plan

19	Construction noise may affect residential and retail areas	High (15)	Establish complaint hotline; Maintain and operate equipment properly
20	Greenhouse gas emissions may occur	High (16)	Optimize construction materials and resources
21	Rail and road operations may be disrupted	Very High(20)	Construction activities to be coordinated in conjunction with road user needs; Road users to be informed in advance about any disruptions to services
22	Local businesses may be interrupted	Medium (10)	Early consultation with affected business owners and local community members
23	Local landowner may oppose the project	Low(6)	Involve landowners in early developmental stages and keep them well-informed of progress
24	Severe weather conditions may arise	Medium (8)	Seek approval for time extensions
25	Natural disaster may occur	Low (5)	Accept the risk; Keep contingency reserves

3.5 Risk Monitoring

Risk monitoring is the process of tracking identified risks, evaluating the effectiveness of risk response strategies, assessing residual risks and identifying new risks throughout the project

lifecycle (PMI 2013). Ongoing review and control of risks and their impacts help improve the efficiency of the risk management plan (Hartley 2018).

The following tools are recommended for risk monitoring and control in the High Street level crossing removal project (PMBOK 2013) :

- Risk Audit - It is the process of examining and documenting the effectiveness of risk treatment strategies in dealing with identified risks and their causes.
- Variance and Trend Analysis - It is a quantitative evaluation of planned results to actual results.
- Technical Performance Measurement - It is the process of comparing technical achievements against predefined targets.
- Reserve Analysis - It is the process of determining whether the contingency reserves at any particular point of time is adequate to manage the risks remaining at that time.
- Meetings - Periodic status meetings that address project risk management will increase the likelihood of identifying new risks and opportunities.

4. CONCLUSION

This report provides an insight into the risk management processes involved in the High Street Level Crossing Removal Project. Various tools and techniques have been used to identify, analyse, evaluate and treat potential risks facing the project. Further, recommendations for monitoring and control of these risks have also been provided. Following a systematic risk management plan such as the one described in this report is expected to ensure efficient project delivery and contribute to overall project success.

REFERENCES

Curtis, P. and Carey, M., 2012. Risk Assessment in Practice. Deloitte & Touche LLP.

Hartley, S., 2018. *Project Management : A practical guide to planning and managing projects*. 4th edn, New South Wales.

Mahendra, P.A., Pitroda, J.R. and Bhavsar, J.J., 2013. A study of risk management techniques for construction projects in developing countries. *International Journal of Innovative Technology and Exploring Engineering*, *3*(5), pp.139-142.

Odimabo, O.O., Oduoza, C.F. and Suresh, S., 2018. An Insight into the Process, Tools and Techniques for Construction Risk Management. In *Risk Management Treatise for Engineering Practitioners*. IntechOpen.

PMI, A., 2013. guide to the project management body of knowledge (PMBOK guide). In *Project Management Institute*(Vol. 5).

Standards Australia/Standards New Zealand Standard Committee, 2009. AS/NZS ISO 31000: 2009 Risk Management–Principles and Guidelines. *Standards Australia/Standards New Zealand Standard Committee, Sidney*.