Streetspace allocation – new tools and methods, with a Lisbon application

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Abstract

The allocation of space to different uses in busy city streets is a complex and contentious process. Decisions to reallocate streetspace are usually based on public consultation and modelling of a few street redesign options, but results are not compared systematically. In addition, the set of options considered is usually incomplete. This paper proposes a new process for streetspace reallocation, including option generation (with online and physical tools), estimation of performance indicators (with microsimulation), and comparison of options (with a new appraisal tool). The process was applied to the redesign of a busy street in Lisbon. Several options were generated, all involving reducing the space allocated to general motorised traffic. Microsimulation showed that allocating more space to some street uses also bring benefits to other uses. The option to allocate more space to both bus users and pedestrians does not deteriorate movement by other modes. However, appraisal showed that some redesign options go against technical/design standards or political priorities.

Keywords

Streetspace allocation; street design; option generation; appraisal; Lisbon

Introduction

The allocation of space in busy city streets is complex: planners need to decide what space can be used, for what, how, and when. Trade-offs need to be made, as it is generally not possible to fully accommodate the needs of all street uses, including movement by different modes, parking/loading, picking-up/dropping off passengers, waiting for buses, and 'place activities' (e.g. sitting, socializing, playing). Pressures on streetspace are growing, given the development of new forms of mobility (e.g. shared mobility, micro-mobility) and changes in patterns of consumption (e.g. home deliveries). In addition, planners are more aware of the economic, social, and environmental benefits of good-quality streets for pedestrians and 'place activities', especially in the aftermath of the COVID-19 crisis, which led to less commuting and more use of local streets.

The allocation of streetspace is a technical issue, facilitated by new developments such as real-time information collection and variable message signs. It is also a political issue, subject to conflicts (users using space that has not been allocated to them) and protest by stakeholders (e.g. street users, residents, business). These conflicts and protests happen in part because the allocation process is not fully transparent: it relies on modelling and public consultation, but without using formal methods to identify and compare the options for space reallocation. As a result, the number of options presented to modellers and the public is small, without a justification of their relevance, or assurance that alternative options were considered. In addition, modelling tends to focus only on movement (producing performance indicators such as speeds and delays), with little information on the effect of different street designs on stationary activities, such as vehicle parking.

This paper presents a new process for streetspace reallocation (the *MORE Process*), starting with formal option generation procedures (using with two new online tools and a physical design toolkit. The options are then modelled, using microsimulation software, and compared using a new appraisal tool that integrates a variety of indicators for movement and stationary activities.

Lisbon application

The process was applied in five cities in Europe: Lisbon, London, Malmö, Budapest, and Constanta. This paper presents the results of the Lisbon application. The case study street is Rua Morais Soares, a busy street in the city centre with intense demands on space, for walking, cycling, moving by car and bus, car parking, loading, and place activities (Fig. 1). The street is 22m wide - too narrow to fully accommodate all demands for space. Currently, the space is mostly allocated to cars, with two lanes of movement plus a parking lane on each side. Footways are narrow (1.6-1.8m), below even the “absolute minimum” of 1.8m recommended in the *Global Street Design Guide* (NACTO and GDCI 2016, p. 80). This is insufficient on its own, but more so due to the presence of street furniture (traffic signs, bins, shopfront displays), which limits the movement of pedestrians. Other needs for space (e.g. cycling, place activities) are not being fully satisfied due to the lack of dedicated space.

(Fig.1 – Aspect of the Lisbon case study street - Source: Authors 2022)

The main political priorities for this street, according to the city authorities are:

- More space/better conditions for pedestrians (walking and crossing the street), place activities (e.g. strolling, sitting), and passengers waiting for buses
- Not deteriorating the movement of buses
- Achieving the following policy objectives: more sustainable modal split, more place activities and social interaction, improved wellbeing, and more greenery

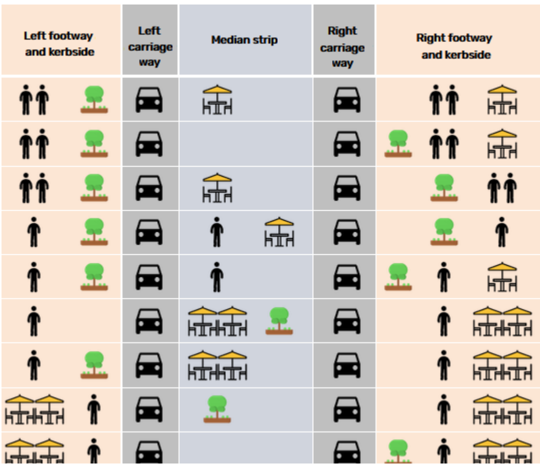
First stage: Option Generation (Online Tools)

Two new option generation tools were developed. Both are freely available from https://ifpedestrians.org/roadoptions/public

The *Streetspace Interventions* tool generates options to reallocate space or time to different street uses, redesign streetspace, or regulate how the space can be used. The tool selects options that fulfil specified priorities regarding which street uses to improve, which uses not to deteriorate, and the five most important policy objectives to achieve. The selection, from a database of 210 options, is based on the likely effect of the options on 28 different street uses by 15 street users (e.g. cyclists moving, cyclists passing through junctions, cyclists parking), and the likely effect on 28 policy objectives (e.g. promote local economy, reduce social exclusion, reduce air pollution).

The *Street Designs* tool generates options to allocate street width to different street design elements (e.g. cycle lanes, bus lanes, space for parking/loading). The tool selects options that fulfil specified priorities regarding which elements should have more space, constrained to the total available width and other design considerations (e.g. buffers between some elements). The selection considers all permutations of various possible widths of all design elements.

The application of the *Streetspace Interventions* tool in Lisbon used as inputs the political priorities presented at the end of the previous section of this paper. Two options fulfilled all the priorities: reduce number of traffic lanes and decrease number of parking spaces. The application of the *Street Designs* tool identified 65 possible designs. Fig.2 is an extract of the results page of the tool, showing a variety of possibilities for adding and rearranging design elements so that footways can be widened and extra space can be allocated to green areas and place activities. Some of the designs were selected by city planners to be carried forward in the process (microsimulation and appraisal).



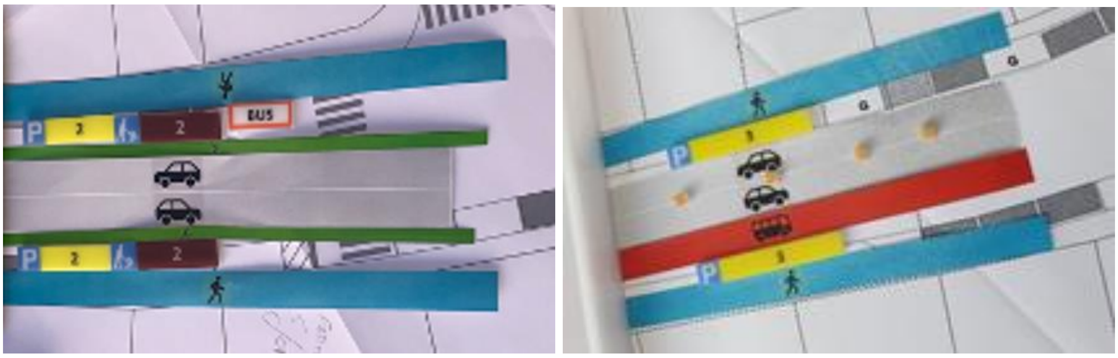
Total street width (m)	Width of Design Elements (m)								Capacity per 75m² of roadspace		
	Walking	Place activities	Green area	General purpose	Bus lane	Cycling	Parking/ loading	Tram line	Movement (people)	Place activities (people)	Parking/ loading (vehicles)
19.5	6	4	1.5	6	0	0	0	0	110	50	0
19	6	2	3	6	0	0	0	0	110	40	0
19	6	2	3	6	0	0	0	0	110	40	0
19	6	2	3	6	0	0	0	0	110	40	0
19	6	2	3	6	0	0	0	0	110	40	0
19.5	4	6	1.5	6	0	0	0	0	80	75	0
19.5	4	6	1.5	6	0	0	0	0	80	75	0
19.5	4	6	1.5	6	0	0	0	0	80	75	0
19.5	4	6	1.5	6	0	0	0	0	80	75	0

(Fig.2 – Extract from application of Street Designs tool in Lisbon - Source: Authors 2022)

Second stage: Option Generation (Physical Design Toolkit)

Further design options can be generated by stakeholders in workshops, using a newly developed physical toolkit. This toolkit contains acetates representing different type of lanes (e.g. cycle lanes, bus lanes) and blocks representing other street design elements (e.g. parking bays, loading bays, taxi stands, bus stops). All elements are represented at the same scale. Workshop participants then create street designs, in cross section, that fit into the street width. The designs can then be imported into design software. The applications of the *MORE Process* in the five cities used LineMap (https://www.buchanancomputing.net/linemap). Designs can be refined and exported to microsimulation software (e.g. PTV Vissim) and consultation platforms (the applications in the five cities used TraffWeb (https://www.buchanancomputing.net/traffweb).

The Lisbon workshops were held on the street, in the same section being redesigned. Passers-by were invited to contribute. The workshops led to the creation of five design options. All involved removing one lane of traffic in each direction and, in some cases, also parking lanes. The released space was used for wider footways (in all options), and for dedicated space for other uses (different in each option): cycle lanes, bus lanes, median strips, green areas, or space for place activities. Fig.3 shows two of the designs created. Some of the designs were selected by city planners to be modelled and appraised.



(Fig.3 – Examples of designs created with the MORE Street Design Toolkit - Source: Authors 2022)

Third stage: Microsimulation

The options for street redesign can then be modelled. The *MORE Process* uses PTV Vissim, software that simulates interactions between street users and estimates average travel times, speeds, and delays for each type of user. The software was improved for this project, including more realistic interactions between motorised vehicles and pedestrians, and a better representation of vehicle parking (allowing for the estimation of number of vehicles that cannot be parked due to the unavailability of space).

In the Lisbon case, four street redesign options were modelled, plus the "do nothing" option. All redesign options involve the removal of one traffic lane in each direction and wider footways. *Option 1 (Priority to parking)* transforms parallel to diagonal parking. The other three options reduce parking space and allocate the released space to:

- *Option 2 (Priority to bus)*: bus lanes in both directions
- *Option 3 (Priority to cycling)*: cycle lanes in both directions, pedestrian refuge in the median strip
- *Option 4 (Priority to bus and pedestrians)*: bus lane in one direction, even wider footways

Modelling was for the AM and PM peak periods. Table 1 shows the results of the modelling, compared with the "do nothing" option

Option	Priority	Effects on priority use	Positive effects on other users	Negative effects on other users
1	Parking	All demand for parking is met		Longer travel times for cyclists and all motorised modes
2	Bus	Slightly shorter bus travel time		• Longer travel time for other motorised modes • Higher pedestrian density • More vehicles that cannot be parked
3	Cyclists	Slightly shorter travel time for cyclists	Lower pedestrian density	• Highest travel times for all motorised modes, out of all options • More vehicles that cannot be parked
4	Bus and pedestrians	• Slightly shorter bus travel time • Lower pedestrian density	Slightly shorter travel time for all motorised modes	Highest number of vehicles that cannot be parked

(Table 1 – Effects of the four street redesign options (from modelling))

As shown, allocating more dedicated space to a given mode(s) improves the conditions of that/those mode(s) although in some cases the improvement is small. However, some options have added benefits of improving other modes. Priority to bus and pedestrians does not deteriorate movement by any mode, only vehicle parking.

Fourth stage: Appraisal

The final stage of the *MORE Process* is appraisal. A new tool is used to compare street design options based on cost (implementation and maintenance) and performance indicators for movement, stationary activities, and wider economic, social, and environmental impacts. Three types of assessments are made:

- Political and technical assessment (highlighting the options that go against political priorities or technical or design standards) – this requires specification of political priorities
- Cost-benefit analysis
- Multi-criteria analysis (ranking of options) - this requires specification of the degree of importance of each indicator for various tool users.

The Lisbon case study included political assessment and multi-criteria analysis. The political priorities are those specified above (under “Lisbon application”). The input for multi-criteria analysis was provided by three city planners. Cost-Benefit Analysis was not performed because of lack of data for unit monetary values of performance indicators (another required input).

The set of performance indicators included: volume, speed, travel time, and delays disaggregated by mode (pedestrians, cyclists, buses, cars/taxis, motorcyclists, and goods vehicles); pedestrian density; number and average duration of car parking, bus stopping, and loading activities; vehicles that could not be parked; number of people strolling; and number of people sitting. No indicators were considered for movement using micromobility vehicles, cycle parking/share, reliability of travel time (for all modes), and trip quality. Estimates were included for the effect of the redesign options on property prices, visits to local shops, PM10 emissions, NO2 emissions, and fuel consumption.

The political and technical assessment showed that:

- Options 1 and 3 violate the city's political priority not to deteriorate bus movement (as shown in Table 1 above).
- Options 1 and 2 violate the city's priority to have more greenery (no extra space is provided for green areas in those two options)
- Options 1-3, and the "do nothing" option violate principles of inclusive design (no full provision is made for pedestrians with disabilities)

Multi-criteria analysis showed that Option 1 was better for stationary activities, Option 2 was better for movement and environment aspects, and Options 3 and 4 were better for economic aspects.

Conclusions

The *MORE Process* brings objectivity to the allocation of space in busy urban streets, a process that is currently based on political decisions and subject to controversy. The new online option generation tools produces a series of feasible options for reallocating streetspace that could otherwise not be included in the reallocation process. The physical toolkit then facilitates discussion and consensus among street users to generate further options. The improved procedures for microsimulation bring a more realistic and balanced perspective to modelling, which currently tends to rely on performance indicators for movement (especially of motorised vehicles). Finally, the appraisal tool accounts for a variety of effects of street allocation on various users and policy objectives.

The application in Lisbon illustrated the use of this process to generate, model, and appraise a set of feasible options to reallocate space in an urban street with space constraints and various demands for that space. The options generated reallocated space away from private vehicles, allowing more space for pedestrians, cyclists, buses, place activities, or greenery. Microsimulation showed that the benefits of some options are not limited to the targeted street use. However, appraisal showed that some options go against technical/design standards and political priorities.

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