**SEVENTH FRAMEWORK PROGRAMME**

**THEME 7 – TRANSPORT (INCLUDING AERONAUTICS)**

****

**Collaborative Project**



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Summary: **reports on the set of measures for VRU Safety selected for evaluation and the results on the assessment of their potential transferability to Brazil, particularly the City of São Paulo, based on expert´s opinions** (gathered from detailed interview with one hired expert and submitted to a calibration seminar with 7 experienced professionals).

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The work of our team is lovingly dedicated to the memory of Elieni Strufaldi, a person who initiated it with us (with dearly interest and happiness, we must say) but was taken from life by a blow of bad luck during a small surgery that, now we desire, it should never be done ...

Affectionately yours, Elieni.

José Alberto Quintanilha

Hugo Pietrantonio

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**List of Terms**

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| Abbreviation | Definition |
| **VRU** | Vulnerable Road User, at least including pedestrians and cyclists or other non-motorized users (may include motorcyclists and other users) |
| **ASL** | Advanced Stop Line, for cyclists, measure providing a waiting position in front of the vehicle queue of an approach at signalised intersection |
| **VAS** | Vehicle Activated Sign, a variable message sign system activated based in detection or other kind of sensor on or near the road |
| **RSA** | Road Safety Audit, a preventive procedure applied to the design phase of the implementation of road schemes (may include monitoring) |
| **RSI** | Road Safety Inspection, a preventive procedure applied to existing roads based on field reviews by road safety experts (similar to a RSA) |
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| **CTB** | Código de Trânsito Brasileiro (Brazilian Traffic Code), the basic law setting the rules of the road and the traffic management in Brasil |
| **CONTRAN** | Conselho Nacional de Trânsito (National Traffic Council), the maximum regulationg body in the Brazilian traffic management system |
| **CET/Sp** | Companhia de Engenharia de Tráfego (Traffic Engineering Company), the main executive body of traffic management in the City of São Paulo |
|  |  |
| **India** |  |
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| **EC** |  |
| **ADB** |  |

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# Introduction

This document presents a preliminary evaluation on the potential for transferability of a list of measures that, in a first view, were judged as representative of European best practices in promoting the traffic safety of VRUs and as being applicable to emerging economies as Brazil and India (the case studies of the SaferBraIn project). Following the Plan of Work of SaferBraIn, these measures should pass a preliminary evaluation of the potential for transferability based on the methodology set out by D2.1 [1] and on the preliminary results on local conditions of D1.1 [2]. This evaluation should be carried-out based on expert opinions. It will also be used as an intermediate evaluation to be considered in the selection of actions to be tested on the pilot studies in WP5 (either based on evaluating design proposals or real implementation of the selected measures).

The suggested measures of D2.1 were analyzed and classified in three main categories:

- general policies for road safety,

- safe planning and design of roads, and

- management of road safety.

The measures of each class with the specific focus on promoting the safety of VRUs, even if their potential could also be demonstrated for other safety targets, were identified.

The complete list of measures to be initially considered in this preliminary evaluation of transferability (i.e. the potential transferability) is the following:

* General policies for road safety
  + Fostering strong, self-standing national bodies;
  + Creating general road safety policies;
  + Integrating land use and network planning;
  + Data record, storage, process for indicators;
  + Data dissemination activities;
  + Fund raising for road safety (road safety tax, insurance companies).
* Safety planning and design of roads
  + Sidewalks / Footpaths;
  + Pedestrian refuges / Footway build-outs or Kerb extensions;
  + Dropped kerbs / Tactile paving / Other facilities for VRUs with disabilities;
  + Zebra crossings / Other facilities for pedestrian priority without signals;
  + Pelican crossings / Other facilities for pedestrian priority with signals;
  + Puffin crossings / Other facilities with technology improvements for pedestrians;
  + School crossing patrols (or patrollers);
  + Footbridges and underpasses;
  + Pedestrian barriers and guard-railing / Bollards;
  + Lifted pedestrian crossings / High visibility pedestrian crossings;
  + Bikeways / Other facilities segregated from motorized vehicles;
  + On–road Cycle Lanes and cycle priority in arterial roads;
  + On–road Cycle Lanes/Routes and cycle priority in non-arterial roads;
  + Shared foot and cycle ways;
  + Exceptions for cyclists / Other facilities for cyclist priority without signals;
  + Advanced Stop Lines (ASLs) / Other facilities for bicycle priority at signals
  + Toucan crossings / Other facilities for cyclists and special users other than pedestrians;
  + Bike stands / Other facilities for parking bicycles;
  + Shared use of bus lanes/bus ways by motorcycles and/or bicycles;
  + Traffic calming or Shared spaces / Shared roadways or Mixed priority routes;
  + Speed humps / Speed cushions / Other devices based on vertical deflection;
  + Speed tables / Raised or Lifted intersections;
  + Chicanes / Priority narrowing / Other devices based on horizontal deflection;
  + Vehicle activated signs (VASs);
  + Road lighting;
  + Safety (speed and red light) cameras / Other electronic enforcement devices.
* Management of road safety for VRUs
  + Black spot analysis;
  + Urban safety management and other area-wide intervention policies;
  + Road safety audit/inspection or other preventive actions;
  + Education and training;
  + Information / Consultation / Participation;
  + Enforcement of priority of VRUs.

This list reveals a clear preference for road safety measures. Broader questions (as vehicles standards and traffic legislation) or measures that were not proven in practice (at least showing clear results in a couple of trials) were not considered at this time, since its final evaluation would demand activities outside the scope of the subsequent tasks of the SaferBraIn project. The restriction of interest applies, however, only to this evaluation task.

For each measure, the first task was the documentation of a faithful (if possible authoritative) description of its concept and its implementation. This description was researched and documented. As a first source, general references as “The Handbook of Road Safety Measures” [3] and the “Best Practices in Road Safety” [4] (an outgrowth from the EC funded SUPREME project) were used. Other references considered relevant were also researched and are presented in the following discussion of each measure. The definition was submitted to SaferBraIn partners and a final agreement was reached.

Using the agreed definition, each country (Brazil and India), prepared a set of activities driven to identify the expert view on the potential transferability of the measures. Following the approach outlined in D2.1, the set of procedures was defined based on the task of identifying (potential) positive and negative effects of VRU road safety measures on institutional/social/economic settings, after analyzing general feasibility (i.e. if the measure is economically affordable, technically and legally feasible). The detailed procedure was discussed with SaferBraIn partners and carried-out by local teams (in Brazil and India).

The next section presents the results from these activities, measure by measure. Then, the last section intends to produce a wider view on the first evaluation, discussing its impact on subsequent activities of the SaferBraIn´s Plan of Work. ... Heger/Claire/Tripodi/Luca´s task ...

# Description of positive and negative effects of VRU road safety measures

This chapter presents the results on the evaluation of positive and negative effects (gathered from local experts) for the selected list of VRU road safety measures considered for the transferability study programmed on the SaferBraIn project. In this step, the evaluation considers the positive and negative effects that can influence the transferability of the measures, accepting that they can be potentially effective on the road if properly understood by road users and adequately applied by road designers. The evaluation also tries to judge to what degree the measures will be relevant (tacking important problems) and effective (reducing accidents that are meant to be reduced) in the context of emerging economies.

This study of potential transferability was organized and conducted by local teams of the SaferBraIn project in Brazil and India, given the methodology described in the report D2\_1 and the initial list of measures set out there. Starting from this general guideline, local teams had the freedom to rearrange and complement the list of measures and to carry-out the data collection task in their preferred approach.

In Brazil, as an example, after designing specific data forms for each measure, one leading expert was interviewed in a more thoughtful way and subsequent seminars expanded the consultation to a larger audience (finally, 7 professionals attended the seminars and were organized in 3 groups, each one led by an experienced professional with larger reputation in road design and accident analysis). After gathering the information, quotations were analysed and a synthesis of the answers were inputted in the tables to be presented here.

This procedure tries to warrant that the quotations are a balanced view of local experts and professionals, not the opinion of a particular one. However, despite the effort made to reach a wider audience, the professionals that attended to the seminar came from companies or developed their carriers in the State of São Paulo (even the City of São Paulo) and this previous experience can have some influence on the common view built from them.

Overall, the procedure tried to fill 4 independent evaluations that were used to prepare the synthesis found in the following charts: 1 for the leading expert, 3 from for groups of professionals (1 from the CET/Sp; 1 from engineering consultancy, 1 from academic experts): The leading expert was the Eng.Adauto Martinez Filho; professionals from CET/Sp were Arc.Nancy Schneider and Arc.Maria Ermelina Brosch Malatesta; professionals from Consultancy were Eng.Airton Mergulhão (VETEC Engenharia Ltda.) and Eng.Leandro Cardoso Trentin (Planservi Engenharia Ltda); professionals from academic positions were Eng.João Cucci Neto (Universidade Presbiteriana Mackenzie; also Traffic Analyst at CET/Sp), Eng.Andréa Ribeiro (MSc student at EPUSP) and Eng.Ivo Chuquer Jr. (MSc student at EPUSP; also Traffic Agent at CET/Sp).

## General Policies to Improve Safety of VRUs

These measures were conceived as those interventions whose application are not decided and committed on a project by project basis. Of course, measures applied at the project level can also be a matter of general policies (e.g. use of road safety audits or campaigns for use of helmets could benefit from support at upper levels). Nevertheless, if the measure can also be applied (decided and committed) at the project level then they were left for consideration in the other classes of measures (to be discussed in items 2.2 and 2.3, ahead).

Following D2.1 [1], and its main source on this point [5], the “ADB Road Safety Guidelines”, these measures can be further classified as measures that promote the Coordination and Management of Roads, the Road Accident Data Systems, and the Road Safety Funding (including the role of the Insurance Industry).

Based on the results of D2.1 and D1.1 [1, 2], the measures included in the class of General Policies to Improve Safety of VRUs are:

* + Coordination and Management of Roads:
    - Fostering strong, self-standing national bodies;
    - Creating general road safety policies;
    - Integrating land use and network planning;
  + Road Accident Data Systems:
    - Data record, storage, process for indicators;
    - Data dissemination activities;
  + Fund raising for road safety (road safety tax, insurance companies).

These are the measures discussed here. These general policies are not limited to promoting the safety of VRUs, as they have a clear potential of application to the overall road safety problem. The following discussion, however, has the focus on the safety of VRUs.

For all these policies, a national (or regional) practice would be present in every country (or region). Then, the question is about the content of European practices that have been applied and that have shown potential for improving the safety of VRUs, measures that elect themselves to further evaluation for transferability, if not embodied into current practices.

### Coordination and Management of Roads

Discussion in D2.1 is not fully precise on the kind of practice on Coordination and Management of Roads that was proven in Europe and should be considered for transferring to emerging economies. Headlines on the “ADB Road Safety Guidelines” [5], listed before, are usually accomplished in some degree by most of these countries.

Brazil, as an example, has a clear legal framework in which roles are split among bodies and agencies, including a National Traffic Council with strong regulating power. Also executive branches covering traffic management, highway management, enforcement of rules, vehicle registration and licensing, driver training and licensing, etc ..., are clearly nominated and their responsibilities defined (dealing with all levels of government: the Union, the States and the Municipalities).

These general measures are certainly interrelated.

The first two items were related to two separate questions: means/tools that can build a stronger coordinating agency and practices that can organize the action of the lower level bodies. The first point recognizes that the high level of attention to traffic safety problems in Europe is something to transfer (as the problem is even larger in emerging economies). The second point questions if there is something peculiar in the practice of European countries in seeking their goals in the traffic safety area that also worth a transferring study or effort. These are the points here. Based on our general sources [3, items 10.1 and 10.3; also 4, pp.9-15], the source of strength of management bodies is an open question. Nevertheless, their vision on the safety management and the use of quantified target are widely acknowledged by their contribution to European achievements.

The last item is treated separately. It is an area with recognized importance but European practices in this area are not clearly stated. Based in the “Best Practices in Road Safety”, the policy for integrating land use and network planning [4, pp.17] was included. However, just one example of this practice is mentioned: the implementation of hierarchical mono-functional networks in the Netherlands. And, as a counterexample, “The Handbook of Road Safety Measures” treated them as separate matters [3, items 10.6 and 10.7]. Best practices were searched for in the procedure for evaluating the measure.

#### Fostering Strong, Self-Standing National Bodies, with Attention to VRUs

Even after the agreement on the scope of this general item (means/tools that can build a stronger coordinating agency), its specific content is not clear.

This proposed measure focus on the necessity to have strong national bodies, with power (means and tools) to organize the efforts from central to local levels, and commitment to tackle road safety issues. The basic steps set out in the “ADB Road Safety Guidelines” (designate a ministerial task force, setting a National Road Safety Council, and identify high risk target groups) should be usually present in most emerging economies [5, p.4-1.1].

As additional strategies, we can mention [3, p.1012]: empowering public agencies, systems of resource allocation, define responsibility for new measures, define the extent of legal responsibility. Also two relevant points can be highlighted as requirements for exercising power: interest in a decision and control of the outcome of the decision (one sociological requirement and one institutional requirement). Nevertheless, actions that were applied to implement these additional strategies in Europe are not clearly stated, especially in relation to warranting attention to VRUs.

The basic requirements set before will be taken for further evaluation here, despite considering that they are not enough to fulfil the goal.

In most emerging economies, as in Brazil, these basic requirements are supposedly accomplished and the evaluation should point to the other requirements to be filled too.

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| **Measure:** Fostering Strong, Self-Standing National Bodies, with Attention to VRUs |
| **Description:** A=define ministerial attribution, B=create a national road safety council, C=define target safety problems (risk groups) |
| **Current Practice:** In Brazil, the National Traffic System is clearly defined in the Brazilian Traffic Code (CTB). There is a National Traffic Council (CONTRAN) with strong regulatory power but not exclusively focused in traffic safety. However, the effective coordination power of the National Agencies can be seen as weak and safety problems are not clearly identified or perceived as priority. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* Political weakness, instead of institutional structure or identification of target groups, was mentioned as the main problem. A Road Safety Council is not in the current traffic law and could conflict with the National Traffic Council-CONTRAN. The national view can be insufficient to tackle the diversity of local problem. | *Regulatory:* The current structure is felt to be adequate (political weakness is taken to be the problem). A new Road Safety Council could improve road safety policies and warrant the focus on risky groups as VRUs. |
| *Technical:* Difficulties in building a technical body and giving them effective management power were mentioned. However, interference of political agents and lack of a safety culture were stressed. | *Technical:* Most judge the current technical means as sufficient. But the need and difficulties of extending road safety policies to less organized bodies were also noted. The need of technical support in disseminating good practices and discussing the proposed ones were also mentioned. |
| *Economic:* If creating new bodies, the need for resources and the difficulties in recruiting skilled professionals would also be notable, even if manageable. | *Economic:* Keeping the current structure carries no additional cost. However, there is a need of warranting resources to traffic safety policies and rationalize their spending at the national level were mentioned. A new agency/council will bring additional costs. |
| *Behavioural:* There is a need to strengthen the national bodies (even local ones) and to extend relevant (and specific) policies to all regions. There is a need to compromise other sectors (as the judicial system and the media). | *Behavioural:* The current structure is taken as a good starting point, even if opting for complementing its content (changing the law). An effort to improve bureaucratic culture and user behaviour on road safety is justified as priority. |

#### Creating General Road Safety Policies (National Vision), with Attention to VRUs

This measure should consider the creation of a traffic safety policy with special concern to VRUs and the organization of a process for seeking their goals and targets.

The emphasis in the importance of setting a general view on traffic safety that asks for improvement is clear in European initiatives (the Sustainable Safety in the Netherlands or Vision Zero in Sweden) [6, 7]. The prototypical approach to seek results in Europe can be translated into the use of quantified safety targets by several agencies (e.g. the U.K.DfT, the Netherlands and Nordic countries). Attention to VRUs is clearly stated in these initiatives. However, it is disputable if these actions are the input to an effective policy or the intermediate output of other factors that explain the emphasis on the road safety problem.

Approaches for selecting and implementing measures for funding based on economic and other criteria were also mentioned. The “Best Practices in Road Safety, as example, mention the experience of Finland in the TARVA program as effective but no data on it was readily available (a similar practice in Belgium was described as promising) [4, pp.14-15].

Given the current stage of understanding, the adoption of a national vision and of quantified safety targets will be taken as the measures to be evaluated.

The shortcomings of this view can be seen when taking the Brazilian case in consideration: as mentioned in D1\_1 [2 ,item 3.1.1, p.11], a draft on a National Traffic Plan was made public in 2004; the number one policy goal was stated as “to improve road safety”; several detailed targets (qualitative and quantitative) were set in the proposal. Notwithstanding, no clear effect on the activities of agencies (other than the federal body) was produced.

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| **Measure:** Creating General Road Safety Policies (National Vision), with Attention to VRUs |
| **Description:** A=adoption of a strong National Vision and B=adoption of quantified safety targets |
| **Current Practice:** In Brazil, efforts were developed to implement a National Policy on Traffic Safety Problems, including the proposition of qualitative and quantitative targets but no effect was produced. Proposition reached the public consultation stage and there is a proposal for voting a legal instrument to state the National Policy on Traffic Safety Problems as part of a National Urban Mobility Direction Act. Furthermore, nowhere a strong vision was credibly set out ... |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* The previous effort in setting targets, including their definitions by law, was remembered as signing to the need of improved approaches. The bureaucratic fear of failing to reach targets was mentioned as a point against them. The difficulty to set targets that could weight the local diversity among cities and regions was mentioned as a problem. | *Regulatory:* The culture of using quantified target seems to be adopted and currently there is a proposal for a law defining goals, if not targets, for national and local mobility plans, including traffic safety. The adoption of the new law (and/or its practice) could increase planning, development, value and objectivity of policies. |
| *Technical:* Technical difficulties were judged as minor but local specificities and availability of good accident data were mentioned as problems. The need of information dissemination on good policies was noted. The possibility that policies would be better applied at an intermediate level (States), neither the national nor the local level, was also suggested. The interference of political agents was also mentioned as a problem. | *Technical:* The quantified targets were mentioned as a tool for reducing political interference in traffic safety policies. The availability of human resources to carry out traffic safety problems was also mentioned. |
| *Economic:* The difficulty is warranting resources legally allocated to traffic education and management was stressed as the main point. Otherwise, resources effectively available could be a constraint. | *Economic:* The management costs are taken as reduced, unless a new technical body would be required to carry-out the tasks. The improvement of the position of bodies in getting resources and benefits to society from reduction of traffic accidents and their effects were also mentioned. |
| *Behavioural:* To get commitment (from the community to the Police) would be the major problem, including continuity and enforcement of targets. | *Behavioural:* Targets are taken as a tool for strengthening the political position of bodies, mostly successful ones, and for control by society. |

#### Integrating Land Use and Network Planning, with Attention to VRUs

This measure should consider the potential for improving road safety, for VRUs in special, through an integrated view (in planning but perhaps in management as well) on creating a built environment with safety by design, taken as a component of a sustainable future.

The general agreement on the potential importance is sure. Also, the knowledge base on actions that can promote it seems to be developing quickly.

Nevertheless, the recognition of policies that can be seen as widely and successfully applied in Europe is less clear. The implementation of hierarchical mono-functional networks in the Netherlands, quoted in [4, pp.17] was characterized by well-known policies that build the functional hierarchy of roads: through roads for long distance travel, with grade separated intersections, physical separation of opposing traffic streams, no access to slow moving traffic and speed limits of 100 and 120 km/h; access roads for opening up residential areas and rural settlements, where motorized vehicles and vulnerable roads users have to interact with low vehicle speeds (30 km/h in built-up areas; 60 km/h in rural areas); and, in the middle, distributor roads for connecting the former roads, with reduced speeds that allow slow and fast traffic to merge in intersections (as in roundabouts) and separated pedestrian and bicycle facilities between them that allow vehicle speeds of 50 km/h in urban areas and 80 km/h in rural areas. Surely, this view mixes usual with disputable measures.

More importantly, no European concept or practice seems to be clearly identifiable with respect to such subject, with one exception: the widespread movement that generate similar initiative named as traffic calming, home zones, 20 or 30 speed zones, shared space, and several others. These initiatives were viewed as a particular component of the implementation of hierarchical mono-functional networks, applied at the level of local roads and mainly to protect residential areas and their life environment.

Some of these concepts, as traffic calming and shared spaces, could equally be applied to other levels (e.g. arterials and trunk roads) and other concepts (shared roads or mixed priority routes) as well. However, none of these alternative applications seem to deny the widespread support to policies driven to create a safe environment to protect residential areas that developed in Europe built into planning procedures.

In Brazil, there is a clear technical support to application of functional hierarchy as road organization principle. However, there no unified view on its application and practices can vary significantly. As a rule, the attention to VRUs is not clearly built into this practice. However, some cities have special requirements on the treatment of pedestrian and vehicle flows to be observed by the circulation systems inside urban developments. Also, some cities have some degree of interference on the approval of major developments (known as traffic generation poles), including the recovery of expenses in adaptation of the physical features or traffic control of roads (as motivated by the generated needs), that can be exercised in the interest of improving the road system for VRUs (and other users as well). However, as a rule, none of these practices usually conform a clear policy and a structural view. The same comment will apply to the adoption of policies for implementation of home zones and 20 or 30 speed zones but, in this area, there is a strong pressure from communities, mostly for protecting their residential environment (not just for traffic safety; also for public security) and by the more affluent areas of the cities. Some cities have legal instruments that regulate the production of “protected” areas, requiring some type of consultation process within communities and with traffic authorities. The City of São Paulo has most of these initiatives.

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| **Measure:** Integrating Land Use and Network Planning, with Attention to VRUs |
| **Description:** implementation of Hierarchical Mono-functional Networks, particularly Home Zones or 20/30 Speed Zones |
| **Current Practice:** In Brazil, no unified view is being proposed or adopted. The concept of road hierarchy is traditionally adopted but its application can vary among jurisdictions. As a rule, it is applied without clear attention to VRUs built into it. Some local agencies have a strong action in approving or conditioning the approval of new developments that can be used to change design decisions. Some municipalities also have some requirements on building codes or urban laws that have attention to road safety and VRUs. However, a structural vision is rare. No national, even local, policy is driven to the promotion of Home Zones, 20 or 30 Speed Zones, but there is a clear pressure for protecting residential zones, at least in more affluent areas and for public safety more than traffic safety reasons ... |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* The planning of land use and networks are traditionally separated and sometimes conflicting in Brazil. Land use policies are local and have to deal with strong economic interests. Pressure for containing traffic in residential areas is confounded with closure of areas for public safety concerns. There are opposition to reducing access to public streets on the judicial system. | *Regulatory:* The concept of road hierarchy is well known in Brazil, and generally accepted as an efficient approach to manage road systems and improving traffic safety. Mono-functional networks could also simplify the task of control and enforcement, and create a policy/culture of local regulation with special focus on VRUs. |
| *Technical:* The technique is seen as known but some criteria could be inappropriate to Brazilian reality, especially considering the wide variety of conditions on cities (legal and physical). Actions would be local in character and require a large number of peculiar studies made by professionals. Acceptance could be a problem, especially in consolidated areas. | *Technical:* The potential of improvement in the urban design could be relevant. Actions of traffic engineering could also be simplified. Additionally, specific projects could bring improvement in value of safety in protected areas. |
| *Economic:* The implementation and maintenance costs are high, but external costs could be even more important (can be judged by the effect on building value or profit from construction activity). | *Economic:* Improvement in the quality of environment (also increase in value of buildings and land value) in benefited areas. Also accident reduction. |
| *Behavioural:* Awareness on the importance of the integrating land use and traffic/transport policies is something to be created. Prejudice to motorized traffic, as reduced speed, is also of concern to some citizens (restraints on mobility are not easily accepted today; change of habit needed). Create “private” public spaces. | *Behavioural:* Can create strong local relationships (among neighbours). Better use of streets by residents. Improved respect to other users, especially VRUs, if accepted. |

### Road Accident Data Systems

This group of measures should consider some kind of standardization of data record of VRUs-related accidents so to make the acquired data available for comparisons and developing road safety indicators. This data should be simple to process and to use. However, reliability also seems to be a main concern related to accident data.

The general approach to selecting and implementing these measures in Europe was taken from the CARE system [8]. This approach was laid down on the assumption that data quality is good and standardization of content and form can provide for the needed information. The “ADB Road Safety Guidelines” [5, p.4-2.1] dig a little bit more into the data quality problem, asking for review of police accident report forms, introduction of computerized data storage and analysis systems, before data dissemination and use. The discussion here splits the points made by the ADB Guidelines in two items: data production, discussed first, and its use, to be discussed next.

A major effort in Europe, in this area, is the development of STATS 19 data form and its analysis system in the UK. However, these proposals seem to be outside the scope of the SaferBraIn project.

In some degree these proposals are accomplished (at least considering the emphasis on actions that can be decided by local bodies). In the City of São Paulo, as an example, police records are currently collected and processed, data is systematically analyzed and available (including its use in a GIS). Matters relevant to local agencies will be prioritized.

#### Data Record, Storage, Process for Indicators, with Attention to VRUs

The importance of data on traffic accidents and their pattern of occurrence was clearly stated in D2\_1. No clear discussion of data gathering procedures in Europe was included detailing how police records are routinely produced and supplied to road safety agencies. The identification of problems in the production of data in emerging economies was discussed in D1\_1. In Brazil, as an example, no direct link from police departments to the traffic authorities is available. The dependence on secondary data sources seems to be a major problem. The question is the identification of institutional actions for warranting that police data reaches road safety agencies (perhaps outside the scope of the SaferBraIn project).

Based on the limited evidence collected, the U.K. system for data gathering and processing is taken here as representative of best practices in Europe (processing of STATS19 forms), due to the direct link from police departments to road authorities in the provision of data. No further proposal for improving data record, storage and process were identified. No clear measure could be related to VRUs, in particular. In D1\_1, accident categories were criticized in the treatment of pedestrian and bicycle accidents. But this critic is valid for current European practices as well. These measures were not further evaluated. The SaferBraIn proposal of building DSS/GIS tools for road safety analysis can touch this missing point.

Recording procedures can include data that gives insight for understanding how VRUs problems are handled within the traffic system. Better details from reports on accidents with VRUs, can help in setting effective requirements and guidelines for their safety. The European initiatives in gathering in-depth accident data can be taken as an approach here [8] but it is not carried-out by executive agencies. In Brazil, the City of São Paulo also has an initiative in collecting in-depth accident that but it was felt as peculiar to its large scale.

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| **Measure:** Data Record, Storage, Process for Indicators, with Attention to VRUs |
| **Description:** direct data processing by police, with spatial reference and standard format, supplied to road authorities. |
| **Current Practice:** In Brazil, production of accident records by police departments is organized but data quality and data provision to traffic authorities is a major problem. The exception is the accident data system for federal highways, recorded and available in the DATATRAN information system. The national information system of traffic authorities (DENATRAN) on road accidents is being revised and currently is taken as poor, being filled with data voluntarily provided by local agencies. The health authorities provide similar data. The treatment to events that involve VRUs is crude. Local initiatives to improve data collection are dispersed and voluntary. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* May have problems with legal constraints on data use. Currently, there is no legal requirement for data provision from police bodies to road agencies (need regulation). May require a new administrative structure (and create additional administrative cost). | *Regulatory:* The record of data is currently done by police officials. Unification of data collection and processing tasks and the provision of data will be a significant benefit to road agencies. May be available to scientific studies/academic institutions as well. |
| *Technical:* There are several problems in data collection and processing, including the integration of police units, the management of data; attention to local data needs. Standards to data records and processing tasks required. Continuous process should be warranted. A new structure will have to be created and the police officials will have to be (re)trained. Police units will have to be integrated. | *Technical:* Current resources could be initially used to collect and process records. Optimization and standardization of data collection will be a benefit. Quality data availability will also generate benefits (identification of black spots, risky groups, etc ...). |
| *Economic:* Current resources of police bodies could have to be supplemented (and related costs can be high). Time to attend traffic accidents could also increase and generated losses to road users. | *Economic:* The resources to be used by road agencies will be reduced. Road safety management can be more effective (accident costs will also be reduced in the long run). |
| *Behavioural:* There is no requirement for providing accident data to road authorities (provision is “voluntary”). The skill level of policemen could be a major constraint on quality data acquisition. Acceptance of data provision to road agencies and academic institutions is absent. | *Behavioural:* The strong link between police bodies and road agencies is positive. Data availability would not depend on local decisions and could provide better data on traffic accidents. |

#### Data Dissemination Activities, with Attention to VRUs

Dealing with data is a sensitive task because one intends to collect the largest amount of data or information on accidents and, to be useful, one also has to process such information in order to produce reliable indicators and monitor accident trends [1]. Information provided in this way is valuable to decision makers and to other users too. Its use in traffic education and public campaigns would also be treated, but separately.

In our general references, information for decision makers is considered relevant by all sources [3, item 10.2; 4, item p.73 mainly; as well as 5, item 4.2] but the discussion is generic and vague. No practice is highlighted as being more efficient. In the “Best Practices in Road Safety”, however, several European initiatives are mentioned: improving accident data (correcting for underreporting or integrating to hospital data), obtaining exposure data (based on travel surveys), integrating data on offences (in general or for speeding, drink and drive and use of mobile phone), and collecting in-depth crash data. It is difficult to ascertain the final effect of these measures. From the judicious review of “The Handbook of Road Safety Measures”, one can grasp that none of these methods have proven results on safety.

Of course, better information has value for itself, warranting that the real situation is known and no opportunity for improvement is being lost. Also, good quality information would be useful to other activities, from traffic education and public campaigns to scientific research or public opinion. These alternative uses were not considered here.

Again, the U.K. practice was selected as representative of organized accident data dissemination of European countries, considering the STATS20 contributory factors system (from which the renaissance of in-depth studies is a step further). The ERSO initiative (European Road Safety Observatory) can also be taken as its supra-national counterpart. The publication of results on data collected was their considered content.

In Brazil, as an example, official statistics are available but confidence on its quality varies. Both general sources of data (DENATRAN and DATASUS) do not include relevant details on individual accidents (as detailed location of the accident, sequence of events involved, and so on) and have to be supplemented by data gathered by local agencies. No clear link from gathering data by police departments and provision of data to road safety agencies exists. Data are available at the internet sites of coordinating agencies but quality is poor and comparative studies are missing (perhaps because of the known problems in the quality of data or conflicts with providers of data). An independent source of data with better quality seems to be a basic requirement for building credible efforts on data dissemination.

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| **Measure:** Data Dissemination Activities, with Attention to VRUs |
| **Description:** comparison of safety performance/accident data made available to the public, with unification/integration of data sources |
| **Current Practice:** In Brazil, official statistics are available but confidence on its quality varies. The national information system of traffic authorities (DENATRAN) on road accidents is being revised and currently is taken as poor, being filled with data voluntarily provided by local agencies. The health authorities provide similar data. Both sources do not include relevant details on individual accidents (as location, events, and so on) and have to be supplemented by data gathered by local agencies. No clear link from gathering data by police departments and provision of data to road safety agencies exists. Data are available at the internet sites of coordinating agencies but quality is poor and comparative studies are missing (perhaps because of the known problems in the quality of data or conflicts with providers of data) ... |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* Currently, the DENATRAN has the initiative on accomplishing this role. However, data is a major constraint (availability and quality).The implementation of a data collection and processing system is a previous requirement. Use of indexes can condition the real concern with their production (e.g. revenue share). | *Regulatory:* The enforcement of responsibility in data collection and processing activities could be a major benefit. Right to access “public data” may improve knowledge and commitment. |
| *Technical:* Currently, data is a major constraint (availability and quality) for performance evaluation and dissemination. Improvement in data collection and processing is a previous requirement. Diversity of local situations could create difficulties for standardization of indexes. Public attitude to different safety problems can also vary. | *Technical:* Current resources could be initially used to collect and process records. DENATRAN seem to have the structure to the dissemination effort, once data availability and quality were gained. Data availability will ease data analysis and could improve knowledge of reality, decisions on interventions and accident monitoring. |
| *Economic:* May require the creation of a new administrative body (costs can be judged as high, given current societal commitment to traffic safety). Better data will be the major constraint. | *Economic:* The time devoted to data analysis will be reduced too. Can improve traffic safety and reduce traffic accidents in the long run. |
| *Behavioural:* Lack of knowledge of the real dimension of the traffic safety problem and features can reduce commitment. Better data will be the major constraint. | *Behavioural:* The sensibility of technicians to traffic safety problems can increase, as well as their understanding. The same for population. |

### Road Safety Funding (and the Role of the Insurance Industry)

This measure should consider the creation of a fund to warrant resources for national and local safety programs either at public or private levels. Its creation is justified by the view that benefits generated by resources applied in road safety pay for their value over the level recognized by the current mechanisms in a country, weighting their alternative uses. Tax instruments can also be seen as measures for correcting the user perceived costs of alternative transport modes (or even of transport by itself) for their externality effects (not only for safety but also for environmental or any other “unperceived” or “unweighted” effects).

Again, a general approach to the problem seems to be outside the scope of the SaferBraIn project. Matters relevant to local agencies will be prioritized.

#### Fund Raising for Road Safety (Road Safety Tax, Insurance Companies) to VRUs

The wider view on taxes for correcting externality effects is taken by “The Handbook of Road Safety Measures” in the discussion of the Motor Vehicle Taxation [3, item 10.9], that will not be pursued here. The view on these measures as revenue raising were present in the “ADB Road Safety Guidelines” and the “Best Practices in Road Safety”, both. The “ADB Road Safety Guidelines” asks for encouraging the participation of the private sector and for setting up a mandatory requirement for third party motor insurance or promoting motor vehicle insurance contribution to road safety through regulation [5, item 4.3]. The implementation ot these measures seem to be outside the scope of the SaferBraIn project.

The availability of funding schemes will be taken for further evaluation here. Perhaps, a deeper view would be required to a proper assessment.

As an example, Brazil have a national fund for traffic safety (including management and engineering) and education for traffic safety (FUNSET) with a share on resources generated from fines (5%, for education and/or engineering; the 95% remains with enforcement bodies, covering its expenses and having to be used in road management and safety). There is also a mandatory requirement for third party motor insurance that nowadays is operated under concession by a private insurance company (Seguradora Líder), for profit, but that also contribute to official resources (10%) to be applied in traffic education. Nevertheless, resources collected, while stamped to roads, are not directed to the national traffic authority or lower level agencies. Any change in this arrangement would require a major institutional effort. The associated work of road safety agencies and private insurance companies would be possible but clear initiatives in Brazil, as for Europe, were not identified.

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| **Measure:** Fund Raising for Road Safety (Road Safety Tax, Insurance Companies) to VRUs |
| **Description:** resources from A=vehicle or road taxes, B=mandatory and voluntary insurance, C=traffic fines, available for safety programs |
| **Current Practice:** In Brazil, road safety resources come from the general budget as a rule. There is a National Fund to Traffic Education and Engineering for Road Safety (FUNSET) that collects part of resources from fines generated by traffic offences and should apply them in road management and safety initiatives. There is a mandatory motor vehicle insurance system that under concession to a private insurance company (Seguradora Líder) that run it for profit but also contribute to funding (for traffic education). The participation of private insurance companies is rare. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are sources of revenue but no clear mechanism for controlling the provision and application of the binding resources. Some cities have Municipal Traffic Funds. Conflicts for road agencies against the general public administration as well as for the population against the road agencies and the government. | *Regulatory:* Several sources of revenue exist. The problem is to be able to warrant the provision and to control the application of revenues (not really simple without social commitment). Can be required to implement Traffic Safety and Education Programs. |
| *Technical:* There is no evaluation of effectiveness of the resources applied (there is some feeling on bad application of resources). Mechanisms for warranting better application of revenues are as important as those for warranting the availability of revenues. | *Technical:* There are resources, mainly for traffic education but also for traffic safety in general. Revenues would permit to maintain actions and educational campaigns, if applied. |
| *Economic:* The revenues can be insufficient in smaller cities. Better financial management of resources can increase the revenues (a specific fund will be required for that function). Mechanisms for controlling the provision and application of revenues will be needed. Other resources do not seem to be justified. | *Economic:* The control of revenues is the main need. Can warrant resources for Traffic Safety and Education Programs driven to real needs without further revenues (or burden on citizens). |
| *Behavioural:* The control of provision and application of revenues would have to be enforced. Technicians also are responsible for misuse of revenues. The control of revenues is the main need. | *Behavioural:* Can intensify the use of Traffic Safety and Education Programs as tools for traffic safety management (to managers and also to technicians). Can fund regular actions. |

## Safe Planning and Design of Roads

These measures are conceived as physical or control treatments applicable to each site, perhaps in interaction to other sites in the same corridor or area, on a project basis. The technical requirements of each measure have to be understood to warrant its proper use in response to road safety problems and the need of road users. For each measure, these features will have to be clearly identified to permit its proper evaluation. This is the task here.

The measures are classified in three groups, as in D2\_1, depending on the main user that constitutes its target beneficiary, as: pedestrian focused measures, cyclist focused measures, and motor vehicle focused measures that benefit VRU safety. However, the original list of measures in item 11 of D2\_1 was evaluated, revised and complemented to reach the final list of measures to be initially considered:

* + Pedestrian focused measures:
    - Sidewalks / Footpaths;
    - Pedestrian refuges / Footway build-outs or Kerb extensions;
    - Dropped kerbs / Tactile paving / Other facilities for VRUs with disabilities;
    - Zebra crossings / Other facilities for pedestrian priority without signals;
    - Pelican crossings / Other facilities for pedestrian priority with signals;
    - Puffin crossings / Other facilities with technology improvements for pedestrians;
    - School crossing patrols (or patrollers);
    - Footbridges / Underpasses;
    - Pedestrian barriers and guard-railing / Bollards;
    - Lifted pedestrian crossings / High visibility pedestrian crossings;
  + Cyclist focused measures:
    - Bikeways / Other exclusive facilities, segregated from motorized vehicles;
    - On-road cycle lane and cycle priority in arterial roads;
    - On-road cycle lanes/routes with cycle priority in non-arterial roads;
    - Shared foot and cycle ways;
    - Exceptions for cyclists / Other facilities for cyclist priority without signals;
    - Advanced Stop Lines (ASL) / Other facilities for cyclist priority at signals;
    - Toucan crossing / Facilities at crossings for cyclists and special users other than pedestrians; ;
    - Bike stands / Other facilities for parking bicycles;
  + Motor vehicle focused measures that benefit VRU safety:
    - Shared use of bus lanes/bus ways by motorcycles and/or bicycles;
    - Traffic Calming or Shared spaces / Shared roadways or Mixed priority roads;
    - Speed humps / Speed cushions / Other devices based on vertical deflection;
    - Speed tables / Raised or Lifted intersections;
    - Chicanes / Priority narrowing / Other devices based on horizontal deflection;
    - Vehicle activated sign (VAS);
    - Road lighting;
    - Safety (speed and red light) cameras / Other electronic enforcement devices.

For this large set of measures, practices of use and design are surely not uniform across Europe. To easy the evaluation, as long as available and representative, the guidelines adopted in the U.K. were taken as the case to evaluate. This decision was based on the leading role of the country in the traffic safety area as well as on the wide availability of knowledge about their practice. Nevertheless, this decision is not without pain. The U.K. practices are is some sense idiosyncratic and not fully applicable to continental Europe (and to most countries outside the heritage of the U.K.). Also, traffic ordinance in the U.K. is peculiar and poorly organized and consolidated, as related to the rules of the road. However, U.K. technical tradition is well-known and increasingly organized and accessible (as in the standards adopted by the DMRB, available at <http://www.standardsforhighways.co.uk/dmrb/>).

At least the following documents were felt to be relevant to some of the measures listed above:

* + Legal acts:
    - The Road Traffic Regulation Act of 1984 [9];
    - The Highway Act of 1980; The Road Traffic Act of 1988; and The Road Traffic Act of 1991;
    - The Road Traffic Offenders Act of 1988; and The Road Traffic Consequential Provisions Act of 1988;
    - The Cycle Track Act of 1984; The Traffic Calming Act of 1992; and the Traffic Management Act of 2000;
    - The Road Traffic Safety Act of 2006;
    - Subsequent changes and updates of these laws.
  + Statutory instruments:
    - The Traffic Signs Regulations and General Directions of 2002 [10]; Subsequent updates at 2004, 2005, 2006, 2008, at least;
    - The Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions of 1997 [11]; Subsequent complements, changes and updates related to pedestrians, cyclists and other VRUs;
    - The Traffic Signs Manual, updated [12];
    - The Highway Code, updated [13];
    - Statutory documents for local jurisdictions or regions (as the Great London Area).
  + Technical documents:
    - The Design Manual for Roads and Bridges (HA, HD, TA, TD, among other advices and requirements);
    - Technical documents of Department for Transport (as the Local Transport Notes and similar advices or requirements);
    - Technical documents of local agencies (as the Transport for London);
    - Technical documents for professional institutions (as the IHT´s Transport in the Urban Environment of 1997 [14] and similar ones).

Of course, review and analysis of this large knowledge base is outside the scope of the SaferBraIn project. However, due to the leading position of U.K. in the road safety area, most of the content from these documents are in the cursory knowledge of most professionals around the world. It is this cursory knowledge that will support most of the evaluations made here, except for critical points, which motivated a careful review of the original sources. The same complementary study was undertaken when the U.K. practice was dismissed and substituted by the practice of other country, taken as more representative or relevant. These points are exceptions that should be made clear in the following discussion. SaferBraIn partners were the main advisors of most comments based on other countries.

### Pedestrian Focused Measures

This category of measures considers those driven to benefit pedestrians. The general approach for the installation of these measures from U.K. practice was taken as documented in [15, 16], complementing the general regulations. For some measures, additional sources of information were considered and will be referred in the following discussion.

The set of measures considered was:

* + Sidewalks / Footpaths;
  + Pedestrian refuges / Footway build-outs or Kerb extensions;
  + Dropped kerbs / Tactile paving / Other facilities for VRUs with disabilities;
  + Zebra crossings / Other facilities for pedestrian priority without signals;
  + Pelican crossings / Other facilities for pedestrian priority with signals;
  + Puffin crossings / Other facilities with technology improvements for pedestrians;
  + School crossing patrols (or patrollers);
  + Footbridges / Underpasses;
  + Pedestrian barriers and guard-railing / Bollards;
  + Lifted pedestrian crossings / High visibility pedestrian crossings.

The potential effectiveness of most of these measures is recognized but only in particular settings where their application is appropriate. Also, some of these measures are peculiar to the U.K. practice and are not applied elsewhere (at least not as in the U.K., as Zebra and Pelican crossings). Some of the other measures seem to be under study (as high visibility pedestrian crossings) or validation (as Puffin crossings, not largely accepted outside the U.K.). Another group of measures were not proposed as safety improvements but as facilities for inclusive mobility (specifically for dropped kerbs, tactile paving and other facilities for road users with disabilities), even if having relevance for their safety as well.

Reviewing “The Handbook of Road Safety Measures”, these measures appear as Traffic Control or as Road Design and Road Equipment but considering coarser measures (e.g. channelization of junctions or traffic control for pedestrians) and without focus on VRUs. However, conclusions support sidewalks and footpaths, pedestrian signals, grade separation, guard-railing, school patrols, refuge isles, raised crossings but not marking alone.

#### Sidewalks / Footways

This group of measures consider the construction or improvement of facilities for the movement of pedestrians along the roads. The measure was not originally proposed by SaferBraIn partners but was suggested for inclusion during the calibration seminar. All the measures considered are traditional and well-know interventions.

The only exception could be the initiative to promote the concept of levelled or lifted sidewalks (meaning flat to pedestrians), requiring that vehicle entries to and exits from developments should be made flat to pedestrians, by inserting a buffer strip in sidewalk areas where vehicle ramps are built to reach the normal level of adjacent sidewalks. This requirement was adopted by municipal laws in some Brazilian cities, as São Paulo, but, nevertheless, its implementation is being too slow (if any).

In Brazil, as a rule, the quality of sidewalks is largely variable and dependent on political pressure from citizens (or their own efforts). In general, the quality is higher in more affluent areas, at least on commercial and residential areas but also along major roads. Exceptions, nevertheless, are frequent also in these areas. The provision of exclusive/segregated ways for pedestrians, including pedestrian streets and areas, are also well known and usual in larger cities, mostly in commercial centres. In any way, the public safety of pedestrians would be a major concern on the wider applicability of exclusive/segregated infrastructure.

The municipality has the power of regulating the requirements for sidewalks but have to engage into a politically costing activity of enforcement if committed to the obedience to municipal rules. However, the lack of standards for pedestrian spaces is usual too. It is a peculiar feature of many cities in Brazil, including São Paulo, that the public service has direct responsibility only for provision and maintenance of the road space. It is the private owner of each parcel that has the responsibility for the sidewalk in front of their parcel. The pressure of citizens can, nevertheless, create the opportunity for public provision.

No clear understanding about European practices, including the U.K. one, could be acquired. However, the higher standard of provision and maintenance of sideways is largely acknowledged. Upgrade the sidewalks in the cities of emerging economies to an European standard is clearly a relevant option and applies to footpaths/walkways as well (relevant for pedestrians safety but also for their comfort in general).

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| **Measure:** Sidewalks / Footways |
| **Description:** increase the use of facilities to easy pedestrian sidewalks along roads and walkways or footways off-roads |
| **Current Practice:** In Brazil, these measures are widely known but their application is limited. In some cities, as São Paulo, there is a legal requirement to build sidewalks flat to pedestrians but, at large, it is overlooked by developers (that usually have the responsibility for provision and maintenance of sidewalks). In general, the quality of sidewalks along main roads is better in affluent areas of the city and deficient in other areas. The situation along minor roads is even more varied. Exclusive/segregated ways (footpaths or walkways), including pedestrian streets or areas, are usual in commercial regions of the larger cities. The public safety would be a major concern on their wider applicability. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* Current law usually limits the responsibility of the public body to the carriage of motor vehicles and define the owner of land as responsible for the provision of sidewalks (the public body can enforce their responsibility at most). Action will be limited under this setting. | *Regulatory:* There are regulations on standards for sidewalks in several cities, including a national standard on provision for users with disabilities. Provision by public bodies or enforcement of land owners responsibilities would be options. Poor areas would be of concern. |
| *Technical:* Better standards for design are required as long as guidance on selecting appropriate floor. In some roads, great conflict between space for sidewalks and carriageway and the interference of entry/exit of vehicles, especially where road grade is steep, will occur. | *Technical:* May improve the walking experience and environment, warranting free accessibility to all pedestrians along the roads. |
| *Economic:* High cost when adapting existing sidewalks. Provision by the public bodies can bring funding problems (despite probable return through increased value of buildings). Maintenance cost can be high. Financing by increase in taxes also is a problem. | *Economic:* Low incremental cost when implemented in the initial development. Cost may be justified given everyday benefit to pedestrians, including the reduction in accidents in sidewalks. |
| *Behavioural:* The enforcement of land owners´ responsibility is a political problem. Benefits can be constrained by implementation difficulty. Sidewalks in bad conditions can disfavour walking as a travel option. | *Behavioural:* Sidewalks in good conditions can avoid pedestrians walking on streets. Quality of the walking environment can be a major benefit for local activities and local users. |

#### Pedestrian Refuges / Footway Build-outs or Kerb Extensions

This group of measures consider the construction of pedestrian refuges, footway build-outs or kerb extensions to assist pedestrians in crossing the roads. All these measures can be applied in junction or midblock crossings and are traditional and well-know interventions.

Pedestrian refuges provide a safe wait area for pedestrians crossing at complex sites but can also be used to reduce turning radius and vehicle speeds of turning vehicles in general (as in a typical layout in U.K. junctions). Pedestrian refuges are usually applied to roads with single carriageway (usually two-way roads) but can also be applied as turning islands at junctions (as in a layout for large intersections of high speed arterial roads typical of the U.S. style). Pedestrian refuges can also be used to build staggered crossing schemes. As such, pedestrian refuges are widely applied in the U.K. and around the world.

Additionally, footway build-outs or kerb extensions reduce the crossing distance in the road and increase visibility for both pedestrians and motorists, requiring appropriate drainage devices. Footway build-outs or kerb extensions are usually applied to roads where parking is permitted or for road narrowing as a speed reducing device at junctions. By this feature, despite widely known, its application around the world seems to be limited to minor arterials, distributor roads and special portions of streets in residential areas.

* *

On advocating the use of both measures, U.K. application and design practices seem to be similar to worldwide ones but the strongest appeal to its potential as a speed reducing device could be taken as peculiar. In the City of São Paulo, main arterials are more like to the U.S. style of avenues, being divided (dual carriageway roads). As a rule, parking is forbidden at least at peak periods. Applicability of build-outs or kerb extensions are then limited in the main arterial system. Pedestrian islands should be more widely applicable. Nevertheless, a significant proportion of minor arterials or distributor roads are two-way single carriageway streets where refuges and extensions are equally applicable but also rare.

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| **Measure:** Pedestrian Refuges / Footway Build-outs or Kerb Extensions |
| **Description:** increase the use of A=refuges and B=build-outs to easy pedestrian crossings in major/minor arterials, distributors or local roads |
| **Current Practice:** In Brazil, these measures are widely known but their application is limited. In larger cities, as São Paulo, main roads are usually dual carriageway roads with parking prohibited, with occasional opportunities for applying these measures; however, minor roads and residential streets also do not have such features, as a rule, despite its wide applicability. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* The requirements for design are not regulated. Responsibility for construction and maintenance has similar problems to those of sidewalks but is more demanding (e.g. drainage). | *Regulatory:* Better comfort and safety for pedestrians. On junctions, it is a self-enforced way to avoid irregular parking near the intersection (a commonly ignored legal requirement). |
| *Technical:* Bad use can transmit false sense of safety (technical requirements are missing). Refuges require good maintenance and signing. Build-outs can cause drainage problems. Both can generate traffic accidents. Build-outs would be effective only where parking is permitted or where the narrowing of the road can be acceptable. Refuges would require roads with parking or wide lanes to be accommodated without creating discomfort and danger to drivers. | *Technical:* Both are commonly used. There can be situations where refuges or build-outs can be made mandatory to reduce pedestrian exposure by reducing time and space needed for crossing. Also can reduce speed and increase driver attention to pedestrians. Have to be designed for VRUs with disabilities and can increase their mobility. |
| *Economic:* The cost of construction and maintenance can be a concern (especially the need for prompt maintenance in case of accidents or other problems, as drainage). | *Economic:* Cost should affordable in most situations (less than a full median). Easy to build and maintain (but need promptness). |
| *Behavioural:* Drivers are not used to find physical obstacle in the road (in Brazil, ghost islands and channelizing devices are more commonly used). It is an obstacle to vehicles. | *Behavioural:* Create a better environment for respectful behaviour of drivers and pedestrians. Favour crossing in the right place (if properly sited). Can reduce vehicle speed in an acceptable way to drivers. |

#### Dropped Kerbs / Tactile Paving / Other Facilities for VRUs with Disabilities

This group of measures consider the installation of dropped kerbs, tactile paving and other facilities for VRUs with disabilities. The approach from the U.K practices was supplemented by local guides [17, 18]. Attention to persons with disability seems to be largely integrated into the current U.K. road design guidelines [19].

These concerns are nowadays present in most countries (following the U.K.DDA of 1995 or the U.S.ADA of 1990). But the level of attention could vary. As example, in Brazil, the Law 10098/2000 (known as Law of Accessibility) lagged in adoption, being complemented only in 2004. Even now, its widespread application is limited to larger cities (as São Paulo).

Dropped kerbs allow wheelchair access to cross the road and facilitates crossing for pedestrians pushing trolleys and prams. The U.K. practice seems to be standard on this.

The tactile paving focuses especially on visually impaired people for providing detectable contrasts in surface texture. The U.K. practice is more comprehensive and could bring a relevant enhancement to most countries. In Brazil, as an example, the use of tactile pavement at road crossings are advised (there is a loose requirement, not clear on where it is mandatory, either for new or for existing roads) but application is limited to differentiate the point where the crossing begins and ends (perhaps guiding on the crossing extension too). Contrasting to this, the U.K. approach uses tactile treatments for intercepting and guiding the user with disability to the crossing site, perhaps supplemented by guard-railing as required.

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Other practices were identified in the U.K. practice. As an example, one can mention sound and tactile support for visual and hearing impaired persons embodied into traffic signals as well as the time extension of crossing times embodied into Puffin signals, in particular. These measures will be evaluated with traffic signal measures, in items ahead.

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| **Measure:** Dropped Kerbs / Tactile Paving / Other Facilities for VRUs with Disabilities |
| **Description:** increase the use of A=dropped kerbs and B=tactile paving for guiding VRUs with disability and easing the task of crossing roads |
| **Current Practice:** In Brazil, the accessibility law is newer and less widely observed. The situation varies among cities. In the City of São Paulo, dropped kerbs and tactile pavements are applied on most major junctions in the consolidated part of the road system. At least a clear approach to make it required for all junctions of major roads and a more comprehensive application of tactile pavements can considered as needed. |

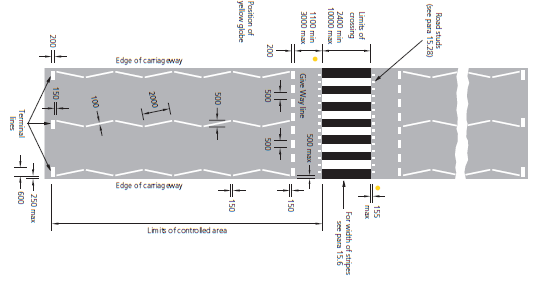
Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* Current guidelines (adopted in 2004) are not largely applied (perhaps known). Mandatory requirements are not clearly stated. | *Regulatory:* There are official guidelines (should be better promoted and enforce; could be improved in clarity). Both measures can be taken as effective for improving mobility of VRUs with disabilities. |
| *Technical:* There is a previous shortcoming in Brazil: quality of sidewalks and their maintenance. Attention to current guidelines has to be increased (promoted or enforced). Supplementary action of public bodies seem to be essential (in Brazil, provision in sidewalks are the responsibility of land owners). | *Technical:* There is no difficulty. Can increase the quality of sidewalks and help pedestrians in crossing. Main effect, of course, should be the increased mobility of VRUs with disabilities. |
| *Economic:* The costs can be a major concern, despite being affordable. There is the need to have better guidelines on where it is fully justified in economic grounds (given the benefit generated). | *Economic:* Costs will be a smaller concern when implemented in the initial development. Small maintenance costs (standard patterns can reduce maintenance costs even more). |
| *Behavioural:* Can be obstructed by other users, especially in mid blocks and in roads with commercial activities in sidewalks. | *Behavioural:* The improved quality of sidewalks for VRUs with and without disabilities can promote better behaviour. Channelizing effect can increase safety of VRUs with and without disabilities. Also favour pedestrians pushing prams and service vehicles. |

#### Zebra Crossings / Other Facilities for Pedestrian Priority without Signals

This group of measures consider the installation of zebra crossings [11], as well as other treatments that give priority to pedestrians in crossing the road without traffic signals (or perhaps enforcing their priority too). In the U.K., zebra crossings are taken as the standard approach to increase the priority of pedestrians in crossing the road without traffic signal, requiring vehicles to stop for any pedestrian wanting to cross the carriageway. It is signed by using yellow globes that highlight the crossing with flashing lights, transverse line markings in the path defined for pedestrians (the zebra pattern), a give-way line marking the position to stop and zig-zag lines marking the crossing controlled length (were overtaking, stopping, parking and some other activities are restrained). It is usually applied at midblock crossings but it can be applied at unsignalized junctions also.

It is typical of the U.K. traffic ordinance system and do not have similar appearance in continental Europe or other countries outside the U.K. heritage. There seems to be no clear standard that is internationally recommended and most countries do not have similar provisions. Then, the level of legal priority of pedestrians can not be clearly improved in these countries. Some related measures are similarly devoted to sign the increased priority of pedestrians at some site, without the use of traffic signals, in other countries. The use of transverse markings for signing pedestrian crossings is usual but their meaning vary.

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In Brazil, for example, crossings without traffic signals can be left unmarked or can be marked with parallel or transverse lines. With or without crossing markings, pedestrians have legal priority against turning vehicles. The interpretation in relation to priority against through vehicles is disputable (most would agree that pedestrians have priority wherever crossing markings are painted). However, observation of pedestrian priority is rare in all settings.

The traffic code of most countries do not make distinction between relative priority of pedestrian (against turning vehicles) and absolute priority (against through and turning vehicles) or even clearly state if general priority signs (e.g. stop and give-way signs) applies to pedestrians similarly as to vehicles. Site features usually require some compromise on the level of priority given to pedestrians, even without traffic signals, but no option seems to be available in most countries. The introduction of new rules of the road is a sensible question (much more in countries where rule of the roads and signing patterns are coded into legal acts, as in Brazil, instead of statutory instruments, as in the U.K.). Change in traffic ordinance and the measure effectiveness had to be considered in the evaluation here. Anyway, measures of this type probably will have to ask for experimental authorization, at least.

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| **Measure:** Zebra Crossings / Other Facilities for Pedestrian Priority without Signals |
| **Description:** use of signing to increase the priority of pedestrians in crossing the road, where there is no traffic signal |
| **Current Practice:** In Brazil, there is no clear option for signing an increased level of pedestrian priority in crossing the road, without traffic signals, that is widely effective. The Brazilian Traffic Code (CTB) is ambiguous about pedestrian priority. Even if agreeing on the interpretation of rules in the Brazilian Traffic Code (CTB), observation to legal rules would be a major problem. Anyway, this type of measure will have to ask experimental authorization. |

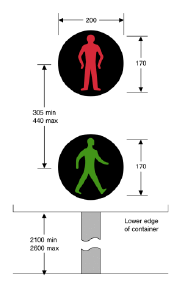
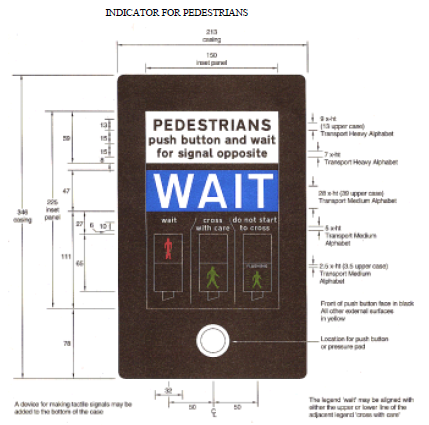
Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is no equivalent crossing type in the Brazilian Traffic Code (CTB). Zebra markings are generally used. Theoretically, pedestrians have absolute priority in all marked crossings without pedestrian signals (zebra or parallel) but reality is different. Experimental authorization, at least, will be needed for a similar sign. | *Regulatory:* An intermediate option between pedestrian signals and simple crossings is needed, that can enforce effective priority of pedestrians in crossings at junctions or mid blocks and eliminate the ambiguity in law and/or practice. May create an hierarchy of priority. |
| *Technical:* There will be a need to set standards and guidelines for use. Trial would require extreme parsimony and constant maintenance. | *Technical:* Difficulties in application are not technical. May replace crossings with pedestrian signals. May provide a crossing type with better conspicuity. |
| *Economic:* Higher cost compared to conventional marking without signals but seems to be affordable. Higher maintenance cost too. | *Economic:* Smaller cost compared to pedestrian signals, for installation and maintenance. May be more effective than conventional marking of pedestrian crossing in reducing accidents. |
| *Behavioural:* To increase the respect to pedestrian priority is a major problem in Brazil. Any effort will require a big effort in information and enforcement activities. | *Behavioural:* May increase respect to pedestrian priority by drivers and the confidence of pedestrians on marked crossings, if effective. |

#### Pelican Crossings / Other Traditional Facilities for Pedestrian Priority with Signals

This measure consider the installation of pelican crossings [10, 11], a signal controlled pedestrian crossing system (usually applied with pedestrian actuation of demand, using push buttons, and mainly at midblock crossings). It is largely similar to the international use of traffic signals for controlled pedestrian crossings, where the pedestrian signal heads are located on the opposite side of the crossing in the carriageway, displaying green and red lights to indicate when it is or it is not safe for pedestrians to cross the road. A clearance interval is also usually displayed as flashing green (as in the U.K.) or red (as in the U.S.) when the green stage is being finished and pedestrian crossings should not start (only crossings on the road should proceed). In the U.K, usually there is also a flashing yellow displayed to vehicles before their green stage (permits to proceed giving way to pedestrians).

The U.K. traffic signal ordinance is peculiar in which the pedestrians are not required to follow the indication (i.e. it is not a traffic offence to cross against the red, despite being advised not to cross, in the interest of safety [11, 13]). Otherwise, traditional signal indications are used. Recently, a new option of pedestrian indication was also permitted [10, 11], using additional messages to pedestrians displayed in the push button unit (in conjunct with push button devices messages) and located on the approach side as is the standard practice in Puffin installations (discussed ahead). The use of audible sounds and tactile devices embodied into push button units are also usual features.

The U.K. practice on the use of pelican crossing installations seems to be similar to the use of traffic signals with pedestrian demanded stages all around the world. In countries with high level of observation to pedestrian priority against turning vehicles, the use of this kind of installation is much smaller than will be required in countries with low observation. However, the use of traffic signals with pedestrian groups and actuated control seems to be reduced in the later countries. Actuated control of pedestrian phases is less important when pedestrian demand is heavy (the rule in larger cities of emerging economies) and less convenient when the road system is hugely congested (also the rule in larger cities). In some sites, these features justify the decision for disactivating pedestrian demand units in peak hours or adopting a very disfavourable treatment to pedestrian actuation parameters. Both practices contribute to the distrust and disobedience of pedestrians on demand actuated signal control. The recent innovations on push button units could remedy some of these shortcomings. The use of flashing yellow at the end of red for vehicles would probably need experimental authorization. The main drawback, however, seem to be that pedestrian crossings in arterial roads (its main place) usually occur at junctions and are handle by fixed time installations.

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| **Measure:** Pelican Crossings / Other Traditional Facilities for Pedestrian Priority with Signals |
| **Description:** increase the use of pedestrian actuated traffic signal, with improved practices of application |
| **Current Practice:** In Brazil, pedestrian actuated signal control is a traditional option. However, its application is reduced by the high level of pedestrian demand and road congestion. Practices as the disactivation of pedestrian actuation on peak hours and disfavourable treatment to pedestrian actuation parameters contribute to the distrust of pedestrians on such kind of traffic signal control. The main drawback to its use, however, is that pedestrian crossings are a major problem in arterial, where fixed-time signal installations are the usual option. The use of flashing yellow at the end of red for vehicles would probably have to ask for experimental authorization. |

Potential for Transferability:

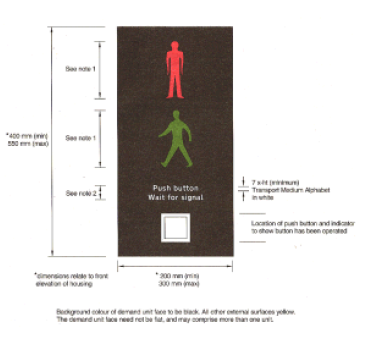
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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are differences compared to the regulation in the Brazilian Traffic Code, despite similarities. Experimental authorization, at least, will be needed for a similar signal (specifically for the flashing yellow at the end of vehicle red). | *Regulatory:* The similarity with the form used in the Brazilian Traffic Code could easy the implementation, if approved. May increase the confidence on pedestrian signals. |
| *Technical:* The timing of pedestrian and intergreen time is complex and should be tailored to local behaviour. Guidelines for installation and timing would be required, if approved. Signals for pedestrians are not priority in Brazil and are dismissed even by pedestrians. May require electronic enforcement in Brazil. | *Technical:* Pedestrian signals are usual in Brazil, at junctions or mid block crossings. Improvements in timing (the flashing yellow) and panels (the pedestrian indicators) may be relevant, increasing confidence in pedestrian signals and reducing unused times. Perhaps, alternative improvements could be made even with conventional pedestrian signals. |
| *Economic:* Cost will be higher than the conventional form (also taken as higher for a pedestrian crossing, compared to simple marking), both for installation and maintenance, if approved. | *Economic:* The added cost can be small. Benefit for pedestrians and vehicles, if approved and effective. |
| *Behavioural:* Currently, pedestrian signals are not fully obeyed (by pedestrians and by vehicles), perhaps due to poor practice in timing and to lack of enforcement. These alternatives for improvement could be easy to implement. New panels can be subjected to vandalism. New messages could require information campaigns, if approved. | *Behavioural:* The use of pedestrian signals could increase, if effective in commanding respect by pedestrians and vehicles and improving traffic operation for both. May be accepted, if approved. |

#### Puffin Crossings / Other Facilities with Technology Improvements for Pedestrians

This group of measures consider the installation of Puffin crossings (Pedestrian User-Friendly Intelligent Crossings), a new system aiming to replace the Pelican crossings (mainly at midblock crossings as well), where improved technology is applied for sensing pedestrian presence and extending pedestrian time to cross [10, 11, 16, 20].

Similar systems were being proposed in continental Europe. Pedestrians are monitored by new detection systems. Technology varies between manufacturers and applications, including bush button units, piezoelectric (pressure mats), microwave or infrared detection of pedestrians on sidewalks (waiting to cross) and microwave or video detection of pedestrians on crosswalks (crossing the road). Detection is used to confirm pedestrian actuation (excluding demands of pedestrians that cross before the pedestrian stage) and to adapt the duration of pedestrian timing to the need of pedestrians at the crossing.

The application of the technique in the U.K. was also combined with changes to pedestrian signal displays and their location. In the case of Puffin crossing, pedestrian signal heads are positioned in the approach side of the crossing, located on the same side as the pedestrians intending to cross, positioned laterally in a way that make the pedestrians face vehicles and displays in the same view. Pedestrians do not see their signal heads after starting to cross the road. They should wait for the green light, showing when it is safe to cross. After start crossing, detectors control the signal displays so that pedestrians have time to cross safely. Improved push button units display messages to pedestrians. At the end of the pedestrian stage, the signal displays red (no flashing interval is used). The use of audible sounds and tactile devices embodied into push button units are also usual features.

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Similar technologies were tested in several other countries (e.g. the Pussycat system in the Netherlands). Nevertheless, the Puffin crossing seems to be settled as the main option for pedestrian friendly crossing technologies and it is being integrated to real time signal control systems from British make, based on SCOOT (the dominant vein in the world). Despite the huge effort on its development, experience on using Puffin outside the U.K. is limited. Even in the U.K., it is progressing yet. A recent report on its use in London [21] reached mixed results and recommended additional study. So its transferability potential should be evaluated with great care. No similar technology is being used in Brazil. Perhaps components could be of interest (sidewalk detection or crossing detection) by itself. Otherwise, it will probably need an experimental authorization.

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| **Measure:** Puffin Crossings / Other Facilities with Technology Improvements for Pedestrians |
| **Description:** introduce the use of pedestrian friendly traffic signal display and control |
| **Current Practice:** In Brazil, no similar technology is in use. Perhaps it should be taken as an experimental system. Perhaps components could be of interest (sidewalk detection or crossing detection) by itself. Otherwise, it probably will need experimental authorization. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is no equivalent signal type in the Brazilian Traffic Code (CTB). Experimental authorization, at least, will be needed for a similar signal. Perhaps, it should be preceded by controlled trials outside actual roads (it is felt as a major change). | *Regulatory:* The approval of a new option could be beneficial. |
| *Technical:* Perhaps traffic controllers and timing practices will have to be changed. Imported hardware and software will be a major disadvantage. Tests are needed to prove the detection effectiveness at sidewalks and crossings, including hardware failures. Behaviour differences could command peculiar practices in Brazil. Blind crossing could be a concern for pedestrians in Brazil. | *Technical:* The approval of a modern option could be beneficial. Better vision of crossing traffic from new signal position can be an advantage. May reduce unused times and warrant pedestrian needs. May reduce red time to vehicles (reducing delay to drivers too). May increase pedestrian safety. |
| *Economic:* No information of cost but could be prohibitive. Detectors could be another source of problems. Maintenance too. | *Economic:* Maybe the better performance can be translated into lower delays and fuel consumption. Perhaps also lower accident rates. |
| *Behavioural:* The blind crossing may be a major discomfort to pedestrians. Informational campaigns may be required at large. | *Behavioural:* The respect to pedestrian signal can increase, if effective. The confidence of pedestrians in pedestrian signal can increase, if effective. |

#### School Crossing Patrols (or Patrollers)

This group of measures consider the use of school crossing patrollers [9] to assist children crossing the road on routes to school, either where there is a crossing (Zebra, Pelican or any other type), even where there is not a crossing, previously, or would not be possible to install a crossing anyway.

In the U.K., local authorities can appoint persons other than constables (policemen) to act in assisting children to cross the road at designated places and times used in the route to or from schools, providing the required training as their duty. Drivers are required to stop their vehicle when the patroller exhibits a prescribed sign. Children are required to start crossing only after the patroller is on the road for stopping vehicles. Patrollers are required to wear an approved uniform, exhibit a prescribed sign to stop vehicles and follow the crossing protocol as for The School Crossing Patrol Sign Regulations of 2002 (in accordance to European Directives 98/34/EC and 98/48/EC). Usually patrollers work voluntarily and have to take care of their uniform and signs. Fines against offences to the patroller command are very high in the U.K. (around £1000) but obedience to and the safety of patrollers is a major concern too.

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Similar arrangements to school crossing patrols are not widespread around the world. In Brazil, as an example, there is no provision for appointing patrollers other than agents of road authorities or policemen to assist in any crossing (even school crossings). However, unofficial crossing patrollers can be found eventually as informal aids to pedestrians wanting to cross busied roads (sometimes hired by local schools, stores and other private agents).

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| **Measure:** School Crossing Patrols (or Patrollers) |
| **Description:** appointment and training of school patrollers by local authorities |
| **Current Practice:** In Brazil, there is no legal provision for patrollers appointed by local authorities other than agents of road authorities or the police that have enforcement power. Informal patrollers are usually used, hired by private companies. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is no provision to official school crossing patrollers (or other types) in the Brazilian Traffic Code. There is no requirement to obey the unofficial patroller. There would be a need to clarify responsibilities of road agencies and the enforcement power. | *Regulatory:* There are unofficial patrollers in Brazil. Regulation could easy the task of providing such support to pedestrians at crossings, with low cost to road agencies, if approved. The enforcement power is seem as essential for warranting effectiveness, if approved. |
| *Technical:* Procedures for training and accreditation of patrollers would have to be defined by road agencies. Criteria for deciding where and how it can be applied would also have to be defined. | *Technical:* The possibility of using patrollers only when needed (in periods with high vehicle and pedestrian flows) is an advantage. Will be complementary to traffic signs or signals. |
| *Economic:* Resources for training and accreditation of patrollers would have to be provided by road agencies. Hiring from private companies may be required to reduce turnover rates of patrollers (reducing training and accreditation costs to road agencies, as well). Cost of enforcement, if traffic agents would be required for it. | *Economic:* Low cost. Social gain from community involvement. Can use employees from private companies as part-time patrollers. Gain in safety to children and other road users, if effective. |
| *Behavioural:* The actions of patrollers can be a source of problems to road agencies. Traffic agents would have more respect. | *Behavioural:* The presence of patrollers (even unofficial) improves pedestrian and driver behaviour and has an educational role. Strengthen the relation between road agencies and communities and increase (the perception of) the presence of road authorities. |

#### Footbridges / Underpasses

This group of measures consider the installation of footbridges and underpasses as grade-separated crossings to allow pedestrians and cyclists to cross major roads safely, especially when the carriageway consists of several lanes in each direction carrying heavy and fast traffic flows, or anywhere when installing level crossing facilities would create massive traffic flow problems and can be ineffective in alleviating road safety problems to pedestrians and other non-motorized users demanding to cross. The general approach from U.K. practices was taken from [19, 22, 23].

The use of footbridges and underpasses is traditional and their application to hard crossing settings is widely supported worldwide. However, the need for providing facilities to cross highways and major urban arterials (also rural and urban motorways, where crossing flows are attracted by some reason or other) is frequently overlooked. The high cost of footbridges and underpasses make the decisions on where to build them a sensible one (even accepting their need, the decision on how many facilities should be spaced along the road is present).

The review of U.K. guidelines reveals a modern approach to planning footbridges and underpasses, devising criteria for satisfying the needs of pedestrians (including those with disabilities) and other non-motorized users as cyclists (and even equestrians). The focus on high standards for footbridges and underpasses as offering a better infrastructure to every non-motorized user and promoting sustainable transport modes is also clear.

Guidelines to accept at-grade crossings are AADT under 8000 and never over 12000 for single carriageway roads, under 16000 and never over 25000 for dual carriageway roads and never over 10000 for wide single carriageway roads [19]. In intermediate situations, acceptance have to consider site specific factors that easy crossing (e.g. an upstream signal), type of crossing demand (user, purpose, etc …), overall diversion and delay to non-motorized users, implications of grade-separated crossing (e.g. environmental impact), and mitigation measures for “informal” at grade crossings (e.g. speed activated signs). Otherwise, footbridges or underpasses would be natural candidates.

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However, no clear information is available on the application of these recent guidelines (stringent ones) and no guideline was found on the decision on how frequently to use grade-separated crossings. This weakness, among others, is a common missing point in the guidelines of several countries. In Brazil, as an example, footbridges (in larger degree) and underpasses (in smaller degree) is increasingly seen as an essential measures to cater with pedestrian needs of crossing high speed and high flow roads, mainly in urban areas. Design criteria are less developed both for requirement and frequency of grade-separated crossing, resulting in the lack of clear advice on its justification along the roads.

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| **Measure:** Footbridges / Underpasses |
| **Description:** increase the use and the standard of footbridges and underpasses, providing for pedestrians with disabilities and cyclists |
| **Current Practice:** In Brazil, footbridges (usually) and underpasses (less frequently) are widely accepted as needed to provide crossing facilities in high speed and high flow roads, especially in urban areas. Nevertheless, their costs undermine the possibility of application at large and ask for better criteria in defining where to use and how frequently use them. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is no official set of guidelines on the use and design of footbridges and underpasses. There is no enforcement power against pedestrians that do not use the facilities. | *Regulatory:* There are guidelines for the use and design from some road agencies. Better guidelines could be prepared. |
| *Technical:* The technical consensus on the decision about at grade and segregated crossings for pedestrians and cyclists must be discussed. Can benefit drivers more than VRUs. There are concerns related to public safety of users. Space may be a constraint. Difficulties in sitting ramps, at least in urban areas. Must be an attractive option to pedestrians and cyclists, to be effectively used. | *Technical:* If effective in attracting pedestrians (and cyclists), it is very effective to their safety and also to traffic flow. |
| *Economic:* High cost, especially for underpasses in urban areas (interference with underground public service infrastructure). Higher costs with provision to cyclists and VRUs with disabilities. | *Economic:* The Benefit / Cost ratio can be adequate, if properly applied and designed (where it is used). |
| *Behavioural:* In Brazil, a large proportion of users will reject the segregated option if there are even risky crossing conditions at grade. Reduce physical effort and warrant public safety are essentials for getting the required level of use. | *Behavioural:* The use of the segregated option is adequate for a properly designed infrastructure, especially by children and women. Effective for reducing severance and integrating the space surrounding the road. |

#### Pedestrian Barriers and Guard-railing / Bollards

This group of measures consider the installation of devices intending to segregate pedestrians, mainly from motorized vehicles, either for reducing its interference to road traffic and conducting them to safer parts of the road or for protecting their space (mainly sidewalks) from the invasion of motor vehicles by parking or running manoeuvres (including vehicles loosing control in accidents). The general approach from U.K. practices was taken in [24, 25] for guard-railing and [26, 27] for protecting devices.

Despite proven to be effective as channelizing device, pedestrian guard-railing is being increasingly criticized by obstructing pedestrian paths and the streetscape. The application in places where the high pedestrian flow can invade the road space or where it is needed to conduct pedestrians to safer crossings sites is undisputed. Nevertheless, the widespread use of guard-railing and their substitution by other measures that made them less needed (as traffic calming measures to reduce motor vehicle speeds and promote a shared use of road) is being scrutinized. The qualitative recommendation is clear: to use pedestrian guard-railing where really needed. Nevertheless, objective criteria seem to be in discussion now.

The use of protective devices for pedestrians can be a related need and can be also an alternative to the use of guard-railing. Bollards are the usual method but other protective devices could be used. When possible and if the intended use is to avoid invasion of pedestrian areas, the recommendation is to substitute guard-railing by other types of segregating devices. Protective devices should be preferred when there is a need to contain motorized vehicles in regular traffic or losing control in traffic accidents and are classified as vehicle or pedestrian restraint systems. There is a large set of options for protective devices and a strong effort for standardization in Europe (covered by EN 1317), mainly based on certification of alternative systems (most of them proprietary systems patented by their developer, not easily accessible to road builders). No clear criteria for justifying and selecting pedestrian protective devices were found.



It seems that U.K. practice is not really distinct from the international one, despite the much larger application found there. In Brazil, the use of pedestrian guard-railing is well-known but constraints come from its interference with land use access and its cost. The use of protective devices for pedestrians is less usual and there is no criteria accepted for its application. Nevertheless, dependence on proprietary systems could be a problem in Brazil (for availability and cost) in promoting its adoption.

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| **Measure:** Pedestrian Barriers and Guard-railing / Bollards |
| **Description:** increase the use of pedestrian guard-railing and of pedestrian protective devices |
| **Current Practice:** In Brazil, guard-railing is well-known and usually applied when the application does not interfere with land use access and its cost is felt as justified. The use of pedestrian protective devices is less usual. There are no criteria accepted for justifying its application. |

Potential for Transferability:

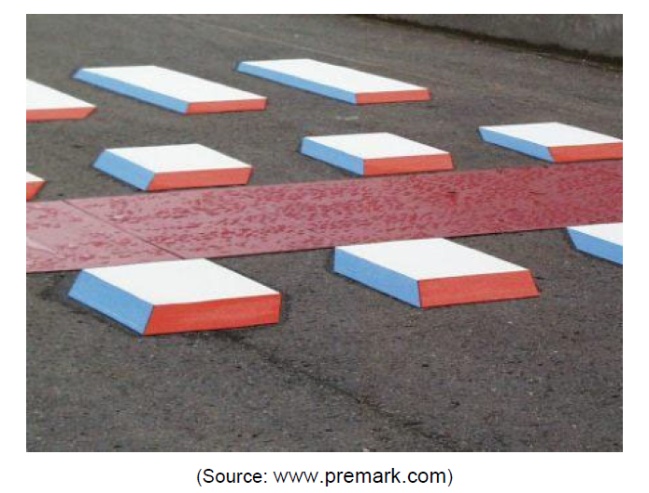
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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is no official set of guidelines on the use and design of pedestrian barriers and, especially, defences (protective devices for pedestrians are not considered in the Brazilian Traffic Code). | *Regulatory:* The pedestrian barriers (guard-railing) is considered in the Brazilian Traffic Code (no additional guideline on its use is available). In general, can be considered as a self-enforced channelizing device for pedestrians that also avoid irregular parking by vehicles. |
| *Technical:* Both are detrimental to the streetscape and reduce pedestrian mobility. May be a hazard to pedestrians. Lack of clear guidelines for use can generate misuse by designers. Need of guidelines to avoid but accommodate misuse by pedestrians. | *Technical:* Pedestrian barriers are usual as channelizing devices and are effective (despite the need to accommodate some degree of misuse by pedestrians). Effective to avoid irregular parking as well. Bollards could be effective as protective devices as well. |
| *Economic:* Installation and maintenance costs may be high if extensively applied. Detrimental effect in the streetscape can also be a concern. | *Economic:* The Benefit / Cost ratio can be adequate, if properly applied and designed. The installation and maintenance cost can be low if applied with parsimony. |
| *Behavioural:* Disobedience by pedestrians should be considered. It is a physical and psychological barrier to pedestrians. | *Behavioural:* Pedestrian barriers are usually effective in channelizing pedestrian devices in Brazil. Bollards or other protective devices are less used. Contribute to organization of pedestrian flows and to the traffic safety of pedestrians, if properly used. |

#### Lifted Pedestrian Crossings / High Visibility Pedestrian Crossings

This group of measures consider special treatments to increase the level of awareness or perception of crossing sites and the observation of priority for pedestrians and other non-motorized users demanding to cross the road.

Lifted pedestrian crossings are a conventional proposal, at least among traffic calming treatments. The general approach was taken from the U.K. practices [15, 28], that treat them as flat-top speed humps (the use as pedestrian crossing is taken as their major advantage). However, the measure does not seem to be widely used in the U.K., even in residential areas or supporting zebra crossings [11, 15]. Speed tables, per se, or lifted intersections, a more radical treatment, uses the same approach but will be discussed in the items ahead.

High visibility crossings seem to be a newer measure. No general approach to this kind of treatment in the U.K. was identified. The measure seems to be developed in Australia and the Netherlands. No clear information of their effectiveness was found.

Several countries have guidelines for design and use of lifted pedestrian crossings that seem to be similar. Accessibility policies also promote this kind of treatment as it can easy the task of crossing for pedestrians with disabilities.

In Brazil, as an example, the measure is advised in accessibility guidelines but with very stringent recommendations. The use in Brazil is also rare and restricted to roads with very small vehicle flows. In the City of São Paulo, there is a legal requirement for a related feature: entries and exits to buildings have to be lifted to the normal level of sidewalks. This obligation is usually overlooked but can contribute significantly to the quality of sidewalks and of walking courses of pedestrians along on urban roads.

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| **Measure:** Lifted Pedestrian Crossings / High Visibility Pedestrian Crossings |
| **Description:** increase the use of lifted pedestrian crossings to promote pedestrians, especially those with disabilities |
| **Current Practice:** In Brazil, lifted pedestrian crossings are recommended by accessibility guidelines as an option to provide for pedestrians with disabilities, but under very stringent criteria (recommended where pedestrian flows are over 500 p/h and vehicle flows are under 100v/h). It remains a measure with rare application. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is a need for better regulation of its use and design. It was introduced by accessibility guidelines but not considered in road design and traffic control guidelines. | *Regulatory:* The use of raised pedestrian crossings is regulated by accessibility guidelines. |
| *Technical:* The technical details have to be developed, especially for drainage. | *Technical:* Increase the respect to pedestrian priority and the comfort in pedestrian crossing. It is effective as speed reducing device also. |
| *Economic:* Cost of installation is medium. However, problems generated by improper design are worse (e.g. drainage problems). | *Economic:* The Benefit / Cost ratio may be adequate when properly applied and designed. Low maintenance cost. |
| *Behavioural:* The use is rare. Drivers are not used to their use. May generate a false perception of priority, if not enforced. Delay for drivers (with or without pedestrians). | *Behavioural:* The respect to pedestrian priority seems to be higher. Favour pedestrian crossings at the high place, if properly applied. Increase the perception of pedestrian crossings. |

### Pedal Cycle Focused Measures

This category of measures considers those driven to benefit cyclists. The general approach was, again, taken from the U.K. practices [19, 29], especially in London [30], complementing the general regulations. For some measures, additional sources of information were considered and will be referred in the following discussion. In the U.K., bus lanes would also be a conventional option to accommodate cyclists but this provision will be discussed in the next section (considering also the option of providing them for the use of motorcyclists).

The set of measures considered was:

* + Bikeways / Other exclusive facilities, segregated from motorized vehicles;
  + On-road cycle lanes and cycle priority in arterial roads;
  + On-road cycle lanes/routes with cycle priority in non-arterial roads;
  + Shared foot and cycle ways;
  + Exceptions for cyclists / Other facilities for cyclist priority without signals;
  + Advanced Stop Lines (ASLs) / Other facilities for cyclist priority at signals;
  + Toucan crossing / Other facilities at crossings for cyclists and special users other than pedestrians;
  + Bike stands / Other facilities for parking bicycles.

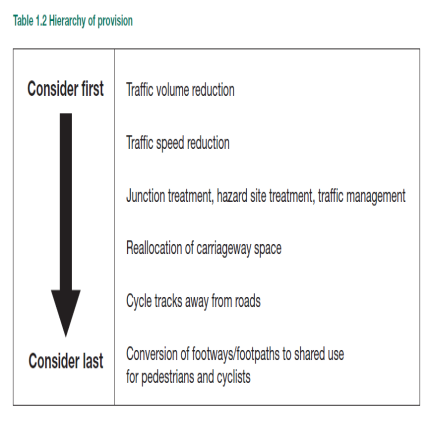
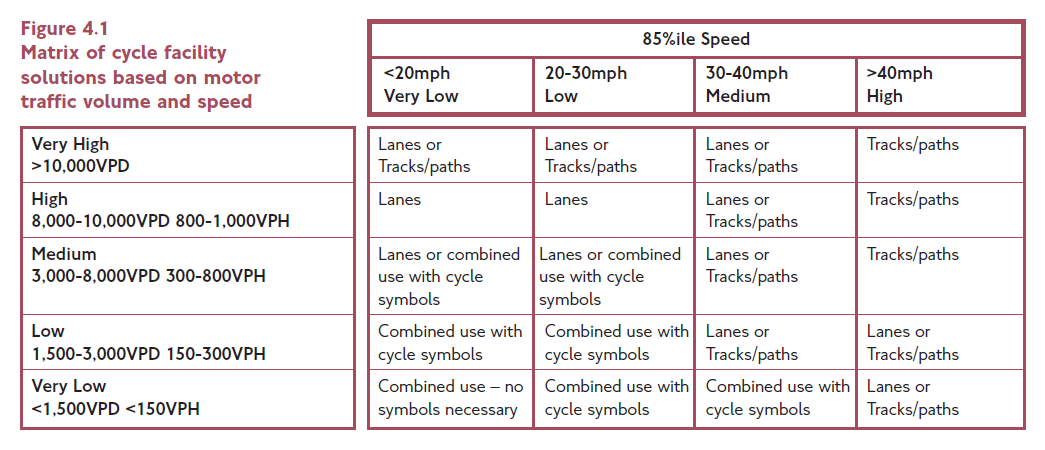
The potential effectiveness of most of these measures is not known. In general, these measures are not proposed as safety improvements but as facilities for inclusive mobility, in development of infrastructure for cyclists. Of course, the concern with safety is built into the proposals for the new infrastructure but much has to be learned about its safety performance in different settings. And again some of these measures are peculiar to the U.K. practice and are not applied elsewhere (at least not as in the U.K., as Toucan and Pegasus crossings).

Reviewing “The Handbook of Road Safety Measures”, these measures also appear as Road Design and Road Equipment or as Traffic Control. The treatment is even coarser and was reduced to one measure: cycle lanes and tracks (few results on effects of traffic control on cyclist accidents are also dispersed on the discussion other measures). Conclusions are supportive but call attention to road junctions as potential safety problems. However, the number of studies is usually small and their methodology is not free of weak points (as not controlling for the number of cyclists before and after the measure or not compensating for the regression to the mean effect). So results should be taken with care.

#### Bikeways / Other Exclusive Facilities, Segregated from Motorized Vehicles

This group of measures consider the provision of off-road cycling infrastructure that is exclusive for cyclists and segregated from motor vehicle traffic, named as bikeways.

The main character of U.K. approach was found in the effort to define standards that have wide applicability and can easy the task of providing infrastructure to cycling on a large part of the road network. First, the discussion about the use of bikeways/cycle-ways/cycle-tracks (i.e. off-road facilities exclusively open to bicycles) was summarized in the concept of hierarchy of provision (where cycle-tracks and shared paths (i.e segregated facilities) are the last options) and in a clear criteria for identifying levels of vehicle flow and speed where some treatment to provide for cyclists is needed (including the identification of roads that are appropriate for cyclists and those where cyclists would not feel safe and comfortable while sharing the roads with motor vehicles). This view was translated into the matrix of cycle facility solutions and some complementary criteria (e.g. the presence of heavy vehicles). Second, the discussion about the design criteria to be applied for links and junctions along the bikeways is detailed, in almost conventional terms, based on qualitative guidelines, including treatments for junctions with normal roads and pedestrian flows.

These criteria were not clearly justified. Similar criteria are used in other countries (e.g. the Netherlands and Australia). The applicability of these criteria, particularly to emerging economies, should be carefully discussed. For example, the criteria are definite only for slow speed (under 30 mph), a situation rarely found in arterial roads, and high speed (over 40 mph). Cycle-tracks are mentioned as a definitive option for speeds of 40 mph or more, a conventional value in arterial roads. These criteria would mean that bikeways/cycle-tracks would be an option to the inadequate provision for cyclists in most arterials (unacceptable for speeds of 40mph or higher, except if cycle lane width could be wider than 1,5m, or 2,0m if overtaking in the cycle lane is to be accommodated). In support of the U.K. approach, at least as applied to London, it is the impressive result of increased use of bicycles in daily trips is a safe way (as long as demonstrated by not increasing their traffic accidents).

In Brazil, as an example, both points are not settled: if such arterials would be inadequate options; if bikeways/cycle-tracks would be the advised alternative option and what level they will have in the hierarchy of provision when compared to shared footway/cycleway option or to provision in non-arterial roads.

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| **Measure:** Bikeways / Other Exclusive Facilities, Segregated from Motorized Vehicles |
| **Description:** implementation of cycle tracks where the option is the provision on high speed and heavy flow roads |
| **Current Practice:** In Brazil, cycle tracks are rarely provided, as it is the case for cycle infrastructure in general. For long distance trips, arterials would be the main option. For short distance trips, local and collector roads would also be options, as well as the irregular use of sidewalks. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific guidelines for selecting or designing cycle-tracks in Brazil, other than general traffic signing guides. Lack of enforcement means for controlling cyclists is also felt. | *Regulatory:* There is general guidance on signs and markings for cyclists, including cycle-tracks with exclusive or shared use. As a rule, bicycles are treated as usual vehicles in the Brazilian Traffic Code, except for the permission to ride on shoulders. In high speed roads without shoulders, minimum speed would preclude their use by bikes. |
| *Technical:* The usual option will be the provision of cycle-tracks along arterials (taking the space of sidewalks or traffic lanes). Then, space constraints should be binding. There is some resistance among technicians on taking space from pedestrians or vehicles. Lack of planning for bicycle infrastructure can be a major shortcoming. | *Technical:* The criteria for segregation seem to be appropriate and applicable to Brazil. The provision of segregate facilities can be a major incentive to the bicycle as a transport mode. The signing and marking of segregated tracks is also easier than other options. |
| *Economic:* The cost of segregated tracks is high (or very high). Options with smaller cost would have to be proposed to avoid restraining the “solution” to a small number of roads. | *Economic:* The improvement in the urban environment should be considered. Benefits to public health from increased use of bicycle too, as well as the potential decrease in congestion, fuel consumption, air pollution and other disbenefits of motorized traffic. |
| *Behavioural:* The possibility of a significant proportion of cyclists preferring the use of the arterials should be considered. Resistance of drivers in losing road space. Risk of accidents with pedestrians. | *Behavioural:* It is the easiest infrastructure for the general population of potential users. May be a major incentive for cycling. |

#### On–road Cycle Lane and Cycle Priority in Arterial Roads

This group of measures consider the provision of dedicated infrastructure for cycling on the road as conventionally applied to arterial roads (i.e. along stretches of wide roads where intersections are spaced and signalized or streets have to give way to the treated road).

Again, the main character of U.K. approach was found in the effort to define standards that have wide applicability and can easy the task of providing infrastructure to cycling on a large part of the road network, as previously discussed. As a general rule, the use of cycle lanes is suggested for roads with speeds under 40 mph and flows under 10.000 vehicles/day. These features would not be usually present in most structural roads of high design standards. The discussion about how to accommodate cycle lanes in roads with constrained cross-sections was settled in the U.K. by the option of implementing mandatory or advisory cycle lanes and in the definition of criteria for selecting the best option (mainly based on road width).

In mandatory cycle lanes, cyclists have the full right to their exclusive use (other vehicles will commit an offence if riding on it). In advisory cycle lanes, cyclists do not have clear priority and should be aware of the need of other vehicles crossing the lane marking for completing some of their manoeuvres (usually due to a road with insufficient width for accommodating all lanes). Nevertheless, liability for accidents could blame drivers for running into them. Also, advisory cycle lanes are used in other situations where some manoeuvres have to cross cycle lanes (as the approach of secondary roads in junctions or when merging or weaving with turning vehicles or buses around their stops). By the U.K. traffic regulation, the use of advisory cycle lanes also has the advantage of not requiring a Traffic Regulation Order to approve them. Mandatory lanes are signed by using continuous lines while advisory lanes are signed by using broken lines, both for with-flow or contra-flow lanes. The use of cycle symbols is required and the application of coloured surfaces is permitted. The treatment of bus stops is another concern for the safety of cyclists (but much smaller than elsewhere).

Despite being peculiar to U.K. signing conventions to cycle lanes, the usual meaning of continuous and broken lines could bring the possibility of applying similar concepts in other countries. But perhaps experimental authorization will be required for the marking or related signing. The remaining question would be that of safety, mainly in roads where approach widths are restrained (those that would justify the use of advisory lanes). Reviewing the U.K. practices, mainly those applied for London [30], mandatory lanes would require 4,5m on the nearside lane to be able to accommodate bicycles and heavy vehicles while advisory lanes are recommended for widths from 3,5m, if flows are up to 5.000 vehicles/day and speed limits are 30 mph or lower (both should be increased by 1,8m if parking and loading is permitted). Additional protection to cycle lanes could be justified too (hatched road markings, intermittent traffic islands, reflective road-studs, raised rib markings [30]).

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| **Measure:** On–road Cycle Lane and Cycle Priority in Arterial Roads |
| **Description:** implement mandatory/advisory cycle lanes for roads with speeds under 40mph and flows under 10000 vehicles/day |
| **Current Practice:** In Brazil, cycle lanes are rarely provided, as it is the case for cycle infrastructure in general. Traffic conditions in arterial roads would not fit U.K. criteria in most cases. For remaining cases, space constrains would probably justify advisory lanes, as a rule, under the proposed criteria. The safety impact of provision in these settings could be adverse to cyclists. |

Potential for Transferability:

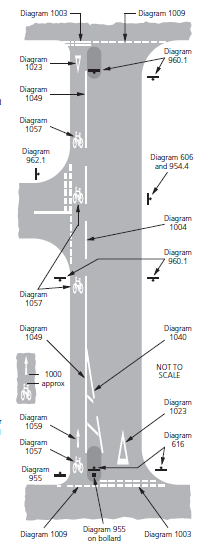
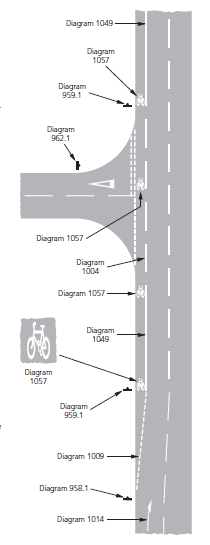
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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific guidelines for selecting or designing cycle-lanes in Brazil, other than general traffic signing guides. Lack of enforcement means for controlling cyclists is also felt. The concept of mandatory and advisory cycle lanes is not officially adopted. Perhaps traffic ordinance for advisory lanes should be more restrictive in Brazil to effectively protect cyclists. | *Regulatory:* There is general guidance on signs and markings for cyclists, including cycle lanes. The concept of mandatory and advisory cycle lane seems to be compatible with the general traffic ordinance in Brazil (its use is similar to the use for signing and marking bus lanes). As a rule, bicycles are treated as usual vehicles in the Brazilian Traffic Code, except for the permission to ride on shoulders. |
| *Technical:* There will be safety problems for cycle lanes in most arterials, judging for the traffic flows and speeds outside the proposed thresholds. Higher bus flows can be a peculiar problem in Brazil. Legal conflict of bicycles and motorized vehicles could be of concern. Space constraints can be binding. | *Technical:* Better organization of road use, introducing some priority/protection for cyclist, if effective. Increase the possibility for using bicycles, sharing the road space of vehicles. |
| *Economic:* Higher maintenance costs of road markings. | *Economic:* Installation cost is low, especially when compared to cycle-tracks. Benefits from increased use of bicycles, if effective. |
| *Behavioural:* The need for regulation of cyclist behaviour would be stressed. Disobedience can be more frequent and enforcement can be more needed too. Respect to cyclist priority could be a major concern, especially in advisory lanes. | *Behavioural:* Incentive to the use of bicycles. Signs the existence of cyclists (and the space where they have priority in road use or at least where they would be more frequently found). |

#### On–road Cycle Lanes/Routes and Cycle Priority in Non-arterial Roads

This group of measures consider the provision of dedicated infrastructure for cycling on the road in non-arterial streets (i.e. along stretches of roads where intersections are frequent and measures are required to convey or enforce priority of the treated road). The treatment of conflicts with parking needs is also a major concern for safety of cyclists in these roads.

The wide applicability of the U.K. approach aimed at reaching non-arterial roads in providing high standard cycle options (as in the LCN+ routes in London). The approach was built on the view that three quarters of trips travel less than 5 miles (8 km) and could use cycling as its mode of transport if the infrastructure is appropriate [19]. This requirement means direct and priority routes (features that favours arterial roads) without heavy traffic and high speed (features that favour non-arterial streets) and wide access to all roads and streets [29].

Alternatives to arterials should provide a direct and priority route (without interruptions to cyclists). Directness is a local attribute to search for in each alternative option. Priority should be signed to attend cyclists and drivers needs, to command respect and become enforceable. The provision of high standard routes using non-arterial streets depends on the possibility of implementing direct and priority routes that can be safe and convenient to cyclists. A large number of treatments at intersections were recommended in the U.K. for application at junctions where the priority of the cycle route should be highlighted and enforced. Additional protection to cycle lanes could be justified too (hatched road markings, intermittent traffic islands, reflective road-studs, raised rib markings [30]).





The viability of selecting and implementing such options could depend on local features of each stretch or area and each city or country. It seems to be a question to be evaluated locally. This viability includes the availability of appropriate routes and the acceptability to cyclists and drivers (mainly for the alternative schemes to warrant priority to cyclists along the routes). Conflicts with parking vehicles should also be considered, if frequent.

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| **Measure:** On–road Cycle Lanes/Routes and Cycle Priority in Non-arterial Roads |
| **Description:** implement direct and priority routes for cyclists outside the main arterial road |
| **Current Practice:** In Brazil, cycle lanes are rarely provided, as it is the case for cycle infrastructure in general. Availability of direct non-arterial routes is a question as it is the provision of the required priority to the selected routes for cyclists, commanding respect by drivers. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific guidelines for selecting or designing cycle-lanes in Brazil, other than general traffic signing guides. Lack of enforcement means for controlling cyclists is also felt. The concept of mandatory and advisory cycle lanes is not officially adopted. The rules of priority to cyclist should be more clearly stated. | *Regulatory:* There is general guidance on signs and markings for cyclists, including cycle lanes. The concept of mandatory and advisory cycle lane seems to be compatible with the general traffic ordinance in Brazil (its use is similar to the use for signing and marking bus lanes). As a rule, bicycles are treated as usual vehicles in the Brazilian Traffic Code, except for the permission to ride on shoulders. The same view could be taken as applied to priority at intersections. |
| *Technical:* The option is not usual in Brazil. Technicians can have resistance to its adoption before some evidence of good results. Conflicts with parking would be frequent. Care should be exercised when deciding priorities for cycling that are opposed to “normal” priority (to roads with larger motorized flow). More than signing and marking, there would be a requirement for effective ordinance (e.g. lifted crossings for cyclists, as well as pedestrians). | *Technical:* The coexistence of bicycles and motorized vehicles is easier in local roads, especially when compared to arterial roads, if bicycles are expected by drivers. More flexibility in selecting treatments. Fits better to the logic of non-motorized transport. May benefit drivers too (clear definition of priority routes). Treatments at crossings can generate other benefits to VRUs (e.g. comfort and safety of lifted crossings). |
| *Economic:* The costs can be high, especially for treatments at intersections. Viability (or implementation cost) will depend on local conditions (e.g. topography). | *Economic:* Installation cost is low, especially when compared to cycle-tracks. Benefits from increased use of bicycles, if effective. |
| *Behavioural:* Legitimate the behaviour of cyclists where its priority is the rule. Local citizens can have disbenefits. Can be unattractive in travel distance and/or time when compared to arterial roads. Information campaigns could be required to support priority rules that would benefit cyclists, complemented by enforcement. | *Behavioural:* The coexistence of bicycles and motorized vehicles is easier in local roads, especially when compared to arterial roads, if bicycles are expected by drivers. Incentive to the use of bicycles. Sign the priority to bicycles to general users of the road. |

#### Shared Foot and Cycle Ways

This group of measures consider shared tracks that can be used by pedestrians and bicycles but exclude motorized vehicle. No clear support for “green routes”, as sometimes called, was found on U.K. documents. However, the segregated alternative with shared use by pedestrians and cyclists seems to be much more usual option in continental countries of Europe (e.g. the Netherlands and Germany).

Commenting on the “hierarchy of provision” of cycle infrastructure, the official guideline mentions that “creating space for cyclists by taking existing foot space from pedestrians is generally the least acceptable course of action” [29]. Nevertheless, where road space is a huge constraint and sidewalks have enough space (as usual in suburban areas or pedestrian areas in city centres), providing for shared use maybe the better option.

Discussing shared provision to non-motorized user (NMU) in the U.K. [19], it is recommended that “combined NMU flows in excess of 200 users per hour require specific marking or different surface texture to denote segregation”, to be understood as shared use with segregated adjacent use. Segregated adjacent use would mean a significant increase in required width on the shared track, to 4,0m or 5,6m (based on acceptable or preferred criteria) compared to shared tracks with non-segregated provision [31]. Shared foot and cycle ways would be a problem to pedestrians (annoyed by the presence of cycles and other NMU) and to cyclists (annoyed by reduced speed and geometric constraints mandated by shared use). Benefits would be recognized on leisure paths where space constraints are not binding. It is not felt to be a relevant option to cycle infrastructure provision at large.

It is understood that shared foot and cycle ways are advised on this peculiar setting (recreational use), with shared use (under 200 users/hour) or adjacent use (over 200/hour). It seems to be a very limited application of the concept, indeed.

This advice is not different of the practice in most countries. In Brazil, where the provision of cycle infrastructure is incipient, the more frequent application is in touristic cities (mainly along beaches) where the adjacent use is usually present (as would be recommended). However, when taking the responsibility for providing infrastructure for cycling at large, frequently the option of shared use of sidewalks with cyclists comes strongly to the agenda and some intermediate criteria could be justified.

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| **Measure:** Shared Foot and Cycle Ways |
| **Description:** implement shared foot/cycleway in tracks with predominant recreational use (with segregation over 200users/hour) |
| **Current Practice:** In Brazil, despite being occasional, the proposed recommendation is very similar to the existing practice (the more common application of cycle infrastructure being present in touristic cities, with adjacent use of stretches along beaches and similar sites). The option of providing for cyclists with shared use of sidewalks is currently in discussion by several cities. |

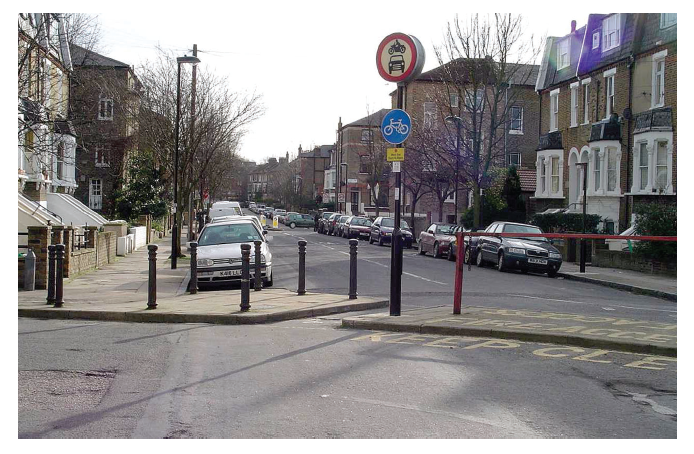
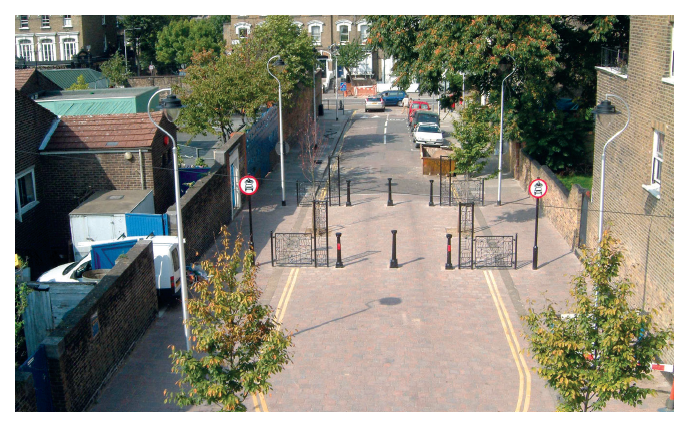
Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific guidelines for selecting or designing cycle-lanes in Brazil, other than general traffic signing guides. Need to be signed as exception (as the general traffic rule is to have bicycles on the road). | *Regulatory:* There is general guidance on signs and markings for cyclists, similar to those applied at bikeways. Permit to change the general traffic rule allocating bicycles to roads when interesting. |
| *Technical:* Potential conflict with pedestrians due to bicycle speed, especially where flow is small. Not acceptable to most professionals (would be accepted only for very small flows). | *Technical:* There have to be taken as an option. May be easy to apply than taking space from motor vehicles in some areas. Increase in the safety of cyclists against provision on the road should be weighted. |
| *Economic:* Cost may be a concern. | *Economic:* Smaller costs than bikeways. |
| *Behavioural:* The shared use should be reserved to leisure areas and segregated adjacent use should be taken as a rule. Speed of cyclists may be a problem. | *Behavioural:* Better environment in the city. Incentive to the use of cycling and to sharing space with other non-motorized users, including pedestrians. |

#### Exceptions for Cyclist / Other Facilities for Cyclist Priority without Signals

This group of measures consider interventions (traffic regulations and supporting facilities) that give special attention to cyclist needs on the roadway by introducing exceptions in the rules of the road (exclusive provision for using the road in the “wrong-way” as contra-flow lanes or executing “forbidden turns” as signed exceptions). The main point seems to be that of seeing cyclists as pedestrians with wheels, instead of non-motorized vehicles, and make every effort to give exceptional treatment to cyclists on road restraints (as usually made for pedestrians), in every site where it is possible to do it [29]. Outside the major arterials, where exceptions could bring relevant conflicts, this approach could give significant advantages to cyclists without compromising the performance of the road system.

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Taking for granted the vision of providing for access to cyclists in every road [19, 29], these measures seem to be the most common action to be applied outside the main part of the road system. In most countries, as for example in Brazil, one can observe violations against the traffic rules by cyclists, especially in minor roads, where they assume freedom to behave in opposition to the rules mandated to other (motorized) vehicles. Nevertheless, based on the proposed view, the need of specific regulation for bicycles seems to be justified in most situations and exceptions are usually better than enforcement to the rules of other (motorized) vehicles to bicycles, as long as being acceptable and safe.

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| **Measure:** Exceptions for Cyclist / Other Facilities for Cyclist Priority without Signals |
| **Description:** treat cyclists as pedestrians, as long as possible, giving them exceptions in road restraints |
| **Current Practice:** In Brazil, these measures were not widely tried. It could be largely applicable in residential areas and also should be complementary to developing cycle infrastructure for cities. |

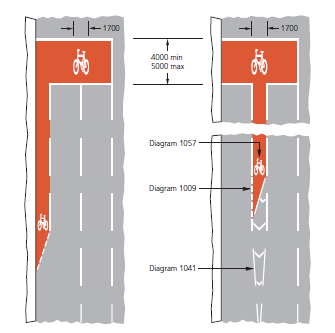
Potential for Transferability:

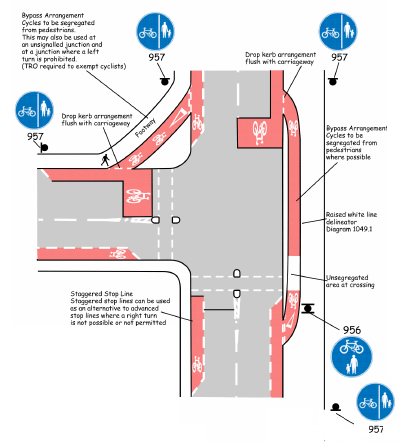
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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no special requirements for signing exceptions of adopting physical measures excusing cyclists. Nevertheless, the signing of exceptions to usual traffic rules generates a high risk of accidents, as long as they are not anticipated by other users. | *Regulatory:* There are signing and marking options for excusing cyclists, as well as physical options. For use of pedestrian facilities, cyclist would have to dismount from the bicycle. |
| *Technical:* Despite being possible, it is foreseen that most exceptions from traffic signing can generate severe risk of traffic accidents, mostly because they are unexpected (case specific problems can occur). | *Technical:* Technical analysis in a case by case basis. Permit the provision of more rational and straight routes for cyclists. Enlarge the options available for traffic ordinance in an area. |
| *Economic:* May require extensive signing for being safe, if not usually applied. Physical exceptions would be easier to apply. | *Economic:* Low cost, as a rule, even more when becoming usual. |
| *Behavioural:* The exception should be better than the usual violations, as a rule but can generate unexpected situations. Observance of signing by cyclists is usually poor. Cyclists can transfer excepted behaviour to other sites where compliance to general rules is required. | *Behavioural:* There could be positive for promoting the respect of cyclists to signing. Promote cycling by providing better routes or showing attention to cyclist needs. |

#### Advanced Stop Lines (ASLs) / Other Facilities for Cyclist Priority at Signals

This group of measures consider the provision of special treatments to cyclists at intersections, notably with the use of ASLs-Advanced Stop Lines (aiming at reducing the conflicts with turning vehicles by giving favourable treatment to cyclists) or other measures to reduce the impact of traffic signals on cyclists (as provision of options for “by-passing” traffic signals, where possible). Signals decided for cyclists (as for cycle-tracks) should also be considered.

ASLs, specifically, are applicable at traffic signals and designed to reduce the task of weaving before turning, if needed, and the conflicts of straight ahead bicycles with turning vehicles. No clear discussion of the potential problems of the use of ASLs was found [29, 30]. The recommendation for London [30] was: “ASL should be provided on all arms of traffic signal controlled junctions except where acceptable alternatives are provided.”

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These measures seem to be complementary to the development of a widespread cycle infrastructure in the cities. In Brazil, as an example, this feature is absent in most cities probably because the mentioned infrastructure is missing too. In most emerging economies, the larger presence of other two-wheelers (especially motorcycles) could be a matter of concern for the effectiveness and safety of ASLs, at least in major roads.

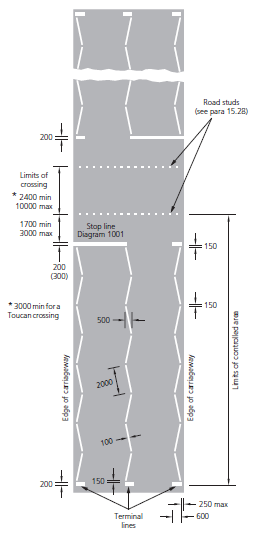
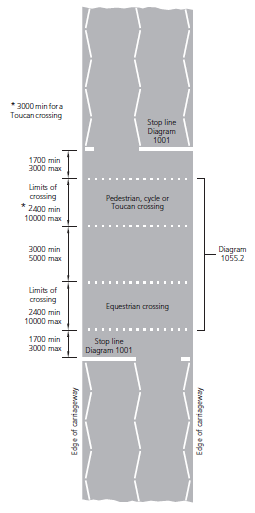
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| **Measure:** Advanced Stop Lines (ASLs) / Other Facilities for Cyclist Priority at Signals |
| **Description:** implement Advanced Stop Lines (ASLs) or other measures for giving priority to cyclists at signalized intersections |
| **Current Practice:** In Brazil, these measures were not tried. It should be complementary to developing cycle infrastructure for cities. |

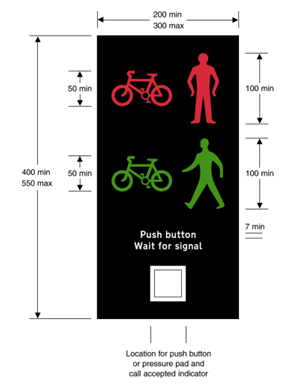
Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific rules or guidelines for use and design of ASLs in Brazil. | *Regulatory:* Sign a policy for supporting bicycle use. |
| *Technical:* There are problems for signing and signal timing for safety of cyclists. Safety can also be a concern in higher speed roads, especially in low flow conditions (without vehicle queues). Reduce length of road for accumulating queues of vehicles. May generate cycling flows between vehicle lanes. Conflicts with motorcycles. | *Technical:* Provide a waiting area to cyclists. Can easy the task of turning to the far side at intersections. |
| *Economic:* More conspicuous marking would require colouring of pavements (and maintenance). Cost can be high. | *Economic:* Low cost compared to other options. |
| *Behavioural:* Obedience will be a concern, mainly the irregular use by motorcycles and especially where flow of bicycles is small. Can generate complex manoeuvres. | *Behavioural:* Promote cycling and the respect of signals by cyclists. |

#### Toucan Crossings / Facilities for Crossing of Cyclists and Special Users Other than Pedestrians;

This group of measures consider the installation of crossing facilities shared among pedestrians and cyclists (without the requirement of dismounting the bicycle for using crossings), known as Toucan crossings, or other special users (as equestrians in Pegasus crossings). Both measures are peculiar of the U.K. traffic ordinance.

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Most countries treat cyclists as vehicles in traffic regulations, as a rule allocating them to traffic lanes only. However, even so, shared crossings can be an option in providing access to cycle lanes, shared paths and cycle-tracks or for helping cyclists in handling complicated intersections (e.g. as an option to ASLs). In some countries, as Brazil, the regulations on signals for cyclists in traffic lanes or crossings are not detailed. Perhaps the measure can be tried with experimental authorization, at least.

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| **Measure:** Toucan Crossing / Facilities for Crossing of Cyclists and Special Users Other than Pedestrians |
| **Description:** implement traffic signals authorizing the crossing of cyclists, beside pedestrian crossings |
| **Current Practice:** In Brazil, the regulations about signals for cyclists in traffic lanes or crossings are to be detailed. Perhaps the measure can be tried with experimental authorization. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific rules or guidelines for use and design of crossings for bicycles in Brazil. Signal faces to bicycles also are included but have to be detailed in current regulations. | *Regulatory:* There would be possible to sign for bicycles crossing with pedestrians. Current regulation would require cyclists to dismount. Perhaps may be tried with experimental authorization. |
| *Technical:* There are no provision for its use and design. Guidance would be required. | *Technical:* There would be benefit in signing for the proper site to the crossing of cyclist and for segregating crossing flows of pedestrians and cyclists. Would require small change in marking and signalling. |
| *Economic:* The increase in the design cost. | *Economic:* Small cost where pedestrian heads are used (not so usual in Brazil as elsewhere). Otherwise, intermediate cost but may also benefit pedestrians. |
| *Behavioural:* There would be a need for information to road users. No rules for enforcement of cyclist behaviour (they would be able to behave as vehicles or as pedestrians). | *Behavioural:* There is a benefit to cyclists (and potentially to pedestrians, where they have not signal heads) of better information. Signals also command better respect in controlling crossings. |

#### Bike Stands / Other Facilities for Parking Bicycles

This group of measures consider the provision of parking facilities for bicycles at destinations, taken as a key element in the development of a cycle-friendly environment.

Following U.K. practices, basic requirements for parking facilities, in addition to good location, are: it should support bicycles without damaging them; it should be possible to secure both the frame and the front wheel to the stand; the stand should not be a danger to pedestrians (especially those with disabilities), and facilities should not detract from the environment (especially at public spaces). The facilities should offer enough security and convenience to attract informal parking. For short visits, formal parking should be up to 25m from destinations when compared to informal options. Security (protection against theft) and nuisance to other users (in general and for pedestrians in particular) are major concerns.

The most common form of cycle parking is Universal (Sheffield) Stands or some variation, using “inverted U” rails and costing between £100 and £200, in the simplest form. Covered parking could add to convenience and cost. Lockers could also permit to left bags, helmets and other accessories with the bicycle. City lockers are the simplest form of lockers and can cost up to five times more than Universal stands and eventually are found for public use. Better services are usually found for a fee to cover supervision and management of facilities (perhaps provided with other services, as the rent of bicycles and related equipments).

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This type of public parking supply can add to private parking supply in destination buildings.

These facilities seem to be complementary to the development of a widespread cycle infrastructure in the cities. In Brazil, as an example, this feature is absent in most cities probably because the mentioned infrastructure is missing too. Facilities at special attractors are usual (e.g. at schools, stores, etc ...) but simpler. However, there is also an increasing trend for providing parking facilities for bicycles at major attractors (e.g. passenger terminals of public transport, mainly for mass transit in larger cities, large factories, etc ...). In this case, parking facilities are also simpler and more compact, providing space for large number of bicycles (up to 2000 per terminal).

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| **Measure:** Bike Stands / Other Facilities for Parking Bicycles |
| **Description:** provision of public parking facilities, either Universal Stands or City Lockers |
| **Current Practice:** In Brazil, these equipments are not available. It should be complementary to developing cycle infrastructure for cities. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is a concern with security against theft. Parking options near building with guard are better. Otherwise, resources for guarding and cleaning of parking sites would be required. | *Regulatory:* Provision of parking facilities is needed. |
| *Technical:* Need of areas and services of guard are the constraints. Mainly where used for integration with public transport (long stay). Parking garages with guard would be preferred for larger facilities. | *Technical:* There are several options that can fit different spaces. |
| *Economic:* There are cheaper options that can be used near buildings and more adequate options for large parking facilities. Rent of parking space is an option but can reduce incentive for cycling. | *Economic:* There are cheaper options that can be used near buildings. A large number of options are available. For large parking facilities, there are more efficient options. |
| *Behavioural:* The concern with theft and vandalism is relevant. Guard is needed. Renting of parking space can be a disincentive for cycling. | *Behavioural:* Good parking facilities for bicycles can be very important for promoting cycling, especially in combination with public transport. |

### Motor Vehicle Focused Measures that Benefit VRU Safety

This category of measures considers those that, despite not directly driven to benefit pedestrians or cyclists, can benefit VRU safety indirectly. This category covers a wide variety of measures. As long as possible, the general approach was, again, taken from the U.K. general regulations [9 to 14] and specific practices, as referred in the following discussion.

The set of measures considered was:

* + Shared use of bus lanes/bus ways by motorcycles and/or bicycles;
  + Traffic calming or Shared spaces / Shared roadways or Mixed priority roads;
  + Speed humps / Speed cushions / Other devices based on vertical deflection;
  + Speed tables / Raised or Lifted intersections;
  + Chicanes / Priority narrowing / Other devices based on horizontal deflection;
  + Vehicle activated signs (VASs);
  + Road lighting;
  + Safety (speed and red light) cameras.

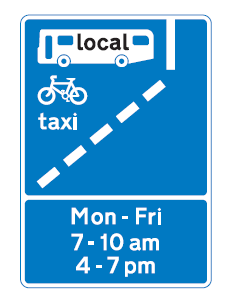
The potential effectiveness of some of these measures is recognized but only in particular settings where their application is appropriate (e.g. speed humps or electronic enforcement devices). Others, despite being well-known measures, have been extensively tried only in particular settings (as traffic calming measures in residential areas) and open to questions due to their strong effect on mobility of motor vehicles. Some other measures seem to be under study, development or validation (as VASs, perhaps better developed outside the U.K.). Finally, some of the measures are currently peculiar to the U.K. practice (as shared use of bus lanes, despite promising prospects for evaluation in other countries).

Reviewing “The Handbook of Road Safety Measures”, these measures appear again as Road Design and Road Equipment or as Traffic Control. For some of these measures, there is ample evidence of effectiveness, including the effect on pedestrian accidents at least. This group of measures has speed limits or speed reducing devices (as speed humps) and traffic calming schemes or road lighting. Raised intersections were not supported and chicanes were not reviewed when used in isolation (i.e. outside traffic calming schemes).

#### Shared Use of Bus Lanes/Bus Ways by Motorcycles and/or Bicycles

This group of measures consider the shared used of bus lanes (potentially bus ways also) by other vehicles, especially bicycles or motorcycles. In the U.K., the general regulation of bus lanes [10, as defined by 9] foresees their use by to accommodate cyclists, as well as taxis, as displayed by traffic signs. Similarly, based on the RTRA [9], this option was extended to other vehicles, particularly for motorcyclists (as updated in [32]).

General traffic lanes are usually less safe for motorcycles and bicycles than bus lanes, except for overtaking of buses and bus stops. Wider lanes (at least 4,0m) are recommended for shared lanes. Special attention to locating and signing pedestrian crossings is also a must. A large program of implementation of bus lanes (Red Routes) in London adopted the sharing with bicycles and motorcycles very frequently but the option seems to be in revision.

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Despite being applicable in other countries, some points need careful evaluation. In Brazil, as an example, bus lanes and bus ways are widespread but their flow is much larger than in London (around 100 to 200 buses/hour in typical arterial corridors of larger cities). The flow of motorcycles is also much higher and chaotic (as pedestrian flows too, perhaps their main victims other than themselves), approaching 1000 motos/hours in some roads.

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| **Measure:** Shared Use of Bus Lanes/Bus Ways by Motorcycles and/or Bicycles |
| **Description:** implement the shared use of bus lanes/bus ways by motorcycles or bicycles |
| **Current Practice:** In Brazil, there is no trial of sharing the use of bus lanes/bus ways with motorcycles or bicycles. The level of flow is much higher for buses (over 100/hour) and motorcycles (over 500/hour) in most arterials, compared to the U.K. and Europe. Brazil is a leading country in the use of bus ways. Bus lanes are also usual but there are problems with compliance to its exclusive use by buses. Option may depend on the position of bus lanes and bus ways (natural for bikes on the near side; for motorcycles in the far side). However, in any case, bus stops are much more heavily used and conflicts with bicycles or motorcycles could be especially relevant. |

Potential for Transferability:

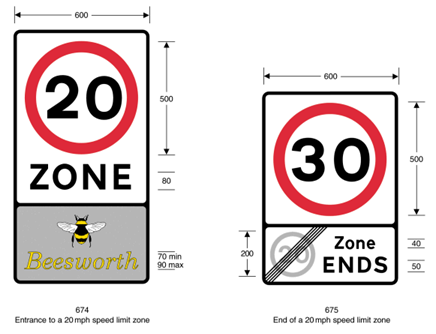
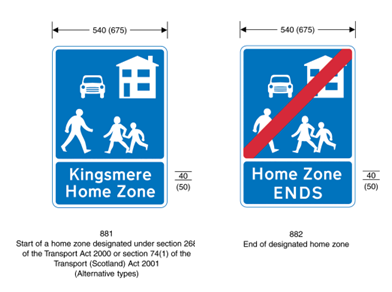
|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific rules or guidelines for sharing bus lanes or bus ways with bicycles or motorcycles (sharing with taxis is usual). Would have to be signed as exception. | *Regulatory:* There is the possibility of signing the shared use of bus lanes or bus ways with bicycles or motorcycles. |
| *Technical:* The required width for warranting a safe overtaking of bicycles or motorcycles by buses or the opposite can be a constraint in most arterial facilities. Sharing can also prejudice bus operation (the intended use of bus lanes and bus ways). Sharing a space with heavy vehicles can be unsafe for motorcycles and especially for bicycles (the conflict between bicycles and motorcycles could be relevant also). The conflict in the entry and exit from facilities can be a problem. | *Technical:* There could be an option where bus lanes or bus ways have low flow of buses and the required width is available. Can be justified if safety can be improved for bicycles or motorcycles (rarely it would be able to accommodate both and buses). |
| *Economic:* There are relevant costs if the required width is not available. Accidents could be a more relevant cost, if ineffective. | *Economic:* There would be small cost if the required width is available. There would be benefit if safety is improved. |
| *Behavioural:* The sharing of road with heavy vehicles would be a major concern for bicycles and motorcycles. Sense of priority can promote unsafe behaviour (e.g. speeding). | *Behavioural:* Better for buses and motorcycle because speeds are similar (provided that overtaking is possible at bus stops). Keep the inter-visibility among users is needed. |

#### Traffic Calming and Shared Spaces / Shared Roadways and Mixed Priority Routes

This group of measures consider the treatment of roads where local uses and other needs have to be accommodated, mainly for motorized and non-motorized users. In this view, it is related to the traditional concept of traffic calming.

The concept of Shared Roads or Mixed Priority Routes were seen as applicable mainly to areas with special urban status (as commercial streets or distributor roads of local or regional centres). However, no clear view on such kind of measure or practice even in the U.K. was found. Most documents (e.g. [33]) lack details on content or application and reports on incipient trials of the proposed approach. No consideration of their specificity was possible other than the application to non-residential areas with special urban status.

As applied to residential areas, it was evaluated here as the traditional concept of traffic calming or the near concept of shared space and several similar initiatives as home zones, quiet lanes, 20/30 zones and others [34]. The newer view of shared space emphasizes road use by cyclists and local activities as well (but the same applies to other initiatives). The recommended approach is the consistent application on an area where it is intended to create a friendly environment to VRUs and local uses, especially to children, olders and other users in their local activities (not only as road users). The emphasis is in the implementation of self-enforced speed reducing devices (e.g. vertical and horizontal deflection devices). As an example, the official guidance for 20 mph zones is to space such devices at 60 to 70 metres, avoiding the application in areas more than 1 km wide [34]. As most of the newer initiatives were not clearly evaluated, the attention is devoted to conventional traffic calming as exemplified by home zones and 20/30 zones.

At the planning level, the same set of measures was considered in item 2.1.1.3, before. Some of the measures can be applied individually and at specific sites and will be so considered in the items ahead. Here the evaluation is related to the recommended application to existing (overall) areas.

In Brazil, as an example, traffic calming concept is well-known but not widely accepted and applied even in its simpler settings (as residential areas). The pressure to protection of residential areas was previously discussed and applies also, however. The need of similar concepts for street in areas with special urban status (as commercial streets or distributor roads of local or regional centres) and even high speed roads (arterials and highways) is also felt but not dealt with properly, at least with a clear and consistent approach.

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| **Measure:** Traffic Calming or Shared Spaces / Shared Roadways or Mixed Priority Routes |
| **Description:** implement traffic calming schemes or related concepts (shared spaces or shared roads) |
| **Current Practice:** In Brazil, no policy for application of traffic calming, shared spaces or shared roads concepts was consistently applied. However, there is pressure for protecting residential areas (on the traffic safety and public safety senses). Commercial streets with clear predominance of local uses and high level of conflict with through traffic are also usual in larger cities. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific rules or guidelines for implementing traffic calming or related concepts. Enforcement would be a problem unless self-enforced devices would be exclusively used. There is no provision for signing of home zones or 20/30 zones. | *Regulatory:* There is the possibility of implementing traffic calming and related concepts, except home zones and 20/30 zones (signing would be required all over the calmed area). |
| *Technical:* There should be guidance on the use of measures. Effect on emergency vehicles or situations would be a concern. | *Technical:* The need of these measures is felt either in residential or other types of areas (including commercial streets). Measures are applicable and will generate lower speeds. Improvements on environmental conditions (including noise and air pollution) can be expected as well. |
| *Economic:* Most physical devices are self-enforced but schemes would have high costs. Otherwise, enforcement would be a concern. | *Economic:* The costs could small compared to the benefits. |
| *Behavioural:* Risk of misuse or abuse is relevant. Acceptance by road users and local citizens is a concern. Noncompliance in internal areas or compensation in external areas also are concerns. | *Behavioural:* Can promote mutual respect. Promote driver behaviour compatible with areas with priority to local activities (residential or others). Strengthen neighbourhoods and protect local activities, mainly for children and olders. |

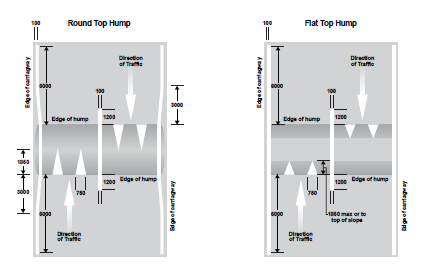
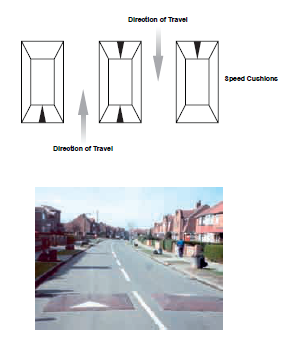
#### Speed Humps / Speed Cushions / Other Devices based on Vertical Deflection

This group of measures consider traditional speed reduction devices based on the introduction of vertical deflections in the vehicle paths, named speed humps and speed cushions as a variation for excusing larger vehicles (in general public transport vehicles) from its secondary effects (discomfort, shock and vibration, among others).

The general approach to the design and application of speed humps was largely developed in the U.K. and their application is well-known around the world. Speed cushions were subsequently developed in Germany to reduce the impact on large vehicles (mainly public transport vehicles) and service vehicles (mainly emergency services) and then providing an option for roads of a higher hierarchy than local streets (where share of large vehicles and desired speeds are both higher).

Traditional profiles for speed humps were circular with maximum height of 100mm and 3,7m long. Newer profiles adopt a smaller maximum height of 75mm. Flat-top humps with ramp around 1:15 (minimum of 1:8 and maximum of 1:30) and minimum plateau length of 2,5m are also largely applied. Other profiles, as sinusoidal humps or sinusoidal ramps to flat-top humps, are also being proposed. Kerb to kerb humps are recommended, but using drainage channels of 200mm if required (bypasses for cyclists could be considered, with minimum width of 1,0m). No required profile is set out but just recommended [34].

For speed cushions, height of 65mm (maximum height of 75mm) is usually recommended for cushions, with minimum width of 1,5m to 1,7m for strategic routes (wider, up to 2,0m, elsewhere), side ramps of 1:6 (minimum of 1:4 and maximum of 1:8), and separation of 0,75m to 1,0m (minimum of 0,5m and maximum of 1,2m). Entry and exit ramps as well as lengths and spacing are similar to speed humps. Alternatives to preserve large vehicles as speed cushions were also being evaluated, as H-humps or S-humps [34].

Because it is a relatively cheap and self-enforced speed reducing device, the use of speed humps is widespread and perhaps abused in some countries. In Brazil, as an example, there is a clear concern with its overuse and misuse (there are official regulations setting their design features and constraining their application but there are complaints on their use, at least by drivers). Some complaints are usually made but current regulation on speed humps is felt to be acceptable. Speed cushions are rarely used.

The development of speed cushions came after, as part of the arsenal of traffic calming devices and tools, and their use is much smaller. In Brazil, as an example, it is very rare. Other traffic calming devices based on vertical deflection (speed tables and lifted intersections) will be discussed in the next item. Perhaps the discussion there will be pertinent to speed cushions as well, more than the situation of speed humps, treated here.

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| **Measure:** Speed Humps / Speed Cushions / Other Devices based on Vertical Deflection |
| **Description:** increase the use of A=speed humps and B=speed cushions in local or distributor roads |
| **Current Practice:** In Brazil, speed humps are widely used. There is a clear concern to its misuse or even abuse and to the need of regulating its proper use on urban roads and other settings. Current regulation is usually accepted as good. Speed cushions are rare. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is guidance on speed humps (not always observed) but not on speed cushions. Use is restrained. | *Regulatory:* The regulation on speed humps is well-known and restrictive. Speed humps are effective and self-enforced devices. May require experimental authorization to the use speed cushions. |
| *Technical:* Safety problems can be generated by misuse or lack of maintenance of speed humps. Effect can be local or require the use of a large number of devices along the road. Traffic (and safety problems) can be diverted to alternative roads. | *Technical:* Effectiveness in reducing speeds and severe accidents is widely acknowledged. There is misuse and abuse. |
| *Economic:* The costs may be a concern. Cost of reduced speed for vehicles (smaller for cyclists with by-passes and heavy vehicles with speed cushions). | *Economic:* Cost is small compared to other options. Benefit of increased safety. |
| *Behavioural:* The traffic diversion effect should be a concern. Compensation of travel time too. Speed cushions are not usual in Brasil. | *Behavioural:* It is a self-enforced and effective device. |

#### Speed Tables / Raised or Lifted intersections

This group of measures consider another set of speed reduction devices based on the introduction of vertical deflections in the vehicle paths, also from the arsenal of traffic calming.

These measures would have the general purpose of changing the road environment, using speed reduction to increase the priority of other users and uses of the road (as for implementation of the concept of shared spaces). In a wider setting, they were evaluated in item 2.2.3.2 before. Here they should be taken as isolated devices. Speed “tables” used for favouring pedestrian crossings (raised or lifted crossings) were also treated before in 2.2.1.10 and this particular setting will not be considered here. Its application in the intersection area as a whole is typical of the peculiar view treated here (combining speed reduction to the desire to convey a meaning of priority to other users and uses).

It seems that the individual application of such devices in the previous settings (i.e. as speed humps or as lifted crossings) is largely dominant (or clearly similar). The use of lifted intersections could be of peculiar interest. Nevertheless, no clear experience with or support to their application in European Countries was identified.

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| **Measure:** Speed Tables / Raised or Lifted intersections |
| **Description:** increase the use of speed tables in local and distributor roads, including lifted intersections |
| **Current Practice:** In Brazil, the use of speed tables is rare, especially as lifted intersections. |

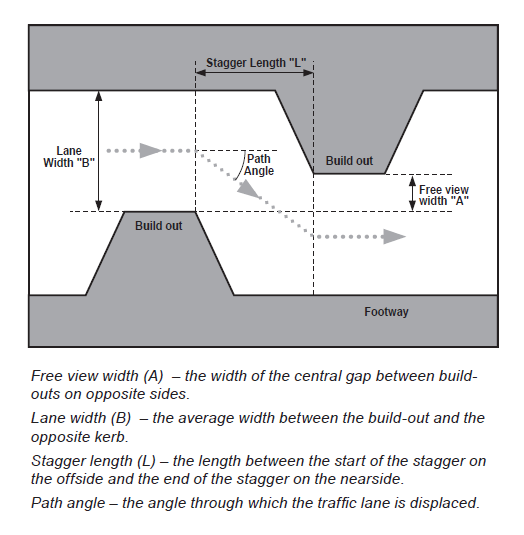
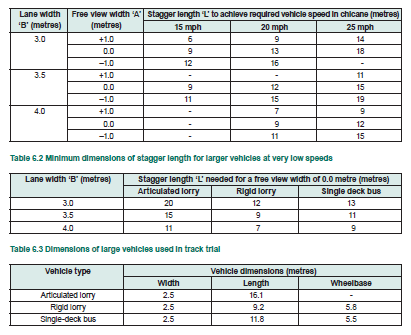
Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific rules or guidelines for implementing speed tables (other than as raised pedestrian crossings) or lifted intersections. No clear view on the effects. | *Regulatory:* May require experimental authorization or trial application. |
| *Technical:* The application of the measure is not widely known. Cost of reduced speed for vehicles (smaller for cyclists with by-passes) | *Technical:* May be interesting for the safety and comfort of pedestrians where applicable (as local roads). Would benefit all crossings on the intersection. But real effect is unknown. |
| *Economic:* Cost may be high in existing roads (cost of change). | *Economic:* The provision with new road or sidewalk development can reduce the installation cost. |
| *Behavioural:* Unknown. May incentive the use of sidewalks by cyclists, at least (by-passes would be required), or even motorcycles. | *Behavioural:* The potential of changing the behaviour of drivers can be realized but real effect in driver behaviour is unknown. Comfort to pedestrians would also be a benefit. |

#### Chicanes / Priority Narrowing / Other Devices based on Horizontal Deflection

This group of measures consider another set of speed reduction devices based on the introduction of horizontal deflections on the vehicle paths, also from the arsenal of traffic calming.

These measures would also have the general purpose of changing the road environment, using speed reduction to increase the priority of other users and uses of the road (as for implementation of the concept of shared spaces). In a wider setting, they were evaluated in item 2.2.3.2 before. Here they should be taken as isolated devices. The use of horizontal deflection of vehicle paths is peculiar and brings additional points. Among these points, relevant for VRUs, their use can be combined with the installation of build-outs or kerb extensions (inheriting their advantages and disadvantages), evaluated in other items. However, horizontal deflection of vehicle paths are not self-enforced to the same degree as vertical deflection and can easily cause loss of control for vehicles. The key parameter to design is taken to be the free view width, to be set from +1,0m to -1,0m [34].

Even in the U.K., acceptance and use of horizontal deflections as speed reducing devices is less frequent and open to question [34]. The same applies to other European countries and internationally, all around the world. Narrowing, per se or implied by devices, also has a potential negative effect on cyclists, unless some kind of bypassing is provided or it is applied through the use of traffic islands or pedestrian refuges. Horizontal deflections of the road alignment are also a common cause of concern with drainage problems to be considered. Drainage channels can be widened to form cycle bypasses.

In Brazil, as an example, there is concern to the safety effect of Chicanes and other devices based on horizontal deflection. However, mini-roundabouts (even roundabouts) are conventionally used as speed reducing and traffic control devices in low traffic areas, with satisfactory results in most cases. This practice signs a major concern with intersections than with road links (where Chicanes and Priority Narrowing would be applied).

It seems that the individual application of such devices (i.e. isolated from traffic calming or related initiatives) is rare and no clear experience with or support to their individual application in European Countries was identified.

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| **Measure:** Chicanes / Priority Narrowing / Other Devices based on Horizontal Deflection |
| **Description:** increase the use of Chicanes or other speed reducing devices based on horizontal deflection of vehicle path |
| **Current Practice:** In Brazil, the use of Chicanes or similar measures is rare. The use of mini-roundabouts (even roundabouts) is the only notable device that is conventionally applied (combining speed reduction and traffic ordinance), usually with satisfactory results. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific rules or guidelines for implementing traffic calming or related concepts. Enforcement would be a problem unless self-enforced devices would be exclusively used. | *Regulatory:* May require experimental authorization or trial application. |
| *Technical:* Complex design. Drainage would be a problem. May generate a relevant risk of accident (including shock to kerbs). May be difficult to negotiate for heavy vehicles. | *Technical:* Applicable to local roads, reducing speeds and traffic flow. Maybe an intermediate option to speed humps (up to 25mph). |
| *Economic:* Intermediate cost when applied to existing roads. Cost of reduced speed for vehicles (smaller for cyclists with by-passes but larger to heavy vehicles, in general). Potential of accidents. | *Economic:* The provision with new road or sidewalk development can reduce the installation cost. Benefit of increased safety if effective. |
| *Behavioural:* There is a concern with the potential adverse effect on safety (if not perceived or believed). May generate racing behaviour. | *Behavioural:* May be potentially effective in reducing speed (calming the traffic). May improve the urban environment. Improvement in pedestrian safety and increase in pedestrian areas. |

#### Vehicle Activated Signs (VASs) for VRU Safety

This group of measures consider the use of vehicle activated signs (VASs) or other variable message signs that were designed to be responsive to vehicle speed, weather condition or other feature of traffic operation that can mandate adaptation of traffic rules or require additional warning to road users. The U.K. approach seems to be incipient [35] and do not seem to make full exploitation of the current technologic potential. However, it will be taked as the practice to be evaluated here because it reached official acceptance.

Based on a long-standing effort in developing and testing of devices with VASs, current U.K. guidelines are devoted to the application of installations where traffic detectors are used to measure the speed of approaching vehicles and the information is used to display variable messages to the specific vehicles that could be at danger (and/or generating risk to others). Conventional measures were speed limits (variable limits, whose values are not clearly discussed) or warnings to slow down (only to vehicles over the threshold value of speed).

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The U.K. guidelines have special attention to determine the use of VASs as compared to usual traffic signs (in one side) and electronic enforcement of speed (in other side). The clear guidance is to avoid excessive use of VASs, requiring that it should be applied only at sites with records of accidents. The reason to favour its use against speed cameras is not clearly stated and should be left for the local authority.

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| **Measure:** Vehicle Activated Signs (VASs) for VRU Safety |
| **Description:** implement Vehicle Activated Signs (VASs) at sites with accident records |
| **Current Practice:** In Brazil, no similar technology is in use. Perhaps it should be taken as an experimental system. Perhaps components could be of interest (LED signs or weather sensors) by itself. It probably will need experimental authorization. At least, they will have to complain to the general standards set to usual signs (e.g. negative contrast) as no specific provision to variable signs exists. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are no specific rules or guidelines for implementing vehicle activated signs. | *Regulatory:* Perhaps experimental authorization could be required for the use of VASs. Could be easily regulated. |
| *Technical:* There are doubts on the operation of VASs (e.g. in multilane roads, with equipment failure). No improvement on message (same content as static signs). Sign uses positive contrast (do not fit to the standard sign face). High maintenance requirement. | *Technical:* The use of vehicle activated sign to the users requiring the information can be seen as generically recommended. Reinforcement of warning signs is felt as positive. |
| *Economic:* The cost is foreseen as high, compared to static signs. | *Economic:* Compared to electronic enforcement devices, cost is smaller (perhaps effectiveness too). |
| *Behavioural:* Perhaps the use should be parsimonious to preserve effectiveness. It is not known by drivers. Vandalism can be a problem. | *Behavioural:* Potentially better in inducing the required behaviour and commanding obedience. |

#### Road Lighting for VRU Safety

This group of measures consider traditional use of road lighting devices to increase the traffic safety of pedestrians and other VRUs.

Despite being conventional, road lighting has special significance for VRUs and usually requires the use of specific criteria for their traffic safety. In general, road lighting also has the potential to increase public safety and the quality of the urban environment as well. General criteria for road lighting usually recognize the special needs of VRUs but they are not applied by road engineers and several other requirements can easily dominate the design practice and overlook the questions related to their traffic safety. However, in some countries, there are specific criteria for road lighting based on traffic safety requirements. In the U.K. guidelines for design of pedestrian crossings [16], the requirement was set that “the pedestrian approach (at least the area covered by the tactile paving surface) and the carriageway crossing area must be illuminated to a uniform level” (lighting levels and special criteria for conflict areas are as defined by BS 5489:1, item 11).

In Brazil, as a rule, the quality of road lighting is largely variable. In general, the quality is higher in more affluent areas, at least on commercial and residential areas but also along major roads. Exceptions, nevertheless, are frequent also in these areas. The provision of road lighting for exclusive/segregated ways for pedestrians, including pedestrian streets and areas, is a major concern in larger cities, mostly in commercial centres, mainly for the public safety and the quality of the urban environment.

No clear understanding about European practices, including the U.K. ones, could be acquired. However, the higher standard of provision and maintenance of road lighting, including sideways and crossings, is largely acknowledged. Upgrade the road lighting in the cities of emerging economies to an European standard is clearly a relevant option and applies mainly to crossings for traffic safety and exclusive or shared footpaths/walkways for public safety (and also for their comfort in general).

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| **Measure:** Road Lighting for VRU Safety |
| **Description:** increase the use of road lighting in sensitive areas for the traffic and public safety of VRUs and the quality of their environment |
| **Current Practice:** In Brazil, the importance of road lighting for pedestrians and other VRUs is widely recognized but systematic efforts for providing for their specific needs is not similarly widespread. Some cities, as São Paulo, have programs for improving the lighting or pedestrian crossings and other sensitive areas for VRUs. However, there is no official requirement for lighting sensitive areas for VRU safety. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is no clear requirement for lighting of all crossings. | *Regulatory:* The lighting can be provided. The requirement can be decided by the national regulating body (CONTRAN). |
| *Technical:* The requirement for maintenance should also be considered. Supports (lighting poles) can be struck by vehicles. | *Technical:* The visibility of pedestrians is increased, improving pedestrian safety. |
| *Economic:* Intermediate cost, including power supply. | *Economic:* The reduction of pedestrian accidents would be the major (and intended) benefit. |
| *Behavioural:* No negative point. | *Behavioural:* Also improve the public safety as well as traffic safety. |

#### Safety (Speed / Red Light) Cameras / Other Electronic Enforcement Devices

This group of measures consider the introduction of devices for electronic enforcement and surveillance. Despite proposed in the last 20 years, these devices are largely applied around the world and largely recognized by their effect in controlling speeds and reducing accidents.

As for speed humps, it is a relatively cheap speed reducing device. By generating revenues from fines, it is also a self-financed (perhaps rent generating) measure. Both features could explain the reason for the widespread use, and perhaps abuse, of cameras in some countries. In the U.K., a national programme for deployment of safety cameras (as speed and red light electronic enforcement devices are called) was set up since 1992 and the discussion on the use and abuse is a major concern since then. Safety cameras are operated by police departments and fines are collected by courts. Nevertheless, a cost recovery system was implemented with the intervention of the Department of Transport, for warranting that the revenue generated by the electronic enforcement schemes could return to the agencies and areas that applied them. Despite strong administrative support to safety cameras, a recent change of orientation (as from 2007) was decided that recommends that speed management should be integrated into road safety programmes (instead of taken as a separate endeavour). Requirements to the use of safety cameras were also reduced and levelled to the requirements of other road safety measures (as traffic calming devices or VAS). Funding also was levelled to the same approach used for other measures. Experience has to be accumulated on the effect of the new policy but, nevertheless, its message is clear: to reduce the specific incentive to the use of safety cameras.

In Brazil, as an example, there is also a clear concern with its overuse and misuse especially for speed control (there are official regulations setting the requirements for their application, including the need of an engineering study that should be made public and that should be monitored for the effect on traffic accidents, but again there are complaints on their use, at least by drivers). The use for controlling red light violation or invasion of pedestrian crossings is less usual. Some complaints are made but current regulation on electronic enforcement is felt to be acceptable. Electronic enforcement is also used for other tasks (e.g. control of lanes allocated to special vehicles as buses, control of circulations restraints based on license plate numbers, as adopted in the City of São Paulo), not only safety related ones.

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| --- |
| **Measure:** Safety (Speed / Red Light) Cameras / Other Electronic Enforcement Devices |
| **Description:** increase the use of electronic enforcement and surveillance devices in roads |
| **Current Practice:** In Brazil, electronic enforcement devices are widely used, mainly for control of speed, red light violations, invasion of pedestrian crossings, invasion of exclusive bus lanes or bus ways, violations of restraints on circulation based on license plate numbers, and some other applications. There is a clear concern to its misuse and even abuse and to the need of regulating its proper use on urban roads and other settings. Current regulation is usually accepted as good. Fines are usually collected by road agencies. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There are deficiencies in the current regulation. | *Regulatory:* The current regulation is felt as acceptable. |
| *Technical:* The application practice should be improved. The complexity of the technique and of the data processing motivated the contracting of third party private services. | *Technical:* The correct application is highly effective (to VRUs and also to motorized vehicles). Design is simple. |
| *Economic:* The cost is high and constant maintenance is required. | *Economic:* The cost is low, considering the effectiveness. Can reduce the need of enforcement by the police or traffic agents. Benefit from reduction of traffic accidents warrant a short pay-back period. |
| *Behavioural:* The aversion to the use of electronic enforcement devices is high in the population (mostly among drivers). Change in behaviour can be punctual if use is dispersed. | *Behavioural:* The effectiveness of enforcement is clearly improved. Change in behaviour can increase if widespread used. |

## Management of Road Safety for VRUs

These measures were conceived as those interventions that have to promote road safety on a project by project basis but are not related to technical options for scheme planning and design. The measures were further classified into two groups: improvement of hazardous locations and road safety education.

Based on the results of D2.1 and D1.1 [1, 2], the measures included in the class of Management of Road Safety for VRUs are:

* + Improvement of Hazardous Locations:
    - Black spot analysis;
    - Urban safety management and other areawide intervention policies;
    - Road safety audit/Road safety inspection / Other preventive reviews;
  + Road Safety Education (User Needs and Participation Process and others):
    - Education and training;
    - Information / Consultation / Participation;
    - Enforcement of VRU priority on the road.

### Improvement of Hazardous Locations

This group of measures consider management procedures that monitor the road network for safety problems and tries to introduce improvements on the safety level of roads. Generally the approaches can be classified as reactive (based on the identification of sites with past accident records denoting safety problems) or preventive (based on the identification of safety problems before the occurrence of accidents).

The first approach is classically related to black spot identification, analysis and correction, a management procedure based on monitoring the spatial concentration of accidents and trying specific corrections to the problems that can explain this safety record. Other approaches are also possible (as those devoted to risky accident types or user groups and those applied on a corridor or area) but less usual.

The second approach is more recent. Its importance increases as black spots are eliminated or a higher standard of road safety is mandated. When it is no longer acceptable to wait for accidents to reveal safety problems, preventive actions should be applied. Two traditional preventive approaches, at least in the U.K., are Urban Safety Management and Road Safety Audits (and Inspections or Reviews, when applied to existing roads). Other approaches are also possible (as the use of the Traffic Conflict Analysis Technique) but were not considered.

#### Black Spot Analysis, with Attention to VRUs

Black spot treatment programs are the more traditional and widely applied approach in road safety engineering. Their strengths as well as their weakness are clearly discussed in several classical sources (e.g. the U.S.ITE Traffic Engineering Handbook or the U.K.Accident Investigation Manual, among many others). A major methodological revision to its approach came in the 1990´s through a critic based on detecting and eliminating the regression to the mean bias. Hauer [36] can be mentioned as an authoritative reference on this update. A recent evaluation of European practices against this new yardstick was done by Elvik [37].

Actions driven to black spot management should be routinely implemented by almost all agencies that have gained access to systematic accident data. A basic view in “The ADB Road Safety Guidelines” can be translated as: 1. Train a small team to monitor the safety of its road network; 2. Identify and improve the HRL (inter-urban and urban) according to annual targets; 3. Focus on speed reduction near schools, in residential and other areas with pedestrian and cyclist accidents. The last point was added to the traditional vision, asking for particular attention to VRUs. Other points are usually adopted in general. In Brazil, as an example, cities that have an organized data collection system for accident records usually have also some procedure for monitoring black spots and treating them (as in the City of São Paulo), even if there is no institutionalized requirement for carrying it out.

The review of European practices on black spot management by Elvik [37] mentions that, at that moment, no European country implemented state-of-the-art methods for black spot management. Practices varied a lot among countries and no clear set of recommendations can be grasped from current methods, other than the adoption of a black spot management program (if it was not adopted yet and if spatial concentration of accidents is a sharp features of accident occurrence patterns in the country). The basic attention to black spot management was then evaluated here.

|  |
| --- |
| **Measure:** Black Spot Analysis, with Attention to VRUs |
| **Description:** implementation and monitoring of black spot programs, weighting the harm to VRUs |
| **Current Practice:** In Brazil, agencies that have an organized accident database usually carry-out black spot analysis among their routine activities. However, there is no institutional requirement for doing it or for giving special attention to VRUs. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* The emphasis on the VRU safety should be added. The action on black spots do not show the level of results needed. | *Regulatory:* The official requirement for treatment for black spots can boost their study (and related policies).The black spots are usually known in most cities or highways. Actions for black spots can guide more general policies. |
| *Technical:* The requirement of monitoring should be added. Local actions do not solve general problems. Problems in accident data can prejudice black spot analysis (further data would be needed). | *Technical:* The procedure used in black spot analysis is well known and can be effective to solve local problems. Engineering measures are usually effective in solving local problems. |
| *Economic:* Other criteria can change the correct use of resources. A high skilled team of professional is needed for black spot analysis. | *Economic:* Resources are usually available. Social return to interventions is usually positive and rapid. |
| *Behavioural:* Calling for reaching accident reduction targets is weak. Actions driven to local problems usually are not effective in promote the change in behaviour required for other sites. | *Behavioural:* The fighting of black spots brings respect and credibility to road agencies. Black spot programmes generate the knowledge and improvement in techniques applied in road safety. |

#### Urban Safety Management or Other Area-wide Intervention Policies, with Attention to VRUs

Europe is largely acknowledged as pioneering road safety initiatives that adopt a broader view to improve traffic safety, either by promoting mass action plans and route action plans, or even more by applying area-wide schemes, namely urban safety management (as advocated in the UK) or road safety management (as advocated in France). Both are proposed as systematic and integrated approach that should go beyond black spot management programs in building safety into the road systems by treating consistently every site where an accident potential exists, even if accidents were not observed at a site but the potential risk were demonstrated in similar sites, and by implementing actions that add to the safety potential of engineering measures through traffic education and information, enforcement activities, integration other land use projects, ... As long as local improvements in road systems proceeds and spatial concentration is reduced by effective black spot management programs, these area-wide, systematic and integrated policies should be called into action, for dealing with more scattered and uncertain patterns of occurrence.

Here, the UK initiative for promoting USM-Urban safety management is taken as example, because it is better documented (see [38]) but similar initiative also can be found on continental European countries (e.g. [39]). A recent recommendation was published the U.K.Department for Transport [40] and its application to developing countries was investigated by the U.K.Department for International Development, including two field applications: one in Bangalore, India, and other in Cirebon, Indonesia [41]. The peculiar view of emerging economies is the goal here.

USM includes integration with other efforts that can be relevant to traffic safety (road and land use projects, information and participation or education and enforcement activities) but this synergy will not be considered here (some of these complementary measures are evaluated in other items). The U.K.DfT Guidelines [40, chapter 3] were taken here as the authoritative version of the proposed approach for USM, defined as a structured approach to accident prevention and casualty reduction on urban roads.

USM can be applied in two levels: Local Area Safety Schemes (LASS) or Whole Urban Area Safety Schemes (WUASS). Attention to VRUs is among the USM principles, as well as other users and people with disabilities. Conventional measures, as the implementation of adequate road hierarchy, including provision for pedestrians and cyclists travel needs, the adoption of speed management actions, including physical measures as well as enforcement by police or with electronic devices, and adoption of traffic management, restricting unwanted traffic but preserving access to emergency vehicles to buildings and their premises, should be used to achieve a safer distribution of traffic and their speed and manage conflicting uses of the road. All these measures are selected in a participatory process that support the vision built on the urban area. USM stresses that technical methods are means to support political commitment and community involvement in the building of a urban vision and the achievement of their safety goals.

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| **Measure:** Urban Safety Management or Other Area-wide Intervention Policies, with Attention to VRUs |
| **Description:** adopt USM or other area-wide road safety actions, from clear vision, community participation and strong political commitment |
| **Current Practice:** In Brazil, local agencies occasionally set road safety programs with wide scope, strong political support and participation but these trials should be taken as exceptions more than as a rule. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* The social support to road safety measures should increase to boost more advanced policies. | *Regulatory:* Social support can improve public policies and justify better investments. |
| *Technical:* No clear strategy to get social involvement. Lack of clear guidelines can compromise results and produce deviation from goals. | *Technical:* Techniques are not unusual. Preventive and large scale action. |
| *Economic:* Resources should be firmly compromised. Need to justify the use of resources in sites without accident records. | *Economic:* The existing resources can produce social involvement. High prospect of social return with safety and other benefits. Adoption of standardised treatments can simplify design and implementation. |
| *Behavioural:* The means for increasing social involvement have to be discovered (or created). | *Behavioural:* Can generate general change of behaviour. Long range effect of improving the position of the road agencies. |

#### Road Safety Audit/Road Safety Inspection / Other Preventive Reviews, with Attention to VRUs

RSA-Road Safety Audits (applied to road projects) and, as recently proposed as a distinguished practice, RSI-Road Safety Inspections (applied to existing roads) were largely developed in U.K., with its first application to road safety projects dating from the 1980´s. After this initial impetus and adoption in the U.K., RSA/RSI was considered in several countries, including less developed and emerging economies. In some countries, RSA/RSI reached the point of being mandatory to some class of road projects and strongly recommended to most others. It is a method for avoiding traffic accidents by preventive actions based on the judgement of a qualified expert on road safety and accidents.

Again, the UK experience will be taken as representative of good practices on RSA/RSI application. The main document that boosted the dissemination of the technique (IHT´s Guidelines on Road Safety Audit) reached the 3rd Edition in 2008 [42]. Also, revisions of the governmental requirements for the application of RSA/RSI in the U.K. were recently updated for its 4th revision in 2003 [43] and complemented with concerns on non-motorized users needs (not only safety) in 2005 [44]. This well established practice is taken as the standard for RSA/RSI application here, mostly based on the official recommendations layout in the “British RSA Requirements” [43, 44], including NMUA-Non-motorized Users Audit. These requirements usually refer to highways (specifically to trunk roads and motorways) but will be generally described as applying to roads (some adaptation to urban roads should apply). A wide variation in practice is usually admitted and will not be discussed (see [42, 45]).

In the “British RSA Requirements”, RSA is defined as the evaluation of road schemes during design and at the end of construction with exclusive focus to identify potential safety problems that may affect road users and suggest measures to eliminate or mitigate those problems. Road schemes to be audited include new construction or permanent changes to existing roads, as changes to road layout, kerbs, signs and markings, lighting, signalling, drainage, landscaping and roadside equipment (excluding regular temporary schemes and like-for-like replacement). Auditors should examine the overall geometry of the scheme with attention to all users and special concern with VRUs, including the very young, the elderly and the mobility or visually impaired. Auditing stages are: 1- Completion of preliminary design (defining land taking); 2- Completion of detailed design (...); 3- Completion of construction (preferably pre-opening or up to 1 month after opening); 4- Monitoring (with 12 to 36 months of accident data after opening).

The overall process is managed by an appointed Project Sponsor. (RSI are not treated in the current British requirements). The Audit Team should be independent of the Design Team and have at least two persons with appropriate training, skills and experience, including an Audit Team Leader and sometimes complemented by independent Specialist Advisors. The RSA starts with an Audit Brief (stating its scope and coverage, accompanied by the required documentation, as prepared by the Design Team and submitted to approval by the Project Sponsor) and is completed with the Audit Report (prepared by the Audit Team and submitted to the Project Sponsor, with a separate statement of each identified problem, describing the location and nature of problem and the type of accident considered likely to occur, followed by an associated recommendation). It is the responsibility of the Project Sponsor to ensure that all problems raised are given due consideration, to write Exception Reports for proposing alternative treatments of each problem, separately, and to instruct the Design Team in respect of any changes required as resulting from the RSA.

NMUA is a complementary process, asking for exclusive focus on VRUs needs, including disabled people, with a method aiming at integration instead of independence to design. It is felt as relevant as the failure to attend to VRUs needs can explain violations or other types of unsafe behaviours. However, its use is beginning and it will not be analyzed here any further.

|  |
| --- |
| **Measure:** Road Safety Audit/Road Safety Inspection / Other Preventive Reviews, with Attention to VRUs |
| **Description:** adopt RSA and/or RSI as mandatory or recommended practice |
| **Current Practice:** In Brazil, there are trials of RSA application, mostly to existing roads (as RSI), either urban roads or highways (sometimes large scale trials), but as voluntary practice decided by local agencies or road concessions. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* There is no requirement for its mandatory application (either as RSA to design of new schemes or RSI to existing roads). Clear guidelines are needed (to avoid conflicts in application). | *Regulatory:* Voluntary application has promoted knowledge. Role of the independent auditor adds to the design view and promote a more balanced view on safety problems. Mandatory requirement would be an option for official action. |
| *Technical:* The concept and clear guidelines need to be disseminated and standardised among professionals. Auditor should be compromised with project results (or called for results). Can increase time schedule of projects. | *Technical:* The accumulated knowledge is a good starting point for regulation or guidance. Improvements in design practice and in final schemes are expected. Can avoid vicious and biased actions. |
| *Economic:* Need of resources, mainly human resources. | *Economic:* Better design can bring more benefits and do it quickly. |
| *Behavioural:* Sometimes the agency sponsoring the project is not the agency responding for road operation (and safety). Conflicts between designers and auditors can occur and should be avoided. | *Behavioural:* The improvement in the safety of future design practice is foreseen, with due attention to avoiding defective schemes. |

### Road Safety Education (User Needs, Participation Process, and others)

This group of measures consider management procedures devoted to other tasks than that of monitoring the road network for safety problems. Generally the actions are driven to promotion of behavioural changes, perhaps with a long range approach to the improvement of the road safety situation. Policies for education and training road users, for implemention of procedures warranting information, consultation or participation of those affect by interventions or having an interest in their effects, and for improving the respect to the priority of VRUs in the road were considered for evaluation. However, in general, clear information on effective measures could not be gathered and no further evaluation were carried-out.

#### Education/Training for the Safety of VRUs

This group of measures consider actions driven to improve the general education of road users, especially for promoting the safety of VRUs. Despite generically mentioning that the inclusion of road safety in the school curriculum (appropriate to each age group) is a long time reality in Europe and advocating a more participative education process in which end-users and decision-makers partake solutions (starting from the analysis of real users needs), no clear information on the nature of traditional and innovative approaches was found, on the practices that proven to be effective and can be taken as candidate for transferring.

A general report on an European study aiming at the evaluation of road safety education practices [46] concluded that although a large number of programmes exist, evaluation is rather limited and is mostly based in intermediate results (instead of accident reduction). The vast majority of considered programmes have children before teenage as the target group and focus on their role as pedestrians. A major exception was not noted but can be mentioned: large scale efforts to train cyclists, both adults and children. The U.K. practice was an example of such kind of program, now driven by the CTSB-Cycle Training Standards Board and carried-out based on private accreditation institutes. The 3-level program for adult cyclists is: 1-basic skills training, 2-introducing to road cycling, 3-advanced road skills [47]. A 3-level program was also proposed for children: 1A-learning basic skills, 1B-basic skills training, 2-introducing to road cycling. The CTSB maintain the National Standards adopted for training and promote cycling organizations and accreditation institutes. However, limited evaluation of the final effectiveness of such kind of program is known [48].

The proposed approach to a new process stresses the search of an appropriate medium to make the exchange of opinions a fruitful measure, beyond usual procedures (interviews, focus groups, ...) and including other techniques (as mental maps and walkability lists) dedicated to users who may prefer “solo” medium to express their need: mental maps to sketch their way home/school and highlight aspects they perceive as more dangerous or safer; walkability lists were users choose the more appropriate answers to define problems characterizing their everyday walks. It seems to be proposed as an innovative approach instead of being the description of a widely applied and proven practice in Europe.

The need to improve the education of drivers and VRUs in the path to improve the VRU safety can be taken as accepted in most countries, mainly in emerging economies and less developed countries. The way to proceed, other than through the improvement of the general level of education and building a respectful environment for all road users, is not clear. In Brazil, as an example, no clear practice on road safety education (either developed in regular schools or carried-out as an external effort) was applied at large. Initiatives are isolated and do not surpass the test for idiosyncrasy of their propositions.

No measure was selected for evaluation.

|  |
| --- |
| **Measure:** Education/Training for the Safety of VRUs |
| **Description:** implement training for specific classes of VRUs as adult cyclists or child cyclist |
| **Current Practice:** In Brazil, no clear policy for training VRUs exists, either in schools or other institutions. Drivers of non-motorized vehicles and mopeds are not required to have a license for conducting its vehicles in the road, made them similar to pedestrians in this respect (despite possible to require the registration of non-motorized vehicles, attributed to local authorities, usually they are not registered and can ride on the roads without control). Initiatives to train pedestrians or non-motorized drivers are rare. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* | *Regulatory:* |
| *Technical:* | *Technical:* |
| *Economic:* | *Economic:* |
| *Behavioural:* | *Behavioural:* |

#### Information / Consultation / Participation for the Safety of VRUs

This group of measures consider measures aimed at increasing the integration of agencies and the public in discussion of traffic management issues. The U.K. approach is a clear example of a process built into traffic regulations, as the RTRA [9].

Statutory requirements and additional recommendations are clear summarized in the IHT guidelines [14, chap.10]. Three levels or involvement of the public are distinguished: 1-information: when the public have to notified about new traffic measures (a one-way process); 2-consultation: when view from the public should be sought at various stages of policy formulation and implementation (a one-way process with feedback); 3-participation: when public views are expected to be embodied into the policies (a two-way process). Under U.K. regulations, several measures require consultation to specific bodies (as police) and the public, as Traffic Regulation Orders. Nevertheless, it is conventionally recommended that the same approach should be adopted for all measures as long as possible, especially when public support and change of attitudes are important to achieve final effectiveness. Despite being traditional, no evaluation of the final effectiveness of such kind of program in improving road safety, particularly for the VRUs, was found.

In Brazil, as an example, no national requirement for embodying information / consultation / participation processes into the formulation and implementation of traffic policies is adopted as a general rule. Some specific measures can be submitted to this requirement. A major example is the requirement to inform the public about engineering studies that justified and monitored the use of electronic enforcement devices for speed control. Larger projects have strongest requirements for public audiences. Local agencies can also be submitted to more stringent rules based on municipal laws on budget approval. Most of these initiatives are related to the evaluation of urban or environmental impact of new developments or projects.

No measure was selected for evaluation.

|  |
| --- |
| **Measure:** Information / Consultation / Participation for the Safety of VRUs |
| **Description:** define requirements for information, consultation or participation in projects that have effects on VRUs |
| **Current Practice:** In Brazil, requirements for public information were limited (e.g. of studies used in implementing electronic enforcement devices for speed control). Wider consultation requirements, including public audiences, are limited to large scale projects that have to obtain approval from reports on environmental impact and/or neighbourhood impact. |

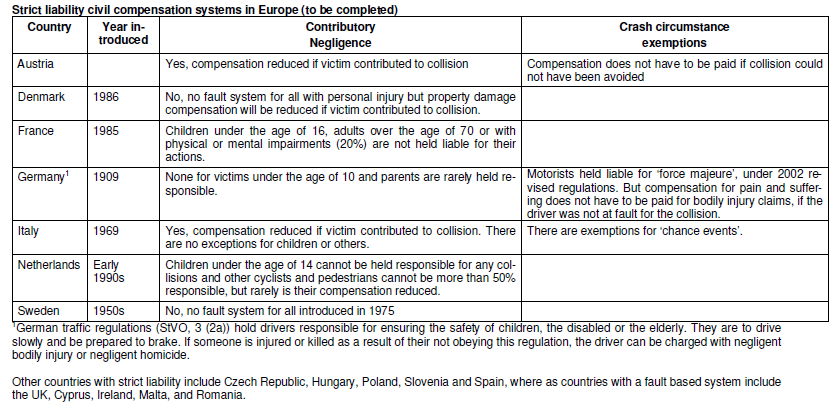
Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* | *Regulatory:* |
| *Technical:* | *Technical:* |
| *Economic:* | *Economic:* |
| *Behavioural:* | *Behavioural:* |

#### Enforcement of VRU Priority on the Road

This group of measures consider measures driven to increase the respect to the rules of road that give priority to pedestrians or cyclists. The relevance of this aspect for the safety of VRUs is widely acknowledged for explaining the difference in road safety achievements in more or less developed countries. Nevertheless, the specific reasons that explain the higher observation to VRU priority in developed countries is not clearly stated (other than the general difference on the educational level of the population, the degree of concern with safety issues, and the efficiency of the judicial system). A related issue is the current debate about the variation of this aspect among European countries and policies that can promote an improved situation. Awareness campaigns are quoted as a conventional tool but their effectiveness is not demonstrated. By the contrary, there are signs of their insufficiency and the need of enforcement or other supporting measures. No clear policy seems to be currently adopted and the debate seems to be open.

As example, the discussion on the adoption of strict liability rules (for motorized users in accidents with VRUs or generally for heavier vehicles in accidents with light vehicles or VRUs, including special concerns with children and olders) is currently in place [49]. Practice vary a lot among European countries and no consensus seems to be reached.

**

In Brazil, the problem is felt as being very relevant. Nevertheless, it is a commonly neglected area of traffic safety policies. Proposals for strengthening the judicial treatment of offenders in traffic accidents were made several times and usually rejected on political grounds. No proposal for adoption of a strict liability rule is currently in debate.

No measure was selected for evaluation.

|  |
| --- |
| **Measure:** Enforcement of VRU Priority on the Road |
| **Description:** introduce strict liability rules in traffic accidents involving VRUs |
| **Current Practice:** In Brazil, prosecution for traffic accidents in general and particularly those related to VRUs is rare and faulty. The judicial system is largely inefficient and open to personal influence and arbitrary decisions. Strict reliability rule is not adopted. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory:* | *Regulatory:* |
| *Technical:* | *Technical:* |
| *Economic:* | *Economic:* |
| *Behavioural:* | *Behavioural:* |

# To Summarise

This chapter initiates the analysis of the results gathered from the preliminary evaluation of the potential transferability for the selected list of VRU road safety measures considered on the SaferBraIn project, Further analysis should be carried-out during next stages of work, so as to produce useful results for the transferability study and the pilot studies.

To produce a big picture of the results, the views from experts were translated into a set of weights attached to six dimensions of interest:

* + - * + the expected effect of each measure on VRUs (pedestrians and cyclists), mainly on their safety;
        + the expected effect of each measure on Car users, in general (as motorized vehicles);
        + the expected effect of each measure on Other road users, when a peculiar effect can be foreseen to some particular class of road users (e.g. transit users or motorcyclists);
        + the expected effect of each measure on Agencies, either local agencies or higher level agencies that implement the measure;
        + the viability of each measure based on their Regulation requirements or impacts;
        + the viability of each measure based on their Technical requirements or impacts;
        + the viability of each measure based on their Economic requirements or impacts;
        + the viability of each measure based on their Behavioural requirements or impacts.

As long as possible, the weights were defined to reproduce the features considered by experts on the evaluation sheets, as consolidated in the previous chapter. The scale of weights was varied from +3 to -3 (from positive to negative evaluation), conveying the meaning of features considered as having small, medium or high effects. The numeric scale was adopted to permit some subsequent fine tuning on the evaluation (that could be required for distinguishing the value to be attached to measures) to be done in next tasks.

The results were presented in Table 3.1 (parts A, B.1, B.2, B.3, and C).

Table 3.1 – Summary of Weights and Scores for Evaluated Measures – Part A. General Policies for Road Safety

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Measure:** | **Effect on Ped/Bic** | **Effect on Cars** | **Effect on Others** | **Effect on Agencies** | **Regulatory Score** | **Technical Score** | **Economic Score** | **Behavioural Score** |
| **Fostering Strong, Self-Standing National Bodies, with Attention to VRUs** | 0 (uncertain) | 0 (uncertain) | 0 (uncertain) | 1 (small but significant improvement) | -1 (mostly existent but would require change in law) | -2 (difficult task for effective power, lack of political support and safety culture) | -1 (resources if a new body is to be created; warrant resources also is a problem) | -2 (technical difficulties, need to compromise other areas, reach local bodies, ...) |
| **Creating General Road Safety Policies (National Vision), with Attention to VRUs** | 0 (uncertain) | 0 (uncertain) | 0 (uncertain) | 1 (small but significant improvement) | 0 (change in law is not required but could be chosen) | -1 (lack of good accident data, need of human resources) | -1 (availability of resources is not warranted) | 0 (uncertain; commitment is a problem but targets can help) |
| **Integrating Land Use and Network Planning, with Attention to VRUs** | 2 (safer environment) | 1 (mixed) | 0 (mixed; higher cost to developers can be transferred to land prices) | -2 (demanding) | -2 (local and separate policies, as a rule, and under high pressure) | -2 (local actions on a wide area; need of criteria but known tools) | -1 (impact in development and maintenance costs can be high; benefit to citizens) | -1 (mixed; support from citizens; opposed by developers and judicial system) |
| **Data Record, Storage, Process for Indicators, with Attention to VRUs** | 1 (expected) | 1 (expected) | 1 (expected) | 0 (mixed; costs to police; benefits to other bodies) | -2 (no current duty of data provision for the police; but data is collected) | -2 (poor data quality; difficulties in coordinating units and forms) | -1 (resources for police have to be supplemented but reduce for others) | -2 (major change in procedures and culture in police but major benefit) |
| **Data Dissemination Activities, with Attention to VRUs** | 0 (uncertain) | 0 (uncertain) | 0 (uncertain) | 0 (mixed; pressure for results but better knowledge) | -2 (there is a body but data provision is a problem; data quality also) | 0 (not hard, if data provision and quality could be warranted) | 0 (not hard, if data provision and quality could be warranted) | 1 (pressure for results but better knowledge) |
| **Fund Raising for Road Safety (Road Safety Tax, Insurance Companies) to VRUs** | 1 (expected) | 1 (expected) | 1 (expected) | 1 (benefit if resources are warranted) | 1 (several sources but not effectively available) | -1 (lack of control and mechanisms for warranting good application) | 1 (benefits from availability of resources, if effective) | 1 (benefits from availability of resources but control is needed) |

Table 3.1 – Summary of Weights and Scores for Evaluated Measures – Part B.1. Safe Planning and Design of Roads: Pedestrian Focused Measures

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Measure:** | **Effect on Ped/Bic** | **Effect on Cars** | **Effect on Others** | **Effect on Agencies** | **Regulatory Score** | **Technical Score** | **Economic Score** | **Behavioural Score** |
| **Sidewalks / Footways** | +2 (comfort and safety for pedestrians; also for cyclists if shared) | +1 (benefit of taking pedestrians from the road by defective sidewalks) | +1 (as for cars) | -1 (increased effort for provision and maintenance; small compared to road provision) | -1 (local laws; usually attributed to developers) | -1 (better standards are required; space can be a constraint) | -1 (low cost, except in the adaptation of existing roads; everyday benefit) | -1 (require public provision or enforcement against developers) |
| **Pedestrian Refuges / Footway Build-outs or Kerb Extensions** | +1 (comfort and safety for pedestrians) | -1 (potential obstacles) | -1 (as for cars) | -1 (increased effort for provision and maintenance)  +1 (self-enforced) | -1 (lack of standards and requirements) | +1 (well known and effective; but applicable only if large width or parking; drainage) | -1 (low cost but requires prompt maintenance) | +1 for pedestrians (safe crossing)  -1 for vehicles (new obstacle) |
| **Dropped Kerbs / Tactile Paving / Other Facilities for VRUs with Disabilities** | +1 (for VRUs with disabilities; may be essential in some settings) | 0 (no effect) | 0 (no effect) | -1 (increased effort for provision and maintenance) | 0 (there are standards that should be enforced) | -1 (quality of sidewalks comes first);  +1 (improved standards) | -1 (low cost; but should be standardized) | + 1 (channelizing effect);  -1 (but may be obstructed) |
| **Zebra Crossings / Other Facilities for Pedestrian Priority without Signals** | +1 (if effective, but limited applicability) | -1 (delays if effective VRU priority) | -1 (as for cars) | 0 (uncertain) | -3 (could require change in law, authorization or new practice) | 0 (undefined; need guidelines; limited applicability) | - 1 (intermediate cost)  +1 (if effective) | +1 (if effective, fill the need to increase VRU priority)  -1 (may require enforcement) |
| **Pelican Crossings / Other Facilities for Pedestrian Priority with Signals** | +1 (if effective, but undefined applicability) | +1 (intermediate delay compared to conventional midblock signals) | +1 (as for cars) | 0 (similar to conventional midblock signals) | -2 (require experimental authorization or new practice) | +1 (similar to conventional signals);  +1 (if effective) | 0 (similar cost; potential benefit of reduced delay to vehicles) | -1 (change in regulation; new panels may suffer vandalism)  +1 (if effective) |
| **Puffin Crossings / Other Facilities with Technology Improvements for Pedestrians** | +1 (if effective, but undefined applicability) | +1 (if effective, but undefined applicability) | +1 (as for cars)) | -1 (uncertain; added effort for maintenance may be relevant) | -2 (require experimental authorization or new practice) | 0 (uncertain) | -1 (added cost; perhaps better for road users) | -1 (undefined acceptance and effectiveness; need campaigns) |
| **School Crossing Patrols (or Patrollers)** | +1 (relevant but limited applicability) | 0 (very small; delays) | 0 (as for cars) | 0 (very small; train and enforce) | -3 (could require change in law, authorization or new practice) | -1 (training and enforcement) | 0 (small cost; benefit to children and parents) | 0 (undefined; action of patrollers and driver response) |
| **Footbridges / Underpasses** | +2 (if high use, very effective) | +1 (reduce conflicts) | +1 (as for cars) | -2 (large investment  +1 (easy to maintain; self-enforced)) | 0 (usual; better guidelines) | 0 (usual, better guidelines) | -2 (high cost);  +1 (but socially effective) | +1 (if high use, effective)  -1 (required spacing) |
| **Pedestrian Barriers and Guard-railing / Bollards** | +1 (safer)  -1 (obstruction) | +1 (safer) | +1 (as for cars) | -1 (investment for provision; need of maintenance)  +1 (self-enforced) | 0 (usual; better standards) | +1 (well known and effective; better standards) | -1 (cost of provision and maintenance) | +1 (self-enforced)  -1 (obstruction to pedestrians) |
| **Lifted Pedestrian Crossings / High Visibility Pedestrian Crossings** | +1 (if effective) | -1 (discomfort) | -1 (as for cars) | -1 (investment for provision; need of maintenance)  +1 (self-enforced) | 0 (but stringent criteria) | 0 (but better guidelines) | -1 (high cost) | +1 (self-enforced)  -1 (acceptance for drivers) |

Table 3.1 – Summary of Weights and Scores for Evaluated Measures – Part B.2. Safe Planning and Design of Roads: Cyclist Focused Measures

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Measure:** | **Effect on Ped/Bic** | **Effect on Cars** | **Effect on Others** | **Effect on Agencies** | **Regulatory Score** | **Technical Score** | **Economic Score** | **Behavioural Score** |
| **Bikeways / Other Exclusive Facilities, Segregated from Motorized Vehicles** | +2 (bikes, best option)  -1 (peds if space is lost for bikeways) | +1 (reduced conflict with bikes)  -1 (if space is lost for bikeways) | +1 (as for cars) | +1 (easy to design; no enforcement)  -2 (large investment) | +1 (well-known, even if not widespread) | +1 (easy to design)  -1 (space constraints can be binding) | -2 (high cost of provision; added maintenance)  +2 (large benefits) | +2 (best option to cyclists)  -1 (opposition of users that lose space to bikeway) |
| **On-Road Cycle Lanes and Cycle Priority in Arterial Roads** | +1 (increase awareness of cyclists on road)  -1 (respect may be a problem) | -1 (space constraints and conflicts with cyclists) | -2 (safety of conflicts with bus stops; large bus flow in arterials) | -1 (hard to design; conflicts)  -1 (investment; may require enforcement) | -1 (need better regulation or new practices; but compatible) | -1 (space constraints and conflicts with cyclists) | -1 (intermediate cost)  +1 (intermediate benefit) | -1 (respect may be a problem)  +1 (incentive to cycling) |
| **On-Road Cycle Lanes/Routes and Cycle Priority in Non-Arterial Roads** | +1 (increase awareness of cyclists on road)  -1 (respect may be a problem) | 0 (fewer conflicts) | -1 (may affect local citizens)  +1 (may improve local areas) | -1 (investment; may require enforcement) | -1 (need better regulation or new practices; but compatible)  +1 (well-known local measures) | -1 (conflicts with local uses; treatments at intersections) | -1 (intermediate cost)  +1 (intermediate benefit) | +1 (incentive to cycling) |
| **Shared Foot and Cycle Ways** | +1 (bikes, safer space)  -1 (peds, conflict with bikes) | +1 (reduced conflict with bikes) | -1 (for local uses if bicycle flow is high) | -1 (investment; maintenance; but easy to design) | +1 (well-known, even if not widespread) | 0 (could be limited for low bike flow) | -1 (intermediate cost) | +1 (shared use may build a better environment)  -1 (speed of bicycles) |
| **Exceptions for Cyclists / Other Facilities for Cyclist Priority without Signals** | +2 (better for bikes)  -1 (may be unsafe) | -1 (may generate additional conflicts) | -1 (as for cars) | -1 (increase complexity of signing) | 0 (possible) | -1 (case by case analysis)  +1 (better design) | -1 (increased cost of signing) | 0 (uncertain; may be positive or negative) |
| **Advanced Stop Lines (ASL) / Other Facilities for Cyclist Priority at Signals** | +1 (bikes, small benefit)  -1 (may be unsafe) | -1 (may generate additional conflicts) | -1 (conflicts with motos; may be very unsafe) | -1 (complex signing and timing) | -3 (need to be regulated by law) | -1 (complex signing and timing)  -1 (may be unsafe) | -1 (increased cost of signing; maintenance too) | -1 (obedience and safety are concerns) |
| **Toucan Crossings / Other Facilities for Crossing of Cyclists or Special Users Other than Pedestrians** | 0 (uncertain) | 0 (no effect) | 0 (no effect) | -1 (increase complexity of signing) | -1 (at least, would require experimental authorization) | -1 (no guidance or regulation) | -1 (small cost, if there are pedestrian signal heads) | -2 (users need information; no enforcement rule for cyclists) |
| **Bike Stands / Other Facilities for Parking Bicycles** | +2 (very important) | 0 (no effect) | 0 (no effect) | -1 (investment; maintenance; perhaps guarding) | 0 (possible) | +1 (well-known; several options) | -1 (low cost but can require better options) | -1 (concern with theft and vandalism)  +1 (promote cycling) |

Table 3.1 – Summary of Weights and Scores for Evaluated Measures – Part B.3. Safe Planning and Design of Roads: Motor Vehicle Focused Measures that Benefit VRU Safety

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Measure:** | **Effect on Ped/Bic** | **Effect on Cars** | **Effect on Others** | **Effect on Agencies** | **Regulatory Score** | **Technical Score** | **Economic Score** | **Behavioural Score** |
| **Shared use of bus lanes/bus ways by bicycles or motorcycles** | +1 (bikes, right to use bus lanes but not clearly safe) | +1 (benefit if motorcycles are attracted to bus lanes) | +2 (motos, right to use bus lanes but if width is enough)  - 1 (buses, loss of exclusivity) | 0 (no effect; enforcement is a problem but is not worse than today) | +1 (it seems compatible with current regulation) | -1 (conflicts with buses; required width with provision for overtaking would be a constraint) | -1 (if width of bus lanes have to be increased) | -1 (conflicts with buses; entry and exit of bus lanes; rules for overtaking) |
| **Traffic Calming or Shared Space / Shared Roadway or Mixed Function Roads** | +2 (better and safer environment) | -2 (lower speed and comfort) | -1 (as for cars but smaller effect) | -1 (increase complexity of design or change of paradigm) | 0 (possible; may require experimental authorization for some measures) | -1 (case by case analysis)  +1 (better design for local areas) | -1 (cost may be high) | +2 (benefits to local activities)  -1 (acceptance by vehicle users) |
| **Speed Humps / Speed Cushions / Other Devices based on Vertical Deflection** | +1 (increased safety) | -1 (lower speed and comfort) | -1 (as for cars but smaller effect) | +1 (well-known; not for cushions) | +2 (regulated and well-known)  -1 (no regulation for cushions) | +2 (well-known and easy to apply)  +1 (cushions are less known) | +1 (small cost; B/C to society is more important) | +1 (self-enforced but can cause diversion and compensation) |
| **Speed Tables / Lifted or Raised Intersections** | +1 (potentially effective for peds) | -1 (potentially similar to speed humps) | -1 (as for cars) | -1 (unusual; cost of installation and change) | -1 (may need guidance or authorization) | -1 (not widely known or used) | -2 (high cost; can be reduced for new roads) | 0 (uncertain; potentially effective) |
| **Chicanes / Priority Narrowing / Other Devices based on Horizontal Deflection** | 0 (potentially effective for peds; concerns on adverse effects) | -1 (intermediate speed reduction) | -1 (as for cars) | -1 (unusual; complex design and intermediate cost) | -1 (may need guidance and/or authorization) | -2 (not widely known and used; complex design) | -1 (intermediate cost; intermediate effects) | 0 (uncertain) |
| **Vehicle Activated Signs (VAS) for VRU Safety** | 0 (uncertain) | 0 (uncertain) | 0 (uncertain) | -1 (unknown equipment and use; high cost) | -1 (may need guidance and/or authorization) | -1 (seems experimental) | -2 (high cost foreseen) | -1 (unknown effectiveness; vandalism) |
| **Road Lighting for VRU Safety** | +2 (increase traffic and public safety) | +1 (improved visibility) | +1 (as for cars) | -1 (effort in installation and maintenance) | 0 (not mandatory but possible; better guidance) | +1 (effective and simple) | -1 (intermediate cost, including power supply) | +1 (general improvement of safety) |
| **Safety (Speed and Red Light) Cameras / Other Electronic Enforcement Devices** | +2 (safe; very effective but effect may be punctual) | -1 (lower speed and fines) | -1(as for cars) | -1 (complex contracting)  +1 (revenue from fines; self-funding) | +1 (regulated) | -1 (complex contracting)  +1 (simple application) | -1 (high cost)  +1 (revenue from fines) | +1(effective; effect may be punctual)  -1 (public acceptance) |

Table 3.1 – Summary of Weights and Scores for Evaluated Measures – Part C. Management of Road Safety

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Measure:** | **Effect on Ped/Bic** | **Effect on Cars** | **Effect on Others** | **Effect on Agencies** | **Regulatory Score** | **Technical Score** | **Economic Score** | **Behavioural Score** |
| **Black Spot Analysis, with Attention to VRUs** | +1 (effective but diminishing results and no focus on VRUs) | + 1 (effective but diminishing returns) | +1 (as for cars) | +1 (well known but pressures for other actions) | +1 (recommended but not required or called for targets) | +1 (well known but diminishing results) | +1 (positive but diminishing results) | +1 (strengthen road agencies; no behavioural change) |
| **Urban Safety Management / Other Areawide Interventions, with Attention to VRUs** | 0 (uncertain; no focus on VRUs) | 0 (uncertain) | 0 (as for cars) | +1 (strong position)  -1 (hard process) | -1 (no statutory basis but local regulation) | -1 (no clear guidance; hard process) | +1 (can manage existing resources) | 0 (uncertain but potentially effective) |
| **Road Safety Audit (RSA) / Road Safety Inspection (RSI) / Other Preventive Reviews, with Attention to VRUs** | +1 (guidelines with attention to VRUs) | +1 (guidelines with attention to motorized vehicles) | +1 (as for cars) | -1 (need of resources and management) | -1 (need of support seems essential) | -1 (guidelines have to be disseminated) | -1 (has to be effective to compensate cost and time increase) | 0 (uncertain but potentially effective) |
| **Education and Training of Road Users for the Safety of VRUs** | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) |
| **Information / Consultation / Participation Process, with Attention to VRUs** | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) |
| **Enforcement of VRU Priority on the Road** | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) | 0 (undefined) |

Summarising the implication of these initial results, ... Corazza/Heger/Tripodi/Luca´s task ...

* Bullets
* Bullets

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# Appendices

## Evaluation for “General Policies to Improve Safety of VRUs”

* + Coordination and Management of Roads:
    - Fostering strong, self-standing national bodies;
    - Creating general road safety policies;
    - Integrating land use and network planning;
  + Road Accident Data Systems:
    - Data record, storage, process for indicators;
    - Dissemination activities;
  + Fund raising for road safety (road safety tax, insurance companies).

|  |
| --- |
| **Measure:** Fostering Strong, Self-Standing National Bodies, with Attention to VRUs |
| **Description:** A=define ministerial attribution, b=define a national road safety council, C=target safety problems (risk groups) |
| **Current Practice:** In Brazil, the National Traffic System is clearly defined in the Brazilian Traffic Code (CTB). There is a National Traffic Council (CONTRAN) with strong regulatory power but not exclusively focused in traffic safety. However, the effective coordination power of the National Agencies can be seen as weak and safety problems are not clearly identified or perceived as priority. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: A e B=o CONTRAN é um órgão politicamente fraco, portanto sujeito a pressões. A=criação de outro conselho dividiria responsabilidades. C=embora os grupos de risco sejam conhecidos faltam dados para quantificar / detalhar a situação.  **B**: Dificuldade na diversidade dos municípios.  **C**: Discordo de criação de mais um conselho. Devemos utilizar as estruturas que já existem. Seria só um aumento na burocracia.  **D**: (Experimental) Possíveis conflitos com regulamentações existentes no CTB. Possíveis conflitos de interesse político. | *Regulatory*  **A**: A e B=no Brasil, já existe o CONTRAN, com representação ministerial. C=os principais grupos de risco são conhecidos.  **B**: Garantir, padronizar melhorias nas condições de segurança. Política única focada nos indicadores estratégicos.  **C**: A vantagem seria um conselho mais focado. Talvez mais para frente, quando as estruturas estiverem mais fortes.  **D**: (Possível) Abertura para novos elementos de regulamentação e medidas de penalidade. Destaca a relevância da segurança de VRU. |
| *Technical*  **A**: A e B=por ser órgão fraco, algumas vezes as decisões políticas prevalecem às técnicas. Falta a motivação / conscientização da sociedade para a questão da segurança no trânsito (Falta o marketing de segurança e falta a cultura/valor da segurança).  **B**: Dificuldade na formação de um corpo técnico com qualidade que faça uma gestão efetiva da aplicabilidade das metas propostas.  **C**: Não tem.  **D**: (Desconhecido) Criação do novo órgão que pode ser usado politicamente. | *Technical*  **A**: A e B=não há dificuldades técnicas para o CONTRAN, que inclusive conta com o apoio técnico das câmaras temáticas.  **B**: Estender políticas de segurança para todo pais, principalmente aos municípios sem estrutura administrativa suficiente.  **C**: É possível e existem técnicos no Brasil capazes para compor esse conselho.  **D**: Desenvolvimento e divulgação de práticas de segurança. Criação de novas propostas de segurança de VRU. Maior discussão sobre as novas técnicas. |
| *Economic*  **A**: Não há problemas econômicos.  **B**: Dificuldades burocráticas para contratação de mão de obra especialidade, empresa pública.  **C**: Aumento dos custos por conta da burocracia mas é custeável.  **D**: Alto custo. Todo novo órgão gera um custo para a união que tem que ser absorvido pela população. | *Economic*  **A**: Não há problemas econômicos.  **B**: Garantir orçamento voltado as políticas de segurança, realizar campanhas nacionais.  **C**: Poderia ser um centralizador de programa, reduzindo custos. Haveria, eventualmente, ganhos caso os acidentes foram reduzidos, por conta da criação desse novo conselho.  **D**: Diminuição dos acidentes gera um ganho econômico que justifica o investimento. |
| *Behavioural*  **A**: A e B=há necessidade de fortalecimento institucional dos órgãos de trânsito  **B**: Não atingir alguns problemas específicos da região.  **C**: Hoje não há o mesmo respeito que na Europa. (p.ex) porque é um reflexo da própria ineficiência do sistema judiciário como um todo. Não há credibilidade, o que reflete na falta de obediência da população as leis de trânsito. Outro aspecto a considerar é a “má vontade” da mídia em relação a fiscalização de trânsito. Sempre há matérias sobre a “indústria de multas”, por exemplo. Isso se deve a o fato que a fiscalização de trânsito é uma ação democrática, ou seja, multa tanto o rico como o “pobre”. Os formadores de opinião não se conformam de receber o mesmo tratamento de uma pessoa “qualquer” e se fazem ouvir pela mídia, depreciando a fiscalização.  **D**: Possíveis conflitos políticos. | *Behavioural*  **A**: Considerando a estrutura já disponível, basta encontrar os meios ou torná-los mais fortes.  **B**: Garantir uma melhoria nacional de comportamento.  **C**: Depende apenas de uma alteração na legislação federal.  **D**: O novo órgão deverá divulgar uma cultura específica para o VRU, que deveria alterar o comportamento dos usuários. A possibilidade de legislação e penalidades afetaria o comportamento dos usuários. |

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| **Measure:** Creating General Road Safety Policies (National Vision), with Attention to VRUs |
| **Description:** Adoption of a strong National Vision and of quantified safety targets |
| **Current Practice:** In Brazil, efforts were developed to implement a National Policy on Traffic Safety Problems, including the proposition of qualitative and quantitative targets but no effect was produced. Proposition reached the public consultation stage and there is a proposal for voting a legal instrument to state the National Policy on Traffic Safety Problems as part of a National Urban Mobility Direction Act. Furthermore, nowhere a strong vision was credibly set out ... |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: O plano nacional de trânsito teve pouco efeito. Não há previsão de votação / Aprovação do PL  **B**: Dificuldade em acompanhar o cumprimento / resultado das metas.  **C**: Descrédito no caso de haver campanhas / investimentos e não serem atingidas as metas.  **D**: Pela diversidade entre os estados brasileiros é extremamente difícil criar metas unificadas para todos. | *Regulatory*  **A**: Já existiu um plano nacional de trânsito com ênfase na segurança, incluindo metas. Existiu um PL para aprovação de um plano nacional de mobilidade.  **B**: Maior objetividade nas atividades dos municípios relacionados as políticas públicas.  **C**: O planejamento e o desenvolvimento da ação em favor da segurança.  **D**: Criação de metas específicas que valorizarão o tema segurança de VRU. |
| *Technical*  **A**: Não há problemas técnicos  **B**: Não levar em consideração as especificidades locais.  **C**: Existem grandes dificuldades no registro de acidentes. As metas seriam baseadas em dados que poderiam não refletir a realidade.  **D**: Precisariam ser criados órgãos estaduais que tratem de forma específica e local as novas medidas de segurança. Eterno conflito com fluidez do trânsito. | *Technical*  **A**: Não há problemas técnicos.  **B**: Dificulta ingerências locais no desenvolvimento das políticas de segurança.  **C**: Existem recursos humanos para propor as medidas e caso sejam atingidas as metas, a vantagem é refletida na sociedade.  **D**: Desenvolvimento e divulgação de técnicas e políticas de segurança. |
| *Economic*  **A**: Recursos atribuídos localmente ao Sistema Nacional de Trânsito, não são efetivamente alocados por decisão política.  **B**: Dificuldade dos municípios em obter verba especifica para o cumprimento da meta.  **C**: Não há. Essa providência tem custos relativamente baixos.  **D**: Custos de criação dos órgãos específicos e de implantação de obras especificas de segurança. | *Economic*  **A**: Há previsão local de recursos.  **B**: Facilita a obtenção de orçamento público.  **C**: Caso as metas sejam atingidas, o custo é desprezível , pela economia social de redução de vítimas.  **D**: Diminuição dos custos com acidentes. |
| *Behavioural*  **A**: Falta encontrar os meios para tornar o PNT uma realidade.  **B**: Não envolvimento da população na definição de meta, causando uma dificuldade no seu envolvimento.  **C**: Depende muito do apoio da polícia. Os agentes de trânsito não têm a autoridade reconhecida pela população no mesmo nível que a polícia.  **D**: Metas específicas precisam de fiscalização exclusiva, e adaptação para a cultura de cada estado. Metas precisam ter continuidade na fiscalização para serem sempre efetivas. | *Behavioural*  **A**: O PNT foi longamente discutido e parece consistente.  **B**: Intensifica o comprometimento da população.  **C**: Aumento no respeito e credibilidade dos órgãos de trânsito no caso de atingirem as metas proposta.  **D**: A divulgação e fiscalização específica para segurança, atinge o comportamento de forma positiva, desde que haja continuidade nas ações (vide faixa de pedestre em Brasília) |

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| **Measure:** Integrating Land Use and Network Planning, with Attention to VRUs |
| **Description:** implementation of Hierarchical Mono-functional Networks, with Attention to VRUs, particularly Home Zones or 20/30 Speed Zones |
| **Current Practice:** In Brazil, no unified view is being proposed or adopted. The concept of road hierarchy is traditionally adopted but its application can vary among jurisdictions. As a rule, it is applied without clear attention to VRUs built into it. Some local agencies have stronger action in approving or conditioning the approval of new developments that can be used to change design decisions. Some municipalities also have some requirements on building codes or urban laws that have attention to road safety and VRUs. However, a structural vision is rare. No national, even local, policy driven to the promotion of Home Zones, 20 or 30 Speed Zones , but there is a clear pressure for protecting residential zones, at least in more affluent areas... |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Normalmente existe separação entre as políticas de trânsito / transporte e uso do solo, chegam a ser conflitantes. Há interpretações locais contra os “bolsões residenciais” (Medidas de proteção para áreas residenciais). Atuação do ministério público.  **B**: Restrição do direito de circulação dos usuários externos. Moradores confundem segurança viária com segurança patrimonial.  **C**: Há dificuldade em cumprir (quando existem) os planos urbanísticos porque normalmente o poder econômico prevalece. A especulação imobiliária distorce a legislação.  **D**: (Possível) Medidas restritivas, com prejuízo ao tráfego de passagem, redução das velocidades. | *Regulatory*  **A**: Normalmente os órgãos de trânsito já possuem critérios para hierarquização de vias.  **B**: Organiza a circulação no espaço público. Garante melhoria dos índices de acidentes.  **C**: É mais fácil controlar / fiscalizar o tráfego em áreas mono-funcionais.  **D**: Criação de política e cultura de regulamentação local, focada no VRU. |
| *Technical*  **A**: Não há.  **B**: Faltam critérios de projeto adaptados à realidade brasileira.  **C**: Existe uma variação muito grande de legislação e de tipologia nas cidades, dificultando medidas genéricas.  **D**: (Widely Known) Necessidade de grande número de projetos específicos para cada área, elaborado por especialistas. Medidas bastante restritivas, sujeitas a não aceitação pela população. Dificuldade em áreas já consolidadas. | *Technical*  **A**: Não há.  **B**: Desenvolve técnicas para melhoria do desenho urbano.  **C**: A aplicação das medidas de engenharia é facilitado.  **D**: Projetos específicos que valorizam a segurança em bolsões específicos. |
| *Economic*  **A**: Não há.  **B**: Alto custo de implantação e manutenção. Especulação imobiliária.  **C**: É uma questão grave. Não dá para estimar o custo, por conta dos prejuízos pessoal e dos grupos econômicos (construtores).  **D**: (Alto custo). Custo dos projetos e de sua implantação. | *Economic*  **A**: Não há.  **B**: Valorização urbana e paisagística.  **C**: Valorização das áreas planejadas e atingidas pelas medidas.  **D**: Redução dos acidentes. |
| *Behavioural*  **A**: É preciso conscientizar os administradores públicos da importância da integração das políticas de trânsito / transporte / uso do solo. Além da falta de integração é notória a falta de fiscalização do cumprimento das políticas de uso do solo.  **B**: Privatização do espaço público.  **C**: Será necessário uma mudança no hábito dos motoristas que não estão acostumados com restrições de circulação em vias secundárias.  **D**: (Adapt) Não aceitação à: Restrições ao tráfego de passagem; Redução das velocidades (Obstáculos). | *Behavioural*  **A**: ---  **B**: Aproxima as pessoas, melhorando a convivência.  **C**: Melhor utilização da via pelos moradores.  **D**: Aceitação plena pelos usuários locais. Melhoria da civilidade e respeito ao VRU. |

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| **Measure:** Data Record, Storage, Process for Indicators, with Attention to VRUs |
| **Description:** direct data processing by police, with spatial reference and standard format, supplied to road authorities. |
| **Current Practice:** In Brazil, production of accident records by police departments is organized but data quality and data provision to traffic authorities is a major problem. The exception is the accident data system for federal highways, recorded and available in the DATATRAN information system. The national information system of traffic authorities (DENATRAN) on road accidents is being revised and currently is taken as poor, being filled with data voluntarily provided by local agencies. The health authorities provide similar data. The treatment to events that involve VRUs is crude. Local initiatives to improve data collection are dispersed and voluntary. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Existe grande dificuldade na coleta / processamento dos registros. Há dificuldades na integração dos bancos de dados dos diversos órgãos (Polícia, trânsito, saúde, etc) e até mesmo das unidades policiais.  **B**: Dificuldade em especificar inclusão de dados de interesse. Gestão da centralização das informações.  **C**: Tornar o BO um instrumento que também seja usado para fins científicos e não só jurídicos como é hoje, essa é uma grande dificuldade.  **D**: (Possível). Aumento do trabalho dos policiais. Aumento da burocracia. Criação de novos órgãos e departamentos. Necessidade de cobrança por órgãos beneficiados. | *Regulatory*  **A**: Todo acidente de trânsito gera um (ou mais) registros, normalmente para polícia, contendo as informações básicas para análises de segurança.  **B**: Facilidade de acesso e garantia de informação.  **C**: Já existe uma estrutura (Polícias), que atende todo território e comparece à totalidade dos acidentes.  **D**: Unificação da tomada de dados. Criação de órgãos específicos de dados. |
| *Technical*  **A**: A falta de uniformidade na informação contida nos registros, assim como na forma / procedimento dos registros.  **B**: Garantir atualização permanente e continua.  **C**: Não existe um sistema integrado de registro.  **D**: (Known), Despreparo dos policiais. Necessidade de criação de setores específicos de banco de dados. Necessidade de acompanhamento das vítimas pós-acidente. | *Technical*  **A**: Já existem recursos técnicos para o registro / processamento de informação em tempo real.  **B**: Otimiza o processamento e analise das informações. Padronização da metodologia de coleta.  **C**: Permitiria um estudo mais aprofundado e mais eficaz dos acidentes.  **D**: Unificação dos relatórios de acidentes. Criação de banco de dados homogêneo confiável nacionalmente. Identificação dos pontos críticos. Hierarquização dos locais de acidentes, etc. ... |
| *Economic*  **A**: Em geral, a polícia e os órgãos de trânsito não dispõem de recursos para modernizar / informatizar o registro / processamento das informações.  **B**: Custo operacional de processamento.  **C**: Custos altos com o sistema integrado e com o treinamento dos agentes (muito altos)  **D**: (Affordable) Custo do maior tempo no atendimento das ocorrências. Criação de banco de dados locais com novos funcionários com enormes investimentos. | *Economic*  **A**: ---  **B**: Enxugamento da equipe de processamento do órgão de trânsito.  **C**: A longo prazo, a redução dos acidentes decorrentes dos estudos de segurança.  **D**: Redução dos acidentes à médio prazo. |
| *Behavioural*  **A**: Não existe mecanismo para cobrar / exigir dos órgãos de trânsito o envio de dados.  **B**: Submissão à decisão do responsável.  **C**: Para os usuários (Polícia) haverá dificuldade em mudar a forma de preenchimento dos BOs e também valorizar o instrumento como ferramenta científica.  **D**: (Acceptable)--- | *Behavioural*  **A**: A possibilidade de conexão direta da polícia com os órgãos de trânsito é positiva.  **B**: Menor dependência à decisões locais.  **C**: Confiabilidade maior dos dados.  **D**: Aplicável se for regulamentado. |

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| **Measure:** Dissemination Activities, with Attention to VRUs |
| **Description:** integration of data sources and comparison of accident data made available to the public |
| **Current Practice:** In Brazil, official statistics are available but confidence on its quality varies. The national information system of traffic authorities (DENATRAN) on road accidents is being revised and currently is taken as poor, being filled with data voluntarily provided by local agencies. The health authorities provide similar data. Both sources do not include relevant details on individual accidents (as location, events, and so on) and have to be supplemented by data gathered by local agencies. No clear link from gathering data by police departments and provision of data to road safety agencies exists. Data are available at the internet sites of coordinating agencies but quality is poor and comparative studies are missing (perhaps because of the known problems in the quality of data or conflicts with providers of data) ... |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: As estatísticas disponíveis são incompletas, inconsistentes o, até mesmo conflitantes e não permitem identificar em detalhes os fatores de risco.  **B**: Mau uso das informações, distorção dos dados.  **C**: Resposta geral: os aspectos citados na resposta anterior continuam sendo um problema nesta questão. Uma vez resolvidas as dificuldades, a disseminação será viável, de forma simples e barata e confiável (via internet).  **D**: (Difícil). Necessidade de coleta de dados Unificada e Confiável em todos locais envolvidos. Criação de órgãos e departamentos que fiscalizem, processem e analisem os dados. | *Regulatory*  **A**: ---  **B**: Democratização da informação.  **C**: --- Vide anterior.  **D**: criação de órgãos específicos com dados confiáveis. |
| *Technical*  **A**: A inconsistência das informações disponíveis não permite credibilidade nos dados dificultando a sua divulgação.  **B**: Não havendo banco Nacional, comparação de dados coletados com metodologias diversas.  **C**: --- Vide anterior.  **D**: (Difícil) Aplicação uniforme dos resultados em todo, território nacional, devido às diversidades técnicas e culturais nos deptos de policia. | *Technical*  **A**: ---  **B**: Facilita, melhora qualidade das analises técnicas.  **C**: --- Vide anterior.  **D**: Disponibilidade de dados para melhor investimentos em segurança. Conhecimento da real situação da segurança de trânsito. Acompanhamento da evolução dos acidentes confiáveis. |
| *Economic*  **A**: A sociedade não valoriza a segurança e não esta disposta a ter gastos adicionais para obtê-la.  **B**: Infra-estrutura necessária com custo alto.  **C**: --- Vide anterior.  **D**: Criação de departamentos e órgãos com funcionários especifico. | *Economic*  **A**: ---  **B**: Minimiza tempo gasto com análise de dados.  **C**: ---  **D**: Diminuição dos acidentes. |
| *Behavioural*  **A**: Considerando a falta do real conhecimento da dimensão e das características do problema, é muito dificil conquistar o envolvimento da sociedade.  **B**: ---  **C**: --- Vide anterior.  **D**: --- | *Behavioural*  **A**: ---  **B**: Sensibiliza, facilita a conceituação da segurança junto aos técnicos.  **C**: --- Vide anterior.  **D**: A população terá real conhecimento da situação da segurança. |

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| **Measure:** Fund Raising for Road Safety (Road Safety Tax, Insurance Companies) to VRUs |
| **Description:** resources from vehicle or road taxes, mandatory and voluntary insurance, traffic fines, available for safety programs |
| **Current Practice:** In Brazil, road safety resources come from the general budget as a rule. There is a National Fund to Traffic Education and Engineering for Road Safety (FUNSET) that collects part of resources from fines generated by traffic offences and should apply them in road management and safety initiatives. There is a mandatory motor vehicle insurance system that under concession to a private insurance company (Seguradora Líder) that run it for profit but also contribute to funding (for traffic education). The participation of private insurance companies is rare. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há mecanismo para exigir o cumprimento da aplicação dos recursos do fundo na segurança no trânsito. Não é possível a vinculação de recursos gerados por impostos.  **B**: Possibilidade de desvio para outras finalidades.  **C**: Dificuldade em fazer cumprir os repasses existentes na legislação.  **D**: Já existem inúmeras formas de arrecadação para o trânsito e esta medida seria só mais uma. | *Regulatory*  **A**: O CTB já estabelece critérios para aplicação dos recursos gerados pelas multas, e pelo seguro obrigatório  **B**: Garantia na implantação de um Programa de Segurança e Educação.  **C**: Já existe uma estrutura regulamentada.  **D**: Já existem esses mecanismos o que precisa é que eles funcionem o se transformem em investimentos reais. |
| *Technical*  **A**: Não há comprovação de efetividade dos recursos aplicados  **B**: Má gestão técnica dos recursos.  **C**: Não há.  **D**: Os recursos existem, falta uma forma de utilizá-los para a real segurança do trânsito. | *Technical*  **A**: ---  **B**: Garantia da qualidade e quantidade de ações implantadas, acompanhadas de campanhas educativas.  **C**: Respaldo para aplicação das medidas de engenharia.  **D**: Idem |
| *Economic*  **A**: Órgãos de trânsito de pequenas cidades de tem dificuldade em gerar/obter recursos  **B**: Má gestão financeira dos recursos.  **C**: Dificuldade de receber o dinheiro que deveria ser destinado aos fundos.  **D**: Seria, mais uma taxação do usuário. | *Economic*  **A**: ---  **B**: Garantia de recursos financeiros compatíveis com as reais necessidades.  **C**: Não há custo adicional para o usuário, pois as fontes já existem.  **D**: Idem |
| *Behavioural*  **A**: É preciso responsabilizar diretamente os administradores públicos que não comprovem a correta aplicação dos recursos  **B**: Distorção dos objetivos pelo corpo técnico.  **C**: Só haveria dificuldade se fosse criado uma nova taxa ou imposto.  **D**: Efeito negativo por ser mais uma taxa sem uma aplicação efetiva. | *Behavioural*  **A**: ---  **B**: Intensificar a importância dos programas de Segurança como ferramenta de trabalho, tanto para os gestores como para o corpo técnico.  **C**: Para as agências, poder contar com recursos para investimento.  **D**: Não é o caso. |

## Safe Planning and Design of Roads

### B.1 Pedestrian Focused Measures

* + Pedestrian focused measures:
    - Sidewalks and Footways;
    - Pedestrian refuges, footway build-outs, kerb extensions;
    - Dropped kerbs, tactile paving, facilities for VRUs with disabilities;
    - Zebra crossing and other facilities for pedestrian priority without signals;
    - Pelican crossing and other facilities for pedestrian priority with signals;
    - Puffin crossing and other facilities with technology improvements for pedestrians;
    - School crossing patroller;
    - Footbridges and underpasses;
    - Pedestrian barriers and bollards;
    - Lifted pedestrian crossing and high visibility pedestrian crossings;

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| **Measure:** Sidewalks / Footways |
| **Description:** increase the use of facilities to easy pedestrian sidewalks along roads and walkways or footways off-roads |
| **Current Practice:** In Brazil, these measures are widely known but their application is limited. In some cities, as São Paulo, there is a legal requirement to build sidewalks flat to pedestrians but, at large, it is overlooked by developers (that usually have the responsibility for provision and maintenance of sidewalks). In general, the quality of sidewalks along main roads is better in affluent areas of the city and deficient in other areas. The situation along minor roads is even more varied. Exclusive/segregated ways (footpaths or walkways), including pedestrian streets or areas, are usual in commercial regions of the larger cities. The public safety would be a major concern on their wider applicability. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: A regulamentação é inadequada, atribuindo a responsabilidade para os responsável.  **B**: Atual legislação que define o proprietário como responsável pela construção e manutenção da calçada.  **D**: --- | *Regulatory*  **A**: Existe regulamentação para construção / manutenção de passeios.  **B**: Garantia da qualidade de conservação e construção.  **D**: Já possui a norma NBR para acessibilidade. |
| *Technical*  **A**: É preciso estabelecer padrões para dimensões, rampas, piso etc.  **B**: Escolha do piso inadequado pelo poder público.  **D**: Grande conflito entre largura da via e passeio. Dificuldades com soleiras elevadas e grade da via. | *Technical*  **A**: ---  **B**: Padronização da construção, universalizando o caminhar.  **D**: Garante a livre circulação ao longo da via para todos os pedestres. |
| *Economic*  **A**: Custo relativamente elevado, para adequação de passeios existentes.  **B**: Necessidade de recursos públicos. Aumento do valor do IPTU.  **D**: Custo de implantação. | *Economic*  **A**: Custo baixo quando.  **B**: Redução dos gastos de saúde com acidentes do caminhar na calçada.  **D**: Custo razoável em relação ao benefício para pedestre. |
| *Behavioural*  **A**: Não há fiscalização.  **B**: Resistência da população por conta do aumento de imposto.  **D**: Passeio irregular inibe sua utilização. | *Behavioural*  **A**: A existência de passeios inadequados induz a circulação de pedestres pelas ruas.  **B**: Garantir o caminhar na calçada, com qualidade.  **D**: Possibilita a plena utilização. |

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| **Measure:** Pedestrian Refuges / Footway Build-outs or Kerb Extensions |
| **Description:** increase the use of facilities to easy pedestrian crossings in major/minor arterials, distributors or local roads |
| **Current Practice:** In Brazil, these measures are widely known but its application is limited. In larger cities, as São Paulo, main roads are usually dual carriageway roads with parking prohibited, with occasional opportunities for applying these measures; however, minor roads and residential streets also do not have such features, as a rule, despite its wide applicability. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: ---  **B**: Uso ou execução equivocada.  **C**: Não há.  **D**: Não se aplica. | *Regulatory*  **A**: Há necessidade de estabelecimento de princípios básicos de projeto: largura, raios de curvatura, sinalização, etc.  **B**: Maior contato e segurança para o pedestre.  **C**: O avanço de passeios nas esquinas inibe um comportamento que já é proibido no CTB.  **D**: Não se aplica. |
| *Technical*  **A**: Um dispositivo com posição/projeto inadequados pode causar falsa sensação de segurança.  **B**: Não existência de normas.  **C**: O refúgio precisa de manutenção constante na sinalização (é um obstáculo no meio de rua). O avanço de passeio as vezes afeta a drenagem de rua.  **D**: Cria um obstáculo na via. Necessidade de ampla sinalização. Necessidade de constante manutenção. Pode gerar acidentes. Precisa de projeto padrão de geometria e sinalização para diferentes implantações. | *Technical*  **A**: Este recurso já vem sendo utilizado no Brasil, com sucesso.  **B**: Possibilidade de se transformar em norma de obrigatoriedade.  **C**: Facilita a travessia de pedestre, por reduzir a exposição na via.  **D**: Extremamente favorável para auxiliar a travessia em duas etapas (caso do refugio). Redução do espaço e tempo de travessia. Reduz a velocidade dos veículos. Aumenta a atenção do motorista. |
| *Economic*  **A**: ---  **B**: Custo de implantação / manutenção.  **C**: Há o custo com a manutenção. Não há agilidade nos reparos e nem na construção.  **D**: Custo de implantação e manutenção. Custo de obra física. | *Economic*  **A**: Dispositivos com baixo custo, comparado com os benefícios gerados.  **B**: Refúgio é a alternativa mais barata ao canteiro central.  **C**: Fácil construção, baixos custos iniciais.  **D**: Baixo custo de implantação. |
| *Behavioural*  **A**: ---  **B**: ---  **C**: Não existe ainda o hábito de construir as medidas em físico – Usa-se prismas que são inadequados.  **D**: Cria obstáculo à livre passagem. | *Behavioural*  **A**: Dispositivo facilita o comportamento associado de motoristas e pedestres  **B**: Estimular travessia no local correto. Reduz velocidade dos acidentes.  **C**: È uma medida facilmente aceitável pelos motoristas e não só pelos pedestres.  **D**: Induz os usuários à travessia em pontos de segurança. |

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| **Measure:** Dropped Kerbs / Tactile Paving / Other Facilities for VRUs with Disabilities |
| **Description:** increase the use of facilities for guiding VRUs with disability and easing the task of crossing roads |
| **Current Practice:** In Brazil, the accessibility law is newer and less widely used. The situation varies among cities. In the City of São Paulo, dropped kerbs and tactile pavements are applied on most major junctions in the consolidated part of the road system. At least a clear approach to make it required for all junctions of major roads and a more comprehensive application of tactile pavements can considered as needed. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Apesar da existência de normas, elas raramente são cumpridas.  **B**:---  **C**: A legislação já existe, mas é pouco conhecida.  **D**: --- | *Regulatory*  **A**: Já existem normas para a execução de rebaixamento de guias e dispositivos de acessibilidade.  **B**: Universaliza a acessibilidade.  **C**: Já existe a regulamentação.  **D**: --- |
| *Technical*  **A**: No Brasil existe uma dificuldade que precede a execução de dispositivos de acessibilidade, que é a existência / conservação das calçadas.  **B**: Poderá acontecer se não houver ou não foram atendidas as normas de execução.  **C**: Na calçada tem muita interferência (poço de visita, coluna). O tratamento tem que se estender para todo o passeio (Deve ser plano por ex.) Em São Paulo, a responsabilidade do passeio é do dono do imóvel e não do poder público.  **D**: Se não obedecer às normas de projeto, pode se um obstáculo para o passeio. Boa parte das ruas não tem passeio adequado para esses equipamentos. | *Technical*  **A**: Não existem dificuldades técnicas na aplicação das normas.  **B**: Melhora a qualidade dos projetos, exigindo qualidade no pavimento da calçada.  **C**: Pode ser pré-moldado, barateando os custos. A construção é rápida. Ajuda na travessia do pedestre.  **D**: Melhoria de acessibilidade para deficientes. |
| *Economic*  **A**: ---  **B**: Alto custo de implantação.  **C**: Não há (Baixo custo)  **D**: Necessidade de investimentos nos locais. Relação custo / benefício questionável em alguns locais. Custo de manutenção. | *Economic*  **A**: Na execução de uma calçada, o custo adicional para torná-la acessível é baixo.  **B**: Custo mais alto na implantação (melhor padrão da calçada) irá minimizar custos com manutenção.  **C**: Baixo custo de construção e manutenção.  **D**: Custo baixo nos projetos novos. |
| *Behavioural*  **A**: ---  **B**: ---  **C**: Uso por outros veículos (moto, automóvel). Nem sempre a G.R fica desobstruída (por ex. Camelôs)  **D**: --- | *Behavioural*  **A**: A existência de uma calçada bem construída / mantida induz ao comportamento adequado dos pedestres.  **B**: Canaliza, oriente o deficiente para local mais seguro.  **C**: Ajuda a concentrar a travessia no local correto, mesmo dos pedestres sem deficiência. Facilita para carrinhos de feira e de bebê.  **D**: --- |

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| **Measure:** Zebra Crossing / Other Facilities for Pedestrian Priority without Signals |
| **Description:** use of crossings to increase the priority of pedestrians in crossing the road, where there is no traffic signal |
| **Current Practice:** In Brazil, there is no clear option for signing an increased level of pedestrian priority in crossing the road, without traffic signals, that is widely effective. The Brazilian Traffic Code (CTB) is ambiguous about pedestrian priority. Even if agreeing on the interpretation of rules in the Brazilian Traffic Code (CTB), observation to legal rules would be a major problem. Anyway, this type of measure will have to ask experimental authorization. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: No Brasil, não há regulamentação similar. Teoricamente o pedestre tem prioridade absoluta em qualquer faixa de pedestres não semaforizada.  **B**: Dificuldade de caracterizar a priorização da travessia em função das travessias semaforizadas também serem zebradas (um único padrão de faixa).  **C**: Não está previsto no CTB. Deverá haver uma revisão / resolução.  **D**: (Experimental) Necessário criar legislação específica que regulamente o dispositivo. | *Regulatory*  **A**: A regulamentação de um dispositivo similar poderia reforçar a segurança em locais críticos.  **B**: Ressalta a prioridade da travessia para o pedestre e condutor.  **C**: Cria uma alternativa entre a sinalização de travessia e o semáforo de pedestres.  **D**: Criar uma hierarquia sobre a preferência de travessia em relação a faixa tradicional. |
| *Technical*  **A**: Há necessidade de estabelecer normas / padrões.  **B**: Exige fiscalização de estacionamento proibido.  **C**: Não há.  **D**: (Unknown) Deve ser utilizado com extrema parcimônia. Necessita manutenção constante. | *Technical*  **A**: Não há dificuldades técnicas na aplicação.  **B**: Substitui, dependendo da situação, a travessia semaforizada. Melhora a condição de visibilidade da travessia.  **C**: Evitaria a utilização do semáforo em alguns casos.. Nem sempre é posível de ser utilizado (depende da via).  **D**: DESTACA o local de travessia. Cria mecanismo de travessia mais forte para o usuário (pedestre e motorista). |
| *Economic*  **A**: ---  **B**: Custo maior com manutenção de sinalização horizontal.  **C**: É uma sinalização mais cara do que a simples faixa.  **D**: (Affordable) Custo de implantação maior que a faixa padrão (inclusive elétrica). Necessidade de manutenção. | *Economic*  **A**: O custo adicional, em relação a uma travessia tradicional, é baixo.  **B**: Alternativa mais barata que o semáforo.  **C**: É mais barato do que o semáforo.  **D**: Custo baixo. Redução de acidentes. |
| *Behavioural*  **A**: No Brasil, a prioridade para os pedestres é apenas teórica com desrespeito por parte de condutores e pedestres.  **B**: Ampla divulgação da preferencial.  **C**: Haveria necessidade de campanhas para pedestres e motoristas.  **D**: (Enforce+Adapt) Necessidade de divulgação da função e fiscalização. | *Behavioural*  **A**: ---  **B**: Maior confiabilidade do pedestre na faixa de travessia.  **C**: Poderia aumentar a respeitabilidade da relação motorista / pedestre.  **D**: Se auto-destaca como travessia de pedestre. Deve se mostrar hierarquicamente mais forte que as travessias convencionais. |

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| **Measure:** Pelican Crossings / Other Traditional Facilities for Pedestrian Priority with Signals |
| **Description:** increase the use of pedestrian actuated traffic signal, with improved practices of application |
| **Current Practice:** In Brazil, pedestrian actuated signal control is a traditional option. However, its application is reduced by the high level of pedestrian demand and road congestion. Practices as the disactivation of pedestrian actuation on peak hours and disfavourable treatment to pedestrian actuation parameters contribute to the distrust of pedestrians on such kind of traffic signal control. The main drawback to its use, however, is that pedestrian crossings are a major problem in arterial, where fixed-time signal installations are the usual option. The use of flashing yellow at the end of red for vehicles would probably have to ask for experimental authorization.  **C**: Semáforo atuado normal, como usado em São Paulo, mas com 2 melhorias: painel indicador e amarelo piscante no final do estágio de pedestre |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há normas criadas para o uso do dispositivo  **B**: Induz a adoção de fiscalização eletrônica para nossa cultura.  **C**: As mudanças na operação não estão previstas no CTB (amarelo piscante no final do estágio)  **D**: Necessita de alteração na legislação no caso do amarelo piscante. | *Regulatory*  **A**: É um dispositivo já regulamentado no Brasil.  **B**: Aumento da confiabilidade da travessia semaforizada.  **C**: Não haveria, desde criada uma nova regra.  **D**: --- |
| *Technical*  **A**: Há muitas discussões sobre o dimensionamento dos tempos de travessia e do piscante.  **B**: falta em São Paulo controladores.  **C**: Não há desde que sempre o semáforo seja instalado seguindo os critérios do projeto.  **D**: Os semáforos convencionais, em grande parte dos casos, têm ciclo inadequado (com demora no acionamento) gerando descrédito. Os ciclos são muito elevados, gerando ansiedade e descrédito. | *Technical*  **A**: É um dispositivo bastante utilizado no Brasil, tanto para cruzamentos como para meio de quadra.  **B**: Melhoria da programação e da visualização da botoeira pelo pedestre.  **C**: O amarelo piscante reduziria a ociosidade. O uso de demanda racionaliza as paradas.  **D**: O uso de semáforos com ciclo adequado, início imediato quando acionado e piscante amarelo no final, seria um grande avanço, tornando viável sua implantação e um número maior de locais. |
| *Economic*  **A**: O custo é alto para uma travessia não semaforizada.  **B**: Representação da caixa de botoeira.  **C**: O semáforo tem custos de material, de implantação e de manutenção (Energia e materiais) relativamente altos.  **D**: Custo elevado de implantação em locais novos. | *Economic*  **A**: O acréscimo de custo em um cruzamento semaforizado não é elevado.  **B**: Reduz a ociosidade do tempo de espera.  **C**: A redução na ociosidade diminuiria os custos com combustível e no tempo perdido.  **D**: Custo relativamente baixo para a nova programação nos semáforos existentes. |
| *Behavioural*  **A**: Há desrespeito por parte de condutores e pedestres.  **B**: ---  **C**: O painel indicador é mais suscetível a depredação, o que aumentaria os custos de manutenção. A alteração na forma de operação iria exigir campanhas educativas.  **D**: Nos semáforos atuais, existe grande desrespeito devido a má programação e falta de fiscalização. | *Behavioural*  **A**: ---  **B**: Maior uso das travessias.  **C**: Aumentaria a respeitabilidade à sinalização (Pela redução de ociosidade)  **D**: Com o novo tipo de ciclo (amarelo piscante) deverá haver um incremento no respeito e na sua utilização. |

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| **Measure:** Puffin Crossing / Other Facilities with Technology Improvements for Pedestrians |
| **Description:** introduce the use of pedestrian friendly traffic signal display and control |
| **Current Practice:** In Brazil, no similar technology is in use. Perhaps it should be taken as an experimental system. Perhaps components could be of interest (sidewalk detection or crossing detection) by itself. Otherwise, it probably will need experimental authorization. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: ---  **B**: Para nossa cultura exige fiscalização eletrônica.  **C**: Está em desacordo com o CTB, pois não tem o vermelho piscante.  **D**: Necessita nova regulamentação. | *Regulatory*  **A**: ---  **B**: Reduz a zero o tempo de espera do pedestre e do condutor.  **C**: Não haveria, desde que criada uma nova regra.  **D**: --- |
| *Technical*  **A**: ---  **B**: Altera o padrão usual.  **C**: Exigiria uma nova tecnologia de programação, que os equipamentos atuais não tem.  **D**: O pedestre depende da correta detecção por parte do equipamento, o que é muito sujeito a falhas. Sujeito a vandalismo (mais que o convencional). A travessia depois de iniciada é cega. | *Technical*  **A**: Há necessidade de desenvolvimento tecnológico ou importação tecnológica.  **B**: Melhor visualização do fluxo junto com a botoeira.  **C**: Reduziria as ociosidades (aborta estágios em que o pedestre acionou e não permaneceu) e garantiria o tempo sempre justo para o pedestre.  **D**: Otimiza o tempo vermelho veicular, garantindo que só seria acionado durante a travessia. |
| *Economic*  **A**: Não há informação sobre o custo deste dispositivo.  **B**: Custo mais alto. Degradação do detector e botoeira.  **C**: É muito mais caro do que o sistema atual.  **D**: Implantação possivelmente muito mais cara que o convencional. Necessita de mais manutenção | *Economic*  **A**: ---  **B**: ---  **C**: Ganho de tempo e no consumo de combustível. Redução das ociosidades.  **D**: Menos espera dos veículos. |
| *Behavioural*  **A**: ---  **B**: ---  **C**: Passa insegurança ao pedestre, pois ele não tem mais referencias visuais após iniciar a travessia. Exigiria campanhas educativas.  **D**: Necessidade de aprendizado por parte dos usuários e difícil confiabilidade na travessia | *Behavioural*  **A**: O respeito ao semáforo seria maior na medida em que não haveria esperas ociosas.  **B**: Melhora a confiabilidade do equipamento.  **C**: Aumentaria o respeito pela sinalização, pela eliminação das ociosidades.  **D**: Maior respeito, uma vez que só seria acionado durante o tempo estritamente necessário. |

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| **Measure:** School Crossing Patrols (or Patrollers) |
| **Description:** appointment and training of school patrollers by local authorities |
| **Current Practice:** In Brazil, there is no legal provision for patrollers appointed by local authorities other than agents of road authorities or the police that have enforcement power. Informal patrollers are usually used, hired by private companies. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Poderia ser introduzido na regulamentação um dispositivo que desse amparo local aos auxiliares de travessia, o dispositivo constituiria uma infração.  **B**: “Responsabilidade” do órgão público pela terceirização.  **C**: Não há regulamentação atualmente. Não existem enquadramentos no CTB para autuação dos infratores.  **D**: Precisa regulamentar o agente para penalizar o desrespeito | *Regulatory*  **A**: No Brasil, já é usual o apoio na travessia em escolas e centros comerciais. São pessoas, sem poder local, normalmente voluntarias ou contratadas por empresas.  **B**: Facilidade de mão de obra. Existência de penalidade para desobediência.  **C**: Daria maior credibilidade ao orientador.  **D**: Possibilidade de penalizar o motorista infrator na faixa de pedestre. |
| *Technical*  **A**: Há necessidade de credenciamento / treinamento dos auxiliares de travessia.  **B**: Dificuldade de recursos suficientes para capacitação e controle do serviço.  **C**: Não pode ser aplicado em vias arteriais e coletoras de alto fluxo.  **D**: Treinamento do agente para controlar os fluxos de pedestre e veículos. | *Technical*  **A**: Normalmente, esse apoio só existe como reforço de sinalização.  **B**: Atividade única do voluntário facilita treinamento.  **C**: É uma medida que só é aplicada quando há demanda, o que aumenta a eficácia de sinalização.  **D**: Facilidade de implantação nos locais. Mais segurança ao pedestre. |
| *Economic*  **A**: ---  **B**: Por ser serviço voluntário, pode haver alta rotatividade que irá demandar maiores custos com capacitação.  **C**: Não existe.  **D**: Custo de disponibilizar mais agentes. | *Economic*  **A**: ---  **B**: Economia de recursos financeiros.  **C**: O custo é baixo para o órgão público. Ganho social por utilizar pessoas da comunidade (Valorização).  **D**: Baixo custo de implantação pelo poder público. Possibilidade de utilizar funcionários da escola. |
| *Behavioural*  **A**: ---  **B**: Mau uso da autoridade e do nome da empresa.  **C**: O orientador não tem o mesmo nível de respeito pelos motoristas em comparação com os agentes oficiais.  **D**: --- | *Behavioural*  **A**: Normalmente, o respeito por parte de motoristas e pedestres, é maior com os auxiliares de travessia.  **B**: Maior entrosamento com a comunidade.  **C**: Tem caráter educativo perante as crianças, que aprendem as regras de travessia e aumenta a exposição e a área de atuação do órgão de trânsito.  **D**: Pouco desrespeito pelos motoristas. |

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| **Measure:** Footbridges / Underpasses |
| **Description:** increase the use and the standard of footbridges and underpasses, providing for pedestrians with disabilities and cyclists |
| **Current Practice:** In Brazil, footbridges (usually) and underpasses (less frequently) are widely accepted as needed to provide crossing facilities in high speed and high flow roads, especially in urban areas. Nevertheless, their costs undermines the possibility of application at large and ask for better criteria in defining where to use and how frequently use them. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: ---  **B**: Inexistência de padrões de utilização. Beneficio de transporte motorizado em detrimento do transporte à pé.  **C**: Não há instrumento legal para fiscalizar o pedestre que desobedece a sinalização e não usa a passarela / passagem.  **D**: --- | *Regulatory*  **A**: Existem normas para elaboração de projetos de passarela.  **B**: Facilidade de normatização.  **C**: Não existem problemas.  **D**: --- |
| *Technical*  **A**: Há necessidade de discutir a segregação ou não de fluxos de pedestres e ciclistas.  **B**: Comprometimento da segurança pessoal em consequência de projetos inadequados. Dificuldade de existir espaço disponível para localização dos acessos.  **C**: Em áreas adensadas, há dificuldade de se encontrar espaço para instalação.  **D**: Passarela não locada na linha de desejo do pedestre e possuir acessibilidade favorável e atrativa, caba sendo desprezada e o pedestre atravessa em nível. | *Technical*  **A**: ---  **B**: Segurança viária total.  **C**: Quando usada corretamente aumenta a segurança (Elimina a exposição do pedestre) e a fluidez (Eliminação de semáforos).  **D**: Quando bem aplicado nos locais de alta atratividade de pedestre, é o mais seguro dispositivo de travessia. |
| *Economic*  **A**: Normalmente, o custo é elevado.  **B**: Custo elevado de obras.  **C**: O custo é alto. Nas áreas adensadas a passagem subterrânea implica em remoção de interferências (Dutos, cabos) o que encarece mais ainda.  **D**: Alto custo de implantação. | *Economic*  **A**: ---  **B**: Custo / Benefício fluidez e segurança.  **C**: O retorno é relativamente rápido, pela redução dos custos com acidentes.  **D**: Se bem aplicada reduz drasticamente os acidentes. (\*bem aplicado, significa que possui rampas/elevadores adequados implantados na linha de desejo com barreiras impedindo a travessia em nível e VDM com poucas brechas) |
| *Behavioural*  **A**: No Brasil, os usuários frequentemente rejeitam as passarelas, quando existe a possibilidade da travessia em nível (Semáforo veicular ou gaps / brechas).  **B**: Resistência do pedestre na sua utilização.  **C**: Existe a resistência no uso pelo pedestre (Problemas com aumento de esforço e de assaltos).  **D**: Passarela mal implantada induz a não utilização. Pode ser um foco de atratividade para comportamento ilícito (assalto, banheiro público, camelo, morador de rua, etc) | *Behavioural*  **A**: Pedestres utilizam normalmente as passarelas quando ela é confortável e conveniente.  **B**: Num projeto adequado, a segurança e conforto oferecido.  **C**: Facilita a integração e o acesso entre áreas segregadas por vias / ferrovias, etc.  **D**: É bem aceita pela população, com maior aceitação pelas crianças, idosos e mulheres. |

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| **Measure:** Pedestrian Barriers and Guard-railing / Bollards |
| **Description:** increase the use of pedestrian guard-railing and of pedestrian protective devices |
| **Current Practice:** In Brazil, guard-railing is well-known and usually applied when the application does not interfere with land use access and its cost is felt as justified. The use of pedestrian protective devices is less usual. There are no criteria accepted for justifying its application. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação do uso de gradis / dispositivos de proteção.  **B**: Falta de critérios compromete a eficácia do uso.  **C**: Não há a figura do (B) no CTB e nem resoluções. O (A) também não tem detalhamento legal (Não existe manual nacional para seu uso e nem qualquer publicação oficial sobre as dimensões mínimas e outros itens construtivos).  **D**: Bollards não são regulamentados. | *Regulatory*  **A**: ---  **B**: Dispositivos versáteis e eficazes para segurança.  **C**: Canaliza o pedestre (A) de modo a não necessitar de fiscalização. O (B) igualmente, pois impede os veículos de estacionarem no passeio.  **D**: Grades já são regulamentadas no CTB. |
| *Technical*  **A**: São dispositivos que, normalmente, prejudicam a paisagem. No Brasil, são mais utilizados para canalizar os pedestres e não para a sua proteção da eventual invasão do passeio por um veiculo.  **B**: Inexistência de padrões de desenho para diferentes situações.  **C**: O (A) pode expor o pedestre a riscos caso não existir espaço para acomodar aquele que atravessa em local não sinalizado. Dependendo do formato pode prejudicar a intervisibilidade. (B) pode provocar riscos de acidentes com pedestres em áreas de altas demandas, pelo choque do pedestre contra o dispositivo.  **D**: O gradil é uma barreira visual e impede a livre movimentação do pedestre sendo inadequado em locais que não há clara necessidade de canalizar. Um obstáculo para a passagem do pedestre. | *Technical*  **A**: Gradis são bastante utilizados para induzir a travessia de pedestres nos locais adequados.  **B**: Elementos que impedem ou organizam a circulação.  **C**: (A) concentra a travessia em pontos apropriados. (B) evita o uso pelo veículo de áreas de pedestres.  **D**: É uma solução positiva nos locais que há extrema necessidade de restringir o movimento de pedestre. O bollard aumenta a segurança do pedestre. |
| *Economic*  **A**: O custo de instalação / manutenção é elevado.  **B**: Custo alto de implantação e manutenção.  **C**: Custo de instalação não é alto, mas requer manutenção constante.  **D**: Possibilidade de degradar a avenida e inibir o comércio local. | *Economic*  **A**: ---  **B**: Custo Beneficio da redução de atropelamentos.  **C**: Melhorias de segurança (redução de atropelamentos) e de fluidez (melhor uso da sinalização).  **D**: Baixo custo de implantação, reduz acidentes. |
| *Behavioural*  **A**: ---  **B**: Desobediência dos pedestres.  **C**: Existe uma resistência por parte dos pedestres em seguir o caminho canalizado. Parte caminha por fora e parte pula.  **D**: É uma barreira física e psicológica a livre movimentação. | *Behavioural*  **A**: As barreiras normalmente conduzem os pedestres para o local seguro, sendo mais eficientes na medida em que impeçam a travessia. Os bollards não são muito utilizados no Brasil, eles não canalizam pedestres e sim impedem a invasão dos veículos nos espaços dos pedestres.  **B**: Organização dos fluxos.  **C**: (A) torna mais claro para o pedestre qual é o local adequado para travessia.  **D**: Canaliza o pedestre para uma travessia segura. |

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| **Measure:** Lifted Pedestrian Crossings / High Visibility Pedestrian Crossings |
| **Description:** increase the use of lifted pedestrian crossings to promote pedestrians, especially those with disabilities |
| **Current Practice:** In Brazil, lifted pedestrian crossings are recommended by accessibility guidelines as an option to provide for pedestrians with disabilities, but under very stringent criteria. It remains a measure with rare application. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Há necessidade de regulamentação das travessias elevadas: posicionamento, dimensões, rampas, sinalização,etc.  **B**: Falta de norma e critérios de utilização.  **C**: O CTB não prevê, embora exista uma Norma de Acessibilidade, o que pode gerar controvérsias.  **D**: --- | *Regulatory*  **A**: ---  **B**: Melhor utilização do dispositivo pelos técnicos.  **C**: ---  **D**: Já existe a regulamentação. |
| *Technical*  **A**: Há necessidade de desenvolver uma solução para drenagem superficial.  **B**: Obra que exige critérios construtivos rigorosos, incluindo drenagem adequada.  **C**: Os critérios construtivos não estão totalmente consolidados.  **D**: Nas vias com baixo volume de pedestre, reduz a velocidade de forma obrigatória (com ou sem pedestre). | *Technical*  **A**: É uma solução aparentemente de maior segurança e conforto para pedestres, possibilitando a continuidade dos passeios.  **B**: Boa alternativa para melhorar visibilidade e conforto do pedestre.  **C**: Define claramente a prioridade para o pedestre. Aumenta a velocidade de travessia, pois não há desníveis.  **D**: Reduz a velocidade e configura o “território” do pedestre, com as prioridades impostas. |
| *Economic*  **A**: ---  **B**: Custo de implantação e manutenção.  **C**: O custo não é baixo. Existe necessidade de projeto e execução cuidadosos para não haver problemas associados, como afetar a drenagem da via, por ex.  **D**: Custo de implantação | *Economic*  **A**: O custo não é elevado.  **B**: ---  **C**: Retorno rápido do investimento, manutenção barata.  **D**: Se bem aplicado, efeito positivo com custo razoável |
| *Behavioural*  **A**: ---  **B**: Falsa sensação de segurança do pedestre devido à falta de fiscalização de prioridade do pedestre.  **C**: O motorista não está habituado e pode não perceber a lombada.  **D**: Ela representa um obstáculo imposto para reduzir a fluidez | *Behavioural*  **A**: Aparentemente, o respeito é maior por parte dos motoristas e pedestres.  **B**: Estimula o maior uso da faixa pelo pedestre, oferecendo conforto e acessibilidade.  **C**: Aumenta a respeitabilidade para com o pedestre.  **D**: Destaca e prioriza o pedestre, de forma física e dinâmica. |

### B.2 - Pedal Cycle Focused Measures

* + Cyclist focused measures:
    - Bikeways and other facilities segregated from motorized vehicles;
    - On-road cycle lane and cycle priority in arterial roads;
    - On-road cycle lanes/routes with cycle priority in non-arterial roads;
    - Shared foot and cycleway;
    - Exceptions for cyclists and other facilities for cyclist priority without signal;
    - Advanced Stop Lines (ASLs) and Bicycle priority at intersections
    - Toucan crossing / Other facilities for cyclist and special users other than pedestrians
    - Bike stands / Other facilities for parking bicycles.

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| **Measure:** Bikeways / Other Exclusive Facilities, segregated from motorized vehicles |
| **Description:** implementation of cycle tracks where the option is the provision on high speed and heavy flow roads |
| **Current Practice:** In Brazil, cycle tracks are rarely provided, as it is the case for cycle infrastructure in general. For long distance trips, arterials would be the main option and the required cycle tracks could be outside the budget of most cities. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: No Brasil, não existe regulamentação especifica.  **B**: falta de política de transporte cicloviário. Falta de normatização para projeto geométrico e sinalização.  **C**: Não há. A regulamentação existente prevê a sinalização necessária. O que não existe é a fiscalização do ciclista.  **D**: --- | *Regulatory*  **A**: A restrição legal para circulação em arteriais talvez seja a velocidade mínima.  **B**: Melhoria urbanística da cidade. Facilidade de adaptação regulamentar.  **C**: Se houver regulamentação para o ciclista (Possível de ser feita), aumentará o respeito pela via segregada.  **D**: Já existe. |
| *Technical*  **A**: Falta de espaço?  **B**: Carência de espaço físico em sistema viário existente. Resistência do corpo técnico em ceder espaço viário para a bicicleta.  **C**: Em geral não existe espaço para as ciclovias nas arteriais. Haveria necessidade de usar parte da via veicular.  **D**: Conflito entre largura da rua/ciclovia. Falta de plano cicloviário | *Technical*  **A**: Em arteriais e algumas coletoras a segregação parece ser a melhor opção, em principio, os critérios propostos são interessantes.  **B**: A segregação física do espaço de circulação da bicicleta facilita a solução técnica de interface com o tráfego motorizado.  **C**: Maior disciplina do fluxo. Incentivo ao uso da bicicleta, retirando parte dos veículos particulares.  **D**: Se bem planejado permite uma grande flexibilidade do usuário de bicicleta. |
| *Economic*  **A**: O custo da segregação é elevado.  **B**: Alto custo da infra-estrutura (ciclovia).  **C**: Custo muito alto. Inviabilizaria a aplicação em muitos locais.  **D**: Custo de implantação elevado. | *Economic*  **A**: ---  **B**: Redução de gastos com saúde pública.  **C**: Com o incentivo a uso de bicicletas, haveria redução de congestionamentos (Melhoria de ar e menos gasto com combustível.  **D**: Benefício ao transporte dos usuários da ciclovia e público. |
| *Behavioural*  **A**: Como tratar os usuários que não usam a infra-estrutura existente?  **B**: Resistência da população usuária do transporte individual motorizado em ceder espaço.  **C**: Possibilidade de atropelamento do pedestre pelo ciclista.  **D**: --- | *Behavioural*  **A**: ---  **B**: Mais facilmente entendida pela população.  **C**: Incentivo ao uso de bicicleta.  **D**: Induz a utilização da bicicleta como meio de transporte. |

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| **Measure:** On–road Cycle Lane and Cycle Priority in Arterial Roads |
| **Description:** implement cycle lanes for roads with speeds under 40mph and flows under 10000 vehicles/day |
| **Current Practice:** In Brazil, cycle lanes are rarely provided, as it is the case for cycle infrastructure in general. Traffic conditions in arterial roads would not fit U.K. criteria in most cases. For remaining cases, space constrains would probably justify advisory lanes, as a rule. The safety impact of provision in these settings could be adverse. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: No Brasil, não existe regulamentação específica.  **B**: Falta de normatização de projeto e sinalização.  **C**: Não há regulamentação no Brasil para o caso da faixa preferencial à bicicleta.  **D**: Proibição de estacionamento e restrição de velocidade. | *Regulatory*  **A**: ---  **B**: Possibilidade de adaptação às normas existentes.  **C**: É possível adaptar a legislação para atender ao conceito da faixa preferencial.  **D**: Existe regulamentação. |
| *Technical*  **A**: Pode haver problemas de segurança na convivência com usuários até 10 mil veículos / dia e velocidade de 64 km / h. Espaço disponível?  **B**: Não existem situações semelhantes para aplicabilidade no sistema arterial de SP. Dificuldade de adoção da medida (ônibus e) estacionamento permitido / fiscalização.  **C**: vai gerar conflitos com os veículos, devido ao volume e velocidade, a exemplo do que acontece com as motos.  **D**: Autoriza um conflito entre veículo/bicicleta. Necessita criar uma cultura de priorização da bicicleta. | *Technical*  **A**: ---  **B**: Organiza a circulação da bicicleta na via. Estabelece uma certa prioridade de circulação da bicicleta na via.  **C**: Melhor organização do fluxo.  **D**: Cria a possibilidade de utilização da bicicleta. Compartilha o mesmo espaço entre veículo/bicicleta. |
| *Economic*  **A**: ---  **B**: Maior frequência de manutenção da sinalização horizontal.  **C**: Não existe. O custo e baixo  **D**: Custo de implantação. | *Economic*  **A**: O custo é relativamente baixo.  **B**: É alternativa mais barata em relação à ciclovia.  **C**: Custos de implantação e manutenção são relativamente baixos;  **D**: Baixo custo. Indução da utilização da bicicleta. |
| *Behavioural*  **A**: Como tratar usuários que não usam / respeitam a infra-estrutura existente?  **B**: Maior dificuldade de obediência exige maior fiscalização.  **C**: Em vias arteriais, a convivência bicicleta o veículos não é adequada. Para evitar invasões a fiscalização teria que ser intensa.  **D**: Difícil no caso do Brasil, os motoristas respeitarem e dar prioridade aos ciclistas, não havendo proibição de circulação. | *Behavioural*  **A**: ---  **B**: Estimula o uso da bicicleta em vias de maior movimento.  **C**: Incentiva o uso da bicicleta.  **D**: Sinaliza de forma mais enfática a existência do ciclista. |

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| **Measure:** On–road Cycle Lanes/Routes and Cycle Priority in Non-arterial Roads |
| **Description:** implement direct and priority routes for cyclists outside the main arterial road |
| **Current Practice:** In Brazil, cycle lanes are rarely provided, as it is the case for cycle infrastructure in general. Availability of direct non-arterial routes is a question as it is the provision of the required priority to the selected routes for cyclists, commanded respect by drivers. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação específica.  **B**: Falta de normatização de projeto e sinalização.  **C**: Igual ao anterior.  **D**: Falta uma regulamentação clara de prioridade do ciclista. | *Regulatory*  **A**: ---  **B**: Solução que consolida uma política de utilização da bicicleta como transporte.  **C**: Igual ao anterior;  **D**: --- |
| *Technical*  **A**: ---  **B**: Ineditismo da situação – Não há resultados disponíveis. Resistência do corpo técnico – implicações quanto à segurança.  **C**: O estacionamento normalmente é permitido em vias não arteriais. Haveria a necessidade de alterar preferências, eventualmente, conflitando com as regras para o fluxo veicular (Vias com maior fluxo en geral são as preferenciais)  **D**: A simples pintura da faixa não induz ao respeito, pela falta de uma cultura de respeito ao ciclista. | *Technical*  **A**: A convivência entre bicicleta e outros veículos em vias locais é mais fácil / segura.  **B**: Maior flexibilidade de solução. Melhor adaptação à lógica de circulação do transporte não motorizado.  **C**: É mais adequado do que o uso de arterial. Pode haver ganho de fluidez, pelo aumento de capacidade (retira estacionamento).  **D**: Travessia segregada ou lombo-faixa deve funcionar de forma positiva. |
| *Economic*  **A**: ---  **B**: Gasto com reforço da sinalização vertical e obras (fx.elevada).  **C**: Não há;  **D**: Custo de implantação. | *Economic*  **A**: O custo é mais baixo.  **B**: Alternativa mais barata em relação à ciclovia.  **C**: O custo é relativamente baixo  **D**: Baixo custo. Incentiva a utilização de bicicleta. |
| *Behavioural*  **A**: ---  **B**: Comprometimento do comportamento do ciclista em situações onde a circulação é regular.  **C**: Conflito com antigos usuários dos bairros. Pode aumentar o percurso para o ciclista. Depende muito da topografia do bairro para ter boa aceitação pelo ciclista.  **D**: Precisa de campanha, educação e fiscalização para criar a cultura de respeito ao ciclista. | *Behavioural*  **A**: A convivência entre bicicleta e outros veículos em vias locais é mais fácil / segura.  **B**: Reforça a prioridade da circulação da bicicleta para todos os usuários.  **C**: Incentiva o uso da bicicleta.  **D**: Induz a utilização da bicicleta como meio de transporte. |

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| **Measure:** Shared Foot and Cycle ways |
| **Description:** implement shared foot/cycleway in tracks with predominant recreational use (with segregation over 200users/hour) |
| **Current Practice:** In Brazil, despite being occasional, this recommendation is very similar to the existing practice (the more common application of cycle infrastructure being present in touristic cities, with adjacent use of stretches along beaches and similar sites). |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação específica.  **B**: De acordo com o CTB caracterizaria uma situação de exceção e necessita de tratamento específico com intensa sinalização vertical e horizontal.  **C**: Não tem.  **D**: | *Regulatory*  **A**: ---  **B**: Cria oportunidade de flexibilizar as normas existentes.  **C**: É possível e já é usado.  **D**: |
| *Technical*  **A**: Diferença de velocidade representa risco.  **B**: Resistência do corpo técnico em adotar essa solução, por ser exceção ao CTB.  **C**: O baixo fluxo pode permitir altas velocidades para os ciclistas, gerando risco de acidentes.  **D**: | *Technical*  **A**: ---  **B**: Ampliação das possibilidades das soluções de circulação cicloviária.  **C**: Aumenta a segurança, pois separa o movimento veicular dos ciclistas.  **D**: |
| *Economic*  **A**: ---  **B**: ---  **C**: Custo alto, pois requer investimento em infra-estrutura.  **D**: | *Economic*  **A**: Custo baixo.  **B**:Solução mais econômica por não envolver infra-estrutura física e pouca sinalização.  **C**: Não tem.  **D**: |
| *Behavioural*  **A**: O uso compartilhado só seria admissível para volumes muito baixos. Em áreas de lazer, as velocidades são normalmente mais baixas.  **B**: Não entendimento inicial por ser solução piloto pode surpreender os pedestres.  **C**: Risco de abuso por parte dos ciclistas (velocidade).  **D**: | *Behavioural*  **A**: ---  **B**: Estimula a convivência entre modais não motorizados.  **C**: Traz melhorias para a cidade (apelo turístico) e incentiva o uso de bicicleta.  **D**: |

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| **Measure:** Exceptions for Cyclist / Other Facilities for Cyclist Priority without Signals |
| **Description:** treat cyclists as pedestrians, as long as possible, giving them exceptions in road restraints |
| **Current Practice:** In Brazil, these measures were not widely tried. It could be largely applicable in residential areas and also should be complementary to developing cycle infrastructure for cities. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: ---  **B**: Contraria as regras usuais de circulação do CTB, gerando um risco grande de acidentes. Não se aplica às exceções físicas.  **C**: Não há.  **D**: | *Regulatory*  **A**: CTB prevê a equiparação do ciclista desmontado com pedestre.  **B**: Flexibiliza a regulamentação.  **C**: É possível. Basta sinalizar os casos de exceção.  **D**: |
| *Technical*  **A**: ---  **B**: Por contrariar o CTB não há experiências já adotadas gerando insegurança mesmo como projeto-piloto.  **C**: Os casos de circulação de bicicletas no contra-fluxo podem gerar problemas de segurança com os pedestres que cruzem a via (chegada inesperada). A liberação de conversão à esquerda também apresenta risco, pois o ciclista teria que trafegar pelo menos parte do percurso na faixa de velocidade.  **D**: | *Technical*  **A**: As exceções devem ser analisadas caso a caso.  **B**: Flexibiliza soluções que garantem a conectividade.  **C**:Permite viabilizar trajetos mais retilíneos e racionais para os ciclistas.  **D**: |
| *Economic*  **A**: ---  **B**: Se for utilizado como projeto piloto exige muita sinalização.  **C**: São medidas de baixo custo.  **D**: | *Economic*  **A**: Custo baixo.  **B**: Gera soluções mais baratas (sem obras) e uma vez consolidado não exigirá muita sinalização.  **C**: Podem ser implantadas com baixo investimento.  **D**: |
| *Behavioural*  **A**: A ausência dessas exceções podem induzir ao desrespeito.  **B**: Situação atípica de circulação surpreenderá pedestres e motoristas e poderá gerar acidentes. Situação de exceção gerará comportamentos inadequados dos ciclistas onde ele deve obedecer ao CTB (circular no mesmo sentido que o tráfego).  **C**: Necessita de campanhas educativas para preparar os usuários, especialmente no caso do compartilhamento ciclistas/pedestres.  **D**: | *Behavioural*  **A**: ---  **B**: Estimula o uso e obediência à sinalização.  **C**: Pode incentivar o uso da bicicleta, dando aos trajetos mais retilíneos e diretos.  **D**: |

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| **Measure:** Advanced Stop Lines (ASLs) / Other Facilities for Cyclist Priority at Signals |
| **Description:** implement ASLs or other measures for giving priority to cyclists at intersections |
| **Current Practice:** In Brazil, these measures were not tried. It should be complementary to developing cycle infrastructure for cities. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação específica.  **B**: Falta de normatização de projeto e sinalização.  **C**: A ASL não está prevista na legislação. Teria que ser criado um projeto experimental, não podendo ser usado em larga escala.  **D**: Falta regulamentação e normas. | *Regulatory*  **A**: ---  **B**: Consolida uma política de utilização da bicicleta como transporte.  **C**: É possível, mas em caráter experimental.  **D**: --- |
| *Technical*  **A**: A existência da faixa sem a ciclofaixa pode incentivar a circulação entre veículos.  **B**: Cria maior dificuldade na sinalização e programação semafórica.  **C**: Existe um risco para os ciclistas no caso de um veículo que chega em velocidade e encontra uma faixa livre (sem fila) e com semáforo já no verde. Os ciclistas podem ainda estar acumulados na zona entre as retenções.  **D**: Faltam critérios de projeto. Cria conflito entre veículo/ciclista. Reduz a caixa de cruzamento. Necessidade de um plano de compatibilização acurada de semáforo. | *Technical*  **A**: ---  **B**: Facilita solucionar áreas de espera de ciclistas nos projetos de sinalização.  **C**: Melhora a segurança em vários aspectos como nas conversões e no posicionamento na via.  **D**: |
| *Economic*  **A**: ---  **B**: Para melhor definição da área é necessário maior gasto com sinalização horizontal implantação / manutenção.  **C**: Não tem.  **D**: Custo elevado | *Economic*  **A**: Custo baixo.  **B**: ---  **C**: Custo baixo.  **D**: --- |
| *Behavioural*  **A**: Pode haver um uso inadequado.  **B**: Possibilidade de uso irregular por motos.  **C**: Poderá haver disputa pelo espaço criado entre as bicicletas e as motos. Também poderá haver desrespeito pelos motoristas, se a densidade de bicicletas for baixa.  **D**: Difícil entendimento das manobras pelos usuários (motorista e ciclista) | *Behavioural*  **A**: ---  **B**: Estimular o uso da bicicleta. Estimula a obediência ao semáforo pelo ciclista.  **C**: Incentiva o uso da bicicleta.  **D**: Induz a utilização da ciclovia. |

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| **Measure:** Toucan Crossing / Other Facilities for Crossing of Cyclists and Special Users Other than Pedestrians |
| **Description:** implement traffic signals authorizing the crossing of cyclists, beside pedestrian crossings |
| **Current Practice:** In Brazil, the regulations about signals for cyclists in traffic lanes or crossings are to be detailed. Perhaps the measure can be tried with experimental authorization. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: ---  **B**: Ainda não há regulamentação no CTB do foco do ciclista.  **C**: Não há na legislação o foco para ciclistas. O uso deve ser em caráter experimental.  **D**: | *Regulatory*  **A**: É possível sinalizar a travessia ciclista / pedestres.  **B**: Garante a vez da travessia da bicicleta. Consolida a bicicleta como veículo para tranporte.  **C**: É possível usar, desde que em caráter experimental.  **D**: |
| *Technical*  **A**: ---  **B**: A falta da regulamentação gerar projetos equivocados.  **C**: Não existe.  **D**: | *Technical*  **A**: Medida deve ser prevista sempre que possível.  **B**: Melhora/Garante qualidade aos projetos definindo os locais de travessia segregando o ciclista do pedestre.  **C**: É possível ser usado sem grandes modificações na sinalização existente.  **D**: |
| *Economic*  **A**: ---  **B**: Aumento do custo do projeto.  **C**: Não existe.  **D**: | *Economic*  **A**: Custo relativamente baixo.  **B**: Custo inicial justificado pela melhoria da segurança.  **C**:Tem baixo custo, onde o semáforo de pedestre é existente. Onde não existe semáforo, sua implantação tem custo médio.  **D**: |
| *Behavioural*  **A**: ---  **B**: Elemento de sinalização ainda pouco conhecido pelo usuário.  **C**: Não há como fiscalizar o respeito ao semáforo pelo ciclista (não existe enquadramento no CTB para isso).  **D**: | *Behavioural*  **A**: Induz a maior obediência.  **B**: Estimula a obediência do semáforo pelos ciclistas. Melhora a segurança do ciclista e pedestre.  **C**: Dá mais segurança ao ciclista, definindo a rota e os locais de travessia.  **D**: |

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| **Measure:** Bike Stands / Other Facilities for Parking Bicycles |
| **Description:** provision of public parking facilities, either Universal Stands or City Lockers |
| **Current Practice:** In Brazil, these equipments are usually not available in general but simplified options can be found in destinations to where cycling is a relevant option. It should be complementary to developing cycle infrastructure for cities.  **C**: Os “City Lockers” de fato não existem no Brasil. Em São Paulo existem os suportes para bicicletas em vários locais, especialmente em estações de transporte coletivo. |

Potential for Transferability:

|  |  |
| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: No Brasil não há regulamentação específica.  **B**: Não garante a preservação da bicicleta contra roubos no caso de paraciclos.  **C**: Uso dos armários é inviável sem uma infra-estrutura de vigilância e de limpeza. Definir a responsabilidade sobre a preservação das bicicletas.  **D**: | *Regulatory*  **A**: ---  **B**: Consolida a utilização da bicicleta como transporte por compor a infra-estrutura cicloviária.  **C**: ---  **D**: |
| *Technical*  **A**: Dificuldade técnica e a identificação de espaços livres.  **B**: Se não houver vigilância ou outra forma de zeladoria não haverá garantia de utilização na integração modal.  **C**: Há necessidade de áreas livres que não atrapalhem a passagem de pedestres.  **D**: | *Technical*  **A**: ---  **B**: Elemento facilmente adaptável na geometria urbana permitindo inúmeras soluções.  **C**: Disciplina o espaço destinado ao estacionamento de bicicletas.  **D**: |
| *Economic*  **A**: O custo de um bicicletário já exige maiores investimentos.  **B**: Não é infra-estrutura barata.  **C**: Os armários e sua manutenção tem custo alto.  **D**: | *Economic*  **A**: O custo de dispositivos simples (paraciclos) é relativamente baixo.  **B**: Vários modelos com desenhos e materiais existentes se adaptam a disponibilidade dos recursos.  **C**: Os suportes tem baixo custo.  **D**: |
| *Behavioural*  **A**: ---  **B**: Facilita roubo/vandalismo se não houver vigilância.  **C**: Necessita de um aparato de vigilância.  **D**: | *Behavioural*  **A**: A existência de facilidades pode incentivar o uso de bicicletas.  **B**: Visualisado e bem aceito pela população.  **C**: Permite que a bicicleta seja usada para cumprir parte da viagem (casa -> estação, por exemplo).  **D**: |

### B.3 - Motor Vehicle Focused Measures that Benefit VRU Safety

* + Motor vehicle focused measures that benefit VRU safety:
    - Shared use of bus lanes/bus ways by motorcycles and/or bicycles;
    - Shared roadway / Mixed function roads;
    - Speed tables;
    - Speed humps and speed cushions;
    - Chicanes and priority narrowing;
    - Vehicle activated signs (VASs);
    - Road lighting for VRUs;
    - Safety, speed and red light cameras.

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| **Measure:** Shared Use of Bus Lanes/Bus Ways by Motorcycles and/or Bicycles |
| **Description:** implement the shared use of bus lanes/bus ways by motorcycles or bicycles |
| **Current Practice:** In Brazil, there is no trial of sharing the use of bus lanes/bus ways with motorcycles or bicycles. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação específica.  **B**: Caracteriza uma situação de exceção para diversos veículos.  **C**: Não existem enquadramentos no CTB para fiscalização de ciclistas.  **D**: | *Regulatory*  **A**: ---  **B**: Não existe impedimento no CTB.  **C**:É possível fiscalizar os veículos.  **D**: |
| *Technical*  **A**: Há necessidade de largura adicional para ultrapassagens.  **B**: Modais com características e tamanhos diferenciados dividindo o mesmo espaço.  **C**: A maior parte das faixas de ônibus está em vias que não permitem o alargamento para 4,0m. Existe risco de acidentes na ultrapassagem, especialmente para as bicicletas. O uso compartilhado da faixa exclusiva tira boa parte da vantagem do transporte coletivo (ou seja, reduz a fluidez), a favor do transporte individual.  **D**: | *Technical*  **A**: ---  **B**: Otimiza e racionaliza a capacidade da via.  **C**: Racionaliza o uso do espaço de via quando a faixa tem baixa densidade de ônibus.  **D**: |
| *Economic*  **A**: Custo do aumento da largura.  **B**: Custo social dos acidentes.  **C**: Não tem. Usa espaço e sinalização existentes.  **D**: | *Economic*  **A**: Custo baixo de sinalização.  **B**: Regulamenta numa mesma sinalização o uso de diferentes tipos de veículo.  **C**:Custo baixíssimo (só placas).  **D**: |
| *Behavioural*  **A**: Há necessidade de prever entradas / saídas da faixa.  **B**: Sentimento de prioridade simultâneo para diferentes condutores, com velocidades diferenciadas.  **C**: Pode gerar conflitos pelo espaço que são difíceis de serem resolvidos a bom termo pela diferença de porte entre os veículos.  **D**: | *Behavioural*  **A**: ---  **B**: Negociação do espaço para mesma velocidade e visibilidade.  **C**:Não há.  **D**: |

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| **Measure:** Traffic Calming or Shared Spaces / Shared Roadways or Mixed Priority Routes |
| **Current Practice:** In Brazil, no policy for application of traffic calming, shared spaces or shared roads concepts was consistently applied. However, there is pressure for protecting residential areas (on the traffic safety and public safety senses). Commercial streets with clear predominance of local uses and high level of conflict with through traffic are also usual in larger cities. |
| **Current Practice:** |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação específica.  **B**: Dificuldade de fiscalização.  **C**: No caso de restrição de velocidade, há necessidade de fiscalização com radar, caso não haja obstáculos físicos (redutores).  **D**: | *Regulatory*  **A**: ---  **B**: Caracteriza e garante a existência de uma área especial.  **C**:É aplicável  **D**: |
| *Technical*  **A**: ---  **B**: Necessário conhecimento técnico do conjunto de medidas.  **C**: O excesso de redutores de velocidades físicos causa desconforto e impede o uso de velocidades maiores em casos de emergência.  **D**: | *Technical*  **A**: Os casos brasileiros (25 de março, 24 de maio, XV de novembro) são na verdade, exemplos de locais em desordem.  **B**: Projeto factível de ser implantado.  **C**:Melhora as condições ambientais (menos ruídos e menos poluição do ar) e de segurança, pelas baixas velocidades.  **D**: |
| *Economic*  **A**: ---  **B**: Alto investimento inicial.  **C**: Caso use dispositivos físicos e redutores, torna-se um investimento de custo alto.  **D**: | *Economic*  **A**: Custo baixo.  **B**: Investimento se paga pelo aumento da segurança proporcionado à região.  **C**: ---  **D**: |
| *Behavioural*  **A**: É preciso estabelecer critérios / procedimentos para coibir desvios comportamentais.  **B**: Possibilidade de desrespeito. Não aceitação por parte da comunidade interna e externa.  **C**: Pode haver tendência dos motoristas tentarem compensar o tempo perdido, excedendo a velocidade em outras vias.  **D**: | *Behavioural*  **A**: Quando não existem regras claras, a tendência é que todos tomam cuidado.  **B**: Adequa comportamento do motorista às características do local. Estimula convivência entre moradores.  **C**: Melhora a condição de convivência dos usuários (moradores, pedestres, crianças etc).  **D**: |

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| **Measure:** Speed Humps / Speed Cushions / Other Devices based on Vertical Deflection |
| **Description:** increase the use of speed humps or apply speed cushions as speed reduction devices |
| **Current Practice:** In Brazil, speed humps are used at large. There is a clear concern with its misuse and to the need of regulating its proper use on urban roads and other settings. Current regulation is usually judged as good. Use of speed cushions is rare. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: ---  **B**: As normas atuais restringem o uso.  **C**:Para as almofadas não existe regulamentação. Para as lombadas existe, mas raramente é cumprida à risca.  **D**: | *Regulatory*  **A**: No Brasil, já existe regulamentação específica (Bem restritiva).  **B**: Gera respeito a velocidade regulamentada.  **C**: Pode ser testada experimentalmente (almofadas). Lombadas – não há.  **D**: |
| *Technical*  **A**: No Brasil, há deficiência na manutenção (Lombada e sinalização).  **B**: Se for intalada em desacordo com as normas ou com deficiência de sinalização, pode gerar acidentes.  **C**: Lombada: requer manutenção constante da sinalização complementar, caso contrário pode tornar o local mais perigoso. Tem o efeito de transferir o tráfego para as vias adjacentes, caso elas não tenham lombadas. Tem redução pontual. Se o trecho é longo, requer muitas lombadas.  **D**: | *Technical*  **A**: É uma boa solução, quando bem aplicada.  **B**: Elemento efetivo para redução de velocidade.  **C**: Reduz efetivamente a velocidade em seus arredores.  **D**: |
| *Economic*  **A**: ---  **B**: Custo alto.  **C**: Custo médio.  **D**: | *Economic*  **A**: Custo relativamente baixo.  **B**: Mais barato que um radar.  **C**: Não há.  **D**: |
| *Behavioural*  **A**: ---  **B**: Em vias com diversas lombadas, o motorista pode procurar caminhos alternativos.  **C**:Tendência de redução do tempo perdido. As almofadas são desconhecidas no Brasil.  **D**: | *Behavioural*  **A**: A lombada é eficiente para induzir comportamentos adequados.  **B**: É um redutor efetivo de velocidade.  **C**: Não há.  **D**: |

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| **Measure:** Speed Tables / Raised or Lifted intersections |
| **Description:** increase the use of speed tables at intersections of local and distributor roads |
| **Current Practice:** In Brazil, the use of speed tables is rare (especially as lifted intersections). |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação específica.  **B**: Não regulamentado no CTB.  **C**: Dispositivo não regulamentado (requisitos de projeto desconhecidos).  **D**: | *Regulatory*  **A**: ---  **B**: ---  **C**: O uso seria em caráter experimental.  **D**: |
| *Technical*  **A**: ---  **B**: Solução pouco utilizada.  **C**: Desconhecido.  **D**: | *Technical*  **A**: Pode ser uma solução interessante em vias locais, com maior segurança / conforto para pedestres.  **B**: Solução para casos com travessias difusas, em todas as direções do cruzamento.  **C**: Desconhecido.  **D**: |
| *Economic*  **A**: Custo médio em vias já existentes.  **B**: Obra cara.  **C**: Custo alto.  **D**: | *Economic*  **A**: Custo baixo, se executado junto com vias / passeio.  **B**: ---  **C**: ---  **D**: |
| *Behavioural*  **A**: ---  **B**: Estimula circulação de veículos como moto e bicicleta, pela calçada.  **C**: Difícil analisar – desconhecido.  **D**: | *Behavioural*  **A**: Induz a comportamentos adequados dos motoristas.  **B**: Conforto aos pedestres.  **C**: Idem ao lado.  **D**: |

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| **Measure:** Chicanes / Priority Narrowing / Other Devices based on Horizontal Deflection |
| **Description:** increase the use of chicanes or other speed reduction device based on horizontal deflection, as mini-roundabouts |
| **Current Practice:** In Brazil, the use of chicanes or similar devices is rare, except for mini-roundabouts. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação específica.  **B**: Não regulamentado pelo CTB.  **C**: No caso dos chicanes, não há regulamentação e nem normas de projeto.  **D**: | *Regulatory*  **A**: ---  **B**: ---  **C**: Possível, mas em caráter experimental.  **D**: |
| *Technical*  **A**: ---  **B**: Projeto difícil de elaboração, envolve drenagem, etc.  **C**: Chicane: pode gerar risco de acidentes no choque contra o alinhamento das guias. Pode dificultar a passagem de veículos de carga.  **D**: | *Technical*  **A**: Aplicação possível em vias locais, com redução das velocidades e desincentivando o uso da via.  **B**: Garante redução de velocidade.  **C**: É mais uma opção de redutor de velocidade, menos agressivo que a lombada.  **D**: |
| *Economic*  **A**: Custo médio, quando executado posteriormente.  **B**: Alto custo de obra.  **C**: Custo de implantação é médio.  **D**: | *Economic*  **A**: Custo baixo, quando previsto na construção da via.  **B**: ---  **C**: Não há.  **D**: |
| *Behavioural*  **A**: ---  **B**: Se não for bem executado, projetado, pode ter efeito inverso.  **C**: Pode provocar parte dos motoristas a percorrer o trecho em alta velocidade para testar suas habilidades.  **D**: | *Behavioural*  **A**: Induzem a redução de velocidade.  **B**: Valorização urbanística. Garante uma baixa velocidade.  **C**: Acalma o tráfego de passagem. O pedestre fica mais seguro. Aumenta o espaço do passeio.  **D**: |

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| **Measure:** Vehicle Activated Signs (VASs) for VRU Safety |
| **Description:** implement Vehicle Activated Signs (VASs) at sites with accident records |
| **Current Practice:** In Brazil, no similar technology is in use. Perhaps it should be taken as an experimental system. Perhaps components could be of interest (LED signs or weather sensors) by themselves. It will probably need experimental authorization. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não há regulamentação específica.  **B**: Não regulamentado no CTB.  **C**: Não está previsto no CTB.  **D**: | *Regulatory*  **A**: ---  **B**: Facil regulamentação.  **C**: precisaria de autorização especial para ser usado (caráter experimental).  **D**: |
| *Technical*  **A**: ---  **B**: Numa via com mais de uma faixa, não deixa claro à qual condutor se destina a advertência.  **C**: Dispositivo complexo para uma mensagem que pode ser passada via placa. A configuração luminosa é diferente do aspecto original da placa. Em caso de falha no equipamento, a via fica sem sinalização.  **D**: | *Technical*  **A**: O uso do VAS é tecnicamente recomendável  **B**: Sinalização de advertência mais reforçada.  **C**: Só sinaliza para os que precisam da informação.  **D**: |
| *Economic*  **A**: Custo elevado  **B**: Mais caro que uma placa de advertência ou regulamentação.  **C**: Custo médio, mas não compensa na relação custo/benefício, em se comparando com a placa normal.  **D**: | *Economic*  **A**: ---  **B**: Mais barato que um radar devido à inexistência da infra interna.  **C**: Não há.  **D**: |
| *Behavioural*  **A**: ---  **B**: Em excesso pode reduzir o efeito esperado.  **C**: Pode sofrer vandalismo mais facilmente. É desconhecido no Brasil – pode surpreender o motorista.  **D**: | *Behavioural*  **A**: O uso do VAS induz a comportamentos adequados.  **B**: Gera mais obediência que uma placa.  **C**: Pode ter efeito de aumentar a respeitabilidade.  **D**: |

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| **Measure:** Road Lighting for VRU Safety |
| **Description:** increase the use of road lighting at sensitive areas for VRU safety |
| **Current Practice:** In Brazil, some cities have implemented road lighting programs for pedestrian crossings or other sensitive areas for pedestrian safety (as the in City of São Paulo). However, there is no official requirement for lighting at these sites. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**:  **B**:  **C**: Não existe obrigatoriedade de iluminar todas as travessias.  **D**: | *Regulatory*  **A**:  **B**:  **C**: Não existe impedimento legal.  **D**: |
| *Technical*  **A**:  **B**:  **C**: Gera mais manutenção. Em caso de abalroamento do suporte, a iluminação pode se voltar contra o motorista.  **D**: | *Technical*  **A**:  **B**:  **C**: Aumenta a visibilidade do pedestre, melhorando a segurança.  **D**: |
| *Economic*  **A**:  **B**:  **C**: Médio, devido ao consumo de energia elétrica.  **D**: | *Economic*  **A**:  **B**:  **C**: Indireto, na redução de acidentes.  **D**: |
| *Behavioural*  **A**:  **B**:  **C**: Não tem.  **D**: | *Behavioural*  **A**:  **B**:  **C**:Melhora também a segurança pública.  **D**: |

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| **Measure:** Safety (Speed / Red Light) Cameras / Other Electronic Enforcement Devices |
| **Description:** increase the use of electronic enforcement devices for VRU safety |
| **Current Practice:** In Brazil, electronic enforcement devices are used at large, including control of speed limits, red light violations, invasion of exclusive lanes, invasion of pedestrian crossings, and some other applications. There is a clear concern to its misuse and to the need of regulating its proper use in urban roads and other settings. The current regulation is usually taken as good. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: A regulamentação existente é inadequada.  **B**: ---  **C**: Não tem.  **D**: | *Regulatory*  **A**: Existe regulamentação específica.  **B**: Garante a obediência à sinalização.  **C**: Já existe regulamentação.  **D**: |
| *Technical*  **A**: No Brasil, existem exemplos de aplicação inadequada da fiscalização eletrônica.  **B**: Requer contratação de serviço terceirizado devido á complexidade tecnológica e infra-estrutura para processamento das informações.  **C**: Não tem.  **D**: | *Technical*  **A**: Bem aplicada, a fiscalização eletrônica é altamente eficiente.  **B**: Projeto simples.  **C**: Aumento na segurança no geral (pedestre, veículos, etc).  **D**: |
| *Economic*  **A**: ---  **B**: Alto custo.  **C**: Equipamentos são caros e necessitam de manutenção constante.  **D**: | *Economic*  **A**: Custo relativamente baixo.  **B**: Reduz recurso humano de fiscalização.  **C**: Trazem retorno rapidamente, devido à redução nos acidentes.  **D**: |
| *Behavioural*  **A**: ---  **B**: Resistência da população. Se houver poucos equipamentos na região torna-se uma obediência pontual, sem alterar comportamento.  **C**: Não é bem aceito pelos motoristas.  **D**: | *Behavioural*  **A**: A fiscalização eletrônica induz a um maior respeito à sinalização.  **B**: Gera mudança de comportamento se disseminado no município. Muda comportamento localizado.  **C**: Aumenta a respeitabilidade da sinalização.  **D**: |

## Management of Road Safety for VRUs

* + Improvement of Hazardous Locations:
    - Black spot analysis;
    - Urban safety management and other larger area intervention policies;
    - Road safety audit/inspection or other preventive actions;
  + Road Safety Education (User Needs and Participation Process and others):
    - Information / Consultation / Participation for safety of VRUs;
    - Education and training for the safety of VRUs;
    - Enforcement of priority of VRUs.

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| **Measure:** Black Spot Analysis, with Attention to VRUs |
| **Description:** implementation and monitoring of black spot programs, weighting the harm to VRUs |
| **Current Practice:** In Brazil, agencies that have an organized accident database usually carry-out black spot analysis among their routine activities. However, there is no institutional requirement for doing it or for giving special attention to VRUs. |

Potential for Transferability:

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| --- | --- |
| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Nem sempre a identificação / tratamento de pontos críticos considera a necessária ênfase aos VRU.  **B**: É necessário porém com um resultado limitado na meta geral de redução de acidentes do município.  **C**: Não há.  **D**: | *Regulatory*  **A**: Na maior parte dos sistemas viários (municipal ou rodoviário), os pontos críticos são bem conhecidos, mesmo com dados incompletos.  **B**: O tratamento orienta na definição de políticas gerais.  **C**: A regulamentação é importante para impulsionar os estudos dos pontos críticos.  **D**: |
| *Technical*  **A**: Em geral, falta o acompanhamento de efetividade da solução adotada.  **B**: Soluciona problemas localizados sem solucionar problemas gerais.  **C**: Existe a dificuldade na coleta dos dados.  **D**: | *Technical*  **A**: Já existem metodologias para identificação e tratamento de pontos críticos.  **B**: Solucionar problemas localizados.  **C**: Em geral os problemas existentes podem ser resolvidos com intervenções de Engenharia.  **D**: |
| *Economic*  **A**: Os recursos existentes, em geral, não são aplicados como deveriam.  **B**: Preferencialmente equipe especializada.  **C**: Custo com a equipe técnica, que deve ser especializada.  **D**: | *Economic*  **A**: Em tese, os recursos existem.  **B**: Cobre custo social.  **C**: A recuperação do capital investido é rápida, pela redução dos acidentes.  **D**: |
| *Behavioural*  **A**: Não existe cobrança pelo cumprimento de metas para redução de acidentes.  **B**: Uma solução pontual não gera mudança de comportamento nos demais locais.  **C**: Não há.  **D**: | *Behavioural*  **A**: ---  **B**: Gera respeito e credibilidade.  **C**: Acúmulo de conhecimento e aprimoramento na aplicação das técnicas com a continuidade do programa.  **D**: |

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| **Measure:** Urban Safety Management or Other Area-wide Intervention Policies |
| **Description:** adopt USM or other area-wide road safety actions, from clear vision, community participation and strong political commitment |
| **Current Practice:** In Brazil, local agencies occasionally set road safety programs with wide scope, strong political support and participation but these trials should be taken as exceptions more than as a rule. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: A sociedade em geral não está preocupada / conscientizada para o problema da falta de segurança no trânsito.  **B**: ---  **C**: Não existem.  **D**: | *Regulatory*  **A**: ---  **B**: Ajuda na definição de políticas publicas.  **C**: Seria recomendável um respaldo oficial para justificar os investimentos.  **D**: |
| *Technical*  **A**: As estratégias utilizadas até o momento não foram suficientes para atrair o envolvimento da sociedade.  **B**: Se não houver definição clara de diretrizes, pode gerar desvio dos objetivos comprometendo o resultado.  **C**: Não existem.  **D**: | *Technical*  **A**: As técnicas para o estabelecimento do USM são conhecidas.  **B**: Soluciona o problema em larga escala.  **C**: Atuação preventiva.  **D**: |
| *Economic*  **A**: ---  **B**: Necessita de verba específica.  **C**: Justificar o investimento em locais de periculosidade não demonstrada pelo número de acidentes.  **D**: | *Economic*  **A**: Existirem recursos para estimular o envolvimento da sociedade.  **B**: Elevado retorno financeiro devido à redução do custo social.  **C**: Economia de tempo pois a análise está pré-concebida.  **D**: |
| *Behavioural*  **A**: É preciso encontrar meios para o envolvimento da sociedade  **B**: ---  **C**: ---  **D**: | *Behavioural*  **A**: ---  **B**: Gera mudança disseminada de comportamento.  **C**: A longo prazo, aumenta o prestigio do órgão gestor de trânsito, pelos resultados obtidos.  **D**: |

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| **Measure:** Road Safety Audit/Road Safety Inspection / Other Preventive Reviews |
| **Description:** adopt RSA and/or RSI as mandatory or recommended practice |
| **Current Practice:** In Brazil, there are trials of RSA application, mostly to existing roads (as RSI), either urban roads or highways (sometimes large scale trials), but as voluntary practice decided by local agencies or road concessions. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory*  **A**: Não existe qualquer iniciativa para tornar a RSA obrigatória, seja para novos projetos seja para vias existentes.  **B**: Necessidade de procedimentos/metodologias claras.  **C**: Não existe obrigatoriedade no Brasil.  **D**: | *Regulatory*  **A**: O Brasil já desenvolve algumas experiências (voluntárias) de aplicação da RSA.  **B**: Garante uma neutralidade/outra visão nos produtos desenvolvidos.  **C**: Pode ser exigido, desde que respaldado oficialmente.  **D**: |
| *Technical*  **A**: Embora já existam alguns procedimentos para aplicação da RSA, há necessidade de disseminação de técnicas e padronização de procedimentos.  **B**: Auditor externo pode não estar comprometido com o projeto, não sendo o responsável técnico pelo projeto.  **C**: Aumenta o tempo do projeto.  **D**: | *Technical*  **A**: Já existem alguns procedimentos para aplicação da RSA.  **B**: Melhora a qualidade dos projetos.  **C**:Evita vícios de projeto. Corrige problemas intrínsecos. Gera projetos mais confiáveis e eficientes.  **D**: |
| *Economic*  **A**: ---  **B**: Equipe especializada.  **C**: Eleva o custo geral do projeto.  **D**: | *Economic*  **A**: A RSA pode trazer diversos benefícios econômicos.  **B**: Gasto inicial justifica os resultados.  **C**: Retorno mais rápido do investimento pela maior eficiência do projeto.  **D**: |
| *Behavioural*  **A**: Normalmente os órgãos que executam as obras não são responsáveis pela operação da via, não tendo compromisso com o futuro desempenho operacional.  **B**: ---  **C**: Eventuais atritos entre as equipes de projeto e de auditoria nos impasses.  **D**: | *Behavioural*  **A**: ---  **B**: Garantia de um comportamento mais adequado.  **C**: Aumenta a dedicação dos projetistas e gera a tendência em fazer projetos mais precisos.  **D**: |

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| **Measure:** Education/Training for the Safety of VRUs |
| **Description:** no measure was evaluated |
| **Current Practice:** In Brazil, no clear policy for training VRUs exists, either in schools or other institutions. Drivers of non-motorized vehicles and mopeds are not required to have a license for conducting its vehicles in the road, made them similar to pedestrians in this respect (despite possible to require the registration of non-motorized vehicles, attributed to local authorities, usually they are not registered and can ride on the roads without control). Initiatives to train pedestrians or non-motorized drivers are rare. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory* | *Regulatory* |
| *Technical* | *Technical* |
| *Economic* | *Economic* |
| *Behavioural* | *Behavioural* |

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| **Measure:** Information / Consultation / Participation for the Safety of VRUs |
| **Description:** no measure was evaluated |
| **Current Practice:** In Brazil, requirements for public information were limited (e.g. of studies used in implementing electronic enforcement devices for speed control). Wider consultation requirements, including public audiences, are limited to large scale projects that have to obtain approval from reports on environmental impact and/or neighbourhood impact. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory* | *Regulatory* |
| *Technical* | *Technical* |
| *Economic* | *Economic* |
| *Behavioural* | *Behavioural* |

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| **Measure:** Enforcement of VRU Priority on the Road |
| **Description:** no measure was evaluated |
| **Current Practice:** **Current Practice:** In Brazil, prosecution for traffic accidents in general and particularly those related to VRUs is rare and faulty. The judicial system is largely inefficient and open to personal influence and arbitrary decisions. Strict reliability rule is not adopted. |

Potential for Transferability:

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| **Negative Effects** | **Positive Effects** |
| *Regulatory* | *Regulatory* |
| *Technical* | *Technical* |
| *Economic* | *Economic* |
| *Behavioural* | *Behavioural* |