Review of Benchmark Infrastructure Costings

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Topics

01 Introduction

02 Overview of Methodology

03 Background Data Processing

04 Monte-Carlo Analysis

05 Standardising Rates

06 Example Results

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01 Introduction

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01 Introduction

The project aims to achieve:

> Streamlined delivery of PSPs and ICPs

> Provide accurate Benchmark Cost Estimates with a high degree of confidence

6 Infrastructure categories were investigated:

> Roads and Intersections

> Bridges

> Culverts

> Sporting Pavilions

> Sports and Recreational Fields

> Community Centers

02 Overview of Methodology

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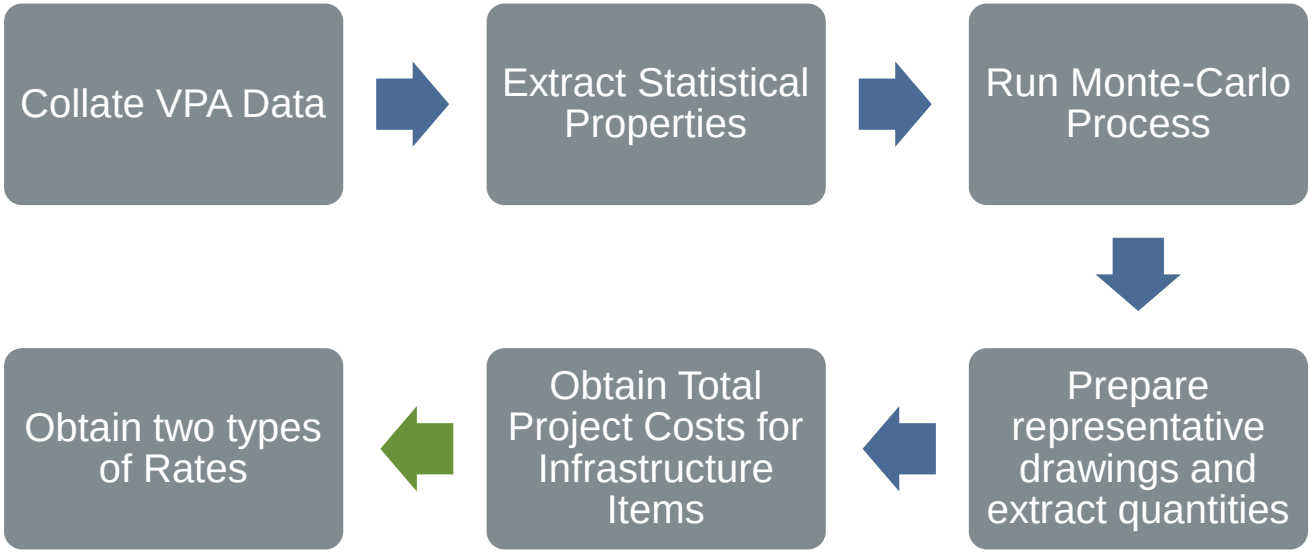
02 Overview of Methodology



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03 Background Data Processing

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03 Background Data Processing

Create a database of previously adopted rates

- Split to various infrastructure items
- Checked for Regional/ Topographical variations
- Estimates with insufficient granularity were discarded

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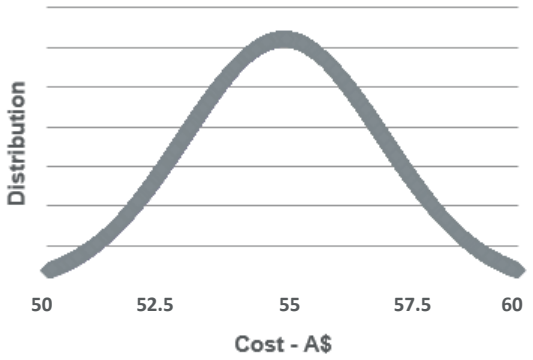
03 Background Data Processing

> Extracting Statistical Properties
  - Average Rate for each element
  - Standard Deviation for each element
> Regional Variances and Topographical Variances were not observed in the data.
> Extracted costs modeled to follow a normal distribution



Example

Item	Estimate 1	Estimate 2	Estimate 3	Mean	Standard Deviation
Kerb (per meter)	55	52	60	55.67	4.041
Drainage Pipe (per meter)	260	250	300	270	26.458

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04 Monte-Carlo Analysis

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04 Monte-Carlo Analysis

- Monte-Carlo analysis is a world-renowned tool used to simulate a range of possibilities
- In this instance, a range of infrastructure costs
- Results can be used to provide Probabilistic Estimates
- Cardno conducted 200,000 simulations
- Quantities for above simulations were extracted from representative drawings

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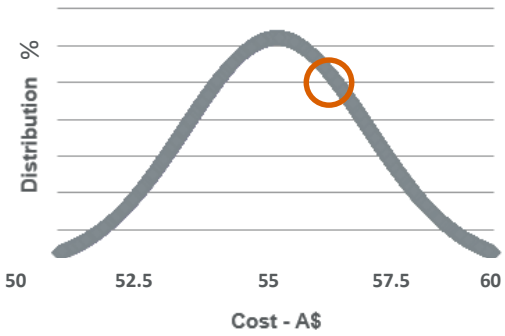
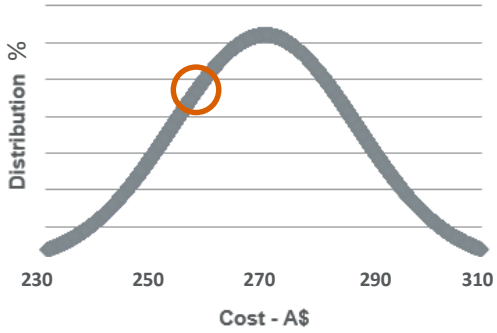
04 Monte-Carlo Analysis





Item	Rate ($/m)	Quantity (m)	Total ($)
Kerb	56.00	10	560.00
Drainage	265.00	10	2650.00
TOTAL			**3210.00**

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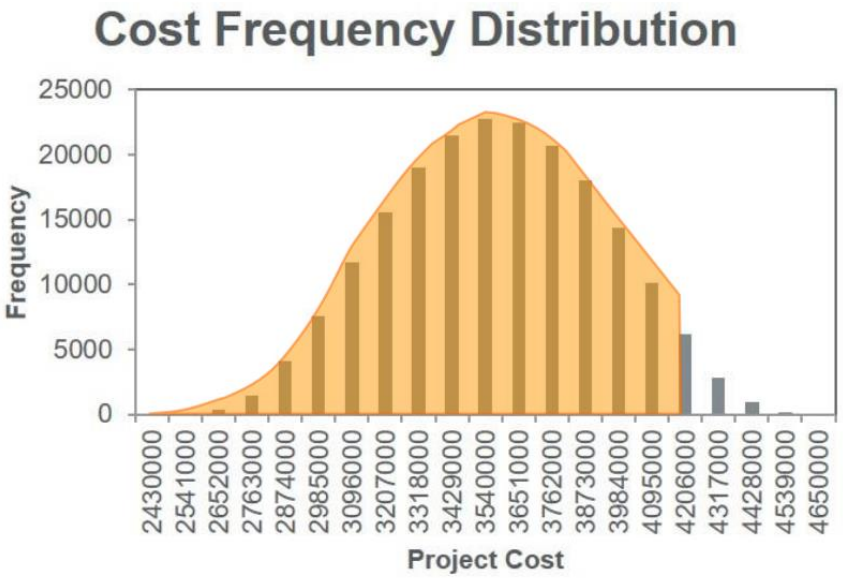
04 Monte-Carlo Analysis

Repeating this process over 200,000 iterations provides a distribution of possible project costs



P50 and P90 Totals were selected.

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05 Standardising Rates

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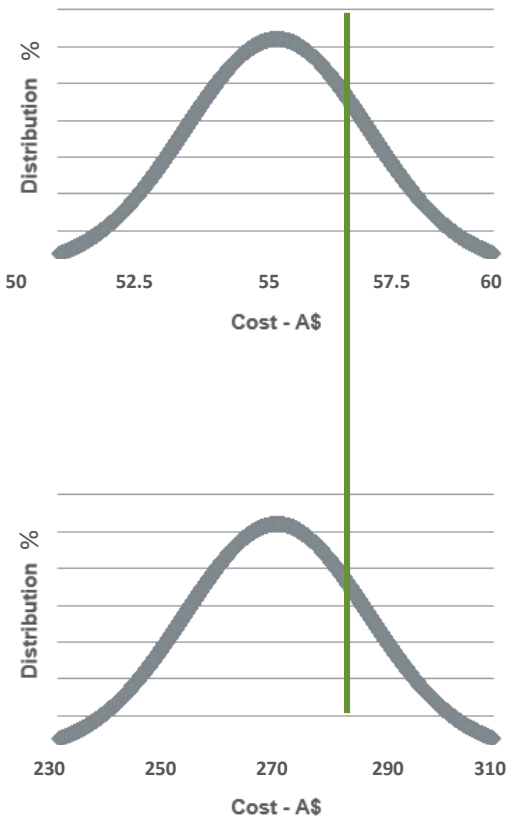
05 Standardising Rates

> Obtained 2 sets of rates for each item producing P90 and P50 Monte-Carlo totals

> Based on ‘Inversing’ Normal Distribution of rates

> Example Monte Carlo result is P90 = $3,420



Item	P90 Rate ($/m)	Quantity (m)	Total ($)
Kerb	57.00	10	570.00
Drainage	285.00	10	2850.00
TOTAL			3420.00

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06 Example Results

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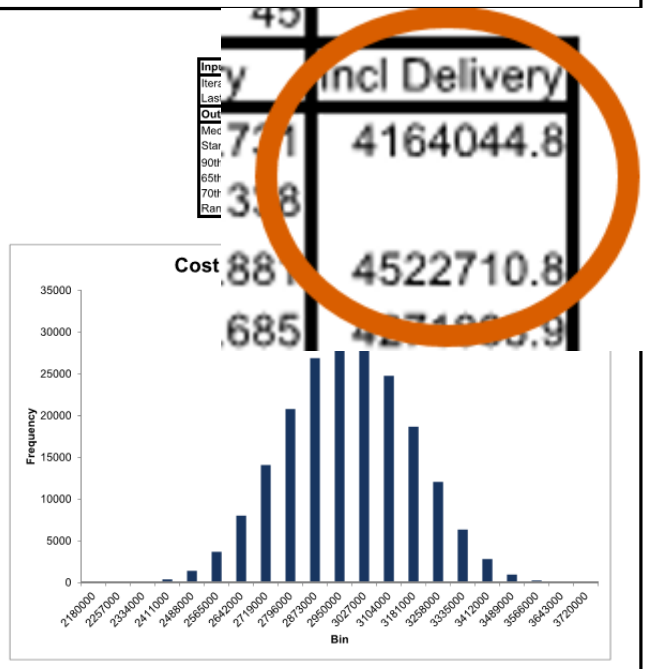
06 Example Results

MONTE CARLO ASSESMENT TEMPLATE

Description: INTERSECTION
Civil Component Number: 7
Date run: 8/03/2018
File name: Item 07 - Primary - Connector Intersection.xlsm

	Sub Item	MonteCarlo Value	Qty	Rate	Average	STD deviation
Sitewo rks and Earthw orks	Site Preparation	0	0		2.385	0.711043834
	Earthworks	229044.141	6106.1	m3	35.425	11.82547985
Road Pavement	Primary Arterial Pavement	701366.8431	5250	m2	157.0833333	33.25720473
	Secondary Arterial Pavement	0	0	m2	123.2288889	16.4777429
	Collector Arterial Pavement	302853.5829	3290	m2	91.07142857	0.731925055
	Subgrade Preparation	0	0	%	15.2125	6.020070598
	Pavement Rehab	0	0	m2	45.9	0
	Pavement Other	0	0	m2	0	0
Concrete Works	Kerb and Channel	119946.872	2950	m	50.41904762	14.46884996
	Cycle Path	157764.9567	2370	m2	59.6	22.8082831
	SUP/ Footpath	67330.40817	1380	m2	58.44380952	21.9444641
	Traffic Island	247016.6989	2890	m2	71.43333333	12.46420758
Drainage	Drainage Pipe 300mm CR Bfilled	40136.46598	290	m	162.3	32.34553035
	Drainage Pipe 375mm CR Bfilled	0	0	m	226.6823529	48.08575979
	Drainage Pipe 450mm CR Bfilled	279341.1314	730	m	291.6666667	71.00176054
	Drainage Pipe 525mm CR Bfilled	0	0	m	375.7142857	65.8298673
	Drainage - pits	71353.99638	32	No.	2325.571429	420.8356652
	Drainage – Sub-soil drainage	51531.371	3440	m	23.047	8.454458245
	Drainage Culvert	0	0	No.	0	0
Traffic	Traffic Signals	350652.9595	4	Item	88375.87737	28427.14503
	Traffic Signal Conduit	0	0	m	45.71428571	18.80349512
Landsc ape	Tree Planting	6906.719373	66	No.	259.6153846	143.4465861
	Landscaping	117855.2745	4570	m2	20.71666667	6.289806568
	Topsoil Seeding	31457.06415	4570	m2	6.996	2.245425968
Street Lighting	Street Lighting (all Inclusive)	0	0	m	207.6668421	67.78887159
	Street Lighting - Intersections	0	4	Item/ Per Leg	0	0
Misc	Regulatory Signage	4652.517305	16	Item	329.2888889	82.3319568
	Linemarking	19883.66087	8540	m2 of Pavement	2.402727273	0.988838621
	Landscape maintenance	75000	1	Item	75000	0
	Tactile Pavers (Hazard only)	10564.66054	24	Item	337.14	207.8332496
Other		0	0		0	0
		0	0		0	0
		0	0		0	0
Delivery	Surveying and Design	5	1	%	5	0
	Contingency	20	1	%	20	0
	Traffic Management	0.5	1	%	0.5	0
	Supervision and Project management	9	1	%	9	0
	Council Fees	3.25	1	%	3.25	0
	VicRoads Fees	1	1	%	1	0
	Environmental Management	0.5	1	%	0.5	0
	Site Establishment	2.5	1	%	2.5	0



06 Example Results

Appendix C	
Description:	INTERSECTION - Primary - Connecor Intersection
Civil Component Number:	Item 7

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks and Earthworks	Site Preparation	0	%	2.385	0	2.602210231	0
	Earthworks	6106.1	m3	35.425	216308.5925	39.0374569	238366.6156
Road Pavement	Primary Arterial Pavement	5250	m2	157.0833333	824687.5	167.2427704	878024.5448
	Secondary Arterial Pavement	0	m2	123.2288889	0	128.2625228	0
	Collector Arterial Pavement	3290	m2	91.07142857	299625	100.1785714	329587.5
	Subgrade Preparation	0	%	15.2125	0	17.05151591	0
	Pavement Rehab	0	m2	45.9	0		0
	Pavement Other	0	m2	0	0		0
Concrete Works	Kerb and Channel	2950	m	50.41904762	148736.1905	54.83900331	161775.0598
	Cycle Path	2370	m2	59.6	141252	66.5674923	157764.9567
	SUP/ Footpath	1120	m2	58.44380952	65457.06667	65.14742171	72965.11232
	Traffic Island	2890	m2	71.43333333	206442.3333	75.24090929	217446.2278
Drainage	Drainage Pipe 300mm CR Bfilled	290	m	162.3	47067	172.1809381	49932.47205
	Drainage Pipe 375mm CR Bfilled	0	m	226.6823529	0	241.3716287	0
	Drainage Pipe 450mm CR Bfilled	730	m	291.6666667	212916.6667	313.3563404	228750.1285
	Drainage Pipe 525mm CR Bfilled	0	m	375.7142857	0	395.8240455	0
	Drainage - pits	33	No.	2325.571429	76743.85714	2454.128639	80986.2451
	Drainage – Sub-soil drainage	3440	m	23.047	79281.68	25.62967457	88166.08051
	Drainage Culvert	0	No.	0	0		0
Traffic	Traffic Signals	4	Item	88375.87737	353503.5095	97059.82403	388239.2961
	Traffic Signal Conduit	0	m	45.71428571	0	51.45839222	0
Landscape	Tree Planting	98	No.	259.6153846	25442.30769	303.4355608	29736.68496
	Landscaping	5000	m2	20.71666667	103583.3333	22.63808173	113190.4087
	Topsoil Seeding	5000	m2	6.996	34980	7.681934494	38409.67247
Street Lighting	Street Lighting (all Inclusive)	0	m	207.6668421	0	228.37504	0
	Street Lighting - Intersections	4	Item/ Per Leg	0	0		0
Misc	Regulatory Signage	16	Item	329.2888889	5268.622222	354.4397199	5671.035519
	Linemarking	8540	m2 of Pavement	2.402727273	20519.29091	2.704798474	23098.97897
	Landscape maintenance	1	Item	75000	75000	86250	86250
	Tactile Pavers (Hazard only)	24	Item	337.14	8091.36	400.6290649	9615.097557
Other		0		0		0	
		0		0		0	
		0		0		0	
Delivery	Council Fees	1	%	3.25	95709.45509	3.25	103934.2238
	VicRoads Fees	1	%	1	29449.0631	1	31979.76118
	Traffic Management	1	%	5	147245.3155	5	159898.8059
	Environmental Management	1	%	0.5	14724.53155	0.5	15989.88059
	Surveying and Design	1	%	5	147245.3155	5	159898.8059
	Supervision and Project management	1	%	9	265041.5679	9	287817.8506
	Site Establishment	1	%	2.5	73622.65776	2.5	79949.40294
	Contingency	1	%	15	441735.9466	15	479696.4176
Total	Excluding Delivery						
	Including Delivery						

2,944,906		3,197,976
4,159,680		4,517,141

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06 Example Results

MONTE CARLO ASSESMENT TEMPLATE

Description: BRIDGE - 50m - Primary
Civil Component Number: 17
Date run: 6/03/2018
File name: Item 17 - BRIDGE - 50m - Primary.xlsm

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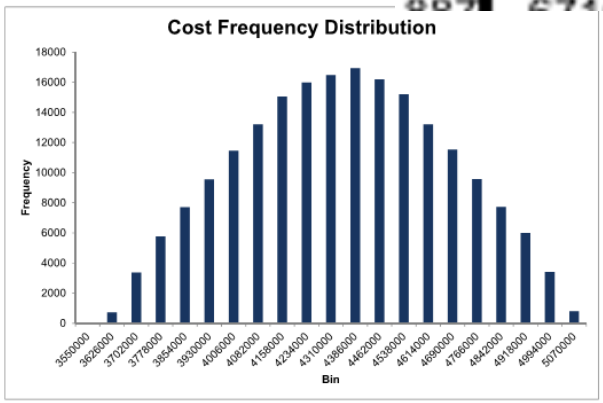
	Sub Item	MonteCarlo Value	Qty	Rate	Average	STD deviation
Site work and Earth work	Site preperation	0	0		37.08	19.719
	Earthworks	642439.6138	12960	m3	46.78	4.554
On-Structure Works	Retaining Walls, abutments, footings	0	0	No.	238163.38	112547.045
	Bridge Deck	0	0	m2	1080	720.278
	Guard Rails/ Balustrade	0	0	Item.	2385	544.472
	Transition Slab	60000	2	No.	30000	0.000
	Asphalt	0	0	m2	40	0.000
	Concrete footway	0	0	m2	38.46	11.964
	Kerb and channel	0	0	m	42.5	3.536
	Overall Super T Cost	3600311.987	825	m2	4352	479.260
Off Structure	Guard Rails/ Balustrade	23655.45476	240	m	145	37.859
	Scour protection	0	0	Item.	0	0.000
	GREAT Terminal	20378.33038	4	No.	5050	57.735
	Off structure barrier	0	0	Item.	1395.5567	874.563
Delivery	Traffic management	3.25	1	%	3.25	1.021
	Contingency	20	1	%	20	0.000
	Survey and Design	5	1	%	5	2.215
	Overheads	0	1	%	0	13.769
	Project Mnagement	9	1	%	9	0.837
	Council Fees	3.25	1	%	3.25	0.000
	VicRoads Fees	1	1	%	1	0.000
	Environmental Management/ Creek Manageme	0.5	1	%	0.5	1.275
	Site Establishment	2.5	1	%	2.5	0.750
Other		0	0		0	0
		0	0		0	0
		0	0		0	0

Inputs	
Iterations	
Last row Number with Data	
Outputs	Excl. D
Median	431
Standard Deviation	320
90th Percentile	472
85th Percentile	464
50th Percentile	431
Range of costs produced	151



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06 Example Results

Appendix C	
Description:	BRIDGE - 50m - Primary
Civil Component Number:	Item 17

Group	Sub Item	Qty	Unit	Rate (P50)	Amount P(50)	Rate (P90)	Amount P(90)
Site work and Earth work	Site preperation		%	37.08	0.000	55.13050285	0.000
	Earthworks	12960	m3	46.78	606268.800	50.94888254	660297.518
On-Structure Works	Retaining Walls, abutments, footings	0	No	238163.375	0.000	341185.0105	0.000
	Bridge Deck	0	m2	1080	0.000	1739.317082	0.000
	Guard Rails/ Balustrade	0	m	2385	0.000	2883.390863	0.000
	Transition Slab	2	No	30000	60000.000	34500	69000.000
	Asphalt	0	m2	40	0.000	40	0.000
	Concrete footway	0	m2	38.46	0.000	49.41165377	0.000
	Kerb and channel	0	m	42.5	0.000	45.7363043	0.000
	Overall Super T Cost	825	m2	4352	3590400.000	4790.698049	3952325.891
Off Structure	Guard Rails/ Balustrade	240	m	145	34800.000	179.6551629	43117.239
	Scour protection	0	Item	0	0.000	0	0.000
	GREAT Terminal	4	No	5050	20200.000	5102.848628	20411.395
	Off structure barrier	0	Item	1395.556667	0.000	2196.101098	0.000
Delivery	Council Fees	1	%	3.25	140129.236	3.25	154217.441
	VicRoads Fees	1	%	1	43116.688	1	47451.520
	Traffic Management	1	%	5	215583.440	5	237257.602
	Environmental Management	1	%	0.5	21558.344	0.5	23725.760
	Surveying and Design	1	%	5	215583.440	5	237257.602
	Supervision and Project management	1	%	9	388050.192	9	427063.684
	Site Establishment	1	%	2.5	107791.720	2.5	118628.801
	Contingency	1	%	20	862333.760	20	949030.408
Total	Excluding Delivery			4,311,669			4,745,152
	Including Delivery			6,305,816			6,939,785

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Thank you

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