RMIT UNIVERSITY

RISK & PROJECT MANAGEMENT (OENG 1117)

Assignment # 3

Project Appraisal Report (Group Assessment) of Murray Basin Rail Project

Date: 19 October 2019

Executive Summary

As an overview of this assignment task we have carried out a *Project Appraisal Report* of an engineering design and development project, based on a critical review of advanced concepts and practices in risk assessment and project management. From the list provided we have selected the following project:

Murray Basin Rail Project

We have covered some explicit tasks in the report which are (a). Problem diagnosis, goals/objectives articulations which include project requirements, problems, constraints, available resources, stakeholders, interest and benefits, KPIs, etc., (b) Project technical description, what new techniques, technologies, management strategies such as budgeting/cost control, procurement approaches, resources and logistics are used in the project. (c) Economics-Based assessment which include financial calculations using different approaches including @Risk 7, capital analysis, etc. (d) Non-Economics-Based assessment which include social, environmental and cultural requirements and analysis, etc. (e) Decision making and recommendation (eventually, according to our calculation and analysis, we reported the project feasibility and recommendation of the optimal project implementation plan (Hou, 2019)

By undertaking the Project Appraisal Report during this assignment of the Murray Basin Rail Project reveals and we judge based on various options such as cost , economic and non economical as feasible and project is viable. we have gained huge knowledge and skill in conducting Project Appraisal which will help us in our future career as project risk managers and engineers.

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Introduction

In this assignment we have applied advanced risk concepts for Project Appraisal Report in light of ISO31000 risk management standards within an engineering context. We have identified risk evaluation tools relevant to engineering and technology-based problems. The Project Appraisal process is then applied to customer-driven project management through the design and development of project proposals. We have developed specific skills in project management systems and discovered economic and commercial business plans at different risk levels. This assignment further advances the skills and their application essential to achieve engineering projects (e.g. mega civil engineering, environmental advancement projects, technology upgrade and product development). We have considered the connection between projects and risk, together with project planning, project control and mitigation plans. The assignment task covers field such as risk philosophy and techniques of advanced project planning and control, the project life cycle, organisational behaviour, performance measurement and evaluation and systems and procedures for project management (Hou, 2019)

Introduction to Murray Basin Rail Project

To cope up with the growing demand for freight services in Victoria's rail freight network, the Murray basin rail project will be a vital contribution. Significant economic growth, new jobs and major enhancement to the transport industry, regional communities and agricultural sector is expected to be driven by this project. Approximately 20,000 truck trips from roads to the ports will be removed which will improve the safety for regional communities and support shifting freight mode from road to rail. For the improvement of more rail transport this project will standardise the rail freight lines at Murray basin region. Furthermore, to reduce the number of trip and increase load capacity, this project will increase axle loading from 19 to 21 TAL (Tonne Axel Load). Due to these modifications, freights from this region to Victoria's ports will become more cost-competitive and efficient. This project not only reduce the logistic costs for primary producers and industries, but also ensures the rail network in this region will meet the future freight demands. (Murray Basin Rail Project – Summary Brochure, n.d.).

Current Problems

There were major 3 problems identified which needed to be addressed for the improvement of rail infrastructure:

a) The international competitiveness of bulk products getting undermined due to restricted access to Victorian ports.

b) Business cost is increasing due to the rail networks poor performance.
c) Community Amenity are getting reduced due to growing road freight movements.

Benefits to be delivered with this Project

The major benefits to be delivered with the Murray Basin Transport Network Initiative project are

a) Reducing the costs for industry and burden for Government. This is approx. 50% contribution of the total predicted benefits. This includes
   i) Reducing land transport cost for the producers
   ii) Deterioration rates on identified routes will be reduced

b) Private investment will be increased. This is approx. 30% contribution of the total predicted benefits. This consists of:
   i) Investment in Port infrastructure will be increased
   ii) Investment in Rail-related infrastructure

c) Efficiency and Safety of the road network will be increased. This is approx. 20% contribution of the total predicted benefits. This includes following:
   i) Hazards on identified routes will be reduced
   ii) Vehicle accidents will be fewer

Project options considered

There were four project options considered for comparing against Government objectives:

i) **Option 1** - standardisation of the Mildura line only via a new link from the Mildura line to the Hopetoun line.
ii) **Option 2** - standardisation of all the existing network including the Mildura line and the branch lines to Sea Lake and Manangatang connected via the existing Geelong to Maryborough line.
iii) **Option 3** - standardisation of all the existing network including the branch lines to Sea Lake and Manangatang connected via reopening the existing standard gauge line from Ararat to Maryborough,
iv) **Option 4 –** Combination of both project option 2 and 3 including standardisation of all the existing network including the Mildura line and the branch lines to Sea Lake and Manangatang connected via both the Geelong to Maryborough line and the reopened Ararat to Maryborough line.

Standardising and upgrading current 19 TAL broad gauge rail track to a 21 TAL rating using Timber replacement sleepers (TRS) are considered for each option. (DEDJTR, 2015)

Recommended Solution & Project Scope of Work

Project option 4 is more superior and preferred solution as it meets all the project objectives.

The Murray basin rail project will upgrade and standardize approximately 1,023 KM of rail track from 19 to 21 TAL in this region. Following tracks considered for:

Table 1: Murray Basin Project Scope of Work

Rail Line	Length	Scope of Work
Maryborough – Yelta track	406 Km	Upgrading and standardising from 19 to 21 TAL
Sea Lake – Korong Vale branch track	142 Km	Upgrading and standardising from 19 to 21 TAL
Manangatang – Dunolly branch track	248 Km	Upgrading and standardising from 19 to 21 TAL
Maryborough – Ararat track	87 Km	Upgrading to 21 TAL and re-opening of the closed standard gauge rail line
Gheringhap - Maryborough track	140 Km	Upgrading to 21 TAL and dual gauging the track

The above scope is depicted in following figure.

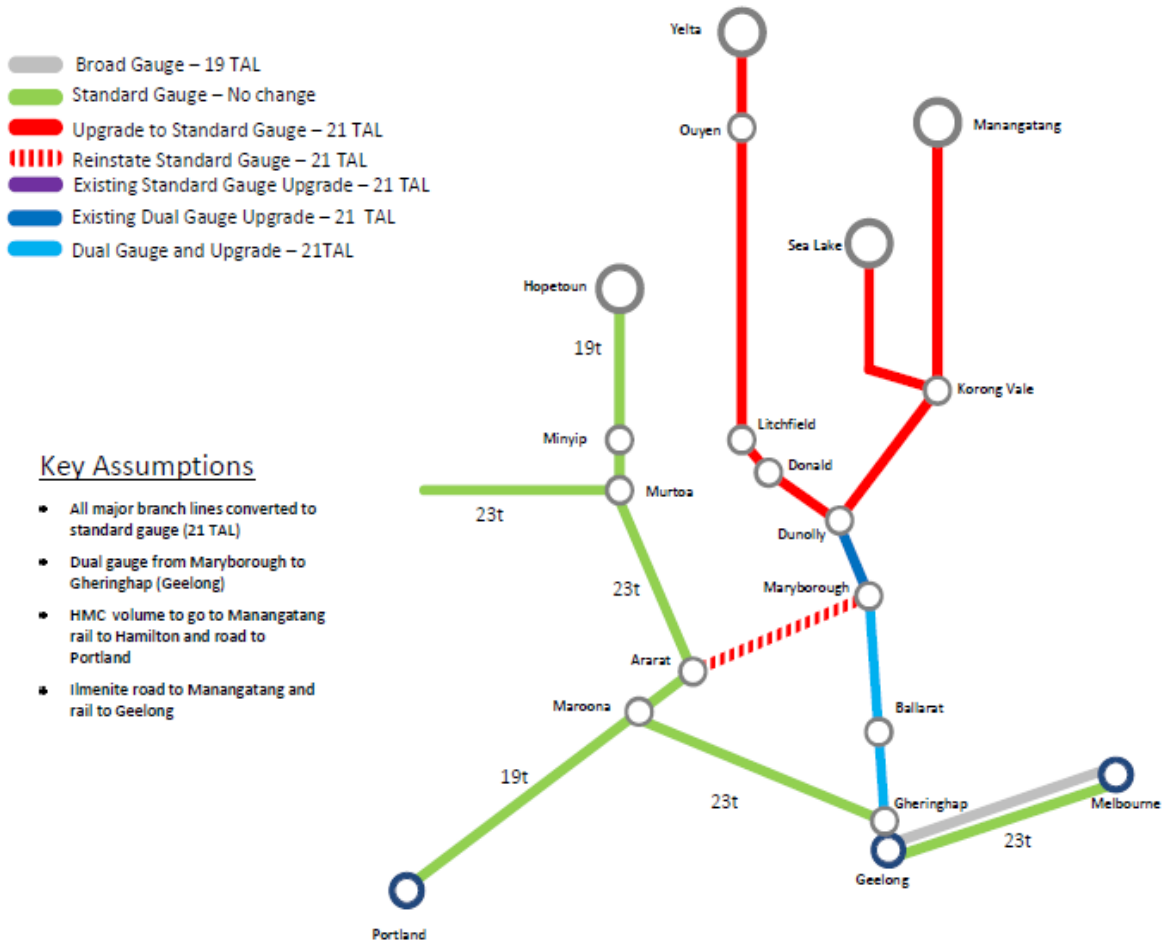


Figure 1: Recommended Solution Schematic (DEDJTR 2015, p.115)

For PTV's requirement to 'future proof the Gheringhap to Ballarat section for broad gauge passenger services, dual gauging to this section was considered. Furthermore, to accommodate existing broad-gauge passenger services, dual gauging of Maryborough to Ballarat section is considered. (DEDJTR, 2015)

In summary the total scope of work with key quantities are as follows:

Element	Quantity
Installation of TRS Concrete Sleepers	271,000 sleepers
Installation of Timber Sleepers (for Dual Gauge Track)	48,000 sleepers
Removal / Refurbishment of Turnouts	142 turnouts
Supply and Install Dual Gauge Turnouts	25 turnouts
Supply and placement of Ballast	215,000 tonne
Level Crossing Upgrades	382
Bridge / Major Culvert	532

Figure 2: Project Scope Summary Quantity (DEDJTR 2015, p.116)

For minimising track closure and service disruption, both upgrading and standardising works need to be accomplished concurrently for each track sector using the same workforce.

An overview Murray Basin Rail Project

Project technical description, what new techniques, technologies, management strategies such as budgeting/cost control, procurement approaches, resources and logistics are used in the project.

According to Infrastructure Australia's Project Business Case Evaluation (PBCE), volume on the Murray Basin rail system is constrained by the combination of broad- and standard-gauge lines. A nineteen-tonne axle load limit and deteriorating levels of service due to a long-term under budget on maintenance. This results in crumbling of the system, plummeting its user-friendliness and flexibility. Therefore, transport times for rail freight are lengthier and less dependable than road, and costs to state exchequer are higher. Swelling rail freight prices have led to in an upsurge in road freight in the Murray Basin area, which has harmful effects on farmer revenues, local facility and the environment.

The elevation of the Murray Basin rail system was earlier registered as a Urgency project on the Infrastructure Priority List (2016).

The sponsor offers a set of rail network enhancements including axle load upgrades from 19 to 21 tonne and standardisation of the current broad-gauge rail system in the Murray Basin Area. The project would also realize the improvement and elevation of the standard gauge rail line between Ararat and Maryborough.

The sponsor's economic assessment of the project specifies a net present value (NPV) of $323.6 million and a benefit-cost ratio (BCR) of 1.7 based on P50 capital costs and a discount rate of 7%, exclusive of broader financial paybacks, which are not likely to be substantial. Infrastructure Australia contemplates that although some of the acknowledged paybacks may be exaggerated the project's paybacks in general are to be expected to exceed its expenses.

Infrastructure Australia contemplates from a tactical standpoint that there is value in using rail to transfer considerable capacities of bulk cargo over extended distances where it is economically feasible to do so. This method is consistent with present tactical arrangement of principles for cargo carriage.

Stakeholder Identification and Consultation

For any successful project its vital to have effective stakeholder engagement. Key stakeholders need to be identified for adequate level of engagement. For adapting the engagement activities effectiveness and analyse specific action for managing stakeholder's expectations and prerequisites, a plan need to be developed. Project scope, schedule and delivery scheme need to incorporate these identified stakeholder's prerequisites. For addressing key stakeholders concern and disputes, a Communications Manager should be assigned in the Project Delivery Group. A plan for communication approved by appropriate authority need to be established as well.

The key government and industry stakeholders, their interest and relationship on this project are listed below (DEDJTR, 2015):

Table 2: Stakeholder Consultation (DEDJTR 2015, p.91 & 92)

Entity	Relationship	Interest
DEDJTR – Ports and Network Integration	Project proponent. Responsible for the delivery of the Business Case for the Murray Basin Rail Freight standardisation project.	Improving the transport efficiency in the Murray Basin; through rail standardisation; enhance access to the ports of Portland, Geelong and Melbourne for Victorian exports; and enable further logistical flexibility and ease of use of the Victorian rail network to support a mode shift to rail.
PTV – Public Transport Victoria	Responsible for Victoria's metropolitan public transport network and operation.	Ensure the project complements PTV's objectives to efficiently plan and manage Victoria's public transport network and service delivery.
VicTrack	Statutory authority responsible for ownership of Victoria's railway land and infrastructure.	Ensure the project enhances the value of the state's rail assets and infrastructure.
ARTC	Statutory authority responsible for ownership of Federal railway land and infrastructure.	Expansion of Victoria's standard gauge network has the potential to increase freight traffic across ARTC's network due to increased rail mode share and improve access revenue.
V/Line	Regional network manager, access provider, works delivery, country passenger services	Responsible for delivery of standardised and upgraded network and its management, and beneficiary of any increase in rail mode share with improved access revenue.
VicRoads	Statutory authority responsible for managing Victoria's road infrastructure and traffic.	Reduction in road mode share for export commodities should reduce maintenance burden on some road sectors.
Iluka Resources	Global mineral sands resources company with operations at Hamilton, and mines at Mittyack, with further planned mine developments at West Balranald and Euston.	Will impact Iluka's bulk freight options for movement of HMC to Hamilton and Ilmenite for export, delivering lower supply chain costs.
Grain Industry (GrainCorp, Emerald Grain, Cargill, Bunge)	Grain traders involved in receival, storage and logistics of moving bulk grain for export from the Murray Basin region.	Where companies have take-or-pay risk, opportunity to reduce rail freight costs by improving asset utilisation and loading efficiencies. Higher rail share will reduce accumulation costs for cargo assembly. Potential for investment in new rail assets.
Pacific National	Rail freight operator	More efficient utilisation of rail assets across the standard gauge network, although will open up the market to competition. Potential to down scale broad gauge freight assets.

Entity	Relationship	Interest
Port of Geelong	Regional port operator – Victoria's largest bulk export port	More efficient commodity movement into ports with less truck movements. Potential for greater port competition to attract standard gauge grain.
Port of Portland	Regional port operator – Victoria's second largest bulk export port	Potential to expand the port's grain catchment and provide greater port competition to attract standard gauge grain. Provide a basis for investment in more efficient rail shunting and discharge arrangements.

Economics-Based assessment which include financial calculations using different approaches including @Risk 7, capital analysis, etc.

Financial Analysis:

Introduction

Financial analysis is an important part for any project as it deals with the financial aspects of a project. The Simplest form of analysis is the total costs of a project which are considered is lower than the total benefits resulting from the project. The basic process to calculate financial analysis is adding the costs and the revenues expected from the project and the savings of the costs for the next coming years and the comparison. To evaluate the costs and benefits for any project the major commonly used techniques are Payback period analysis, calculating rate of return, Net present value calculation and considering internal rate of return (Hou, 2019).

As per the Murray rail basin four options were considered and the financial analysis is calculated for each of the options. The best option is considered based on the several aspects of the calculation.

Benefit-Cost Analysis

Cost benefit analysis is defined as the process where the project can be analysed by considering decisions, systems or by determining a value. The project developers rely on cost benefit analysis as it may be accurately calculated based on opinions and all other aspects. In this Murray rail basin project, the costs involved for the project and benefits considered are also added. The major cost benefit analysis is carried by considering various factors like:

Net Present Value (NPV)

Benefit-Cost Ratio (BCR)

Pay Back period (PB)

Internal rate of return (IRR)

Costs associated with the project:

For this Murray Rail basin there are different types of costs taken into consideration. The Capital costs and Maintenance costs are considered. Capital costs is the estimation for the construction of the project and maintenance costs are calculated per year (Hou, 2019).

Life Cycle of the project	**years**
Project Life Time (yrs)	30
Capital Cost	**$ in million**
Land	50
Investigation and survey	25
Civil works	80
Establishment cost during construction	60
Rolling Stock –Capital cost	50
Rolling Stock(supporting infrastructure)	60
Murray Rail basin Project –capital cost involves	
· Building, construction, Equipments, Rendering of service	10
· Construction	
· Equipments	
Rendering of service	
Summation of capital cost	335
Annual operating cost	**$ in million**
Maintenance	80
Salaries and wages	42
Summation of Costs	122
Resale value	**$ in million**
Resale cost (10% of capital cost)	33.5
Summation of Resale value	33.5

Table 1. Data considered for the project

The above table gives a brief idea of the costs involved in the project and various factors are also taken into consideration for the costs.

Benefits for the project:

For this Murray rail basin, the benefits are considered as direct monetary benefits. The assumptions for benefits are considered based on the successful completion of the project. Several factors are also considered for the successful benefits calculation.

Annual Benefits	**$ in million**
Transit Time Savings	30
Transport Cost Savings	30

Avoided Externalities	30
Avoided Crash Costs	30
Avoided Road Damage	35
Residual Value	10
Summation of Benefits	165

Table 2. Benefits considered for the project

The above table shows the benefits considered using different factors.

Benefit Cost Ratio (BCR):

A benefit cost ratio is used to analyse the overall relationship between costs and benefits of a particular project. In general, it gives the basic idea about the viable, internal rate of return, payback period and net present value(NPV). The project is considered positive when the BCR value exceeds one (Hou, 2019).

BCR value is calculated for Murray rail basin project for 30 year life time with interest rate of 7% (as per the standard of Infrastructure Australia).

$$BCR = \frac{Present\ Value\ of\ Annual\ Benefits}{Present\ Value\ of\ Annual\ Costs}$$

Where

Present value of Annual costs= 122 millions

$$\text{Present Value of Annual Benefits} = (\text{Annual Benefits} - \text{Annual Costs})\ \text{PVF}_{\text{i,n}} + \frac{\text{L}_{\text{n}}}{(1+\text{i})^{\text{n}}}$$

Where:

$$PVF_{i,n}(Present\ Value\ Factor) = \frac{(1+i)^n - 1}{i(1+i)^n}$$

i=7%

n=30 years

$$PVF_{i,n} = \frac{(1+0.07)^{30} - 1}{0.07\ (1+0.07)^{30}}$$

=12.40

$$Present\ Value\ of\ Annual\ Benefits = (165 - 122)\ 13.8 + \frac{33.5}{(1+0.07)^{30}}$$

=597.80 millions

Therefore BCR (7%)=1.107>1

The project is profitable to the company as the BCR value is greater than 1.

Net Present Value(NPV):

Net Present value gives the idea whether the investment in that project is worthwhile or not. It is calculated by difference between the inflow of the cash and outflow in an organization (Hou, 2019).

NPV for Murray Rail Basin Project is calculated using the discount rate 7% for 30 years.

$$NPV = -I_0 + (B - C)\ PVF_{i,n} + \frac{L_n}{(1+i)^n}$$

I_0= Initial Capital Investment

B= Annual net Benefits

C= Annual net costs

$$PVF_{i,n} = Present\ Value\ factor, PVF_{i,n} = \frac{(1+i)^n - 1}{i(1+i)^n}$$

L_n = Liquidation yield in 30 years

i= Dicount rate

n= number of years

$$NPV\ (7\%) = -335 + (165 - 122)12.40 + (\frac{33.5}{(1+0.07)^{30}})$$

NPV(7%) = 202.98 millions

The project can be take into action as the NPV value is positive.

Payback Period(PB)

It is the time length for which the investor gets all the investment in terms of savings.

Payback period is calculated for Murray rail basin project:

PB=(Initial cost(I_0) /Annual Cash Inflow (B-C))

=335/(165-122)

=7 years.

It clearly states that the investor will recover the investment in 7 years after the project completion.

Internal Rate of Return (IRR):

It measures the investment's rate of return. It indicates how fast the investor recover the investment. Higher the IRR value, faster the investment gets recovered.

Internal rate of return is calculated for Murray Rail Basin project using 30 years lifetime.

NPV(7%)=202.98 millions

NPV(12%)=12.49 millions

For IRR:

Let 'x' be the interest rate where NPV is zero:

$$\frac{7-12}{12-x}=\frac{202.98-(12.49)}{12.49-0}$$

$$\frac{-5}{12-x}=\frac{190.49}{12.49}$$

(-5)(12.49)=(12-x)(190.49)

(-62.45/190.49) = (12-x)

-0.327=12-x

X=12.32

IRR=12.32%

The NPV becomes zero at 12.32% discount rate.

Indicators at inflation	4%	7%	12%
Present Value factor (PVF)	17.29	12.4	8.055
Net Present Value (NPV)	418.8	202.98	12.49
Internal Rate Return (IRR)	12.32		
Payback period PB (Years)	7		
Benefit-cost ratio (BCR)	1.16	1.1	1.008

Table 3. The Results for the Financial analysis

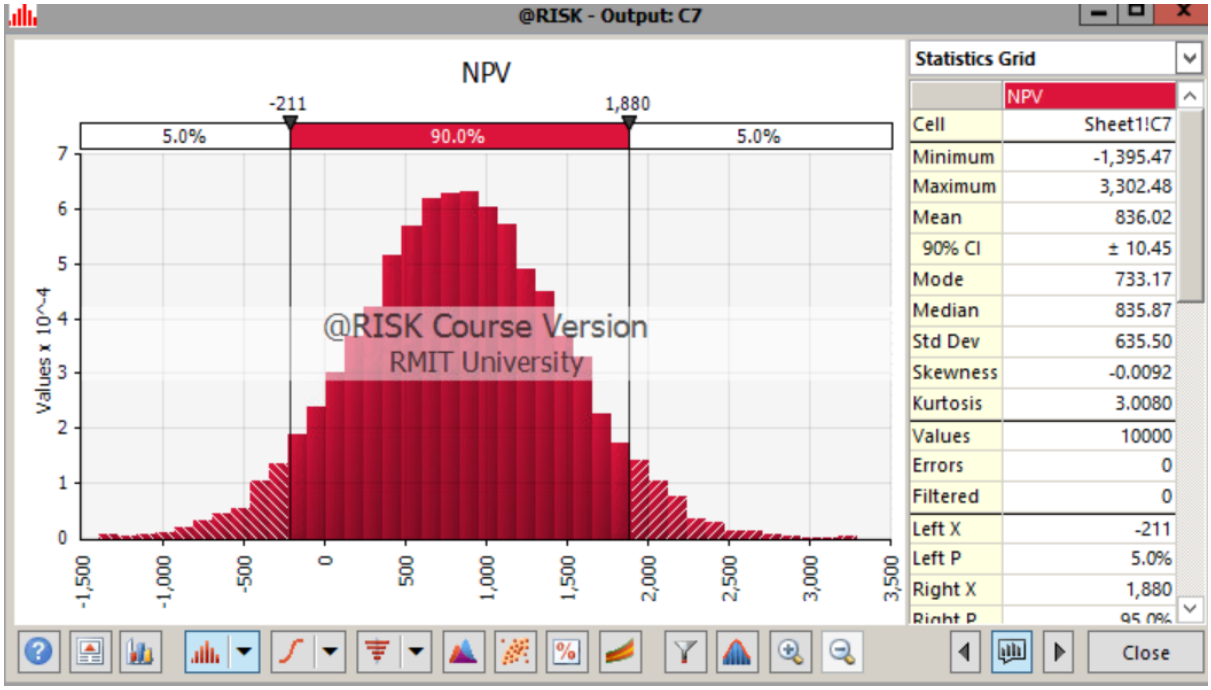


Fig 1.Monte-carlo simulation method

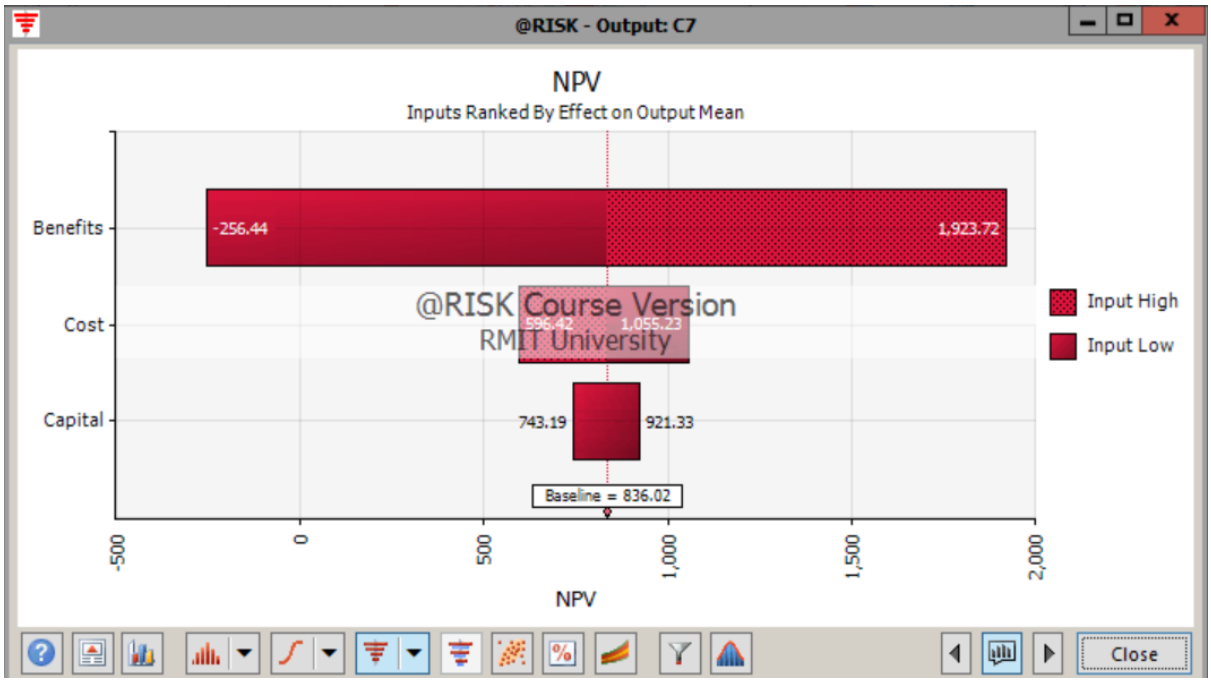


Fig 2. NPV for the output

The above figures show the costs and benefits analysis of the Murray Rail basin by Monte carlo simulation method. The benefits calculated are higher than the costs considered for the project.

ECONOMIC ANALYSIS

INTRODUCTION

In addition to the financial factors for the cost and benefits attributed with the project, economic impact and feasibility of the project is of utmost importance. The project might not be financially sound once reviewed based on financial analysis but would yield far reaching benefits making it a viable option in the longer run and vice versa.

The 4 proposed options for the project have been discussed earlier and financial analysis of the options has revealed Option 3 to be the viable option. These options are evaluated further for their economic benefits on following factors:

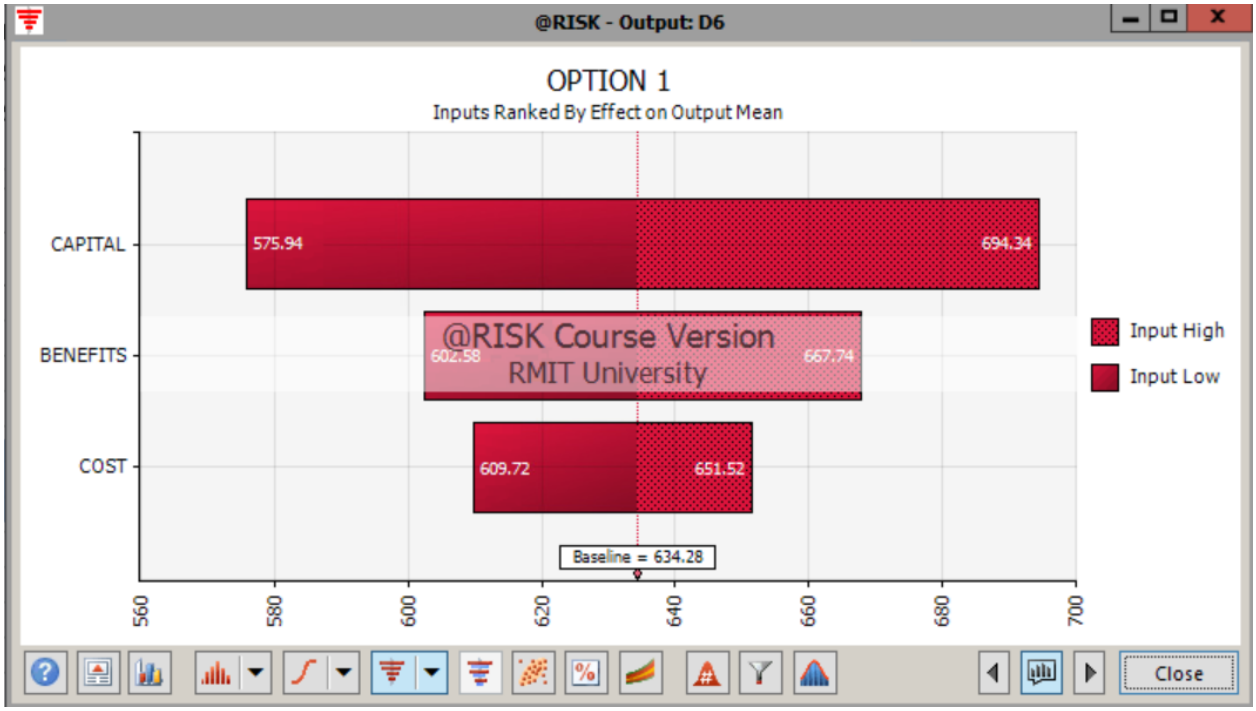
1. **Enhancement in Port Competition**: The accessibility to the ports and the increased traffic with their far-reaching impact
2. **Improved Transport Efficiency Due to Increased Axle Loading and Track Standardization**: The reduced transfer of goods, train changes for passengers and end-to-end traffic availability
3. **Additional Investment Opportunities**: Market optimization and option availability for new ventures
4. **Minimized Conflict Between Freight and Passenger Movement**: Ease of traffic management by not compromising the efficiency of the railroad
5. **Project Deliverability Risk**: Multiple factors during delivery of project including zone changes involving Government approvals, agencies approvals, flora fauna protection and disruptions to existing traffic

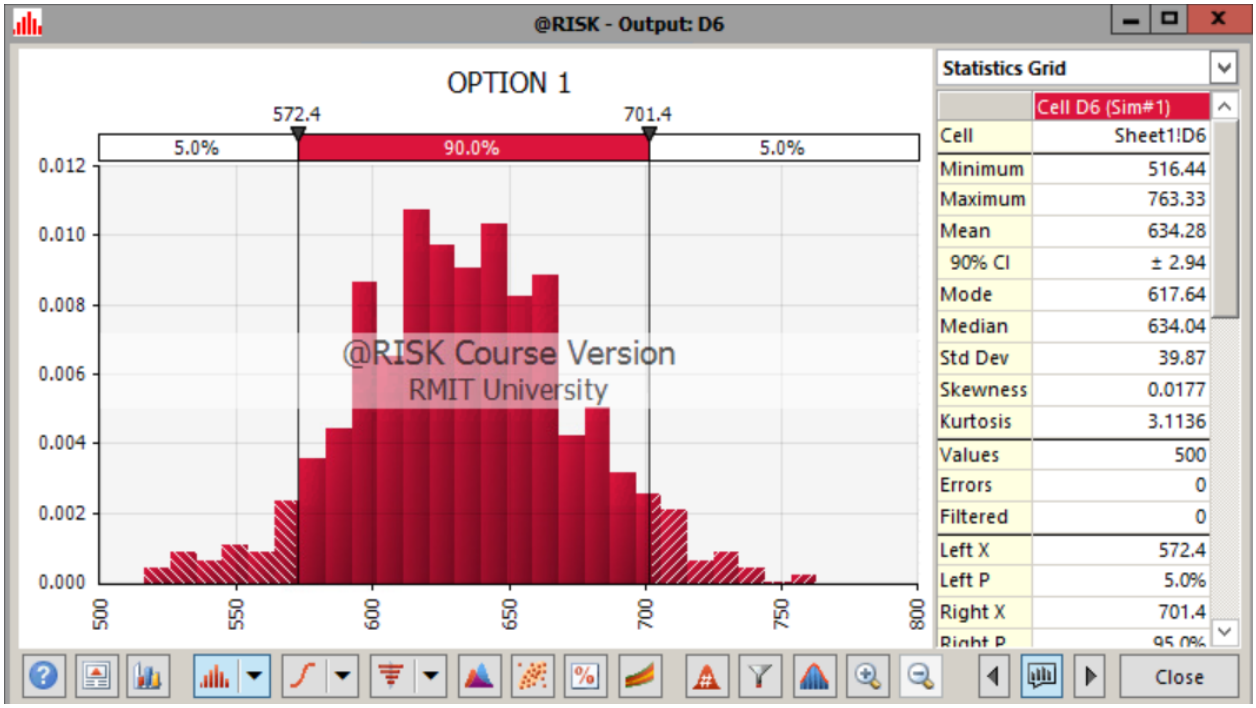
The details with respect to each option have been expanded in the trailing table along with attributed costs (opportunity cost included) for each option.

OPTION 1

The evaluation of this option is as follows:

Indicators at inflation	**4%**	**7%**	**12%**
Present Value factor (PVF)	17.292033	12.4090412	8.05518397
Net Present Value (NPV)	246.60558	153.777764	-67.762727
Internal Rate Return (IRR)	20.282957		
Payback period PB (Years)	10.140146		
Benefit-cost ratio (BCR)	1.0895976	1.03772366	0.95105759

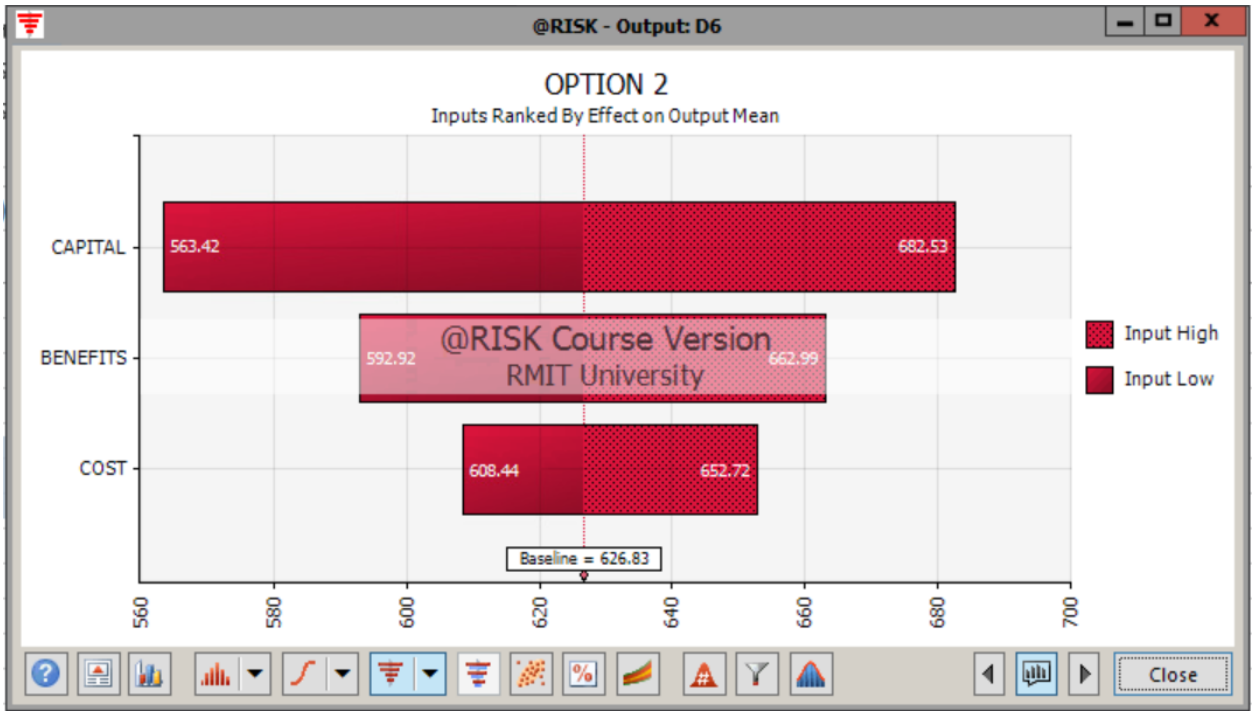


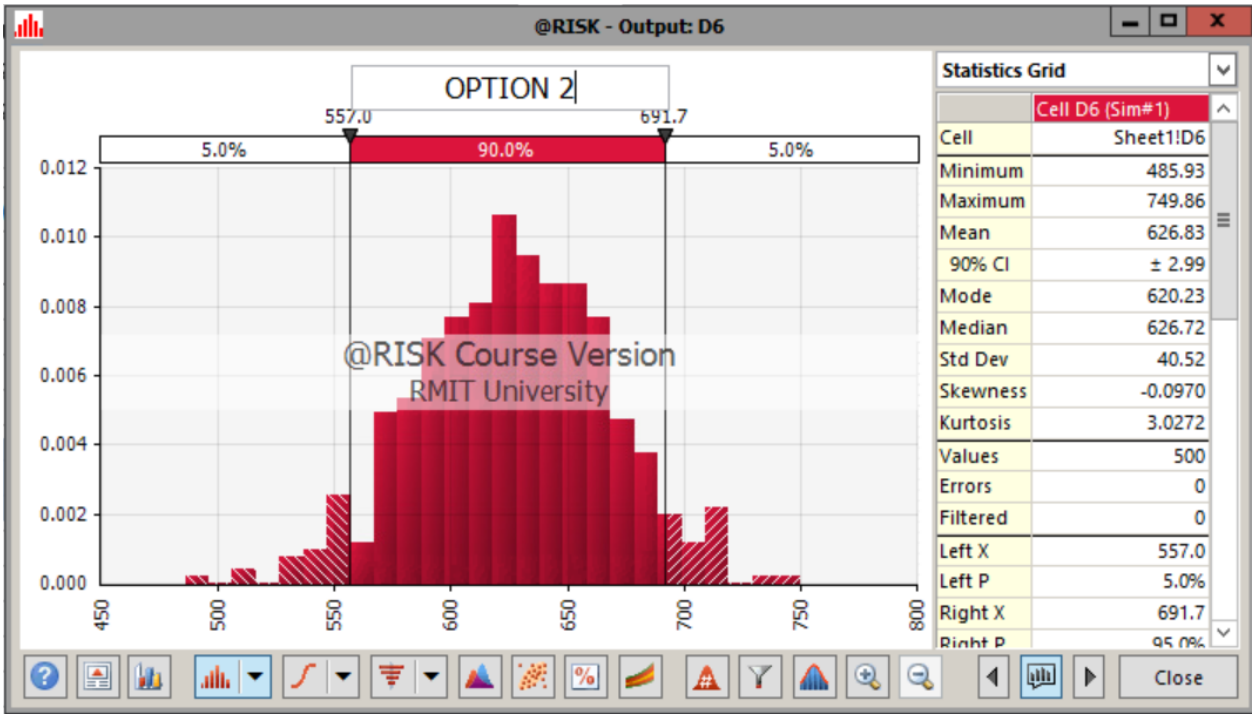


OPTION 2

Indicators at inflation	4%	7%	12%
Present Value factor (PVF)	17.292033	12.4090412	8.05518397
Net Present Value (NPV)	407.47337	269.219074	7.17464964

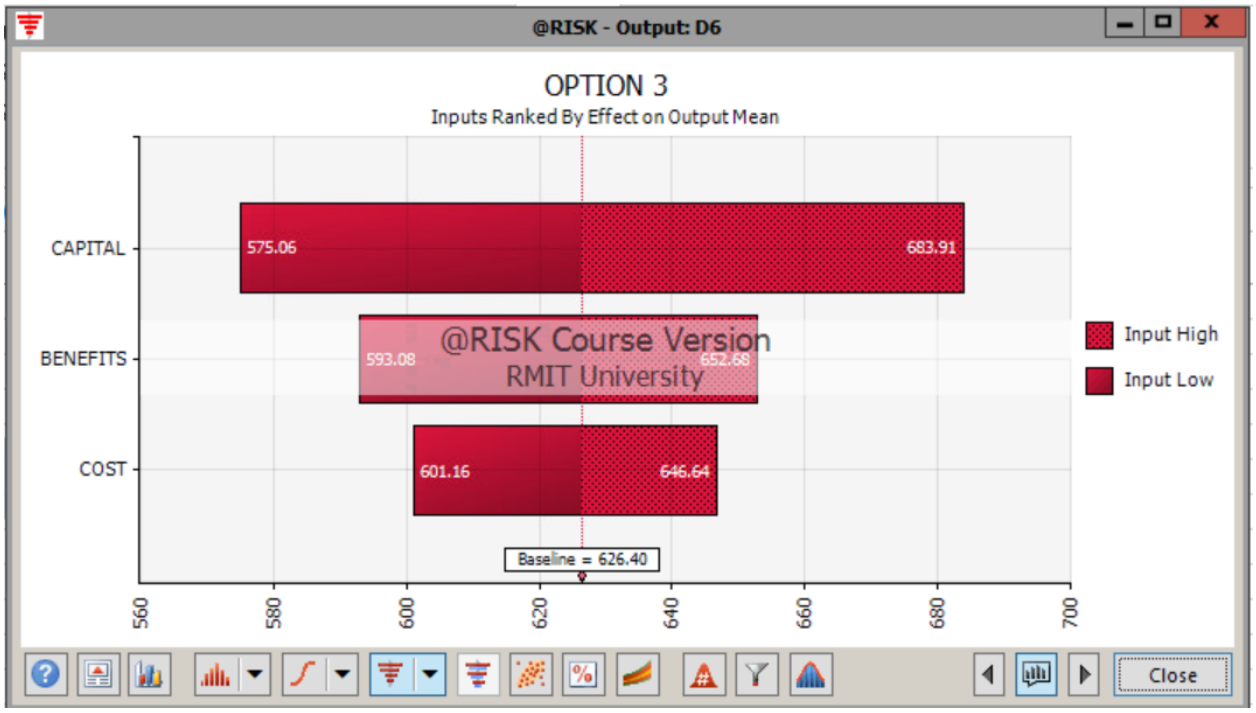
Internal Rate Return (IRR)	**21.74%**		
Payback period PB (Years)	**7.9121398**		
Benefit-cost ratio (BCR)	**1.1593452**	**1.10110645**	**1.00451989**

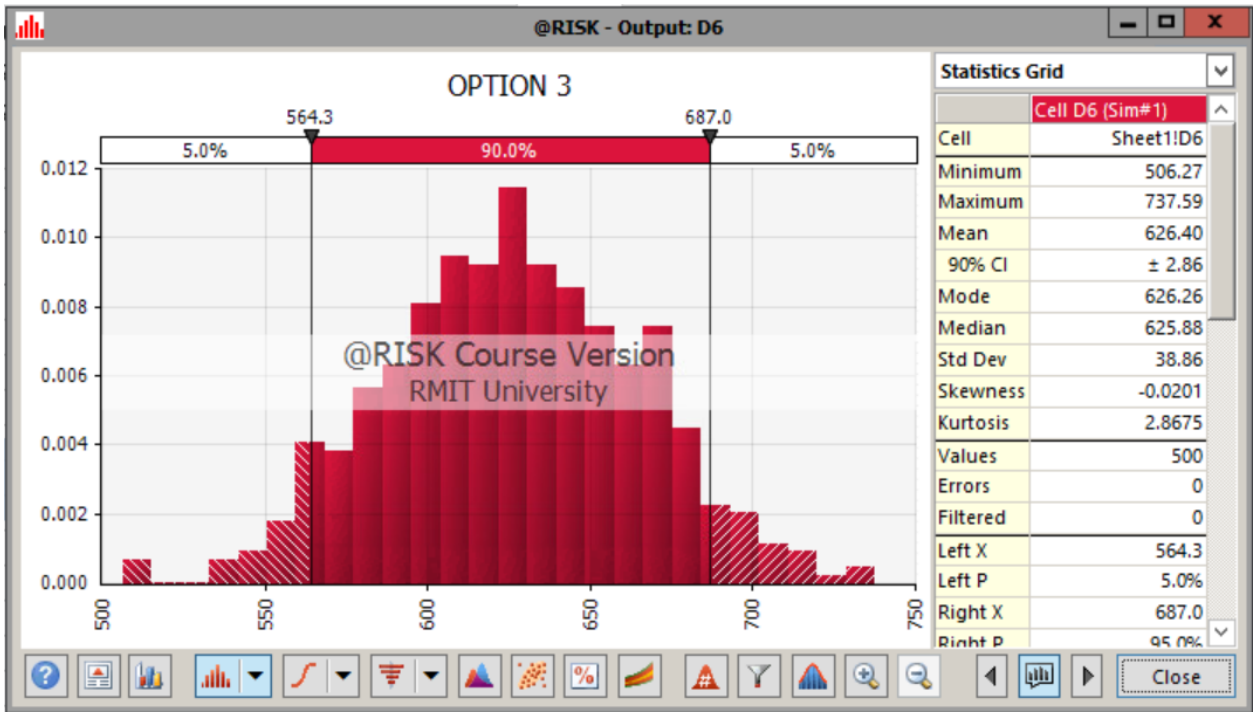




OPTION 3

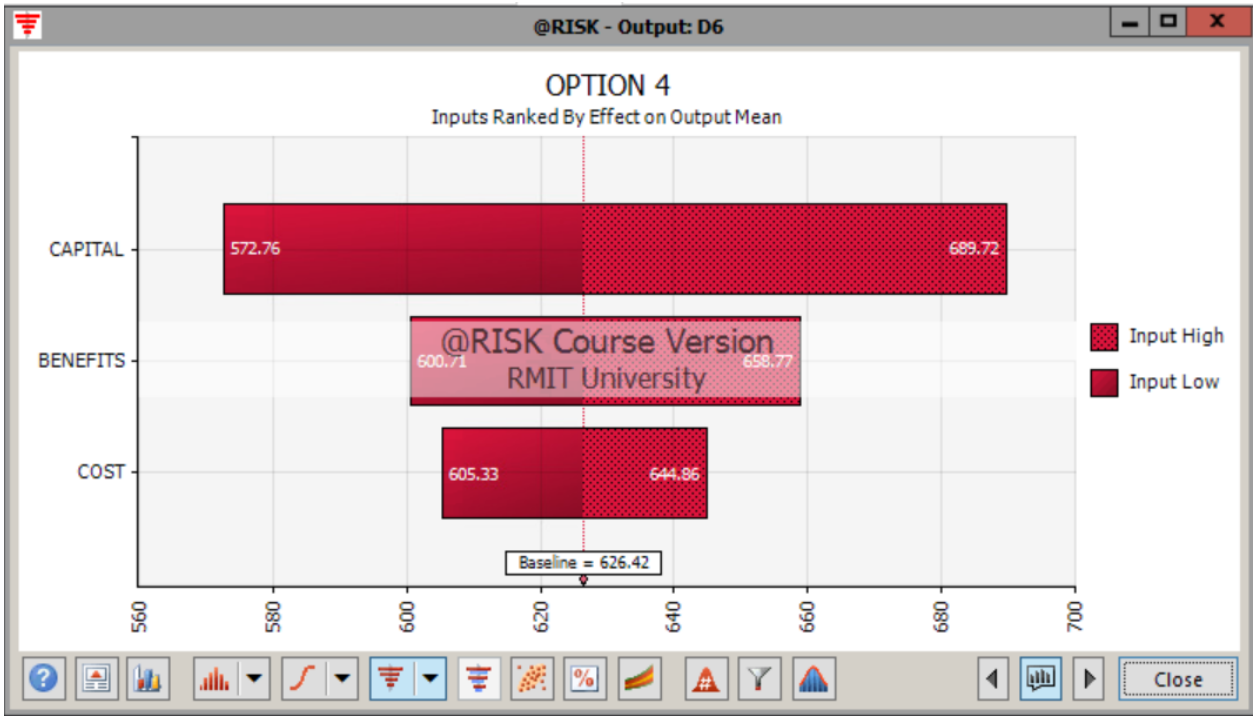
Indicators at inflation	4%	7%	12%
Present Value factor (PVF)	17.292033	12.4090412	8.05518397
Net Present Value (NPV)	463.84539	309.672548	33.4345494
Internal Rate Return (IRR)	22.043031		
Payback period PB (Years)	7.3464912		
Benefit-cost ratio (BCR)	1.1843421	1.12410938	1.02439006

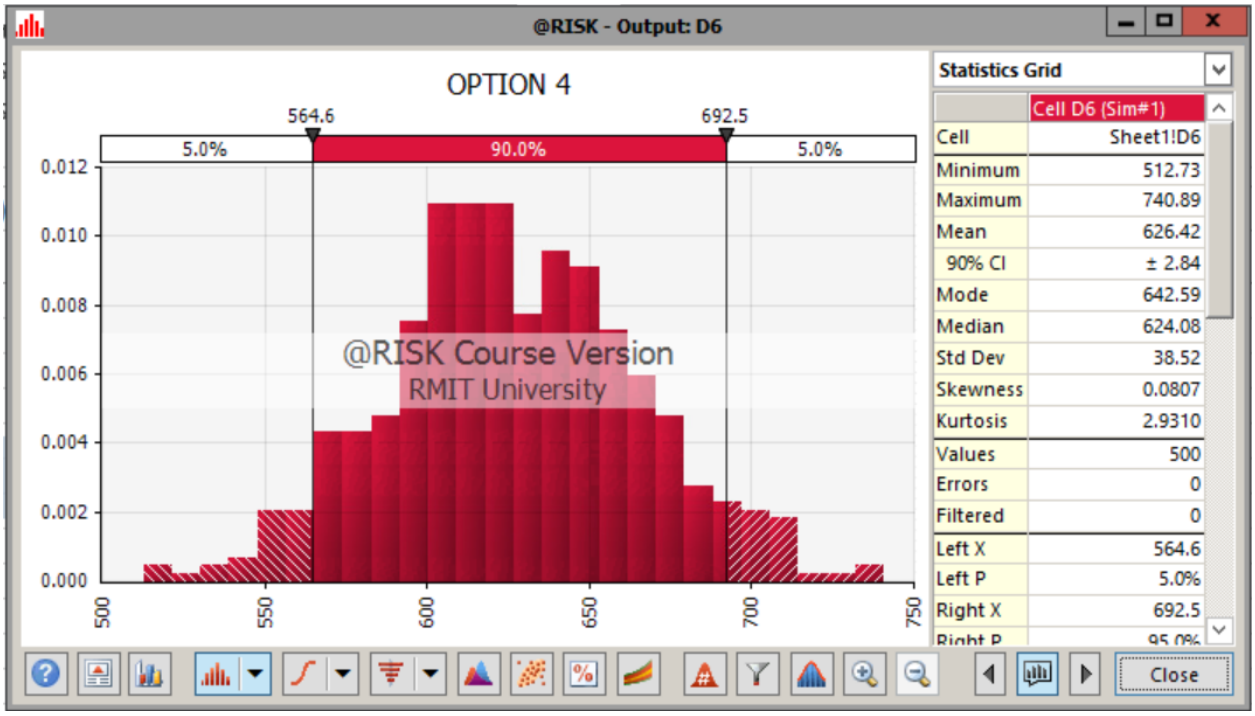




OPTION 4

Indicators at inflation	4%	7%	12%
Present Value factor (PVF)	17.292033	12.4090412	8.05518397
Net Present Value (NPV)	428.74257	284.482195	17.0825259
Internal Rate Return (IRR)	21.860026		
Payback period PB (Years)	7.6887767		
Benefit-cost ratio (BCR)	1.1688513	1.10981213	1.01197376


@RISK - Output: D6
OPTION 4
Inputs Ranked By Effect on Output Mean
CAPITAL
BENEFITS
COST
572.76
689.72
600.71
658.77
605.33
644.86
Baseline = 626.42
@RISK Course Version
RMIT University
Input High
Input Low
560
580
600
620
640
660
680
700
Close


@RISK - Output: D6
OPTION 4
564.6
692.5
5.0%
90.0%
5.0%
0.012
0.010
0.008
0.006
0.004
0.002
0.000
500
550
600
650
700
750
@RISK Course Version
RMIT University
Statistics Grid
Cell D6 (Sim#1)
Cell Sheet1!D6
Minimum 512.73
Maximum 740.89
Mean 626.42
90% CI ± 2.84
Mode 642.59
Median 624.08
Std Dev 38.52
Skewness 0.0807
Kurtosis 2.9310
Values 500
Errors 0
Filtered 0
Left X 564.6
Left P 5.0%
Right X 692.5
Close

ECONOMIC EVALUATION FACTORS		Enhancement of port competition
Option 1	BENEFIT DESC	**Average benefits** Access could be provided to Port of Portland only (through Mildura Line). No change in port access to other lines
	COST/BENEFIT	$20M
Option 2	BENEFIT DESC	**No Change** Mainly focuses on existing infrastructure and does not provide additional access to port
	COST/BENEFIT	-$20M
Option 3	BENEFIT DESC	**Good** Additional line to Ararat and Maroona will enable the accessibility of whole Murray Basin Region to ports in
	COST/BENEFIT	$3M
Option 4	BENEFIT DESC	**Maximum** Maintaining the existing connection and providing direct connection to ports in Geelong and Melbourne
	COST/BENEFIT	$5M


$10M
Maximum
Provides good accessibility to Murray region with access to ports yielding maximum benefits
$2M
Good
Provides good accessibility to Murray region with access to ports. Additional distance to Melbourne ports has its impact on effectiveness of this route
$3M
Average
Provides good accessibility to Murray Basin region but limited benefits to port accessibility reducing the effectiveness
-$4M
Minimal
Minimal benefit to mineral sand industry and no benefit to grain industry
Improved trasport efficiency due to increased axle loading and track standardization

$60M
Good Good benefits but conflict with exiting services would reduce the interest of potntial investors
$100M
Maximum Good accessibility, port access and minimal conflict with existing services can lure more investment
$60M
Average Has significance accessibility to Murray Basin region. But reduced effectiveness to its port access and conflicts with other services would also reduced interest of new investors
-$80M
Minimal No new routes and minimal benefits to major stakeholders resulting in minimal increased investment
Additional investment opportunities

-$25M
Marginally **Improved** Some services diverted to Ararat would not conflict but Geelong Ballarat line would be impacted with conflict as well as restriction of 80kmph
$0
Minimal **Conflict** Diversion of freight services to Ararat causing no conflict with passenger services
-$35M
Maximum **conflict** Conflict of services between Maryborough-Ballarat, Geelong-Ballarat. Also restricting the travel speeds to 80kmph on dual guaging
$15M
Reduced **Conflict** Overall reduced conflict except for retention of passenger/freight lines for broad guage services
Minimized conflict between freight and pessenger movement

-$33M
Medium No planning zone changes but broad guage zone highly impacted during construction stage and would require intermittent closure causing major disruptions
-$6M
Low No planning zone changes and environmental impacts. Freight and passenger lines can operate with minimal conflict and planned closure for shorter intervals with no major disruption.
-$28M
Medium No planning zone changes but involves network closure for substantial time during construction
-$250M
High Involves multiple stakeholders including land access, compulsory land acquisition, road closures, planning zone changes which is estimated to have a 2 years of planning and approval period
Project Deliverability Risk

NON-ECONOMICAL ANALYSIS

The project involves many aspects which cannot be gauged only by their cost feasibility. For instance, the project which would involve demolition or changes to a cultural heritage site will raise hue and cry and the social outcome would render the project option not feasible. The non-economical factors are broadly categorized into two categories, environmental impact and social impact.

STRATEGIC ANALYSIS

The 4 options under discussion options are evaluated on following factors:

1. Benefits
    a. Cost Reduction for industry (lower threshold of 40%)
    The road and rail industry is highly dependent on the commercial road users. The major industries in the Murray River basin are the grain and sand mineral production. The focus of the construction for the project should involve a monetary benefit to these users in order to persuade them using the new network
    b. Increment in private investment (lower threshold of 30%)
    The project should offer new markets and potential for expansion in order to accommodate the private investors
    c. More efficient and safe road network (lower threshold of 20%)
    The threshold was set for the feasible option after careful road analysis for the traffic in Murray Basin region.
2. Cost (already discussed in financial and economical benefits)
3. Time for funding to benefit delivery
4. Risks involved
    a. Lack of funds for maintenance
    b. Discrepancy in model shift
    c. Reduced supply chain benefits at port terminals
    d. Insufficient to entertain new entrants
    e. Economic slow-down impact
    f. Climate Change Impact

Based on the aforementioned factors, option 3 is evaluated the most appropriate in this case offering the best value for the capital and is the safest option as well.

The conjunctive method was used to evaluate the feasibility of option based on the benefits threshold. Following is the depiction which suggest the Option C and D to be most appropriate and offer the benefits equal or over the threshold.

BENEFITS	OPTION A PRODUCER FOCUS		OPTION B MAINTENANCE FOCUS		OPTION C NETWORK INFRASTRUCTURE FOCUS		OPTION D EXISTING INFRASTRUCTURE FOCUS	
Cost Reduction for industry (Threshold >=40%)	✗	10%	✗	20%	✓	50%	✓	40%
Increment in Private Investment (Threshold >=30%)	✗	10%	✗	18%	✓	40%	✓	30%
More efficient and safe road network (Threshold >=20%)	✗	0%	✓	20%	✓	40%	✓	30%

The detailed analysis of the option is as follows:

	OPTION A PRODUCER FOCUS	OPTION B MAINTENANCE FOCUS	OPTION C NETWORK INFRASTRUCTURE FOCUS	OPTION D EXISTING INFRASTRUCTURE FOCUS
BENEFITS				
Cost Reduction for industry (Threshold >=40%)	✗ 10%	✗ 20%	✓ 50%	✓ 40%
Increment in Private Investment (Threshold >=30%)	✗ 10%	✗ 18%	✓ 40%	✓ 30%
More efficient and safe road network (Threshold >=20%)	✗ 0%	✓ 20%	✓ 40%	✓ 30%
COST				
ESTIMATED ANNUAL O&M COST	10M-20M	15M-20M	20M-22M	18M-24M
ESTIMATED COST OVER 30Y	300-600M	450-600M	840-1,050M	740-970M
TIME				
Funding to Benefit Delivery	5 to 10 yrs	1 to 2 yrs	2 to 3 yrs	2 to 3 yrs
RISKS				
Lack of funds for maintenance	High	Low	Medium	Medium
Discrepancy in model shift	High	Medium	Medium	Medium
Reduced supply chain benefits at port terminals	High	Medium	Low	Medium
Insufficient to entertain new entrants	High	Medium	Low	High
Economic slow down impact	Medium	Medium	Medium	Medium
Climate Change Impact	Medium	Medium	Medium	Medium
RANKING	**4**	**3**	**1**	**2**

The options were then evaluated using the Rank-Sum method as tabulated below:

RANK SUM METHOD	RANK POSITION	RATING	WEIGHTAGE
OPTION A PRODUCER FOCUS	4th	1	0.1
OPTION B MAINTENANCE FOCUS	3rd	2	0.2
OPTION C NETWORK INFRASTRUCTURE FOCUS	1st	4	0.4
OPTION D EXISTING INFRASTRUCTURE FOCUS	2nd	3	0.3

The environmental impact analysis of the Option C is carried out for the emissions of CO2, Sox, NOx and Methane. The Global Warming Potential, Acidity Potential and Human Toxicity Potential is tabulated below:

	Emissions (Tons/yr)	Units			GWP	AP	HTP
		GWP	AP	HTP			
CO_2	65,243.00	1			65,243.00	0.00	0.00
SOx	231.00	25	1.2	0.1	5,775.00	277.20	23.10
NOx	32.00	298	0.5	1.2	9,536.00	16.00	38.40
Methane (CH_4)	4,331.00	25			108,275.00	0.00	0.00
GROSS GWP/AP/HTP					**188,829.00**	**293.20**	**61.50**

The social impact analysis was further carried out for site specific parameters. Since the project is covering a vast region and is expected to influence and interact with multiple regional communities so following factors were considered with a deep understanding of each factor.

- Network Accessibility
  The existing accessibility to proposed network site since development of a temporary access way would include multiple local stakeholders as well as involve additional land use
- Resource Availability
  The sustainability approach in gathering locally made material is being considered. Not only that, the availability of local manpower and equipment rental options are being considered as well
- Hydrology and ecological conditions
  The topographic data indicates multiple reservoirs and waterways in the region. Therefore, the preference is to disturb the minimum waterways
- Response from regional councils and residents

The consideration that local councils would be involved during execution of project as well as residents would be included in multiple stages of the project whether for access, jobs or subcontracting

- Response from Grain Industry
  The major stakeholder, the grain industry's reaction to the feasibility of the options is highly influential
- Response from Mineral Sand Industry
  Being one of the major end user, the response from the mineral sand industry dictates the project feasibility
- Response from Road Freight Industry
  The road freight industry would be highly impacted by the availability of another option. The reaction from the stakeholder is also being considered in order to have a mutual agreement of the market availability
- Land Conservation
  Minimum consumption of land for permanent infrastructure
- Aboriginal Heritage Preservation
  No aboriginal heritage should be affected by route or construction of the route
- Disturbance to freight/passenger service
  The disruptions to the freight/passenger services should be minimal and overall impact should not be reducing more than 15% of the existing traffic during construction

The analysis is tabulated as below.

CASES CONSIDERED	OPTION 1	OPTION 2	OPTION 3	OPTION 4
Network Accessibility	Fair	Fair	**Good**	Good
Resource Avaiability	Good	Fair	**Good**	Good
Hydrology and ecological conditions	Poor	Poor	**Fair**	Fair
Response from regional councils and residents	Poor	Fair	**Good**	Good
Response from Grain Industry	Poor	Good	**Good**	Fair
Response from Mineral Sand Industry	Fair	Good	**Good**	Poor
Response from Road Freight Industry	Good	Fair	**Fair**	Poor
Land Conservation	Fair	Poor	**Fair**	Good
Aboriginal Heritage Preservation	Good	Good	**Good**	Good
Disturbance to freight/passenger service	High	Medium	**Low**	Medium
RANKING	**4**	**3**	**1**	**2**

Decision making and recommendation (eventually, according to our calculation and analysis, we reported the project feasibility and recommendation of the optimal project implementation plan.

Project options considered

- **Option 4** – Combination of both project option 2 and 3 including standardisation of all the existing network including the Mildura line and the branch lines to Sea Lake and Manangatang connected via both the Geelong to Maryborough line and the reopened Ararat to Maryborough line.
- We judged project option 4 is more superior and preferred solution as it meets all the project objectives.

Economics-Based assessment

- Include financial calculations using different approaches including @Risk 7, capital analysis, etc.

Financial Analysis:

- We judged as a simplest form of analysis the total costs of Murray Basin Rail project which is shaping out to be lower than the total benefits resulting from the project.

Benefit-Cost Analysis

- We judged Cost benefit analysis for the project analysed by considering decisions, systems, by determining a value. Most of the project developers rely on Çost Benefit Analysis' as it may give an accurate picture, calculated based on opinions and all other aspects. In this Murray rail basin project, the costs involved for the project and benefits considered are also added. The major cost benefit analysis is carried by considering various factors like:

i) Net Present Value (NPV)
ii) Benefit-Cost Ratio (BCR)
iii) Pay Back period (PB)

iv) Internal rate of return (IRR)

Costs associated with the project:

Benefit Cost Ratio (BCR):

- BCR value is calculated for Murray rail basin project for 30 year life time with interest rate of 7% (as per the standard of Infrastructure Australia).
- BCR (7%)=1.107>1
- The project is profitable to the company as the BCR value is greater than 1.

Net Present value

- It gives the idea whether the investment in this project is worthwhile or not. It is calculated by difference between the inflow of the cash and outflow in an organization (Hou, 2019).
- NPV for Murray Rail Basin Project is calculated using the discount rate 7% for 30 years.
    - NPV(7%) = 202.98 millions
- The project can be taken up as the NPV value is positive.

Payback Period(PB)

- It is the time length for which the investor gets all the investment in terms of savings.
- Payback period is calculated for Murray rail basin project as 7 years.
- It clearly states that the investor will recover the investment in 7 years after the project completion.

Internal Rate of Return (IRR):

- It measures the investment's rate of return. It indicates how fast the investor recover the investment. Higher the IRR value, faster the investment gets recovered.
- Internal rate of return is calculated for Murray Rail Basin project using 30 years lifetime to be
- IRR=12.32%
- The NPV becomes zero at 12.32% discount rate.

Monte carlo simulation method:

- Costs and benefits analysis of the Murray Rail basin by Monte carlo simulation method. The benefits calculated are higher than the costs considered for the project.

ECONOMIC ANALYSIS

- The 4 proposed options for the project have been discussed earlier and financial analysis of the options has revealed Option 3 to be the viable option.

NON-ECONOMICAL ANALYSIS

- Non-economic analysis of the Murray Basin Rail Project reveals, and we judge based on various options as feasible and project is viable.

Discussions and conclusions

Although the project sponsors claim that there is no possibility for swelling operator rail access rates/prices to reduce the level of outlay by government. Infrastructure Australia minutes that the of the main benefits linked to the project accumulate directly to rail users and inspires the sponsor to further contemplate prospects for non-governmental sector input to capital and maintenance expenses. There is indication that user charge rules lead to better maintenance outcomes. There is already some evidence of non-governmental outlay in the rail system, with Grain Corp's Project Regeneration ($85 million), the Murrayville line upgrade ($1 million plus a levy of $1.00 per tonne) and port improvements. A substitute method would be to develop MoU's to attain price reductions at sites where upgrades are undertaken and pass on the benefits to grain growers.

A paybacks realisation plan, which comprises performance reporting necessities, and reporting and monitoring of real profits, were supposed to be completed by March 2017. Infrastructure Australia inspires the project sponsors to commence post-completion appraisals throughout operations, and monitor the benefits arising from the project and its risk assessment. All the risk assessment performed during the project should be reflected to future projects (Hou, 2019)

By undertaking the Project Appraisal Report during this assignment of the Murray Basin Rail Project reveals and we judge based on various options such as cost , economic and non-economical as feasible and project is viable. we have gained huge knowledge and skill in conducting Project Appraisal which will help us in our future career as project risk managers and engineers.

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APENDIX – 1

Financial analysis for the options

Option 1

Indicators at inflation	4%	7%	12%
Present Value factor (PVF)	17.29	12.4	8.05
Net Present Value (NPV)	267.4	105.96	-36.24
Internal Rate Return (IRR)	10.72		
Payback period PB (Years)	9		
Benefit-cost ratio (BCR)	1.11	1.06	0.96

Option 2

Indicators at inflation	4%	7%	12%
Present Value factor (PVF)	17.29	12.4	8.05
Net Present Value (NPV)	299.2	133.17	-13.24
Internal Rate Return (IRR)	11.54		
Payback period PB (Years)	8		
Benefit-cost ratio (BCR)	1.13	1.08	0.98

Option 3

Indicators at inflation	4%	7%	12%
Present Value factor (PVF)	17.29	12.4	8.055
Net Present Value (NPV)	165.1	48.56	-53.92
Internal Rate Return (IRR)	9.36		
Payback period PB (Years)	10		
Benefit-cost ratio (BCR)	1.08	1.03	0.94