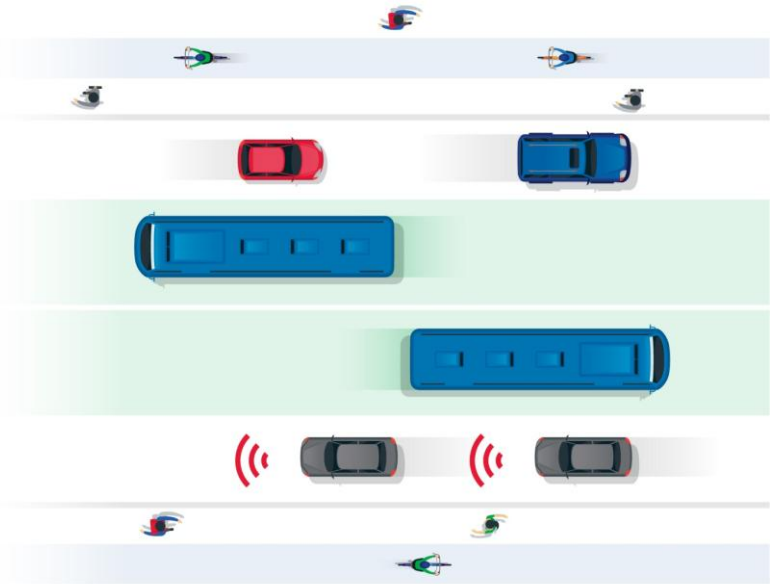


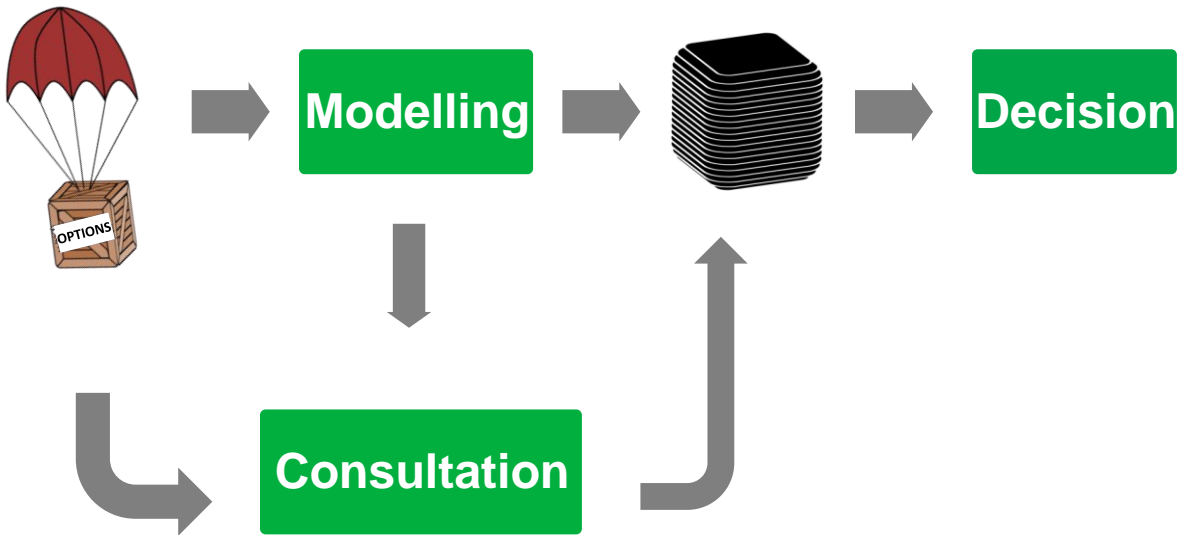
The MORE tools: exploring and assessing options to redesign urban streets

Paulo Ancaies
Peter Jones
UCL (University College London)

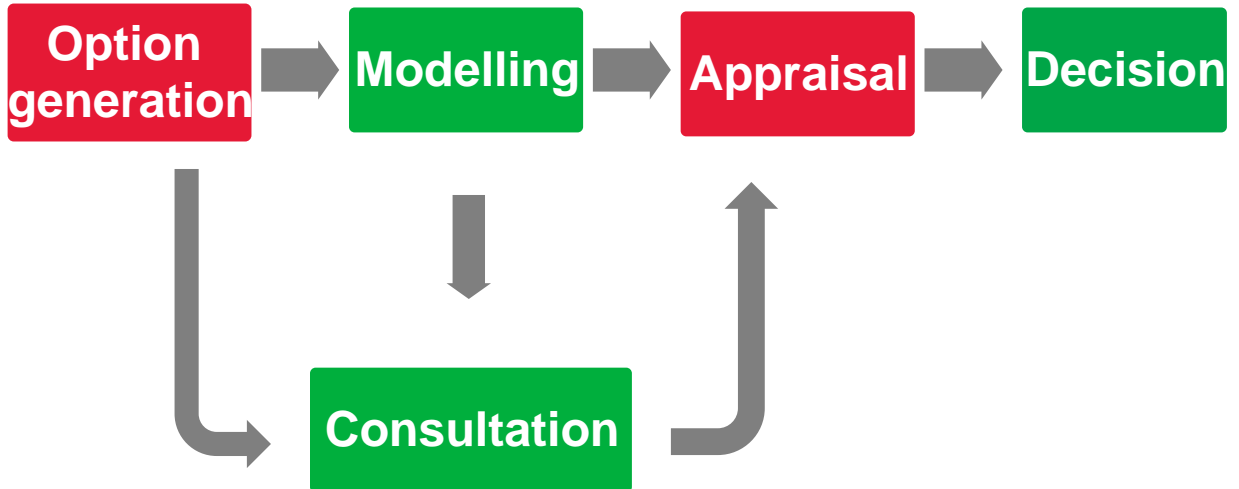
MORE Workshop
22-02-2022



Street (re)design process: now



Street (re)design process: innovations



A new set of option generation tools

ROADSPACE ALLOCATION OPTION GENERATION TOOL



Part of **MORE** Multimodal Optimization of Roadspace in Europe

Funded by



Option generation tools

Tool 1: Policy interventions

Tool 2: Road layout designs

A database of 210 possible interventions. Examples:



Contraflow, bidirectional, etc



Unusual solutions, considering all uses
(including greenery, underground utilities, etc)



Shared solutions



Various possible positions for a design element



Various degrees of segregation between design elements



Policy Interventions tool input 1: Road use priorities

Choose from the green dropdown menus the degree of priority of each type of road user or road use

- 0 Can be worse off than now, if needed
- 1 Should not be worse off than now Choose a maximum of 3 road uses with level 1
- 2 Should be better off than now Choose a maximum of 3 road uses with level 2

Road user	Road use		Road user	Road use	
Pedestrians	Walk	0	Bus drivers	Move	0
	Cross the road	0		Stop	0
	Stroll	0	Bus Passengers	Interchange	0
	Sit (street furniture)	0		Wait	0
	Sit (outdoor cafe)	0		Rail/metro/bus passengers	Interchange
Pedestrians with restricted mobility	Walk	0	Car drivers	Move	0
	Cross the road	0		Park	0
Cyclists	Move	0		Stop	0
	Park	0	Car share users	Move	0
	Rent (dock)	0		Motorcyclists	Move
	Rent (dockless)	0	Taxi drivers (inc. ride-hailing)	Wait	0
Micromobility users (scooters, skates, etc.)	Move	0	Taxi passengers (inc. ride-hailing)	Wait	0
			Goods vehicles	Move	0
		Stop		0	
			Emergency vehicles	Move	0
			Service vehicles	Move	0

Policy Interventions tool input 2: Policy objectives

Fill the checkboxes of the objectives the intervention aims to achieve
Choose only the main objectives (Maximum of 5)

Movement

- Increase number of trips
- Reduce travel time
- Increase travel time reliability
- Reduce congestion
- Improve trip quality
- Achieve a more sustainable modal split

Place

- Facilitate place activities (e.g. people sitting)
- Facilitate kerbside activities
- Improve access to local buildings

Road operation

- Improve resilience (to weather conditions)
- Increase flexibility (to different road uses)

Wider objectives: economic

- Reduce costs of transport
- Promote local economy

Wider objectives: social

- Improve traffic safety
- Reduce community severance
- Increase personal security
- Promote physical activity/health
- Promote social interaction
- Promote social inclusion
- Increase wellbeing

Wider objectives: environmental

- Increase green space
- Improve air quality
- Reduce noise
- Improve visual environment
- Protect soil/water and reduce flood risk
- Improve local climate
- Reduce energy consumption
- Improve regional/global environment

Policy Interventions tool output

POSSIBLE INTERVENTIONS

[Print to PDF](#) [Back](#) [Restart](#) [Save and Finish](#)

- Scroll to see more interventions
- Click on intervention for further information
- Click the checkboxes of the policies that are feasible in your road section


Policy Description

- + Pedestrianisation
- + Part-time pedestrianisation
- + Walkways
- + Greenways
- + Widen footway
- + Raised/kerbed footway
- + Add or widen median strip
- + Walkable median strip
- + Pedestrian fast/slow lanes

Policy Interventions tool output: *Description* page

- Add or widen median strip

Description [Examples and evidence](#) [Effect on road uses](#) [Effect on policy objectives](#)



Type of policy: Space allocation

Also known as central reservation. Space between traffic lanes in different directions. It can be painted, raised with kerbs, or planted. Physical barriers (e.g. guardrailings) may be added, or kept, if already existent, to separate vehicles.

If the median has no physical barriers, it allows vehicles to pass cyclists or slower vehicles; emergency vehicles to cross over into the opposite lane; and pedestrians to stop and cross in two stages (at crossing facilities or informal crossings)

If the median is raised, wide enough, and has few gaps, it also allows pedestrians to walk along the road. Alternatively, it can provide space for place activities (e.g. seating areas), car parking, bicycle parking, or street furniture (e.g. lighting).

Median strips can be green spaces (e.g. trees, swales, grassed strips). If wide, they can be used as a cycle track or as a corridor for trams, light railway systems, or buses. Underground rivers can also be restored to run at-surface along the median.

The presence of a median strip, especially if kerbed, may reduce travel speeds, as gives drivers less flexibility. Kerbed medians without ramps also become a barrier to pedestrians with impairments at informal crossings.

Policy Interventions tool output: *Examples/evidence* page

— Add or widen median strip

Description

Examples and evidence

Effect on road uses

Effect on policy objectives

Examples

- Restricted-access roads (e.g. motorways) and multilane roads usually have wide medians, with barriers at the carriageway edges, and sometimes a grassed strip in the middle.
- In 2013, a long and wide median strip was added to Avenida 9 de Julio in Buenos Aires (one of the widest urban streets in the world), with a busway, greenery, and pedestrian paths.
- The space between Carretera 7 and Calle 32 in central Bogota is a wide median accommodating a cycle lane, several clear paths for pedestrians, benches, a planted strip, and a station entrance.

Evidence

- The redesign of a 4-lane road in New Jersey, adding a raised median, reduced pedestrian exposure risk and increased driver predictability, and little effect on traffic speed and volume.
See: King et al 2003 Pedestrian safety through a raised median and redesigned intersections. Transportation Research Record 1828, p56-66.
- A study in 24 cities in California found that the proportion of streets with (raised or painted) medians is associated with only small changes in the walking and cycling modal share.
See: Marshall and Garrick 2010 Effect of street network design on walking and biking. Transportation Research Record 2198, 103-115.
- Adding a median strip to a road has an estimated monetary benefit for pedestrians crossing the road of £1.08 for each walking trip.
See: Ancaes and Jones 2018 A stated preference model to value reductions in community severance caused by roads. Transport Policy 64, 10-19.

Policy Interventions tool output: *Effect on road uses* page

— Add or widen median strip

Description

Examples and evidence

Effect on road uses

Effect on policy objectives

Likely impact of intervention on road uses

Compared to: Do not add or widen median strip

Road user	Road use	Impact	Reason
Pedestrians	Walk	+	Median strip can be walkable
	Cross the road	+	Can stop in middle of road when crossing. Lower traffic speed
	Stroll	+	Median strip can be walkable
	Sit (street furniture)	+	Median strip can accommodate seating area
	Sit (outdoor cafe)	+	Median strip can accommodate tables
Pedestrians with restricted mobility	Walk	+	Median strip can be walkable
	Cross the road	+	Can stop in middle of road when crossing. Lower traffic speed
Cyclists	Move	+	Fewer unsafe crossing movements by pedestrians
	Park	+	Median strip can accommodate bicycle parking

(...)

Policy Interventions tool output: *Effect on objectives* page

— Add or widen median strip

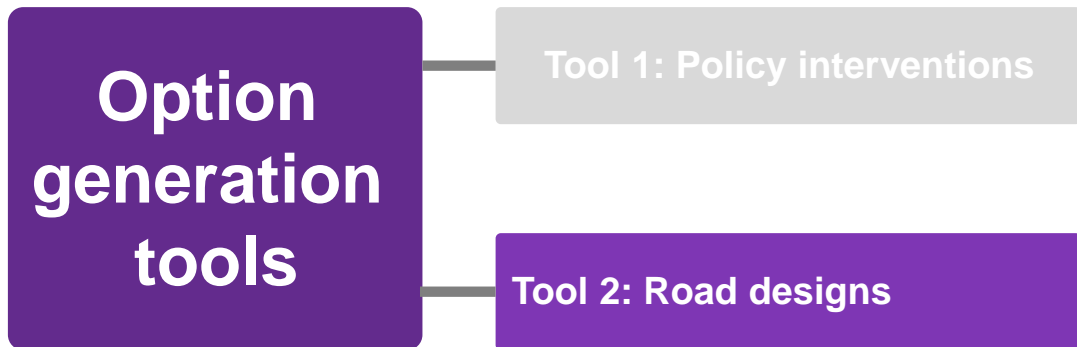
Description Examples and evidence Effect on road uses Effect on policy objectives

Likely impact of policy intervention on objectives

Compared to: Do not add or widen median strip

Objective	Impact	Reason
Movement		
Increase number of trips	+	Encourages more walking. Easier to cross the road
Reduce travel time	-	Probably delays to motorised modes
Increase travel time reliability	-	More probability of queues
Reduce congestion	-	More probability of recurrent congestion, less space
Improve trip quality	+	Easier to cross for pedestrians. Safer for cars
Achieve a more sustainable modal split	o	No evidence on impact on mode choice
Place		
Facilitate place activities (e.g. people sitting)	+	Space can be used for place activities
Facilitate kerbside activities	-	Space probably taken from kerbside area
Improve access to local buildings	-	More difficult to access the opposite side of road
Road operation		
Improve resilience (to weather conditions)	+	Fewer motorised vehicles. Scope to add greenery
Increase flexibility (to different road uses)	-	Fixed element of infrastructure
Wider objectives: economic		
Reduce costs of transport	+	Requires only regular maintenance

(...)



All possible combinations of design elements (which can assume different sizes)

Walking			Place activities		Green area	General purpose		Bus lane	
Narrow	Medium	Wide	Narrow	Wide		1 lane	2 lanes	1 lane	2 lanes
2m	3m	4m	2m	3m	1.5m	3m	6m	3m	6m

Cycling		Bus + cycle	Parking/ loading	Tram line	
1 lane	2 lanes			1 track	2 tracks
2-3m	3-4.5m	4m	2.5m	3m	6m

- Elements assigned to alternative positions on footways, carriageways, and median strip
- Unfeasible combinations removed, buffers between elements (e.g. cycle lanes and parking spaces) added

Road designs tool input 1: *Current situation*

Indicate in the green boxes the road width currently allocated to each design element (counting both sides of the road and the median strip)

* Leave field as 0 if the road does not have that design element

* Insert values in metres

* The total road width should be more than 15m and less than 35m

Space for walking	<input type="text" value="6"/>
Space for place activities (stalls, benches, outdoor cafés, etc.)	<input type="text" value="0"/>
Green area	<input type="text" value="0"/>
Lane for general traffic	<input type="text" value="12"/>
Bus lane	<input type="text" value="0"/>
Space for cycling (cycle lane or cycle track)	<input type="text" value="0"/>
Mixed bus and cycle lane	<input type="text" value="0"/>
Space for parking and loading	<input type="text" value="0"/>
Tram lines	<input type="text" value="0"/>
Total width:	<input type="text" value="18 metres"/>

Road designs tool input 2: *Priorities*

Choose from the green dropdown menus the degree of priority of each design element

- 0: Not relevant in this road (no space provided)
- 1: Relevant, but not priority (will have some space but not more than now)
- 2: Relevant and priority (will have at least the same space but more, if possible)

The tool will show designs with these widths:

These values are calculated automatically

		Minimum	Maximum	
Space for walking	1	4	6	
Space for place activities (stalls, benches, outdoor cafés, etc.)	2	0	6	
Green area	0	0	0	No road designs will include this element
Lanes for general traffic	1	3	12	
Bus lane	0	0	0	No road designs will include this element
Space for cycling (cycle lane/cycle track)	0	0	0	No road designs will include this element
Space for parking and loading	0	0	0	No road designs will include this element
Tram lines	0	0	0	No road designs will include this element

Road designs tool output

POSSIBLE ROAD DESIGNS [Back](#) [Restart](#) [Next](#)

Legend

Walking			Place activities		Green area	General purpose		Bus lane		Cycling		Bus + cycle/Parking/ loading	Tram line		
Narrow	Medium	Wide	Narrow	Wide		1 lane	2 lanes	1 lane	2 lanes	1 lane	2 lanes		1 track	2 tracks	
2m	3m	4m	2m	3m	1.5m	3m	6m	3m	6m	2-3m	5-4.5m	4m	2.5m	3m	6m

Notes

- All designs include a 0.5m kerbzone between the footway and carriageway and a 0.5m frontage zone between footway and building frontages
- The width of a single cycle lane is 2m if on the carriageway and 3m if on the footway/kerbside [cycle track]
- The width of a double cycle lane is 3m if on the carriageway, 3.5m if on the median strip, and 4.5m if on the footway/kerbside [cycle track]
- A buffer of 1m is added between cycle space and moving or parked vehicles and between parked and moving vehicles

Fill the checkboxes of all options you think are feasible in the road subsection

Left footway and kerbside Feasible	Left carriageway	Median strip	Right carriageway	Right footway and kerbside	Total road width (m)	Width of Design Elements (m)							Capacity per 75m² of roadspace			
						Walking	Place activities	Green area	General purpose	Bus lane	Cycling	Parking/Tram loading	Movement (people)	Place activities loading (people)	Parking/ loading (vehicles)	
					18	6	4	0	6	0	0	0	0	110	45	0
					18	6	4	0	6	0	0	0	0	110	45	0
					18	6	4	0	6	0	0	0	0	110	45	0
					18	6	4	0	6	0	0	0	0	110	45	0
					18	4	0	0	12	0	0	0	0	90	0	0
					18	4	6	0	6	0	0	0	0	80	65	0
					18	4	6	0	6	0	0	0	0	80	65	0

(...)

Tool development and refinement

Trial in five cities, in busy roads linking to the European Transeuropean Transport Network



Feedback from road user groups:

International Federation of Pedestrians

European Cyclists Federation

International Association of Public Transport (UITP)

Alliance for Logistics Innovation through Collaboration in Europe (ALICE)

Feedback welcome!

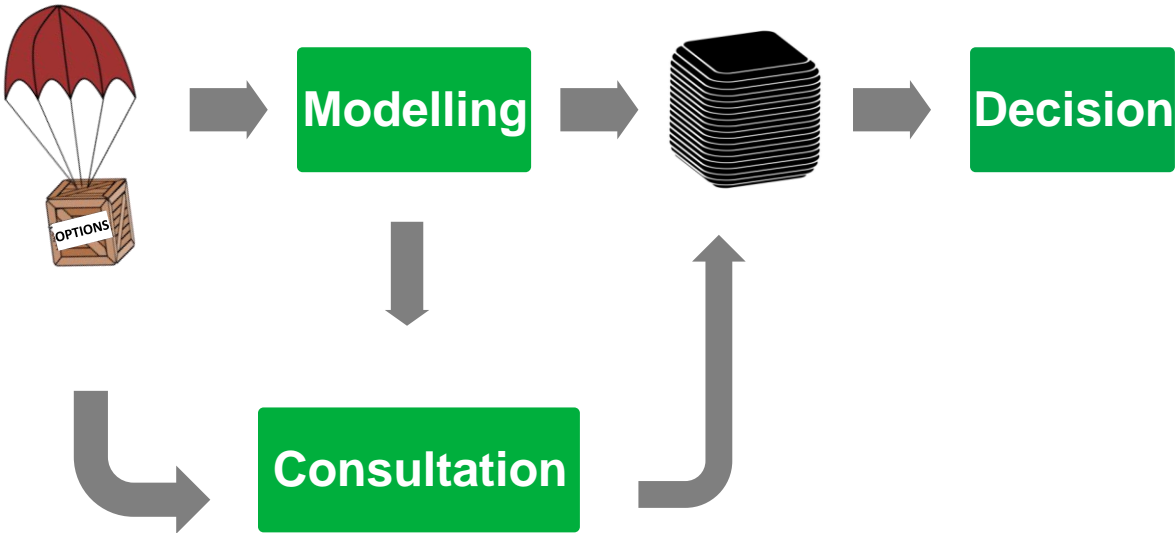
Tools: <https://more.traffwebdev.uk>

Project website: <https://www.roadspace.eu>

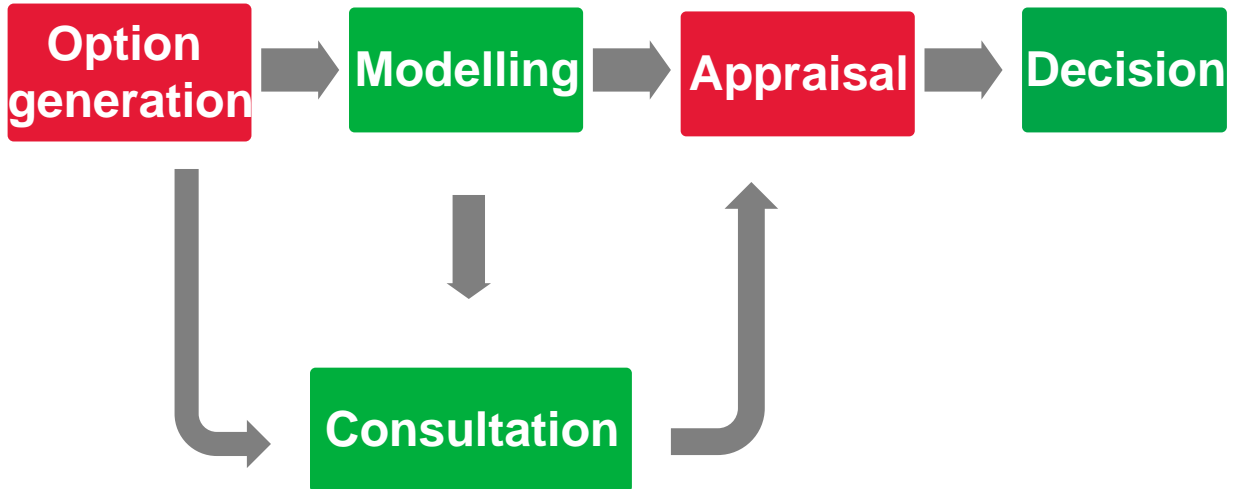
Contact: p.anciaes@ucl.ac.uk

Option appraisal tool

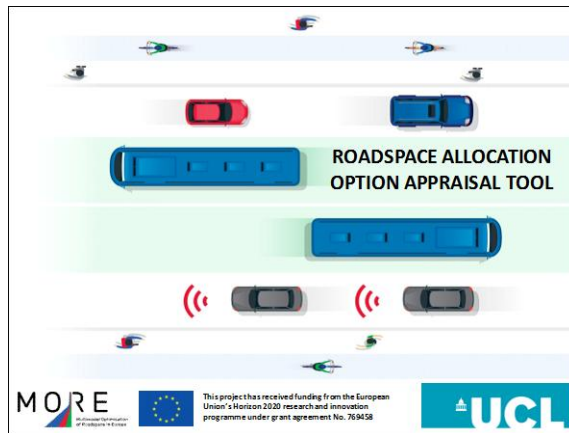
Street (re)design process: now



Street (re)design process: innovations



A new option appraisal tool



Part of **MORE** Multimodal Optimization of Roadspace in Europe

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General inputs

Road design

Option name (short)	Option 0 (Do nothing)	Options for space reallocation			
	6 traffic lanes	Option 1 Widen pavements	Option 2 Add green median	Option 3 Add cycle lane	Option 4 Radical change
Implementation cost (1000€) ①		135.7	90.5	81.3	375.4
Maintenance cost per year (1000€) ①		24.4	16.3	14.6	67.6
Allocated road width (metres)					
<i>Insert from 0 to 60</i>					
General motorised traffic	18	12	16.2	14	6
Bus-only lane					
Cycle-only lane				4	4
Bus+cycle lane					
Bus+taxi lane					
Pavement (walk)	12	18	12	12	12
Pavement (sit)					
Pavement (place activities) ①					8.5
Parking	2.5	2.5	2.5	2.5	
Loading/servicing					
Green areas			1.8		2
Total road width (metres)	32.5	32.5	32.5	32.5	32.5
Pedestrian crossing facilities (number)					
<i>Insert from 0 to 20</i>					
Signalised crossings ①					3
2-stage signalised crossings ①	2	2	2	2	
Footbridge ①					
Underpass ①					
Zebra					
Pedestrian refuge ①					
Total number of crossing facilities	2	2	2	2	3

And also: Performance indicators

Link (by travel mode):

- Volume
- Speed or travel time
- Delays
- Reliability
- Trip quality

Place (vehicle or people-based activities, by type of activity)

- Number
- Duration
- Quality

Wider objectives:

- Property prices
- Traffic safety
- Health (physical activity)
- Air pollution
- (...)

Political and Technical Assessment: further inputs (political priorities)

Road uses			Objectives		
Road user	Use	Priority	Objective	Priority	
Pedestrians	Walk	2	Movement	Increase number of trips	<input type="checkbox"/>
	Cross the road	2		Reduce travel time	<input type="checkbox"/>
	Stroll	1		Increase travel time reliability	<input type="checkbox"/>
	Sit (street furniture)	1		Reduce congestion	<input type="checkbox"/>
	Sit (outdoor café)	1		Improve trip quality	<input checked="" type="checkbox"/>
Pedestrians (restricted mobility)	Walk	2	Place	Achieve a more sustainable modal split	<input checked="" type="checkbox"/>
	Cross the road	2		Facilitate place activities (e.g. people sitting)	<input type="checkbox"/>
Cyclists	Move	2	Road operation	Facilitate kerbside activities (e.g. parking, loading/unloading)	<input type="checkbox"/>
	Park	2		Improve access to local buildings	<input type="checkbox"/>
	Rent (dock)			Improve resilience (to weather conditions)	<input type="checkbox"/>
	Rent (dockless)		Increase flexibility (to different road uses)	<input type="checkbox"/>	
Micromobility (scooters, skates, etc.)	Move		Wider objectives:	Reduce costs of transport	<input type="checkbox"/>
(...)			(...)		

Political and Technical assessment: output

Performance indicator	Unit	Option 0 (Do nothing) 6 traffic lanes	Option 1 Widen pavements	Option 2 Add green median
Implementation cost	€		135,700	90,500
Maintenance/year	€	4,000	24,426	24,426
Link function				
Pedestrians				
Space	Width available	12.0	18.0	12.0
Volume	Flow	3812	5131	5131
Speed	Average speed (km/h)	4.0	5.0	5.0
Travel time	Average travel time (minutes)	30.0	24.0	24.0
Delays	Average delay (minutes/vehide)	2.0	2.0	
Reliability				
Trip quality	% of unsatisfied users	0.09	0.45	0.1
Cyclists				
Space	Width available (dedicated space)	0.0	0.0	0.0
Volume	Flow	4697	5014	5014
Speed	Average speed (km/h)	12.0	12.0	12.0
Travel time	Average travel time (minutes)	10.0	10.0	10.0
Delays	Average delay (minutes/vehide)	1.0		
Reliability				
Trip quality	% of unsatisfied users	0.03	0	0.0
Micromobility				
Space	Dedicated space (yes/no)	No	No	No
Volume	Flow			
Speed	Average speed (km/h)			
Travel time	Average travel time (minutes)			
Delays	Average delay (minutes/vehide)			
Reliability				
Trip quality	% of unsatisfied users			

Green highlights: best option, for a particular indicator

Red highlights: options that violate a design or environmental standard

Cost-Benefit Analysis: further inputs (monetary unit values)

choose built-in unit value, from previous studies

OR specify new unit value

see details of those studies

Data source	Institution (if in official guidance)	Original research	Country	Year	Unit	Original value	Value in 2018 €	Unit	Unit value (2018 €)
<i>Choose data source from dropdown menu</i>								<i>OR choose a unit from the dropdown menu and insert a new unit value</i>	
Link function									
Value of travel time									
Private car driver	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€17.69	€19.81	
Private car passenger	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€17.69	€19.81	
Taxi driver	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€12.96	€14.52	
Taxi passenger	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€17.69	€19.81	
Motorcyclist	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€17.69	€19.81	
Light-goods vehicle	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€12.18	€13.64	
Heavy-goods vehicle	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€14.35	€16.07	
Cyclists	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€10.02	€11.22	
Pedestrians	WebTAG	UK Department for Transport	ITS Leeds	England	2013	Value of 1h working time	€10.02	€11.22	
Congestion/overcrowding multiplier of travel time									
Motorised modes	Swedish guidance	Swedish Road Administration	Börjesson & Eliasson	Sweden	2011	Multiplier of travel time savings	1.5		
Bus	Swedish guidance	Swedish Road Administration	Börjesson & Eliasson	Sweden	2011	Multiplier of travel time savings	1.5		
Cyclists									
Pedestrians	WebTAG	UK Department for Transport	Heuman	England	2005	Value of pedestrian crowding per km	€0.02	€0.02	
Value of road design									
Segregated bus lane									
Segregated cycle lane	WebTAG	UK Department for Transport	Hopkinson and Wardman	England	1996	Value per minute travel time	€7.03	€7.87	
Non-segregated cycle lane	WebTAG	UK Department for Transport	Wardman et al	England	1997	Value per minute travel time	€2.97	€3.33	
Wide cycle lane	WebTAG	UK Department for Transport	Hopkinson and Wardman	England	1996	Value per minute travel time	€1.81	€2.03	
Shared lane bus-cyclists	WebTAG	UK Department for Transport	Hopkinson and Wardman	England	1996	Value per minute travel time	€0.77	€0.86	
Place function									
Value of parking time (cars)									
Value of parking time (bicycles)	WebTAG	UK Department for Transport	Hopkinson and Wardman	England	1996	Value of parking facilities per minute	€0.98	€1.10	
Value of loading time									

(...)

Cost-Benefit Analysis: output

Synthesis of Cost-Benefit Analysis

	Net benefit (over 5 years)	Benefit-cost ratio
Option 0		
Option 1	11,295,799	1.139
Option 2	59,228,846	1.756
Option 3	135,874,630	1.302

→ Synthesis of all monetised values

Monetized value of an indicator, for all options

Detailed Cost-Benefit Analysis

Performance indicator	Unit	Unit money value	Money unit	Monetised changes		
				Option1	Option2	Option3
Implementation cost	€	€	€	-135,700	-90,500	-81,300
Maintenance/year	€	€	€	-122,130	-122,130	-73,000
Link function						
Pedestrians						
Space	Width available					
Volume	Flow					
Speed	Average speed (km/h)					
Travel time	Average travel time (minutes)	0.25	Value per minute per passenger (work time)	63,578,492	63,578,492	-289,230,023
Delays	Average delay (minutes/vehicle)	1.60	Multiplier of travel time savings for delays			
Reliability						
Trip quality	% of unsatisfied users					
Cyclists						
Space	Width available (dedicated space)	Depends on type of space	Value of existence of dedicated space per minute of travel time	0	0	243,973,326
(...)						

Multi-Criteria Analysis: further inputs

Inputs

Performance indicators	Level of the indicator		Scale		Assessor 1	
	Unit	Value now	Worst possible	Best possible	Local government	Neighbourhood associations
Implementation cost	1,000 €	0 €	1,000 €	0 €	3	
Maintenance cost per year	1,000 €	0 €	100 €	0 €	3	
Link						
Private cars						
Space	Width available	8.00	0	24	1	
Speed (km/h)	Average speed (km/h)	31	5	60		
Delays	Average delay (minutes/km)	0.4	1.5	0		

(...)

↓
What you consider as worst possible and best possible value for each indicator

↓
Importance of each indicator
! different assessors have different opinions



Multi-criteria analysis

	Option 0 (Do nothing)	Option 1	Option 2	Option 3
	6 traffic lanes	Widen pavements	Add green median	Add cycle lane
Overall ranking				
Average	1.5	4.2	3.2	1.7
Assessor 1	1	4	3	2
Assessor 2	3	5	4	1
Assessor 3	1	4	3	2
Assessor 4	1	4	3	2
Assessor 5	1	4	3	2
Assessor 6	2	4	3	1
Overall score				
Average	25%	18%	20%	25%
Assessor 1	30%	21%	24%	25%
Assessor 2	12%	9%	11%	26%
Assessor 3	37%	26%	30%	32%
Assessor 4	36%	25%	29%	32%
Assessor 5	18%	14%	16%	18%
Assessor 6	16%	12%	14%	18%
Cost score				
Average	47%	31%	36%	37%
Assessor 1	50%	33%	39%	40%
Assessor 2				
Assessor 3	50%	33%	39%	40%
Assessor 4	50%	33%	39%	40%
Assessor 5	50%	33%	39%	40%
Assessor 6	33%	22%	26%	27%
(...)				

→ Ranking of the options, for each assessor

→ Overall score of the options, for each assessor

→ Partial score of the options, for each assessor

Tool development and refinement

Trial in five cities, in busy roads linking to the European Transeuropean Transport Network



Feedback welcome!

Tools: *now: e-mail me*
soon: from www.ucl.ac.uk/roadspace

Project website: <https://www.roadspace.eu>

Contact: p.anciaes@ucl.ac.uk

Thank you for your attention!



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Multimodal Optimisation
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