i3d3 RANKING	22	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

CONSEQUENCES	Project Initiate	Project Implement	Project Influence	Score (%)
Financial (long life)	-70	-35	65	**-13**
Social (loose fit)	41	-35	66	**24**
Ethical (least pain)	100	0	67	**56**
Environmental (low energy)	17	-15	62	**21**
Score (%)	**22**	**-21**	**65**	**22**

The HZMB is a megaproject, and one of the most iconic infrastructure investments of this century. It is the longest sea crossing in the world. Situated in the Pearl River Delta and owned by the People's Republic of China, it connects Hong Kong, Zhuhai and Macau with a six lane toll road including elevated bridge deck, three large cable-stay spans, artificial islands, undersea tunnel, link roads and border control facilities for each region. The engineering challenge was extremely complex and ambitious. However, its contribution to the economy of the region, to tourism and to the productivity of transport and trade is significant. It is a beacon of ingenuity and human endeavour, but took nearly nine years to build. During this time, 20 workers were killed on the project, and there were over 500 injuries reported. Some news stories point to the bridge being a 'white elephant', as work has already commenced on another sea link between Shenzhen and Zhongshan (including a high speed rail service) that is now expected to reduce demand for HZMB. This is on top of much lower demand figures than expected (currently 2,416-4,791 vehicles/day recorded over first year of operation, down from 33,100 in feasibility study), caused by complexities in immigration, high cost of road toll (RMB 200/trip), triple certification required for third party insurance across three jurisdictions, and current civil unrest in Hong Kong. In the latter case, the bridge is now seen by some as having a political agenda to more tightly connect the special administrative regions to Mainland China control.

i3d3 ranking

Success is measured on a scale of -100 to +100, where the border of success and fail is set at zero. The above table shows success according to project phases and consequences. Each value in this table is assigned equal weight. Light red shaded cells are problems. Success can be a surrogate for wider project 'quality'.

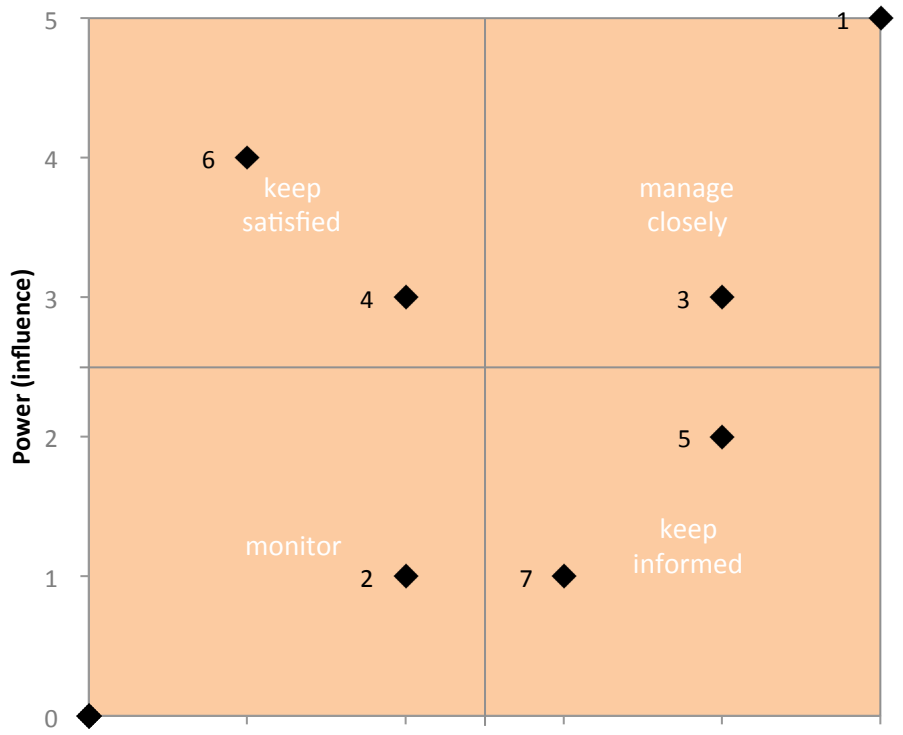
NET BENEFIT	25	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

BENEFIT REALIZATION	winners 5	losers 2

Stakeholders:

	stakeholder ID#	power 1-5	interest 1-5	expected value (%)
Owner/sponsor	1	5.0	5.0	-70
Local community	2	1.0	2.0	41
Shareholders/authorities	3	3.0	4.0	100
Environmentalists	4	3.0	2.0	17
Project team	5	2.0	4.0	-21
Client/end-user	6	4.0	1.0	65
Wider society	7	1.0	3.0	40
	8			
	9			
	10			
	11			
	12			

key: 1=minimal 2=low 3=moderate 4=high 5=extreme

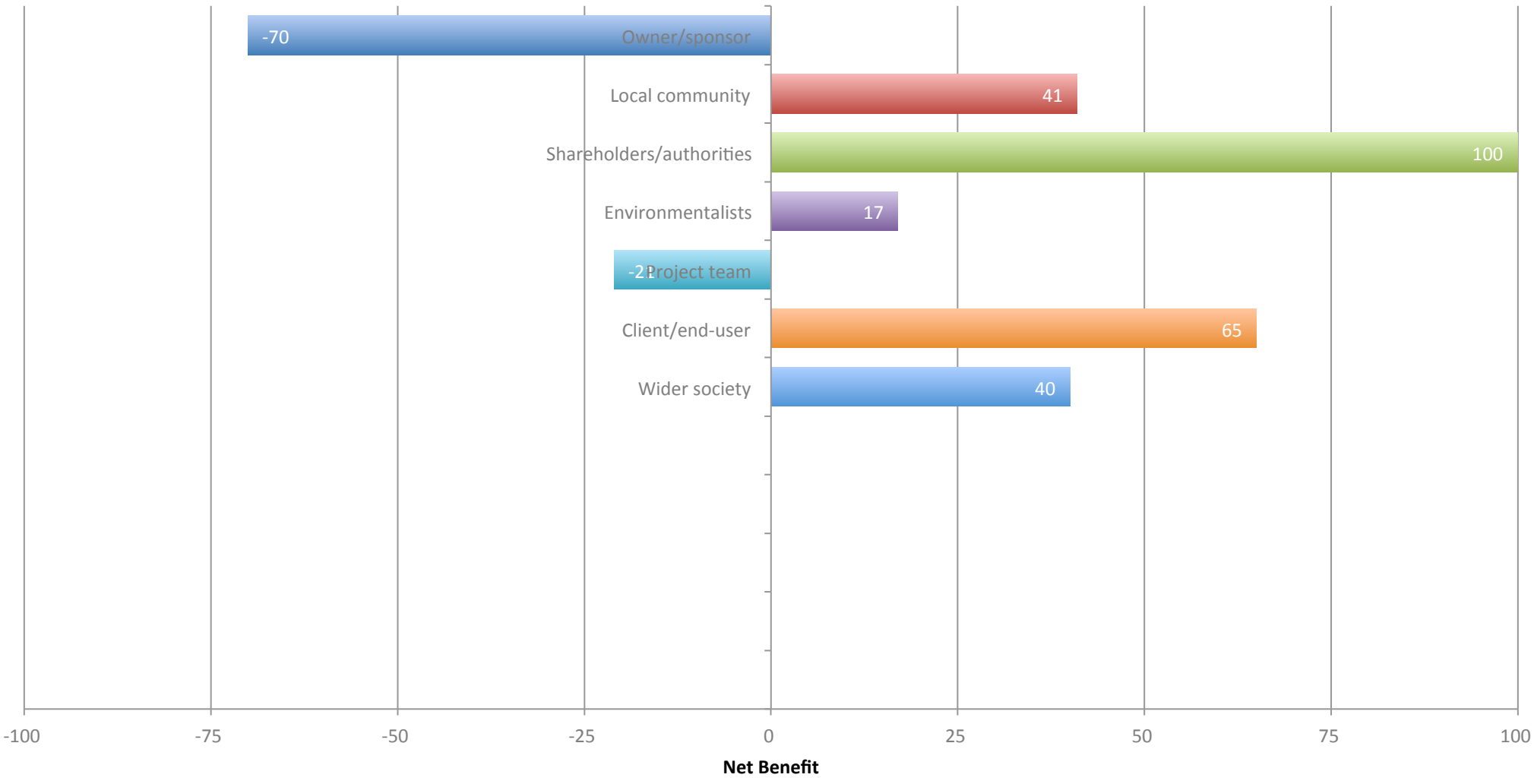


Benefit Register:

	benefit ID#	T/I	D/I	P/E	S/M/L	stakeholder ID#	expected value (%)	realized? Y/N	comments
BCR success score (design) > 0	1	T	D	P	M	1	-70	Y	Project has a negative BCR
LPS success score (design) > 0	2	I	I	P	S/M/L	2	41	Y	
RAR success score (design) > 0	3	T/I	D/I	P	M/L	3	100	Y	
EFP success score (design) > 0	4	I	I	E	L	4	17	Y	
PDS success score (deliver) > 0	5	T	D	P	S	5	-21	Y	Project delivery was considerably delayed
EUS success score (delight) > 0	6	T	D/I	P	S/M/L	6	65	Y	
SDG humanity index > 0	7	I	I	P/E	L	7	40	Y	
	8								
	9								
	10								
	11								
	12								

key: tangible / intangible; direct / indirect; planned / emergent; short term / medium term / long term

mean = 25%



HUMANITY INDEX	40	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

UNITED NATIONS SUSTAINABLE DEVELOPMENT GOAL (SDG) CONTRIBUTIONS	benefit justification

Financial: 0

investments in infrastructure are crucial to achieving sustainable development

not eligible 9

HZMB was financially unviable and delivered well over budget, but otherwise would have contributed to SDG#9 if its financial performance was better.

Social: 0

not eligible

Not applicable.

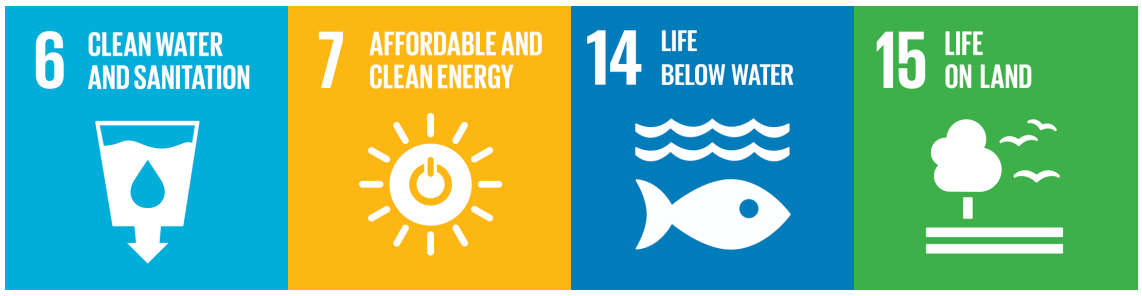
Ethical: 20

access to justice for all, and building effective, accountable institutions at all levels

enter primary SDG# here > 16

HZMB serves as an important and unifying piece of infrastructure connecting three different Chinese cities with three different governance systems.

Environmental: 20



careful management of this essential global resource is a key feature of a sustainable future

not eligible 14

The project had minimal impact on the long-term environmental quality of the Pearl River Delta.

revitalize the global partnership for sustainable development

enter SDG#17* here > 17

*this SDG is only available when the complexity score (delivery) is 12 or more

HZMB was a nation-building project of the People's Republic of China, and involved collaboration with the Special Administrative Regions of both Hong Kong and Macau. It required design and delivery expertise from a large number of international enterprises.

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DESIGN (DSS) 22 Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

SUCCESS FACTOR feasible -70 useable 41 achievable 100 sustainable 17

Profit:

Benefit-cost ratio (BCR) **0.2964**

year	benefit	discounted benefit	cost	discounted cost
0		-	120	120
1		-	3,500	3,431
2		-	5,500	5,286
3		-	6,500	6,125
4		-	7,000	6,467
5		-	6,500	5,887
6		-	5,500	4,884
7		-	3,500	3,047
8	672	573	34	29
9	672	562	34	28
10	672	551	34	28
11	672	540	34	27
12	672	530	34	26
13	672	519	34	26
14	672	509	184	139
15	672	499	34	25
16	672	489	34	24
17	672	480	34	24
18	672	470	34	24
19	672	461	34	23
20	672	452	34	23
21	672	443	184	121
22	672	434	34	22
23	672	426	34	21
24	672	418	34	21
25	672	409	34	20
26	672	401	34	20
27	672	393	34	20
28	672	386	184	105
29	672	378	34	19
30	672	371	34	19
		10,695		36,081

discount 2.00 %
currency RMB (million)

assume BCR (override)

Notes
Benefits and costs should exclude intangible cash flows
Discount rate is net of inflation (i.e. real discount rate)
Cash flows are expressed in Year 0 terms
BCR can be entered directly using 'assume BCR' cell
Immigration operating costs are not included in the project
Life expectancy of bridge estimated at 120-170 years
The project commenced in December 2009
Feasibility study downgraded to 9,200 vehicles/day
Average toll is RMB 200 per vehicle
Maintenance, repair and energy costs assumed at 5% of income
Road resurfacing undertaken every 7 years

People:

Statement: *I support this proposed project*

Local project support (LPS) **0.8252**

strongly disagree	disagree	no opinion	agree	strongly agree	responses
2	11	11	58	21	103

sample return rate N/A 0%

Politics:

Risk and reward (RAR) **2.2436**

ID	reward (opportunities) - * must complete 5	probability 1-3	consequence 1-3	risk level 1-9
A*	Key link between HK and 9 other Guangdong cities	3	3	9
B*	A megaproject of Chinese national pride	2	1	2
C*	Increased trade, tourism and visitor flow	2	3	6
D*	33,100 vehicles and 171,800 passenger trips/day	2	3	6
E*	Economic prosperity for the Guangdong province	2	3	6
F	Social inclusion for people in the region	3	2	6
G				
			mean	5.83

ID	risk (threats) - * must complete 5	probability 1-3	consequence 1-3	risk level 1-9
A*	Competition from future road/rail links	2	2	4
B*	Lower traffic volumes than expected	1	3	3
C*	Immigration complexities (1 country, 3 policies)	2	1	2
D*	White elephant label	1	1	1
E*	Toll charges	3	1	3
F				
G			mean	2.60

Planet:

Ecological footprint (EFP) **14.0000**

environmental categories (impacts)	extreme (0 stars)	high (1 star)	moderate (2 stars)	low (3 stars)	minimal (4 stars)	regenerative (5 stars)
non-renewable energy demand (embodied carbon)		Y				
water quality impacts			Y			
air pollution	Y					
natural resource depletion					Y	
biodiversity loss					Y	
non-degradable or non-recyclable waste to landfill				Y		
	1	1	1	1	2	0

DELIVER (PDS)	-21	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

SUCCESS FACTOR	within budget	-35	on schedule	-35	as specified	0	no surprises	-15

Cost:

	planned	actual		change
Construction (RMB million)	38,120.00	48,070.00		26.10%

Time:

Onsite activity (calendar month)	84.00	106.00		26.19%

Scope:

Length of journey (km)	55.00	55.00	✔	0.00%

Risk:

√ mean risk level (1-3)	2.14	2.35		9.35%

Planned risk events

Probability and consequence are assessed after any mitigation strategies have been included in scope, cost and time estimates

ID	risk event - * must complete 5	planned probability 1-3	planned consequence 1-3	planned risk level 1-9
A*	Industrial accidents	3	3	9
B*	White dolphin impacts near Lantau Island constructions	2	2	4
C*	Complicated construction procedures in open sea	2	2	4
D*	Erosion of artificial islands at tunnel mouth	2	1	2
E*	Delays and overrun due to engineering complexity	2	2	4
F	NEW (ACTUAL) RISKS:			
G	Fake concrete test results by corrupt contractors			
H				
I				
J				
K				
L				
M				
N				
O				
P				
Q				
R				
S				
T				
			√ mean	2.14

Actual risk events

Consequence is determined based on final project outcomes, and should include any unanticipated risk events

ID	risk event - * must complete 5	actual probability 1-3	actual consequence 1-3	actual risk level 1-9
A*	Industrial accidents	3	3	9
B*	White dolphin impacts near Lantau Island constructions	3	1	3
C*	Complicated construction procedures in open sea	3	2	6
D*	Erosion of artificial islands at tunnel mouth	3	2	6
E*	Delays and overrun due to engineering complexity	3	2	6
F	NEW (ACTUAL) RISKS:	3	-	
G	Fake concrete test results by corrupt contractors	3	1	3
H		-		
I		-		
J		-		
K		-		
L		-		
M		-		
N		-		
O		-		
P		-		
Q		-		
R		-		
S		-		
T		-		
			√ mean	2.35

KPIs

-100 ≤ PDS ≤ 100

		change
value (scope/cost)		-20.70%
efficiency (cost/time)		-0.07%
speed (scope/time)		-20.75%
innovation (risk/cost)		-13.29%
complication (time/risk)	✔	15.40%
impact (scope/risk)		-8.55%
profit (scope²/cost²)		-37.11%
people (scope²/time²)		-37.20%
planet (scope²/risk²)		-16.36%
progress (TBL mean)		-30.23%

COMPLEXITY	1-3
X: scale	3
Y: uncertainty	3
Z: stakeholders	3

27

chaotic

DELIGHT (EUS)	65	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

SUCCESS FACTOR	desirable	65	adaptable	66	practicable	67	serviceable	62

Attractiveness:

	mean	influence
Nice to look at?	3.70	
High quality?	3.08	
Profitable?	2.35	
Well-designed?	3.39	
Valuable?	4.36	
Prestigious?	3.71	
Durable?	4.28	
Popular?	3.49	
Joyful?	3.78	
Unique?	4.30	
User-defined …	7.17	
User-defined …	7.67	
	4.27	25.41%

Flexibility:

	mean	
Versatile?	3.84	
Easily modified?	2.52	
Able to be customized?	3.46	
Multi-use?	4.08	
Transportable?	4.15	
Better with age?	3.69	
Modular?	4.67	
Scalable?	4.70	
Technically clever?	4.10	
Timeless?	4.64	
User-defined …	7.17	
User-defined …	8.00	
	4.59	27.27%

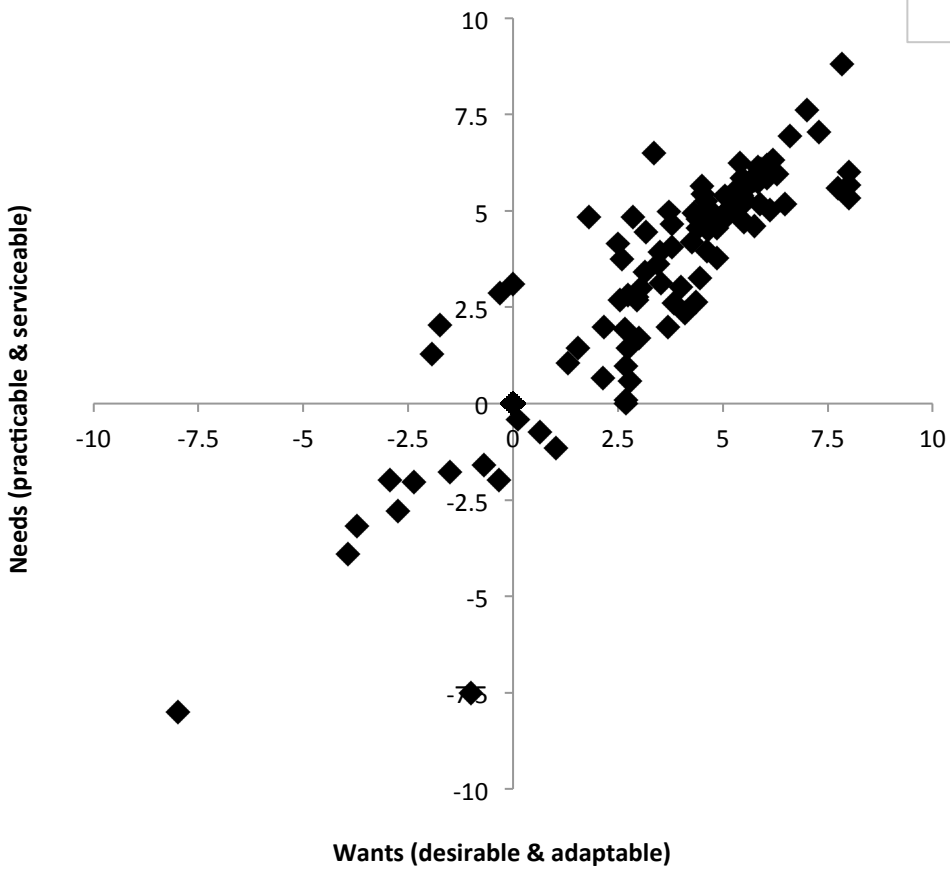
Fit for Purpose:

	mean	
Functional?	4.53	
Appropriate?	4.30	
Robust?	4.31	
Safe?	4.68	
Healthy?	4.32	
Problem-solving?	4.00	
Easy to use?	4.17	
Affordable?	5.11	
Comfortable?	4.66	
Ethical?	4.13	
User-defined …	6.00	
User-defined …	5.86	
	4.67	27.78%

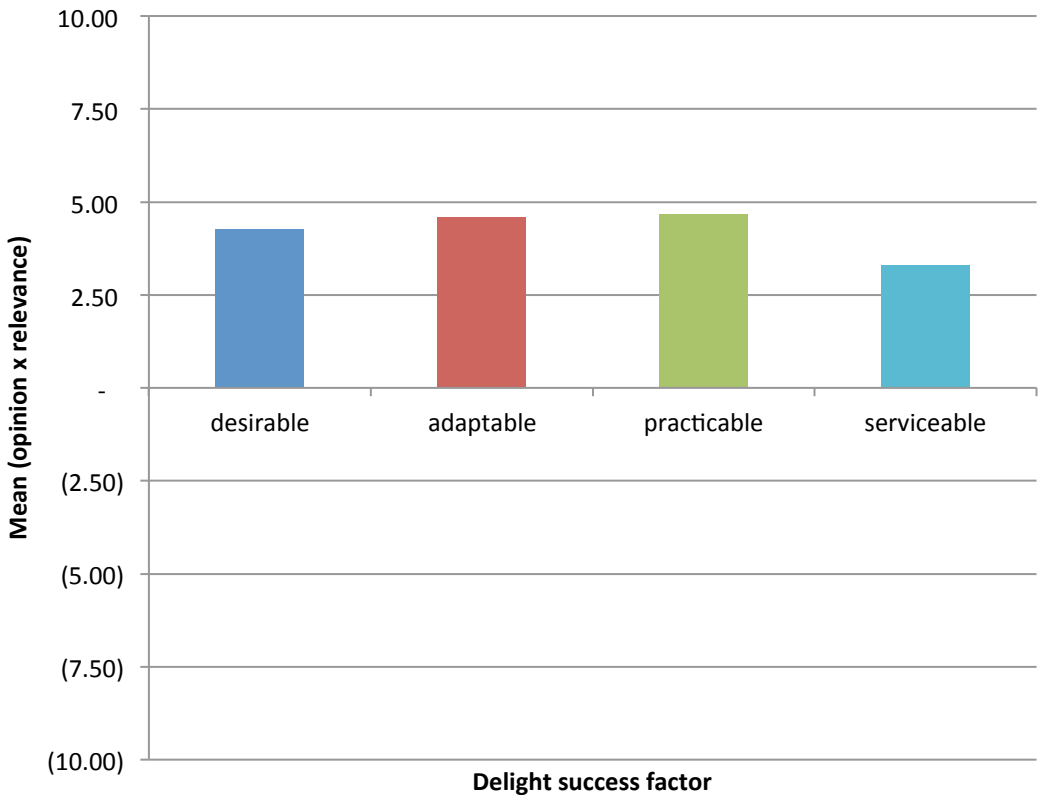
Enduring:

	mean		
Low maintenance?	1.32		
Easily cleaned?	2.69		
Recyclable?	3.59		
Non-toxic?	2.66		
Repairable?	4.32		
Energy efficient?	3.51		
Reliable?	3.82		
Accessible?	3.31		
Regenerative?	2.81		
Habitat-safe?	2.10		
User-defined …	4.75		
User-defined …	4.57		
	3.29	19.54%	
		100.00%	

Q1



percent Q1	82.52	%
total responses	103	



sample		N/A
return rate		0%
expected delight (LPS)		41%
actual delight (EUS)	✔	65%

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Further Information
https://bond.edu.au/cccr
(including latest updates)

Instructions
Enter survey responses to the right of this page. Responses are computed as opinion multiplied by relevance, and are in the range -10 to +10. There is provision for 1,000 responses to be entered against each question. Specify the total responses in Cell K38.

Disclaimer
Every attempt has been made to use unbiased evidence-based data (cells with light grey shading) in this study where possible.

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