Title: Risks Assessment: Gawler Electrification Rail Project

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1. Introduction

1.1 Overview Of the Project

Adopted by the South Australian government the Gawler railway electrification project intends to provide the coordination of electrification and modernisation of the Gawler and Adelaide rail lines. The 8-kilometre-long tracks placed within the city of Gawler will be providing much faster, cleaner and more definite services (ABC Radio Adelaide, 2022). This project also entails the development of the 78 km of the electrified rail line from Gawler to Seaford. The total budget is calculated considering the contribution of different stakeholders including $615 million jointly funded by the state government, with $395 million and the Australian government with $220 million. The main purpose of this project is to provide an electrified line that will support the increased capacity of the region and the enhanced services of the rail corridor at the same time.

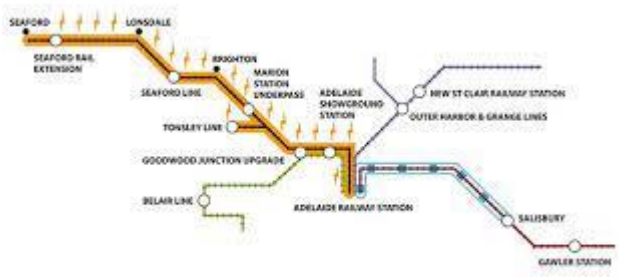


Figure: route map of the new Gawler electrification rail project

Source: Dit.Sa.Gov.Au, 2022.

The scope of the project:

The scope of the Gold Electrification project can be identified in terms of,

- Electrification between the Adelaide-Gawler rail line along with the dry creek railcar depot.
- Developing a new signalling system
- Enhancing the level crossing for the pedestrians
- Acquisition of additional three-car electric trains and fencing of the railway corridor (Dit.Sa.Gov.Au, 2022).

The main contractor for the project was appointed land lease, which carried out the responsibility of the head contractor for the design and construction of the electrification of the

Gawler Railway project. Stage one electrification and construction began in January 2018 and in July 2018, it was extended to include Stage 2, where the electrification of the rail line from Sainsbury to Gawler was conducted (Gashaw and Jilcha, 2020). Along with this, the project has provided employment opportunities for the North Hub on-site employment and the skill and Training Centre was established by landlease. In April 2022, the project entered its final stage with critical testing underway. While maintaining the project requirements, the contractor of the project has focused on adapting temporary changes to local traffic, pedestrian safety, station improvement and gathering passenger information for better execution of the project.

1.2 Project Stakeholders

Project stakeholders are the most crucial component of a project to be successfully delivered as the project stakeholders' requirement is the failing post of developing a project plan and successfully attending it (Investment.Infrastructure.Gov.Au, 2022). Therefore, the stakeholders related to the Gawler electrification rail project are identified in the following manner.

- The government of Adelaide city.
- The government of Gawler city
- The landlease
- The engineers
- Contractors
- Community members
- Common public of Adelaide city and Gawler city.
- NorthHub
- South Australian Government
- State government of Gawler
- The Australian and South Australian Governments

2. Project Context

Context of delivering the project scenario and analysing the project actually occurred, it is important to concentrate on the fact that the South Australian government had proposed to modernise and electrify the Gola rail line in Adelaide. the electrification rail project is used by Gawler city, and around 21000 passengers are entitled to access the line on a daily basis (Jimenez-Octavio et al. 2013). The government representative or Prime Minister Michael Mac Cormack delivered that fifteen electric trains will be included in the modification and

modernization project, which will eventually increase 15% of the capacity of the electrified rail line during peak hours. On the other hand, it is also realised that the electrified caller will line with clean and green energy will be able to provide high-performance train in order to improve the daily commuters' experiences, and it will also ensure reliability and safety simultaneously. From an internal point of view, the project is Another investment which will contribute to enhancing the public transport and comfortable services to the people of South Australia while it will also promote the economic growth through the construction of the new electrified Railway between a lead and Gawler (Liu and Wilkinson, 2013). The project was scheduled to be completed by early 2022 but due to certain circumstances, the project got delayed the total budget allocated for the project was $615 million while adding $175 million was also considered for purchasing extra electric trains.

3. Risk management approaches

The risk management approach in relation to the electrification railway project refers to having a system-based approach that involves the risk management facilities using ISO31000 risk management principles and guidelines. The device management approach in relation to the project can be identified in a combined step of risk management with considering the SD model where the logical framework will be considered using 4 phases.

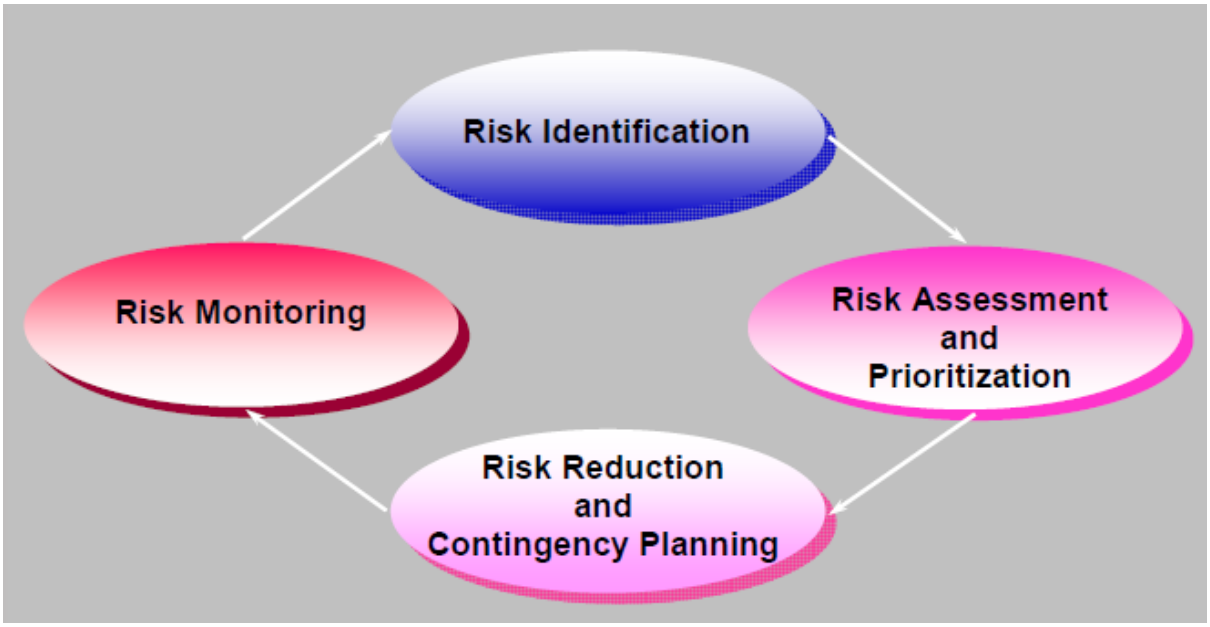


Figure: risk management approach for the electrification rail project Gawler.

Source: Railplanning.Com.Au, 2022

In accordance with the above framework, the first step will be to identify the risk related to the electrification railway project by using all the available literature. Based on the classification of different areas related to the project, 10 risk factors are identified.

Apart from this, the coupled risk relationship can be considered to understand the different risk related to the project and evaluate it from different dynamics to deliver a better understanding. The next step is the risk assessment involves the assessment and prioritization of the risk, which can be conducted using a risk evaluation matrix. Along with the risk management approach of the electrification railway line the next step will involve risk reduction and contingency planning and risk monitoring which will be done by evaluating the selected risk using different methods and tools (Railplanning.Com.Au, 2022). In relation to the Gawler electrification railway project, the contractor, project team and the owners have adapted

3.1 Identify and describe the risk categories

To identify the risk related to the electrification railway project of Gawler the risk register can be considered along with the risk assessment Matrix in the following manner that registering would help in identifying the different categories of the risk and deliver its frequency in likelihood and impact (Railway-Technology.Com, 2022). Therefore, the following risk register will be evident in delivering a clear idea about How the risk will be impacting the project outcome.

Risk	Description	Likelihood	Impact	Owner	Mitigation
Financial risk	The financial risks related to the Gawler electrification railway project refer to the increased amount of financial investment and the main reason behind it is the repeated delay due to several reasons	High	High	Project owners and the government of Australia	The contingency finance should be considered as the project delay and raise in capital demand could occur at any point of time.

	including adverse weather, Covid outbreak and so on. Hence, the previously set budget was blown out by the continuous delay of $100 million which eventually refers to the financial risk in future of the project development process.				
Safety risks	The safety risk in relation to the case study project in terms of electrification of the rail time from diesel to electric. The government of Australia has observed that the lack of proper safety equipment for the workers while working on such electrification projects. Therefore, the risks	Low	High	Engineers, project managers and the contractor	Proper equipment for safety measures while working with electrification requires to be ensured as it will deliver a clear and concise way of maintaining a safe working environment while mitigating the

	involve life loss, workers getting injured and so on.				risk of electrocution.
Vegetation risks	The vegetation risk is also evident in the context of the project as vegetation management needs to be conducted in a proper manner including framing and removal of the vegetation along with the way of the project of the line development. the lack of proper vegetation management could lead to major risks of passenger safety and also operational disruption could also be conducted in the due course.	Low	High	Project manager, contractor	Proper vegetation management should be done with a review committee which is assigned to deliver better review of the project process and its involved ideas at the same time.
Technical risks	Along with the facilities the case study project also involves technical risks that include the failure of the	Medium	High	System engineers, designers and project manager	In order to mitigate the risk in the technical scenario, it is important to

	electrification function and the delay in launching the electric train due to the delivery delay and so on. Along with this, the technical risks involved changes in design and design error, critical functions of electrification system, failure or system glitch in the signalling system and so on.				understand the technical requirements of the project at the first-hand and also consider strategies to manage the technical aspects of the project by focusing on the technical management strategies and developing a team that would be responsible for managing and reviewing all the technical stuff related to the project.
Schedule risk	The schedule risks refer to the delay of the project and the risk of late project delivery is also there. Therefore, in the context of the case study, it could	High	Medium	Project manager	To mitigate the schedule risks in relation to the project additional labourers could be appointed to speed up the

	be stated that the schedule risks occurred due to the delay in electric train delivery and the other reason for project delay which eventually influence the project completion rate.				project development process and also the sub-tasks could be minimised in order to reduce the stress over the schedule.
Procurement risks	The procurement risks involve the delay in bidding processes and causing a lack of familiarity with the Gawler electrification procurement guidelines. The lack of proper idea about the procurement method adopted by the engineers and the project managers of the electrification railway project could create risk related to delayed and non-	Medium	High	Contractor, project manager and engineers	Mitigate the issue a proper procurement management plant needs to be developed by the project manager and the communication needs to be in proper manner regarding the moment while explaining all the related aspects of electrification railway project to the contractor designers and

	sustainable design process which letter could create major risk for a set of passengers and the infrastructure of the entire project at the same time				the project team members can help in enhancing the appropriate standard and reducing the future risk at the same time.
Operational and maintenance risk	Operation and maintenance are also evident in the context of the case study project as the constraints in both the technical and operational issues where the space consumption and vegetation management need to be considered first-hand. Apart from this, the operational risks can involve the operation of electric field lines that run on electric power, and the sources can shut down at any time due to the lack of	Low	Medium	Project manager, contractors and engineers.	To mitigate the operation and maintenance issue the project manager and the contractors need to develop a proper operation management strategy where the electrification and the signalling system need to be considered at the hand, and proper maintenance of the electrified lines should be conducted.

	proper backup. moreover, the maintenance in the due course is to maintain the electric field lines, and the vegetation can grow with frequent night periods. If the vegetation and the electrification cannot be maintained in a proper manner there for safety issues and life risks can be considered in the due course.				Therefore maintenance and operational review should be conducted by the committee where the proper report can be submitted to project managers and the board members for further review and decision making.
Political risks	The political risk is also evident as it involves the changes in government and law regulations that could significantly influence the project development process for the project completion simultaneously.	Low	Low	Government	The issue can be mitigated by focusing on creating a contract between the government and also developing a contingency plan if any government changes there for the project

	Currently, the project is being funded by both the state government of Australia and the central government of South Australia, but if the political scenario gets changed, therefore, the project could be at risk as different opinions of the political regulations can impact the project development process significantly.				will not be influenced by the decisions and the project manager at the contractor will remain the same for the sake of the project to be completed within the given time and budget.
Management risks	In relation to the case study project, the management risk refers to different aspects of management practices and their applicability in the project and the inability of project leaders to adhere to a single agreement framework.	High	High	Project manager	The management risk can be mitigated by focusing on the content management scenario and the ability of the project manager to carry out is his or her

	Therefore, it can be stated that the management risk involved decision defects by the management, conflict of interest among the team members and the project manager and other stakeholders, corporate defaults and insufficient members' ability are also involved in the risk assessment of the management related to the custody project which eventually will lead to the poor performance and lack of efficiency in the project development process.				responsibility to the level of efficiency. the current management practices can be reviewed and analysed based on the performance and proper strategic decisions can be made by the board of members and the project manager included making divisions of the responsibilities for creating the project team that can carry out additional responsibilities to effectively mitigate those issues and its impact over the project at the same time.

Construction risks	Construction risk in relation to the electrification railway project involves different aspects like poor site organisation and management of the electrified rail line development. Apart from this the construction risk also involves the failure of equipment, lack of availability of the equipment, delay of equipment delivery like the electric trains, Poor quality of materials, supplying rail tracks and other materials with delayed schedules, Quality control within the construction work and so on are involved in the construction risk	High	High	Contractor, project manager	To mitigate the construction rest it is important for the contractor and the project manager to co-jointly develop an appropriate month strategy and understand the each and every step of the construction work starting from equipment delivery to equipment implementation along with the electrification of lines and a worker safety all the aspects need to be ensured.

	which eventually increases the risk of project development quality and Standards in the future long run.				

3.2 Analyse the risks within each category

Based on the above register it is realised that the project involves many risks among those based on the major risks identified and with the help of the risk matrix the impact and likelihood can be segmented in the following figure.

likelihood

	Insignificant	Minor	Moderate	Major	Catastrophic
Certain	NIL	Vegetation risks	NIL	Technical risks	Financial risk
Likely	NIL	NIL	Safety risks		Procurement risks
Moderate	Safety risks	Vegetation risks	Operational and maintenance risk	Construction risks	Schedule risk
Unlikely	NIL	NIL	NIL	NIL	Management risks
Rare	Political risks	NIL	NIL	Technical risks	NIL

Impact

Based on the above risk Matrix it can be stated that the figure has been evident in identifying the major risk related to the electrification railway project of Gawler and the risk matrix has been also evident in providing a clear indication of the risk that can influence the project to a

catastrophic level. It can be realised that the risk like financial risk, procurement risk, Schedule risk, management risk, technical risk, construction risk, safety risk, and vegetation risk is evident in providing measures to catastrophic impact to the project. On the other hand, from the point of view of the likelihood, the construction and schedule risks are moderately possible to occur while the management risk is unlikely to occur as the project manager has been contributing their atmosphere in managing the project (Railway-Technology.Com, 2022). Apart from this, the political risk and technical risk are identified as the air from the point of view of likelihood but they could significantly impact the project as the technical disk has the moderate possibility to impact the project and offer will political risk is very rare in terms of occurrence.

3.2 Identify and discuss appropriate risk management strategies

Risk management strategies are important to consider in the context of identifying how and which waves will be implemented to mitigate the identified risks. In the context of the electrification railway project of Gawler, it could be stated that the project risk is identified based on the possible scenarios related to the project. The risk management strategy involves risk identification using the register where all the possible risks are mentioned and discussed along with the mitigation strategy. The risk also involves the identification of the likelihood and impact of each disk which eventually could help the project manager and the team to make proper decisions for developing a treatment plan (Roadsonline.Com.Au, 2022). With this, the risk management strategy will also involve the evaluation of the risk by focusing on the richest type and utilising different evaluation models stated below.

- The fall tree diagram
- SWOT analysis
- Fishbone diagram
- The why methodology analysis
- The bow tie diagram

These are the risk evaluation models that will be adapted and implemented in the context of the identified risk related to the case study project.

Along with this the risk management strategy also include the level of risk and the authorised person who will be resolving the issue within a certain period of time. The following table can help in identifying all these aspects as a whole (Rsgx.Com, 2022).

Risk level	Authorised person	Review time
Extreme	Project manager, board of members	6 months
Moderate	Project team, engineers	12 months
Likely	The project manager or risks assessor	6 months
Rare	Team leader	6 months

Among all the risks mentioned in the above table, only the low-risk would not be required any model-based evaluation and can be accepted without any treatment plan but there are chances of occurrence which would direct the project team and the project manager to consider a treatment plan as a contingency practice and just to be sure to maintain safety and ensure the quality of the project (Wilfing *et al.* 2021). Here, the project manager, contractor, risk assessor, and team leaders will be the authorised person to carry out all the project Risk Management related activities.

4. Risks Evaluation

In order to conduct a risk evaluation of the identified top 10 risks by the project of Gawler electrification Railway project, it is important to identify the risks first-hand. Therefore, below are the top risk that will be evaluated with the help of quantitative assessment methods.

- Financial risk
- Safety risk
- Schedule risk
- Vegetation risk
- Operational and maintenance risk
- Technical risk
- Management risk
- Political risk
- Procurement risk
- Construction risk

Risk 1: Financial Risk

In the context of analysing and evaluating the financial risk related to the case study project, the swot analysis of the Gawler electrification railway project will be conducted. SWOT analysis will be effective in understanding the weaknesses and strengths that the project could encounter which eventually will help in identifying the financial risk that it can incur in the future course of project development (Sutton, 2022). The following table of SWOT analysis can be considered in this regard.

Strength	**Weaknesses**
• **Modernisation and electrification of the railway line between Adelaide and Sainsbury.** • **Proving the daily commuters' experience with the public transportation** • **New signalling system for improved railway signalling and transportation.** • **increased capacity of busiest Railway lines at peak hours with the fastest and cleaner services.** • **Construction of an electricity feeder station at Kilburn.** • **Considering pedestrian safety by enhancing the presbyterian crossing and fencing the railway corridor**	• Delay in electric train delivery by the suppliers. • The increased cost of the project is due to the continuous project delays. • Project budget blows out due to the delay. • lack of a common ground agreement between the governments. • The increased inconvenience of the computers and the common people due to the closed railway lines for a long period of electrification work (Uzuka, 2013).
Opportunities	Threats

• **To attain economic development by expanding its roots.** • **Improved public transportation eventually contributes to the economic and business growth of the region.** • **with a cleaner and greener energy supply.**	• The threat of electrification malfunctions of the rail line. • Schedule expansion is another trait that can be delayed project delivery which eventually causes inconvenience and satisfaction among the common people. • the cost to run out is another threat that can significantly influence the project quality and its delivery date (Гаврилюк, 2017).

Figure: SWOT analysis

Source: self-developed

Based on the above SWOT analysis of the respective project it is quite evident that the weakness and strengths and happily manifested that the financial risk is evident as the project other aspects like schedule equipment raw materials are all related to the financial aspects. for example, the delay in electric train delivery could cause more time for the project to wait and the standard project can cause a significant amount of financial requirement for labour charges and maintenance of the existing raw materials and so on. Therefore, it is evident that the project needs to consider better project financial management plans in terms of reducing the risk and managing the future finances in an effective manner (Akkerman and Akkerman, 2017).

Risk 2: Safety Risk

The safety risk is another important area of risk evaluation related to a project which eventually delivers a clear idea about the safety measures that the project needs to consider. If the study project can be analysed then the safety risks are detected in terms of the project is shifting its diesel form of the railway line to the electrification in terms of modernizing and it involves the safety risk like electrification failure, signalling system failure, risk of workers occupational health and safety, hazardous materials and so on (Alawad *et al.* 2020). Therefore, based on the primary idea an assessment evaluation can be done with the help of fault tree analysis which eventually can contribute to identifying the risk in a proper manner.

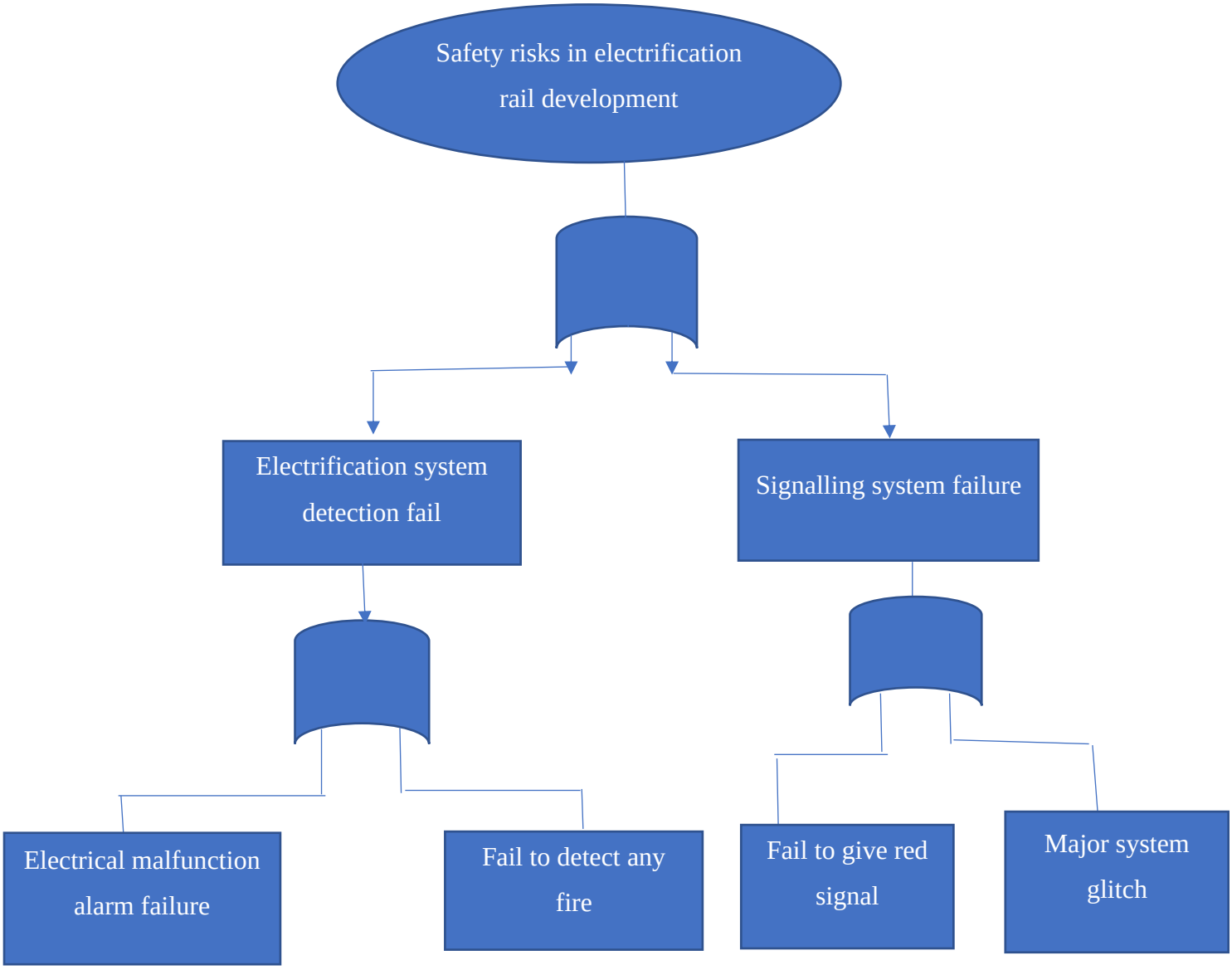


Figure: Fault Tree Analysis

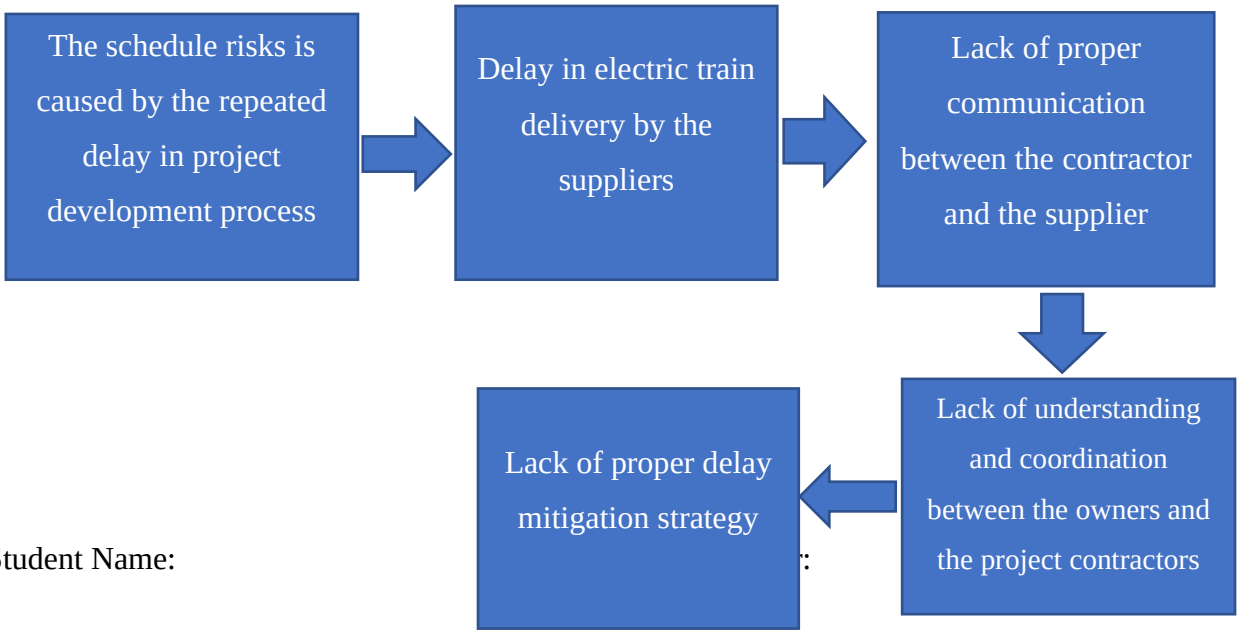
Student Name: Student Number:

Source: self-developed

Based on the above fault tree analysis, the safety risk and b and evaluated in terms of two main aspects: electrification system detection failure and signalling system failure. The electrification system detection failure can cause significant electrification malfunction along with failure, which refers to the alarm going off or failing to signal the electric train drivers or the station regarding the electrical malfunction. On the other hand, another as severe as was under the electrical system failure is the failure to detect any fire due to the electrical malfunction within the lines or within the stations. In this regard, the electrical trains could catch fire due to electrical malfunction, which causes safety rules for passengers and the entire facility (Alawad *et al*. 2020). Another significant area of safety risk is the signalling failure system which involves two other aspects such as providing a Red Signal to the electric train driver so that proper measures can be taken and the major system Glitch in the same context can cause malfunction of the signalling system which eventually can cause major pollution. These are the properly evaluated possibilities of the safety days which require an immediate treatment plan by the project team members.

Risk 3: Schedule Risk

The schedule list is another important issue identified within the case study project which refers to the analysis of why the schedule has occurred in the first place. As discussed in the above-described register the schedule risks occurred due to the repeated delay in the project development process and manifest a clear idea about how the project schedule is affected due to various reasons including Covid 19, political disagreements, system failure and so on (Baranov *et al.* 2019). Therefore, in order to understand the risk in a proper manner the why methodology will be implemented for further evaluation.



Based on the why methodology analysis of the schedule raise it can be realised that the first step of the way metallurgy has manifested why the schedule risk occurred in the first place. The first step of the analyses has manifested that the sketch dual risk is mainly caused by the repeated delay in the project development process, which can be identified in terms of covid-19 super spread, delay in raw material delivery, delay in electric trains delivery by the suppliers and so on. On the other hand, the second step of the risk evaluation is highlighted by the fact that the delay in the electric train could be considered as one of the main reasons for schedule delay or scheduled risk as the entire concept depends on the same aspect (Koshkarov *et al.* 2018). The Government of Australia have purchased 10 electric train from the suppliers, which are the main attraction of the project was the third step of the evaluation have manifested that there is a significant lack of communication between the contractor and the supplier, which might have caused the delay in delivery of the electric trains. Most importantly, the fourth stage of the why methodology analysis refers to the lack of understanding and coordination between the owners of the project and the project contractor, which eventually creates confusion and adherence to the schedule risk of getting delayed. The last age has manifested the lack of proper delay mitigation strategy is one of the main reasons that the schedule risk has been dominating so far (Park *et al.* 2016). Therefore, the evaluation has manifested the possible causes of schedules occurring within the case study on the project and this can be created as a strong foundation to develop a treatment plan in future.

Risk 4: Vegetation Risks

The vegetation risk is another important factor in the due course which should be considered by the project team and the contractor as vegetation refers to the growing plants over the railway tracks which can significantly cause safety risks and operational risks for the electrification railway facilities. The vegetation risk refers to the lack of proper management of visitation within the area where the project is being implemented or developed. The lack of proper vegetation management can lead to measuring safety risks of the passengers and operational destruction of the electrification railway facilities at the same time (Li *et al.* 2011). With the help of a detailed evaluation, the risk can be evaluated in a proper manner to manifest

how the risk is influential on the project and what mitigation plan can be developed to control the risk in future.

Figure 1: Vegetation Risks evaluation table

Evaluating measures	Description
Description of possible causes	• Lack of proper vegetation management along the corridor present from the applied and Gwalior. • The continuous electrification works for the line between Adelaide and Gawler can impact largely on the vegetation management process. • Installation of 25kV overhead wiring system that includes mast and gantries. • Installation of a new signalling system • Fencing of the rail corridor to improve passenger or passer-by safety (Park and Ahn, 2017).
Description of possible impacts	• Lack of vegetation can create issues for Safety measurement around the electrical infrastructure if there is no vegetation clearance of 3 from the electrical overhead wiring system. this would significantly in the wearing failing on track or onto the overhead wires, which can cause a severe collision in the electrical train. • Lack of safety fencing is another important area within the vegetation raised as the lack of fencing can

	clearly reduce the chances of the electrified lines to be clean and operable for the electric trains. vegetation along with the fencing could also impact the removal or the old fencing system which can create a challenge for the construction work. • The challenges or issues related to the installation of a common service route will also be included in the vegetation management risk process as without managing the vegetation the root system of the existing trees can create challenges for the construction workers to implement the system.
Current control	The current controlling system refers to the application of different measures and risk mitigation policies, along with this, the project team is considering three-step controlling of the vegetation risks such as design where the team would consider moving infrastructure to reduce the impact of the construction from the trees. On the other hand, the second step includes a survey, where the OHW clearance will be surveyed. In the third stage, the construction will take place where the vegetation management needs to be conducted by a specific team or labour forces (Yang, 2015).
(Who is getting effected	By the vegetation risks, the project itself is getting affected as it invites additional construction works.

Risks 5: Operational and Maintenance Risk

In relation to discussing the operational and maintenance risk related to the electrification railway project, it can be stated that there are a significant number of chances that the operational and maintenance could occur. As per the risk register, the operation and maintenance risk involved the operational issues have the space consumption is one of the major challenges for the electrification railway project as it will require a long route of electric wiring, and this can go over the cultivating lands at the same time. Apart from this, the maintenance issues are involved in terms of maintaining the electrical lines and vegetation that can interrupt the operation and overheard wiring of the electrical line and sensing facilities (Zhang *et al.* 2018). Therefore, operational and maintenance risks could be discussed with the help of the following table.

Figure 2: operational and maintenance risks evaluation

Evaluating measures	Description
Description of possible causes	• Lack of proper knowledge about the electrification railway functionalities and operations among the team members. • The delay in raw material supplier for possessing proper construction equipment at the right time. • The lack of expertise among the workers or the labour. • Lack of proper safety measures for the workers working with electrification work. • Lack of maintenance team and experts in the electrification works and wiring. • Less vegetation management which is creating difficulty for maintenance

	of the overhear wiring and signalling system.
Description of possible impacts	• The delay in developing the electrification on lines and electrification wires in a proper manner. • The communication issues between the suppliers and the contractor is another possible impact as it will definitely contribute to the operation and maintenance criteria (Zhang *et al.* 2018). • Increase the number of accidents at the construction site due to the lack of proper safety measures while working on the electrification units by the labours. • Growing vegetation on the electrification units placed beside the rail lines throughout the entire route and can create difficulty for the maintenance team to maintain the wires and change them when required.
Current control	In the context of controlling the current operation and maintenance issue, it can be stated that The contractor and the project manager of the electrification railway project have focused on maintaining the vegetation in order to enhance its maintenance facilities and reduce the risk related to it while the operational risks are being controlled by

	focusing on the communication and coordination between the contractor and the supplier related to the raw material supply and the supply of electric trains at the same time.
Who is getting effected	By the operational and maintenance risks, the project itself is getting affected as it directs the project towards delay and non-completion within the given time and resources.

Risk 6: Technical risk

Another risk is identified as the technical risk related to the case study project where the electrification railway construction had different technical abilities or discrepancies that can create significant challenges for the construction work to be completed successfully. The risk registers the technical risk related to the case study project involves in terms of electrification functions, delay in launching the electrical trains, complexity in system integration and construction design, risk in construction design, lack of proper supervision, and lack of communication. Based on the identified risks, the bow tie diagram will be used to evaluate the related technical challenges depending on which future solutions can be identified at the same time.

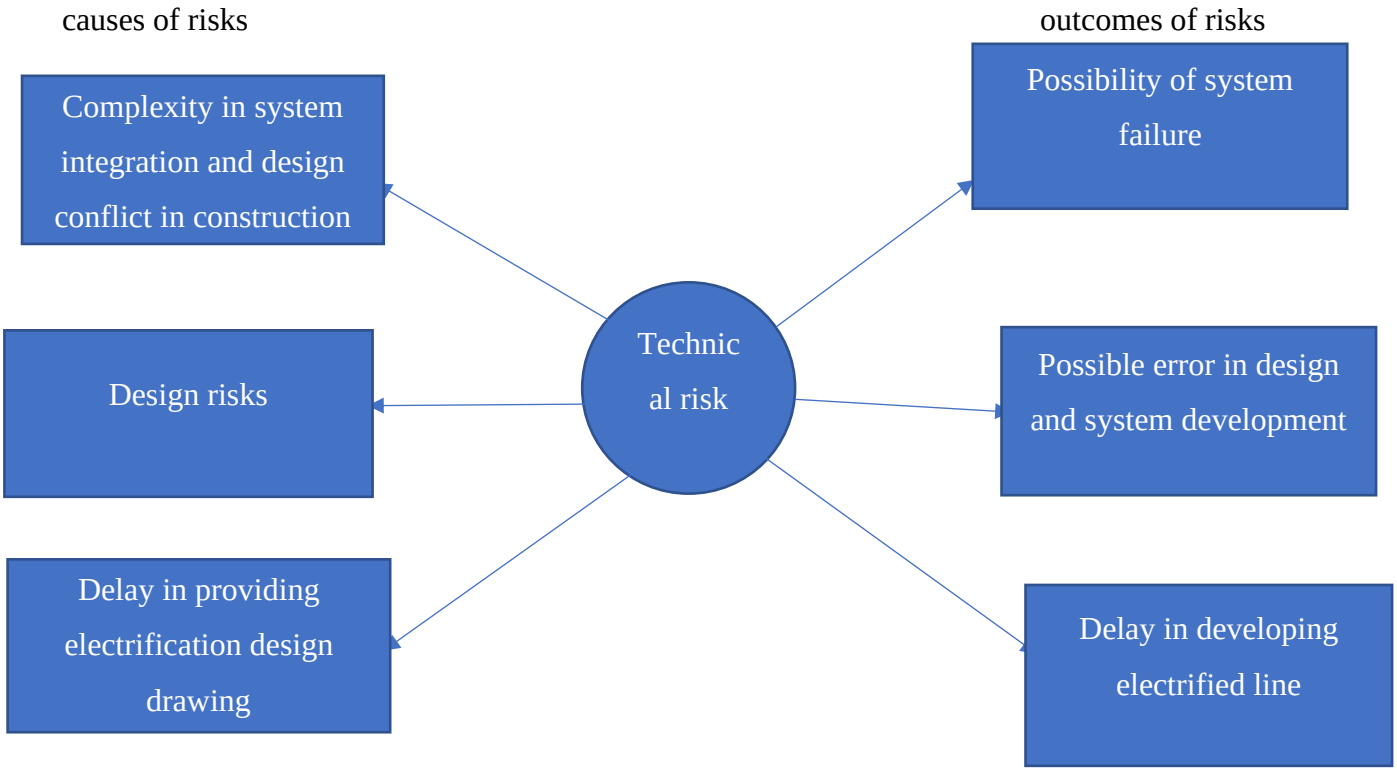


Figure 3: Bow- Tie diagram for technical risks analysis

The bow tie diagram basically delivers a clear picture of the risk assessment scenario where the two aspects are considered, such as the cause and outcome of risks. Depending on the bow tie diagram, it can be stated that the causes of breast ka identified in terms of complexity in system integration and design conflict in the construction, design risks related to the electrification works and delay in providing electrification design drawings which eventually can impact the project development process. considering the outcome of the risk, it can be realised that possibility of system failure is the common outcome of the complexity in system integration and design conflict. On the other hand, the design related to the electrification work scan delivered the outcome like a possible error in the design and system development process (Wilfing *et al.* 2021). Moreover, the delay in providing electrification design drawings can significantly generate outcomes like delays in developing electric field lines, and the project completion will be halted at the same time. Therefore, it can be realised that the bow and tie diagram has significantly manifested how the technical risk can impact the project development process and what are the main causes of the technical digest in the electrification railway project of Gawler.

Risk 7: Management risk

Management is another crucial form of a project development process where the challenges of the risks are important to identify so that proper mitigation procedures or policies can be implemented. in the context of the case study project, the management risk is quite evident as the electrification construction is quite complex in nature, and it requires intense contribution from the management scenario to detect all the issues and deliver proper medication. As per the risk register, the management risk related to the respective construction project can be identified in terms of the inability of the project leader to adhere to the single agreement point which Also involves the decision defects by the management and the conflict of interest are also evident in due course, apart from this the insufficient member's ability to adhere to the different task, and the risk assessment of the management depending on the disagreement of different stakeholders are also observed in due course (Yang, 2015). Therefore, the risk can be evaluated with the help of the following table in a definite manner.

Figure 4: Management risks evaluation

Evaluating measures	Description
Description of possible causes	• The mutual disagreement among the different stakeholders involved in the project management team, such as the project manager, contractor designer, and so on which can cause a significant management risk. • The insufficient ability of the members to carry out individual tasks can also create management risk as it can create a backlog in management practices. • The lack of proper risk assessment based on the management activities and future scenarios to adhere to the construction work.
Description of possible impacts	• Internal conflict between the management executive and the different stakeholders can cause a lack of information or confusion. • Increased confusion among the team members due to the lack of proper communication of the decision-making process can get affected. • The lack of communication and coordination between different significant stakeholders can create project schedule delays or the cost consumption rise related to the project.
Current control	Current control can be identified in terms of a single point of communication where the

	Government of South Australia has appointed A committee which should be considered as the point of communication to the government. On the other hand, all the project related stakeholders are entitled to communicate with each other but it still is not enough as there is MS communication between the suppliers and the contractor's regarding the delivery of electric train and this would result in a delay in the project delivery and inconvenience of the common people or daily commuters.
Who is getting effected	With these risks, the management of the project along with other stakeholders are getting affected day by day. This could also influence the common public being the potential stakeholder at the same time.

Risks 8: Political risk

Political risks are another significant challenge that can impact a project from a different perspective, and in the context of the case study project, the political risk is considered to be very rare. As per the risk register, it could be realised that Political risks involved the possibility of government change or the changes in regulation which is quite rare in nature and has the lowest possibility of occurrence (Railplanning.Com.Au, 2022). Based on the identified, the below table can help in evaluating the risk and understanding its possibility and probability towards treatment development.

Figure 5: Risk Evaluation of Political Aspects

Evaluating measures	Description
Description of possible causes	• In the government of South Australia or the Australian government might change its ruling parties.

	• The changes in the legislation related to the civil construction and electrification railway construction project.
Description of possible impacts	• The delay or the halt of construction work due to governmental changes or the change in power might significantly impact the future course of the project. • Changes in regulation related to the electrification work in the railway of the railway construction might create a lot of changes in the construction works along with the risk of cost consumption and schedule delay.
Current control	The current controlling measures related to the political risk have not been considered by the project team of the project manager but as a contingency plan, continuous communication with the government and time to time review is being provided to maintain a continuous communication channel with the government.
Who is getting effected	If such risk occurs, therefore, the entire project will be getting affected along with different stakeholders and the common people who depend on public transportation specifically Railway transportation for their daily commuting facilities (Railplanning.Com.Au, 2022).

Risk 9: Procurement risk

The procurement risk is also evident in terms of creating challenges for the electrification rail project to complete within the given time period as procurement refers to the different building processes and bidding processes of the project related aspects. in the context of the case study project, the procurement risks identified involve delay in the bidding process and cause a lack of familiarity with the Gawler electrification requirement guidelines. Along with this, the lack of proper procurement methods adopted by the Engineers is not properly communicated with the rest of the team which could create a significant procurement risk related to the project. Therefore, the below table might help in evaluating the procurement risk related to the project and help in understanding how this can be mitigated in the long run.

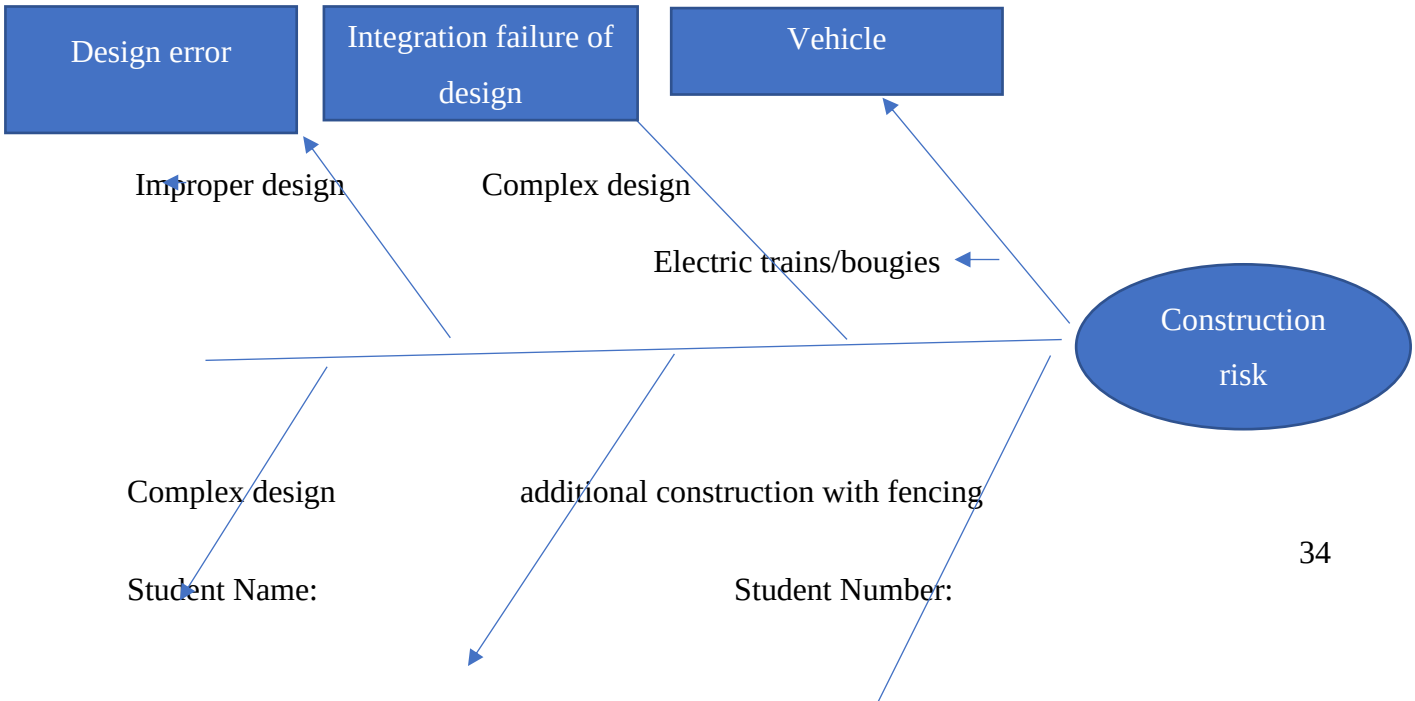
Evaluating measures	Description
Description of possible causes	• The lack of proper understanding of the property or method by the project team members. • The inability to properly bid for conducting delay in the bidding process. • The lack of understanding of the electrification requirement guidelines and procurement applicability related to the project. • The proper element method adopted by engineers is not properly communicated with the rest of the project team members or the workers for designers. • the lack of proper understanding of the procurement outcomes related to a project can also create a lack of knowledge in the same context leading to the challenges.
Description of possible impacts	• Delay in project delivery or project development process

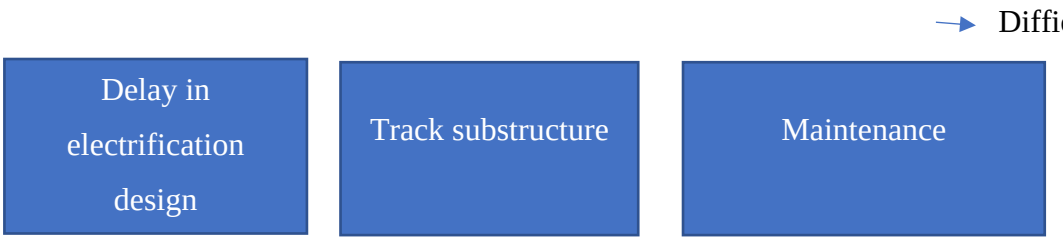
	• Lack of proper procurement method application at the right place • Lack of knowledge among the project team members
Current control	Along with this, the controlling measures for the procurement risk are identified with the proper knowledge delivery to the project team members and frequent meetings by the project manager are conducted.
Who is getting effected	The risks can affect the project team members and the project development process.

Risk 10: Construction Risks

One of the major risks is identified in terms of construction risk, which refers to the Challenges encountered by the project team members while conducting the construction work. The risk register has manifested that the construction risk is quite evident as it involves different aspects such as Site organisation and management of the electrified rail line. On the other hand, the construction risk also involves Failure of equipment, lack of proper equipment availability, delay in equipment delivery, poor quality of materials and supply chain disruption (Liu and Wilkinson, 2013). Quality control and so on. with the help of a fishbone diagram the risk can be evaluated in the following manner for a better understanding of the risk intensity.

Figure 6: Fishbone Diagram To Evaluation Construction Risk





Based on the fishbone diagram analysis it is realised that the construction risk is dependent on several aspects such as a vehicle, integration failure of design, design error, delayed electrification design drawing, track substructure, and maintenance. These aspects are quite evident in enhancing the construction risk like the improper quality description in supply chain quality issues, lack of proper equipment application within the construction site failure of equipment and so on (Liu and Wilkinson, 2013). Therefore, it can be stated that the evaluation has benefited the significance of construction risk and the treatment plan that should be considered on an immediate basis.

5. Treatment Plan

Treatment for the risks	Treatment option	Cost of implement	Risks rating before treatment	Risks rating after treatment	Cost/benefit analysis	Responsibility	Timetable	Monitoring
Financial risk	Considering additional contingency finance resource	$150 million	Extreme	Medium	Accepted	Government	July 2022	Weekly meetings
Safety risks	Safety gears for the workers to save	$30000	Moderately high	Low	Accepted	Contractor	August 2022	Quarterly review

	themselves from electrocution							
Vegetation risks	Developing the committee to review vegetation status	$25000	Moderate	Low	Accepted	Project manager	October 2022	6 months
Technical risks	Technical management strategy and management review	$15000	Extreme	Moderate	Accepted	Engineers' approval	December 2022	6 months
Schedule risk	Employ additional labours to speed up the construction process	$25000	Moderate	Low	Accepted	Project manager	January 2023	6 months
Procurement risks	Proper procurement strategy	Nil	Moderate	Low	Accepted	Project manager	March 2023	3 months

	development							
Management risks	Management review and brainstorming	Nil	Extreme	Low	Accepted	Manager executive	April 2023	1 month
Construction risks	Construction equipment delivery and construction safety measures	$48000	Extreme	Moderate	Accepted	Project manager	2023	1 month
Political risk	Contract for not changing the project course	Nil	Moderate	Low	Accepted	Government	Yearly	Yearly
Operational and maintenance risk	Committee development	$14000	Moderate	Low	Accepted	Project manager	3 months	Quaterly

6. Conclusion and Recommendation

To conclude the report, it can be stated that the entire report is based on the Gawler the electrification railway project in South Australia which is funded by both the state government

and Central Government of South Australia. The total budget of the project is $615 Million which had been expanded to $750 million till now due to the delay in the project schedule. The report has conducted a risk assessment of the project by considering 10 major risks related to the electrification railway project and focusing on each with their evaluation. there are different risk assessment tools utilised to evaluate each risk while depending on the evaluation the treatment plan along with cost and benefit analysis is delivered in the report. Therefore, It is realised that the treatments are quite effective but certain recommendations to the project can be made based on the evaluation.

Recommendation

- Developing a strong procurement plan for the project and construction works to be initiated and conducted in a systematic manner.
- The project is to develop a committee to review the vegetation status of the electrification line on a monthly basis so that the visitation can be controlled and the risk can be reduced.
- Additional training and development can be provided to the management department called mitigating the Management related issue.
- An effective communication channel between other stakeholders and the project team needs to be developed for a continuous and smooth flow of information related to the project (Dit.Sa.Gov.Au, 2022).
- The government needs to control the skin dual delay and proper construction work controlling measures need to be implemented to prevent the delay of the schedule.
- Construction risks are also important to control whereas the project manager and the contractor food considered additional labour employment and providing safety gear to the workforce for better performance.

References

ABC Radio Adelaide, 2022. *Rail electrification budget blows out by $100 million as project delayed again*. [online] Abc.net.au. Available at: <https://www.abc.net.au/news/2020-12-07/gawler-train-line-electrification-delayed-and-over-budget/12956408> [Accessed 26 May 2022].

Akkerman, G. and Akkerman, S., 2017. High-speed railway highlights. *Herald of the Ural State University of Railway Transport*, (2), pp.46-56.

Alawad, H., Kaewunruen, S. and An, M., 2020. A Deep Learning Approach Towards Railway Safety Risk Assessment. *IEEE Access*, 8, pp.102811-102832.

Baranov, L., Kulba, V., Shelkov, A. and Somov, D., 2019. Indicator-based approach to safety management of railway infrastructure facilities. *Dependability*, 19(2), pp.34-42.

Berdysheva, Y., 2016. An evaluation of economical and social prerequisites of high-speed transport lines in the Siberian federal region. *Herald of the Ural State University of Railway Transport*, (4), pp.170-176.

Dit.Sa.Gov.Au, 2022. *Gawler Rail Electrification Project - Department for Infrastructure and Transport - South Australia*. [online] Dit.sa.gov.au. Available at: <https://dit.sa.gov.au/infrastructure/public_transport_projects/gawler_rail_electrification_project> [Accessed 26 May 2022].

Gashaw, T. and Jilcha, K., 2020. Railway Construction Project Risk Assessment Techniques: Systematic Literature Review. *International Journal of Services and Operations Management*, 1(1), p.1.

Investment.Infrastructure.Gov.Au, 2022. *Project Details*. [online] Infrastructure and Regional Development. Available at: <https://investment.infrastructure.gov.au/projects/ProjectDetails.aspx?Project_id=097117-17SA-NRP> [Accessed 26 May 2022].

Jimenez-Octavio, J., Sanchez-Rebollo, C. and Carnicero, A., 2013. The Dependance on Mechanical Design in Railway Electrification: Focusing on the ac Perspective. *IEEE Electrification Magazine*, 1(1), pp.4-10.

Koshkarov, V., Samuylov, V. and Koshkarov, E., 2018. New technology of designing and building high-speed railway mainlines. *Transport of the Urals*, (4), pp.35-40.

Li, S., Meng, Q. and Qu, X., 2011. An Overview of Maritime Waterway Quantitative Risk Assessment Models. *Risk Analysis*, 32(3), pp.496-512.

Liu, T. and Wilkinson, S., 2013. Can the pilot public-private partnerships project be applied in future urban rail development?. *Built Environment Project and Asset Management*, 3(2), pp.250-263.

Park, J. and Ahn, T., 2017. An Analysis of Installation of Railway Construction Project Management System on Carbon Reduction. *Journal of the Korean Society for Railway*, 20(3), pp.382-388.

Park, S., Lee, J. and Kim, S., 2016. Performance Assessment of High-Speed Transponder System for Rail Transport on High-Speed Line. *Journal of the Korean society for railway*, 19(3), pp.304-313.

Railplanning.Com.Au, 2022. *Gawler Rail Electrification Project – Program Review - Rail Planning Services*. [online] Rail Planning Services. Available at: <https://www.railplanning.com.au/our-projects/project/gawler-rail-electrification-project-program-review/> [Accessed 26 May 2022].

Railway-Technology.Com, 2022. *South Australia starts electrification of Adelaide-Gawler commuter line*. [online] Railway Technology. Available at: <https://www.railway-technology.com/news/south-australia-starts-electrification-of-adelaide-gawler-commuter-line/> [Accessed 26 May 2022].

Railway-Technology.Com, 2022. *South Australia starts electrification of Adelaide-Gawler commuter line*. [online] Railway Technology. Available at: <https://www.railway-technology.com/news/south-australia-starts-electrification-of-adelaide-gawler-commuter-line/> [Accessed 26 May 2022].

Roadsonline.Com.Au, 2022. *Timeframes confirmed for SA's Gawler Rail electrification*. [online] Roads & Infrastructure Magazine. Available at: <https://roadsonline.com.au/timeframes-confirmed-for-gawler-rail-electrification-project-final-works/> [Accessed 26 May 2022].

Rsgx.Com, 2022. *Commisioning And Network Services On The Gawler Rail Electrification Project*. [online] Rsgx.com. Available at: <https://www.rsgx.com/projects/commisioning-and-network-services-on-the-gawler-rail-electrification-project> [Accessed 26 May 2022].

Sutton, M., 2022. *Adelaide's train network to shut down for Fringe opening to deal with Gawler Line delays*. [online] Abc.net.au. Available at: <https://www.abc.net.au/news/2022-01-24/train-network-to-shut-down-for-adelaide-fringe-opening/100777574> [Accessed 26 May 2022].

Uzuka, T., 2013. Faster than a Speeding Bullet: An Overview of Japanese High-Speed Rail Technology and Electrification. *IEEE Electrification Magazine*, 1(1), pp.11-20.

Wilfing, L., Michael, J. and Schütz, D., 2021. Risk assessment of route options for the Hanau–Würzburg/Fulda railway project. *Geomechanics and Tunnelling*, 14(1), pp.78-88.

Yang, S., 2015. Optimal Vertical Stiffness of Fastener of Concrete Track in High-Speed Railway. *Journal of the Korean society for railway*, 18(1), pp.43-52.

Yu, Y. and He, W., 2013. Comfortable Evaluation of Bridge-Station Combined Large Span High Speed Railway Station under High Speed Train Load. *Applied Mechanics and Materials*, 477-478, pp.727-731.

Zhang, B., Liu, Y. and Qiao, S., 2018. A Quantitative Individual Risk Assessment Method in Process Facilities with Toxic Gas Release Hazards: A Combined Scenario Set and CFD Approach. *Process Safety Progress*, 38(1), pp.52-60.

Гаврилюк, В., 2017. The modelling of returntrection current distribution in rail line. *Electrification of Transport*, 0(13), pp.64-70.

7. Appendices (analysis, matrix and substantiation of risks)

Figure 7: Map Of Gawler Electrification Rail Project

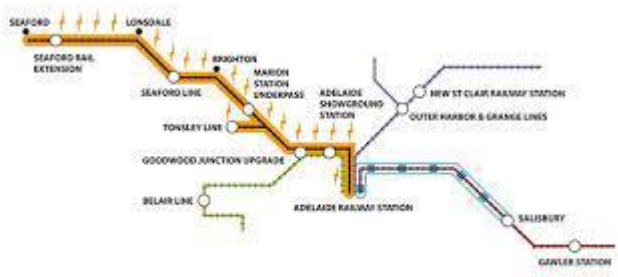


Figure 8: SWOT analysis of the Gawler project

Strength	Weaknesses
• Modernisation and electrification of the railway line between Adelaide and Sainsbury. • Proving the daily commuters' experience with the public transportation • New signalling system for improved railway signalling and transportation. • increased capacity of busiest Railway lines at peak hours with the fastest and cleaner services. • Construction of an electricity feeder station at Kilburn. • Considering pedestrian safety by enhancing the presbyterian crossing and fencing the railway corridor	• Delay in electric train delivery by the suppliers. • The increased cost of the project is due to the continuous project delays. • Project budget blows out due to the delay. • lack of a common ground agreement between the governments. • The increased inconvenience of the computers and the common people due to the closed railway lines for a long period of electrification work.
Opportunities	**Threats**
• To attain economic development by expanding its roots. • Improved public transportation eventually contributes to the economic and business growth of the region. • with a cleaner and greener energy supply.	• The threat of electrification malfunctions of the rail line. • Schedule expansion is another trait that can be delayed project delivery which eventually causes inconvenience and satisfaction among the common people. • the cost to run out is another threat that can significantly influence the project quality and its delivery date.

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Figure 9: fault tree analysis

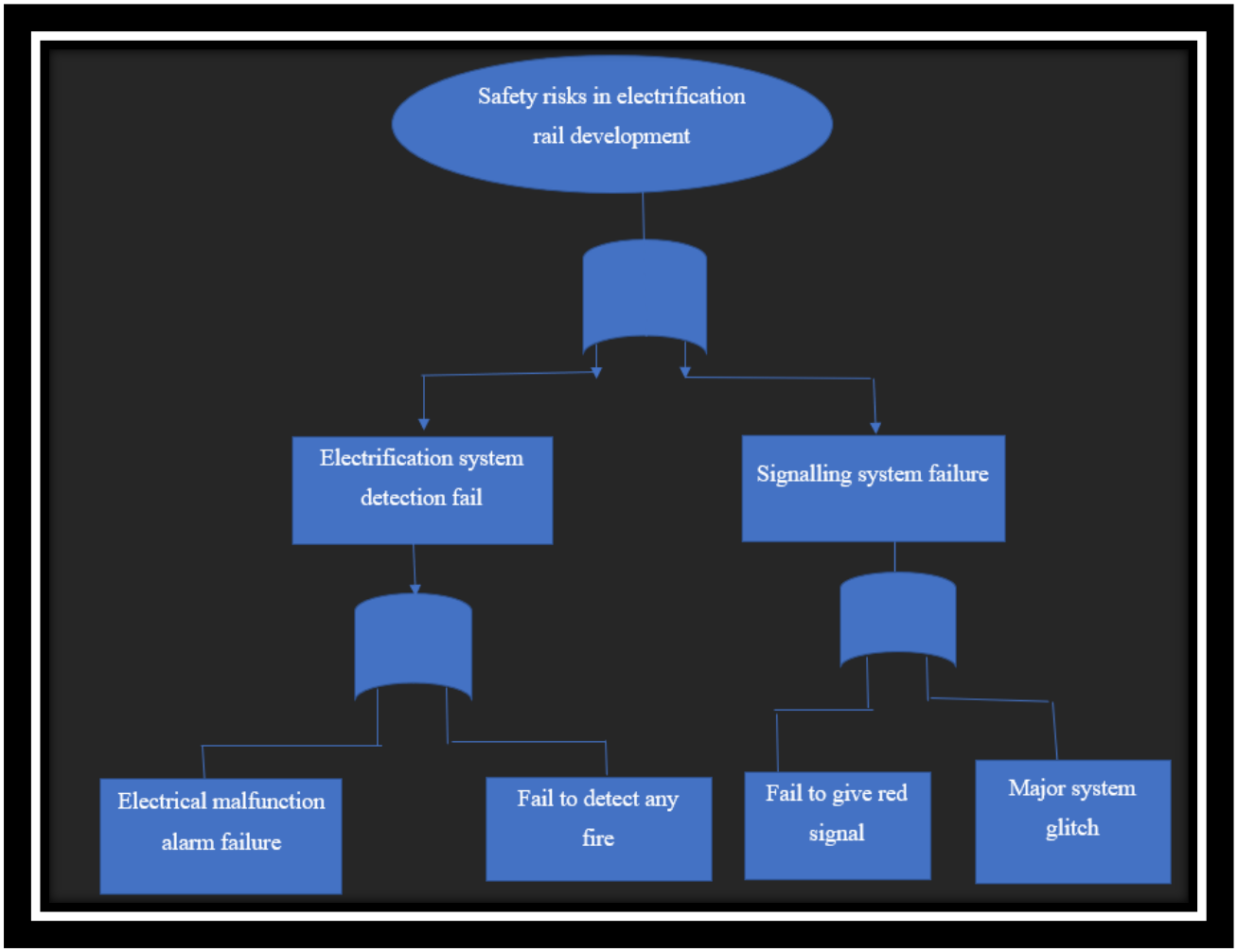


Figure 10: why methodology analysis

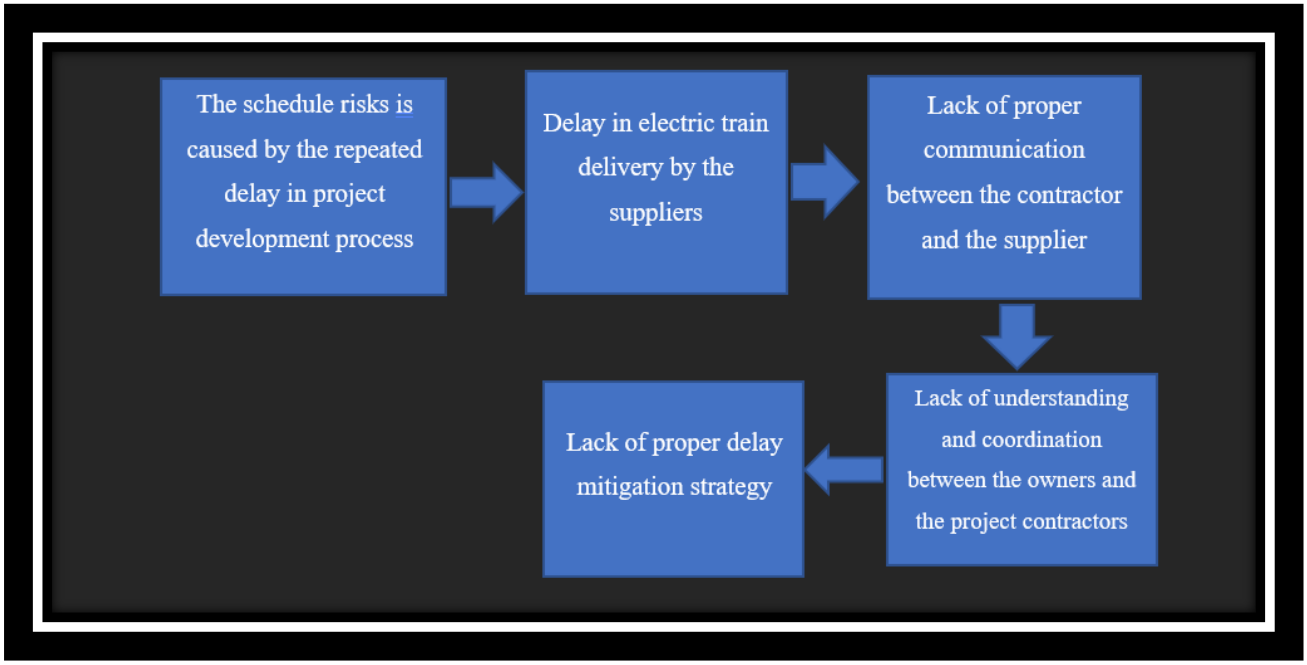


Figure 11: Bow Tie diagram

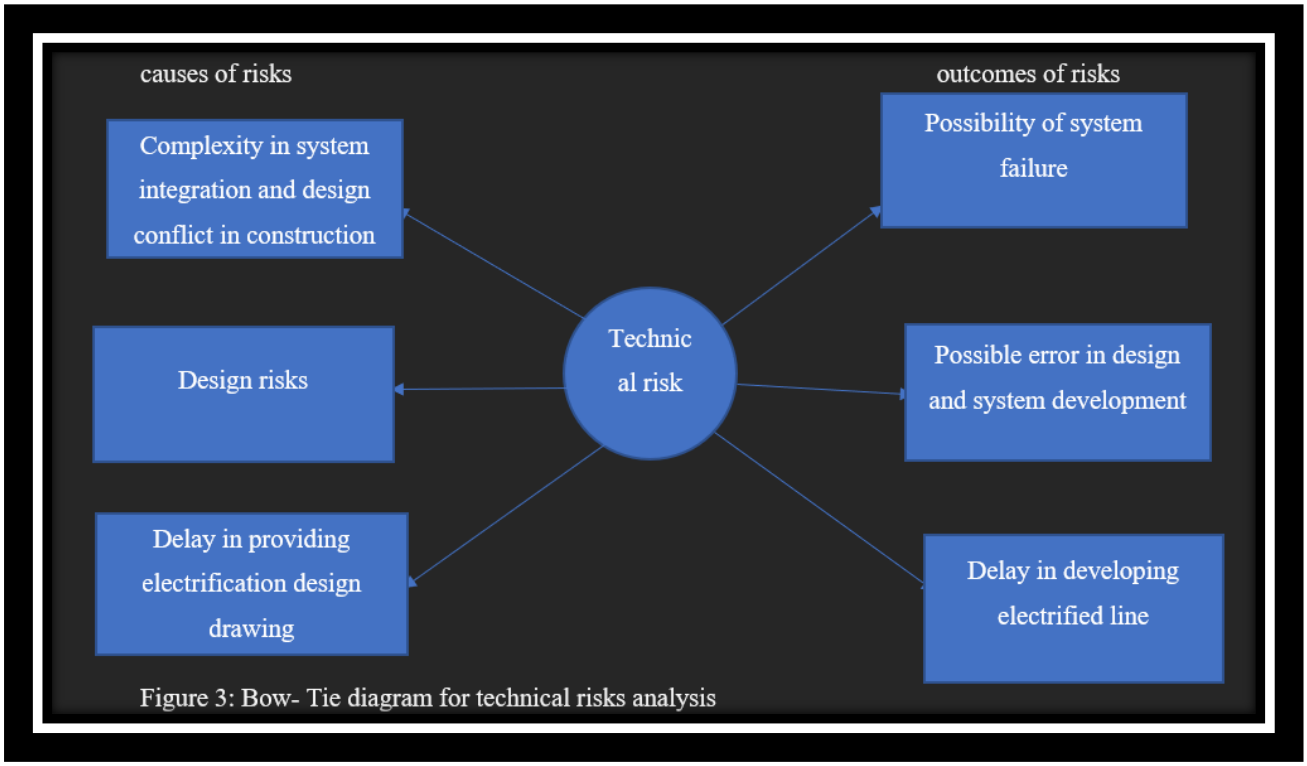
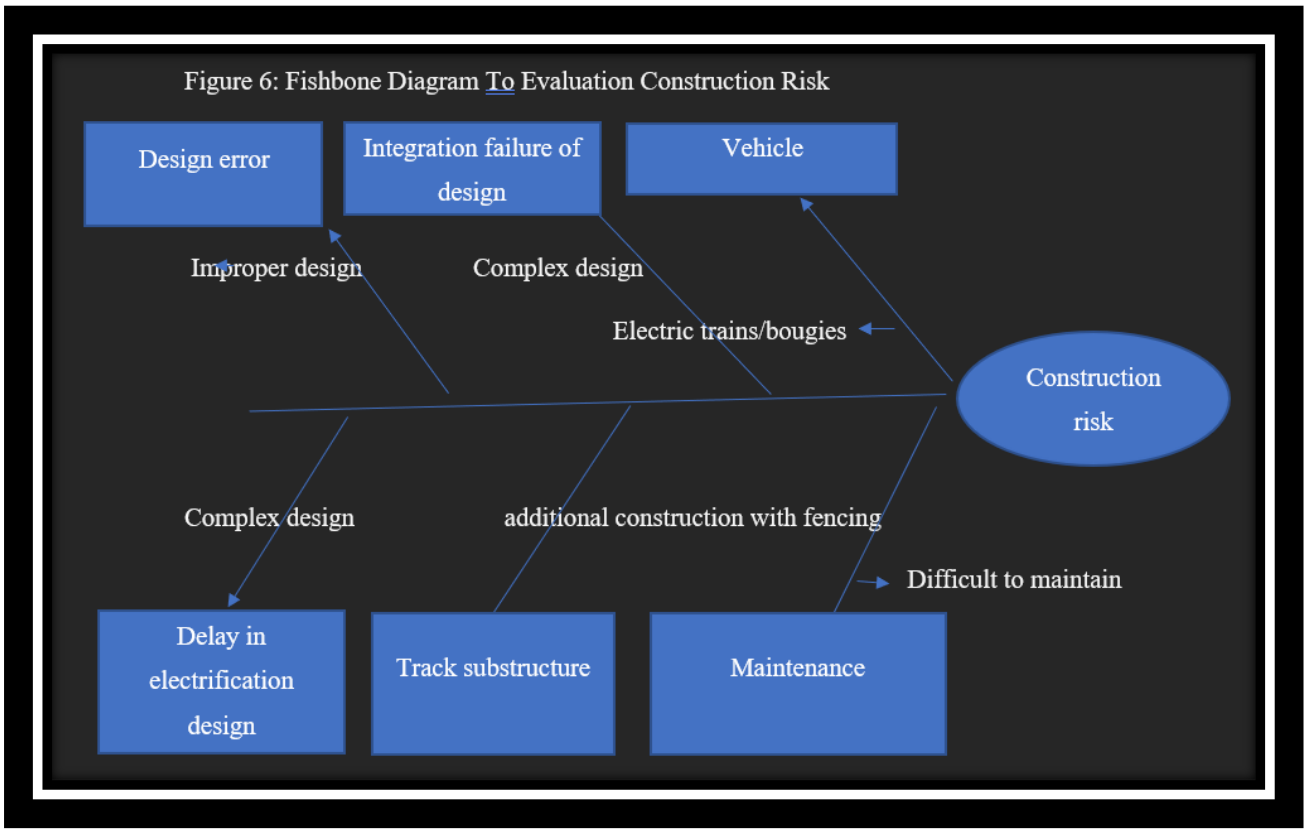


Figure 12: fishbone diagram



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