Innovative guidelines and tools for vulnerable road users safety in India and Brazil [SaferBraIn]. D4.1 Guidelines for integrated land use and transport planning for VRU safety

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SEVENTH FRAMEWORK PROGRAMME
THEME 7 – TRANSPORT (INCLUDING AERONAUTICS)

Collaborative Project

Project Acronym: Safer Brain

Project Coordinator: CTL – Centro di Ricerca per il Trasporto e la Logistica – Roma (Italy)

Proposal full title: Innovative Guidelines and Tools for Vulnerable Road Users Safety in India and Brazil

Grant Agreement n°: 233994

Document Title: Guidelines for Integrated Land Use and Transport Planning for VRU Safety

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Executive Summary

The main aim of the SaferBraIn project is to improve safety levels of the road transport system and its components in Emerging Economies, focusing the attention on vulnerable road users (VRUs), and contributing to the overall scope of reducing the number of fatalities and severity of injuries caused by road accidents in countries such as India and Brazil.

This report focuses on the land use and transport planning process and through a review of current guidelines and best practice in Europe, investigates the degree to which safety is considered as part of the process and the needs of the more vulnerable users of the road (i.e. pedestrians and bicyclists) are considered.

The main objective of this document is to recommend best practice guidelines for integrated land use and transport planning in Emerging Economies for Vulnerable Road User (VRU) safety, based on current European best practice. The aim is not to develop brand new guidelines, but to identify those existing guidelines which can be recommended for best practice in the Emerging Economies. The recommendations are then evaluated by local SaferBraIn partners (from India and Brazil) to identify any difficulties and also any benefits of applying the recommendations to Brazil or India.

A synthesis of the work already completed in SaferBraIn to analyse the local (India and Brazil) requirements and to determine the conditions for transferability, detailed in SaferBraIn Deliverables 1.1 and 2.2, is provided, with the aim of identifying any results which may be of relevance to developing the recommendations in this study. Particularly, the Transferability Audit process that has been developed is identified as a tool that could be beneficial in selecting effective best practice.

A variety of best practice guidelines, guidance documents and EC funded studies in the areas of land use and transport planning are identified in the review as having potential for being recommended for best practice in Emerging Economies, many of which have an emphasis on sustainability. Relevant guidance from the USA, Australia and Canada is also sourced.

From the review undertaken, a summary of best practice recommendations is identified which could potentially be transferred to Emerging Economies. All of the recommendations are linked to the guidance documents that deal with the relevant issues. Three main recommendations are provided:

1. Stakeholder participation should be considered.
2. A step by step planning process should be developed.
3. VRU-specific principles should be implemented into the step by step process.

Other recommendations include:

1. Ensuring accessibility for all.
2. Integration of policies.
3. Consideration of potential future development impacts.
4. Consideration of existing and future needs of all road users but from the point of view of VRU safety.

There are potential positive and negative impacts to applying these best practice recommendations to India and Brazil. Detrimental issues identified include bias towards more affluent areas or business interests, lack of political support, deficiency in technical skills and overriding support for the motorised vehicle. Positive aspects include taking the wider
approach would generate wider results, such as reducing travel distances and car use and there would be benefits to the ‘community’ feel of many of the roads in India, where roads are more than just a travel route. Safety implications that should be considered include sustainable mobility, priority to VRUs, accessibility, modal split considerations and the specific measures to be used to implement the planning process.

Further work to be undertaken in SaferBraIn will look to identify specific measures that could help to successfully implement the best practice recommendations in Emerging Economies. This study has been a useful first insight into the issues associated with transferring European best practice to Emerging Economies. Beyond the SaferBraIn study, the issues highlighted in this report would benefit from being evaluated further using real world case examples and looking in more depth at each stage of the planning process.
# Table of Contents

**Executive Summary** .................................................................................................................. 2

**List of Terms** ................................................................................................................................. 7

**Executive Summary** ....................................................................................................................... 8

1. **Introduction** ............................................................................................................................... 10
   1.1. What is Land Use and Transport Planning? ............................................................................. 10
   1.2. Land Use and Transport Planning in Emerging Economies ................................................. 11
   1.3. Aims and Objectives ................................................................................................................. 12
   1.4. Report Layout ........................................................................................................................... 12

2. **Synthesis of Findings from SaferBraIn D1.1 and D2.2** .......................................................... 14
   2.1. Findings of D1.1 ....................................................................................................................... 14
   2.2. Findings of D2.2 ....................................................................................................................... 15
   2.3. Conclusions of Synthesis ......................................................................................................... 18

   3.1. Introduction .............................................................................................................................. 20
   3.2. Land Use and Transport Planning to Reduce VRU Accidents .............................................. 21
   3.3. Land Use and Transport Planning Guidance in Europe and beyond ................................. 22

4. **Recommendations for Best Practice Guidelines for Land Use and Transport Planning focussed on VRU Safety** ........................................................................................................ 39
   4.1. Stakeholder Participation in the Transport Planning Process .................................................. 40
   4.2. Principles for Developing a Transport Plan Aimed at VRU Safety ....................................... 41
   4.3. Process for Integrated Land Use and Transport Planning ....................................................... 47

5. **Identification of Safety Implications** ....................................................................................... 57

6. **Comparison of Local Conditions against Best Practice Recommendations** .......................... 60
   6.1. Brazil ...................................................................................................................................... 60
   6.2. India ...................................................................................................................................... 64

7. **Conclusions** ............................................................................................................................... 69

References ........................................................................................................................................... 71

Appendix 1: **Transferability Audit Scores for India** ................................................................. 74
Index of Tables

Table 1: Main Recommendations of TRANSPLUS .................................................................26
Table 2: Principles for Developing a Transport Plan Aimed at VRU Safety ......................42
Table 3: Contribution of Policy Instruments to each Strategy Element ............................52
Table 4: A Policy Integration Matrix ................................................................................53
Index of Figures

Figure 1: Pyramid of Road safety Measures to be Transferred and the Evaluation Resolution .................................................................16
Figure 2: Outline of a Transferability Audit Process .........................................................17
Figure 3: The Road Safety Space Concept........................................................................17
Figure 4: Example of the Problem Priority Matrix (PPM)..................................................18
Figure 5: Logical structure of the PROSPECTS Methodological Guidebook ..................24
Figure 6: Case Study in Nottingham, UK, where the Principles now Established in Manual for Streets 2 were applied to a City Ring Road in 2004 .......................................................35
Figure 7: Layout of Recommendations for Transport Planning for VRU Safety ...............40
Figure 8: Relevant Stakeholders in Land Use and Transport Planning Policies ...............41
Figure 9: Crossing Area in Shoreditch Triangle...............................................................44
Figure 10: Oxford Circus Diagonal Pedestrian Crossing ..................................................46
Figure 11: An Example of a High Street in the UK where the Five Practical Steps were Implemented........................................................................47
Figure 12: Logical structure of the PROSPECTS Methodological Guidebook ...............48
Figure 13: Models for Predicting Impacts ........................................................................54
Figure 14: An Appraisal Framework ................................................................................55
Figure 15: Transferability Audit Scores for Guidance Documents Reviewed in Section 3.3 75
Figure 16: Transferability Audit Scores for Principles Listed in Section 4.2 .......................75
Figure 17: Transferability Audit Scores for Logical Structure Outlined Section 4.3 ..........77
## List of Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATC</td>
<td>Automatic Traffic Counts</td>
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<tr>
<td>AusRAP</td>
<td>Australian Road Assessment Programme</td>
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<tr>
<td>CABE</td>
<td>Commission for Architecture and the Built Environment</td>
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<td>CIHT</td>
<td>Chartered Institute of Highways and Transportation</td>
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<tr>
<td>CTC</td>
<td>Cycling and Towing Club</td>
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<tr>
<td>DOT</td>
<td>Department Of Transport (USA / Australia)</td>
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<tr>
<td>DSS</td>
<td>Decision Support System</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<td>EMBARQ</td>
<td>World Resource Institute's Centre for Sustainable Transport</td>
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<tr>
<td>EPSRC</td>
<td>Engineering and Physical Sciences Research Council</td>
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<td>EU</td>
<td>European Union</td>
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<td>EuroRAP</td>
<td>European Road Assessment Programme</td>
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<tr>
<td>FAO</td>
<td>Food and Agricultural Organisation of the United Nations</td>
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<tr>
<td>HLO</td>
<td>Higher Level Objective</td>
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<tr>
<td>IHE</td>
<td>Institute of Highway Engineers</td>
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<td>ITP</td>
<td>Integrated Transport Plans</td>
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<tr>
<td>IRAP</td>
<td>International Road Assessment Programme</td>
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<tr>
<td>LUT</td>
<td>Land Use and Transport</td>
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<td>LUTI</td>
<td>Land Use and Transport Interaction</td>
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<td>LUTR</td>
<td>Land Use and Transport Research</td>
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<tr>
<td>MPO</td>
<td>Metropolitan Planning Organisation</td>
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<tr>
<td>NATA</td>
<td>New Approach to Appraisal</td>
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<td>NGOs</td>
<td>Non-Governmental Organisations</td>
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<tr>
<td>NUTP</td>
<td>National Urban Transport Policy</td>
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<tr>
<td>PITU</td>
<td>Urban Transport Integrated Plan</td>
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<tr>
<td>PPG13</td>
<td>Planning Policy Guidance 13: Transport</td>
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<tr>
<td>PPM</td>
<td>Problem Priority Matrix</td>
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<td>PROSPECTS</td>
<td>Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems</td>
</tr>
<tr>
<td>SOLUTIONS</td>
<td>Sustainability of Land Use and Transport In Outer Neighbourhoods</td>
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<tr>
<td>TA</td>
<td>Transferability Audit</td>
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<tr>
<td>TfL</td>
<td>Transport for London</td>
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<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>USA</td>
<td>United States of America</td>
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<tr>
<td>USRAP</td>
<td>United States Road Assessment Programme</td>
</tr>
<tr>
<td>VAS</td>
<td>Vehicle Activated Signs</td>
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<tr>
<td>VRU</td>
<td>Vulnerable Road User</td>
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Executive Summary

The main aim of the SaferBrain project is to improve safety levels of the road transport system and its components in Emerging Economies, focusing the attention on vulnerable road users (VRUs), and contributing to the overall scope of reducing the number of fatalities and severity of injuries caused by road accidents in countries such as India and Brazil.

This report focuses on the land use and transport planning process and through a review of current guidelines and best practice in Europe, investigates the degree to which safety is considered as part of the process and the needs of the more vulnerable users of the road (i.e. pedestrians and bicyclists) are considered.

The main objective of this document is to recommend best practice guidelines for integrated land use and transport planning in Emerging Economies for Vulnerable Road User (VRU) safety, based on current European best practice. The aim is not to develop brand new guidelines, but to identify those existing guidelines which can be recommended for best practice in the Emerging Economies. The recommendations are then evaluated by local SaferBrain partners (from India and Brazil) to identify any difficulties and also any benefits of applying the recommendations to Brazil or India.

A synthesis of the work already completed in SaferBrain to analyse the local (India and Brazil) requirements and to determine the conditions for transferability, detailed in SaferBrain Deliverables 1.1 and 2.2, is provided, with the aim of identifying any results which may be of relevance to developing the recommendations in this study. Particularly, the Transferability Audit process that has been developed is identified as a tool that could be beneficial in selecting effective best practice.

A variety of best practice guidelines, guidance documents and EC funded studies in the areas of land use and transport planning are identified in the review as having potential for being recommended for best practice in Emerging Economies, many of which have an emphasis on sustainability. Relevant guidance from the USA, Australia and Canada is also sourced.

From the review undertaken, a summary of best practice recommendations is identified which could potentially be transferred to Emerging Economies. All of the recommendations are linked to the guidance documents that deal with the relevant issues. Three main recommendations are provided:

4. Stakeholder participation should be considered;
5. A step by step planning process should be developed;
6. VRU-specific principles should be implemented into the step by step process.

Other recommendations include:

5. Ensuring accessibility for all;
6. Integration of policies;
7. Consideration of potential future development impacts;
8. Consideration of existing and future needs of all road users but from the point of view of VRU safety.

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Further work to be undertaken in SaferBrAln will look to identify specific measures that could help to successfully implement the best practice recommendations in Emerging Economies. This study has been a useful first insight into the issues associated with transferring European best practice to Emerging Economies. Beyond the SaferBrAln study, the issues highlighted in this report would benefit from being evaluated further using real world case examples and looking in more depth at each stage of the planning process.
1. Introduction

The main aim of the SaferBraIn project is to improve safety levels of the road transport system and its components in Emerging Economies, focussing the attention on vulnerable road users (VRUs), and contributing to the overall scope of reducing the number of fatalities and severity of injuries caused by road accidents in countries such as India and Brazil.

The main outcome of the project will be the development of innovative guidelines, recommendations and tools for Vulnerable Road User (VRU) safety on Indian and Brazilian roads. These guidelines and recommendations will mainly focus on improving safety as part of the design and development process of safe roads. However, safety is also an important consideration at an even earlier phase, during the planning process, and not just of individual roads, but of whole road networks and how future development will also impact on safety levels.

This report focuses on the land use and transport planning stages and through a review of current guidelines in Europe, it will investigate to what degree safety is considered as part of the process and to what degree the needs of the more vulnerable users of the road (i.e. pedestrians and cyclists) are considered.

This report draws together the findings of the local conditions review (SaferBraIn Deliverable 1.1) and the review of conditions for transferability (Deliverable 2.2), as well as a review of current land use and transport planning best practice guidelines in Europe to allow an assessment of the feasibility of applying the best practice (or a version of them) to Emerging Economies.

1.1. What is Land Use and Transport Planning?

Land use planning is the process of planning how to use land in an area and aims to regulate the use of land efficiently and fairly. The aim is to ensure land is used to the greatest benefit of the wider economy and population and environmental protection.

It is made of a number of different disciplines, of which the ones most relevant to the SaferBraIn study and the work being undertaken in this report are:

- Urban planning – aims to improve the built, social and economic environment of communities. Aspects include: aesthetics, safety, slums, decay, reconstruction/renewal, transport, suburbanisation, environmental factors, light and sound;
- Urban design – concerns the arrangement, function and appearance of a town or city. It is similar to urban planning, but is concerned more with the physical enhancement of the public environment, whereas urban planning often involves managing private development using established methods;
- Transport planning – this involves the evaluation, assessment, design and placement of all types of transportation facilities (e.g. roads, paths for pedestrians and/or cyclists, public transport).

Transport planning is the area of land use planning that is most relevant to the scope of the SaferBraIn study, although the principles of urban planning and urban design also need to be considered.

In the UK, transport planning has been a developing discipline over the past 50-60 years, since the increasing popularity of the motor car meant that road capacity started to overtake motor vehicle use, leading to concerns about congestion and the environment. The first policies for redesigning urban areas and managing traffic were publicised in the book “Traffic in Towns” (Buchanan, 1963), which warned of the potential damage caused by the motor car, while also offering ways to mitigate it. Around the same time the Smeed Report (Smeed,
1964), a UK Government commissioned study undertaken between 1962 and 1964, investigated alternative ways of introducing congestion charging for road use. The report did not go as far as making specific recommendations, but it did conclude that congestion charging could work and should be considered. However, it received little political support.

More recently, the publication of the Planning Policy Guidance 13 (Department for Communities and Local Government, 2001 revised in 2011), along with the Government White Papers¹ “A New Deal for Transport” (Department for Transport, 1998) and “Transport Ten Year Plan 2000” (Department for Transport, 2000) all outlined that unrestrained growth in road traffic in the UK was not sustainable, citing concerns about congestion, environmental impact and discrimination against the more vulnerable users in society (e.g. the poor, elderly, disabled).

These more recent documents highlight the importance of integration in the following ways:

- within and between various transport modes;
- with the environment;
- with land use planning;
- with policies for education, health and wealth creation.

1.2. Land Use and Transport Planning in Emerging Economies

In Emerging Economies, such as India and Brazil, the country is in the process of rapid growth in terms of economy, industrialisation and business. As opposed to the gradual development of transport infrastructure over a number of decades, such as typically seen in many developed countries across Europe and beyond, the rate of change in these countries is much faster. Therefore many of the “stages” of transport development that has been observed in Europe may be “skipped” over to try and deal with the ever changes demands (e.g. the rapid in change from walking to car use; changing from an untreated track to an 8 lane highway; from segregation to shared use). These sort of issues need to be taken into consideration when suggesting European measures and methods for introduction to Emerging Economies. The mix and type of road users is another extremely important factor to consider when planning land use and transport networks.

Land use and transport planning is already a consideration in India and Brazil. For example, in India, the National Urban Transport Policy (NUTP) was developed in 2006 to integrate land use and transport planning in cities and recommends priority to be given to public transport users and non-motorised users. In Sao Paulo, there is Urban Transport Integrated Plan (PITU) which includes projections for improving rail, road and public transportation up to 2025, although the focus on pedestrians and cyclists in this plan appears to be limited.

EMBARQ is the World Resource Institute’s Centre for Sustainable Transport and aims to “make cities better places to live”, by, among other objectives, reducing pollution and emissions, improving public health, improve quality and cost effectiveness of urban transport, improve traffic safety, security and accessibility and improving quality of public spaces for all.

It includes countries such as Mexico, Brazil, India, Turkey and Peru. It brings together expertise from a wide range of disciplines, such a transport and urban planners, architects, environmental experts, designers and journalists. They work with governments, the private sector and civil societies to provide advice and expertise to urban development projects being undertaken in the above countries, often related to walking and cycling.

¹ A white paper is an authoritative report or guide that helps solve a problem. In terms of government papers, it is an informal name for a parliamentary paper enunciating government policy
Organisations such as the United Nations (UN) Road Safety group, "Make Roads Safe", the World Bank Global Road Safety Facility and the Global Road Safety Forum focus more specifically on road safety issues in Emerging Economies, particularly for the more vulnerable road users, but have a part to play in the development of transport and land use plans which consider the safety issues.

The International Road Assessment Programme (iRAP) started as an umbrella organisation of EuroRAP, USRAP and AusRAP and has developed to facilitate work in emerging economies and pre-emerging economies. This organisation aims to significantly reduce road casualties of all types (motorised and non-motorised) by improving the safety of road infrastructure, particularly on high risk roads. Its work in countries such as India, South Africa, Chile and Peru (among many others) helps to ensure that future road planning and development considers safety as part of the planning process to ensure that new roads are developed to a high level of safety in terms of the assessment and rating process and lessons can be learnt from other countries.

1.3. Aims and Objectives

The main objective of this short overview is to recommend best practice guidelines for land use and particularly for transport planning in Emerging Economies for Vulnerable Road User safety, based on current European best practice.

The aim is not to develop brand new guidelines, but to identify those existing guidelines considered to be best practice which can be recommended for application in emerging economies. In this study, best practice refers to any guidelines or guidance documents which are known to have current or past influence on transport planning or land use developments. This also includes the findings of collaborative studies such as European Commission funded projects, where the findings are generally based on current knowledge and what is considered to be best practice.

The role of safety will be considered in the existing guidance and observations will be made about the levels to which safety is considered in an integrated plan, such as those highlighted above.

The guidelines will include (i) recommendations for a process for developing a land use and transport plan, (ii) recommendations for stakeholder participation, and (iii) guidance for taking into account VRU safety in a transport plan. As part of these three areas, some general guidance will be provided for achieving this best practice and which existing documents can be used as guide.

The findings from this work will be developed further as part of the development of the more detailed guidelines and recommendations for road safety management, infrastructure design and road safety audit, to be reported in SaferBrain D4.2. Specific VRU safety-related practices and measures will be identified and evaluated in D4.2 and they will be linked to the general best practice outlined in this report.

1.4. Report Layout

In order to achieve these aims, this study started with an overview of the research undertaken regarding local requirements and transferability conditions (reported in D1.1 and D2.2 respectively) to identify the issues that may be of relevance to evaluating the transferability of any best practice to Emerging Economies (Section 2).

A review of identified existing guidance related to transport planning and land use is presented in Section 3.
Following on from this review, Section 4 suggests recommendations for best practice in an integrated land use and transport planning process.

Section 5 reports on the evaluation undertaken by local (India and Brazil) partners, highlighting the potential issues with implementing to local conditions.

Section 6 summarises the main safety implications of related to transferring the best practice, based on a review of the findings from all previous sections.

The report finishes with a summary list of the main conclusions Section 7.
2. Synthesis of Findings from SaferBrIn D1.1 and D2.2

The aim of this chapter is to present a synthesis of findings from the SaferBrIn Deliverables D1.1 (Analysis of Local Requirements) and D2.2 (Conditions for Transferability). This information will then be used in subsequent chapters in this report to help assess the feasibility of applying the recommended best practice to Emerging Economies.

2.1. Findings of D1.1

The main objective of SaferBrIn Work Package 1 was to provide a better understanding of requirements regarding the safety of VRUs in Emerging Economies. This was achieved by undertaking a short analysis of local accident databases, a survey of road infrastructure, land use configuration and planning and a survey of the local current road safety management procedures. The findings of these analyses was reported in Deliverable 1.1.

Within D1.1, three levels of analysis were outlined, being Macroscopic level (decisions and actions made at the Government and national level), Mesoscopic level (organisations and groups, both private and public, that implement, maintain or otherwise support the policies instituted by the Macro level), and Microscopic level (the road user and the situation on the streets and roads). Reported here are the findings of D1.1 that relate directly to transport planning and land use and will be of use when developing the best practice guidelines in D4.1.

2.1.1. Macroscopic Level

The national policies in the European Union (EU) are very different from Brazil and India. In the EU there are national policies, based on targets, with permanent monitoring. This has lead to a proactive and integrated approach, recognising that road design and land use planning influence human behaviour. The reactive approach of Brazil and India is due to the lack of the existence of data monitoring collected on the national level. All the countries have road design standards, as well as safety and equipment for vehicle standards. In India the plans and policies include “Road Safety” and “National Urban Transport” policies and “Comprehensive Mobility” plans.

The main difference between India and Brazil in relation to the EU is the focus of the approach. EU countries benefit from an integrated approach because they recognise that road design and land use planning influence human behaviour, and this principle leads these countries towards an effective safety strategy that is far more important than just setting up safety restrictions for vehicles. India does not take into account the specific characteristics of VRUs when performing road safety audits. In Brazil there has been more awareness of VRUs but relies on implementing road signage standards.

Gender issues are important in transport planning and policy making to improve equality of mobility, and also bring the focus of transport planning on to people instead of the vehicle. India and Brazil do not consider gender issues at all in road safety policy making, in Europe collection of transport data takes into account gender and age.

2.1.2. Mesoscopic Level

At this level there are many differences between the EU, Brazil and India. Data collection, performance reviews, the enforcement of vehicle standards and driver behaviour exist in every region, but in a different way and at a different level. Programmes for VRUs are widespread in the EU, but not in Brazil and India. In the EU safety is a national issue, with several organisations responsible for road safety and coordinated by ministries. Differences in accident data collection can not only be found in the chosen data levels, but also in the
definitions of the indicators being used. This indicates that the DSS to be developed during the project will have to consider these differences in the data required and the definitions of data types used.

Brazil and India are both significantly larger than European countries in terms of population, while at the same time showing a much lower average income. A comparison solely between Brazil and India also clearly shows that these two countries are relatively different.

Similarities can be seen in the male/female allocation of fatalities for each country. The overall tendency of the roughly 80% to 20% allocation is remarkable. Europe has a relatively high rate of registered vehicles compared to Brazil and India, but Europe has a relatively low number of fatalities per registered vehicle. Factors to explain this could be: safer cars, more traffic separation, a higher focus on traffic education, different standards for roads, and a different approach to land use planning. The identification of risk for road users appears to be quite different between Brazil, India and Europe. The main risk in India is related to illegal crossings of arterial roads by pedestrians, whereas in Brazil risk factors are associated with priority for VRUs on roads. In the EU road safety audits and inspections are conducted while in India and Brazil they are not properly regulated and enforced. Main commonalities (between Brazil and Europe) concern the emphasis that is put on safety standards for the use of safety belts and helmets, as well as the accident reliability aspects.

In all the regions analysed the performance review is considered fundamental for road safety improvement. Differences appear between India and Brazil: in India the focus is at a national level, with particular attention to highways, while in Brazil the local reviews are better than the national ones. All the three regions are investing in permanent review processes. Europe is now focussing more on cultural and behavioural aspects.

2.1.3. Microscopic Level

The main difference is the focus of the EU on a behavioural approach including the position of VRUs. Brazil and India do not consider VRUs as safety priorities, and with VRUs having priority on the road (which is generally not respected). Some countries in the EU consider that changing the design of urban infrastructures (creation of “home zones” for instance) can trigger a huge change in traffic behaviour.

2.2. Findings of D2.2

The aim of SaferBrain Work Package 2 was to identify the performance efficiency of practices and methodologies intended to be applied in Emerging Economies compared to their application in European countries, using the already available experiences with these measures.

To achieve this, a generalised Transferability Audit was developed to check the applicability and acceptability of available road safety measures, guidelines and tools from European countries to Emerging Economies.

Transferability in the context of road safety relates to the possibility of a road safety measure that has been successfully implemented at one location being successfully implemented at another location (e.g. different location in the same city, a different city or a different country). It describes the process of assessing the feasibility of transferring the measure rather the selection of a specific measure that could be transferred.

Past European Commission (EC) funded research projects where transferability has been studied are reviewed and methods of assessing transferability have been developed (e.g. TRANSPLUS, LEDA, CIVITAS) are reviewed. An assessment of the feasibility of using the methods developed in these studies for use in SaferBrain is also included.
Factors which can be used to assess how transferable a measure is include those belonging to the institutional domain (political, regulatory issues), the economic domain (e.g. availability of funding, personnel and technical knowledge) and the societal/cultural domain (e.g. acceptability) and these can be influential at a local or a more general level. The “4 E’s” (Engineering, Education, Economy, Enforcement) and their role within transferability was also discussed. All of these issues can be evaluated at a microscopic, mesoscopic or macroscopic level, as outlined in Figure 1 (reproduced from SaferBrain D2.2).

Figure 1: Pyramid of Road safety Measures to be Transferred and the Evaluation Resolution

An outline of a Transferability Audit process for use in SaferBrain is given (Figure 2 - reproduced from SaferBrain D2.2), which outlines six steps which allow decision makers to assess the more appropriate safety measures for the target context. Safety issues for the target context have been identified from each of the 3 domains identified (institutional, economic and societal/cultural). The strategic goals (known as High Level Objectives – HLOs) were developed from the safety issues. This means that the process outlined in Figure 1 can be undertaken.
In addition, the report also introduces the “Road Safety Space” concept for inclusion in the transferability process and adapts it to include the evaluation of VRU behaviour (Figure 3 - reproduced from SaferBrain D2.2).

![Figure 2: Outline of a Transferability Audit Process](image-url)

![Figure 3: The Road Safety Space Concept](image-url)
To be able to evaluate and quantify the transferability of safety concepts and measures, a Problem Priority Matrix (PPM) was developed. The PPM enables, for each concept or measure being evaluated, to answer the question *Would this Vulnerable Road User safety measure be a problem for (i) Society/Culture, (ii) Institutions and/or (iii) Economy?*

This was undertaken by providing a score according to a 1-5 Lickert Scale (S), 1 being the least challenging and 5 the most challenging; and this would be multiplied by the weight (W) for the category of road users/modes mostly affected, according to the following values: 4 (car drivers), 3 (two-wheelers), 2 (cyclists), 1 (pedestrians).

The scores for the societal/cultural, institutional and economical areas are combined to make an overall problem score for the measure/concept. The lower the score, the least challenging and most beneficial to VRUs is the measure/concept. The higher the score, the most challenging and the least beneficial to VRUs is the measure/concept. An example of the Problem Priority Matrix can be seen in Figure 4 (reproduced from SaferBrain D2.2).

![Figure 4: Example of the Problem Priority Matrix (PPM)](image-url)

The main conclusions of developing a Transferability Audit as highlighted in D2.2 were that a level of expertise is required to ensure evaluations are as accurate and useful as possible. A high transferability score does not necessarily mean a measure or concept should be discarded. However, some adaption to local conditions prior to installation might be required to ensure its successful implementation. Concepts and measures should not be limited to just engineering and enforcement packages. Consideration of education and enforcement packages for measures and concepts should also be considered. This audit process is a useful first attempt at trying to quantify the transferability of measures using existing experiences, but consideration should be given for further development and adaption in future work, both within SaferBrain and beyond. A general awareness of the differences in the cultural issues between India and Brazil is also provided.

### 2.3. Conclusions of Synthesis

Compared with Europe, India and Brazil have a more reactive approach to road design and planning and also safety. There is no constant monitoring of targets, which national policies could be based on.

India and Brazil have in the past not taken an integrated approach, so issues related to road user behaviour, particularly VRUs, have not been considered alongside safe road design.

Safety audits have generally not been as standard in Emerging Economies such as India and Brazil and enforcement is not always strictly adhered to. Therefore, when attempting to transfer guidelines and standards that already exist in Europe to Emerging Economies such as India and Brazil, careful consideration about these issues should be given.
In terms of land use transport planning in general, what can be learnt from the work undertaken particularly in D2.2 is that the transferability process could also be useful for determining what aspects of current European land use and transport planning guidelines could successfully be transferred for use in Emerging Economies. This Transferability Audit process will be considered in the work undertaken in this report, although as it is not part of the scope of the work, it will be undertaken using the expert opinion of the local SaferBraIn partners rather than experts in the field. A more detailed evaluation of specific transport planning measures and concepts will be considered for the work to be reported in D4.2.

The findings of this synthesis of the results of D1.1 and D2.2 will inform the best practice guidelines to be recommended in this report, highlighting issues of transferability and the current practice and policies within the Emerging Economies, to help decide which best practice guidelines will be applicable and transferable. Partners in Brazil and India have a crucial role in supporting the decisions regarding best practice and transferability to Emerging Economies.
3. Review of Land Use and Transport Planning Guidelines in Europe and beyond

3.1. Introduction

Walking and cycling are transport modes where relatively unprotected road users interact with traffic of high speed and mass (SafetyNet, 2009). This makes pedestrians and cyclists vulnerable. They suffer the most severe consequences in collisions with other road users because they cannot protect themselves against the speed and mass of the other party.

Typical European Measures that can be taken to reduce the future number of crashes involving pedestrians and cyclists, and/or to decrease the severity of resulting injuries, relate to:

- The traffic system itself, such as separation of motorised traffic from non-motorised traffic, area-wide speed reduction, and the provision of walking and cycling networks;
- Proper design of pedestrian and cyclist facilities;
- Improvement of the visibility of pedestrians and cyclists;
- Vehicle design, in particular crash-friendly car fronts and side under-run protection on lorries;
- The use of protective devices like bicycle helmets;
- Education and training of pedestrians and cyclists as well as drivers.

The development of large areas without the direction of a long-term land usage plan can lead to unnecessary traffic or complicated and dangerous traffic system, which may increase the number of accidents. In urban areas, the risk of injury accidents per kilometre driven is higher than in rural areas. An increase in the size of urban areas may therefore increase the accident rate (Elvik et al., 2009). The objective of land use planning used as a traffic safety measure, particularly across Europe, is to:

- locate roads, residential areas, workplaces and other industries in such a way that the traffic volume is low and smooth and travel distances are minimised;
- create a road network that separates access roads from roads for through traffic and ensures that traffic volume on access roads is as small as possible;
- design individual roads so that the accident rate on the road is low;
- make the traffic system simple and easily understandable for all road users.

Land use plans and land usage can influence traffic safety by affectting traffic volume, the distribution of traffic on different types of roads, the modal split of transport, accident rates on each road and the location of industries that generate a lot of traffic in such a way that traffic to and from these industries can use public transport or those parts of the road network that have the lowest accident rate.

A fully functioning and developed transport system is also vital to economic well-being, as well as environmental considerations. The UK transport system currently supports over 61 billion journeys a year, which makes up a significant proportion of the carbon use in people’s lifestyles. The Chartered Institution of Highways and Transportation (CIHT manifesto, 2010) suggests that in the UK, a 5% reduction in travel time for all business and freight travel on the roads alone could generate around £2.5 billion of cost savings to the economy. The main priority for investment within the transport system is to maintain and safely operate the network. In more recent urban transport development plans, journey reliability is now often considered to be more important than journey time, particularly when considering sustainability.
In Section 3.2 a brief overview of land use and transport planning aspects, focused to VRUs, is provided. Section 3.3 presents some land use and transport planning guidelines, not all specifically related with VRUs safety, which could be used as basis for recommendations development.

### 3.2. Land Use and Transport Planning to Reduce VRU Accidents

Long-term planning is needed to create the fundamental changes that will improve the safety and mobility of vulnerable road users. Measures require a framework that takes the various needs of VRUs into account. Concepts like Sustainably Safe Traffic (Wegman & Aarts, 2006) and Vision Zero (Tingvall, 1995) provide the framework that long-term planning requires. These concepts stop defining road fatalities as a negative but largely accepted side-effect of the road transport system. Rather, road fatalities can and should be avoided, and the probability of crashes can be reduced drastically by means of the infrastructure design. Where crashes still do occur, the process which determines the severity of these crashes should be influenced in such a manner that the possibility of severe injury is virtually eliminated (AA.VV., 2009).

The Dutch Sustainably Safe Traffic system is currently characterised by:

- A structure that is adapted to the limitations of human capacity through proper design, and in which streets and roads have a neatly appointed function, as a result of which improper use is prevented;
- Vehicles which are fitted with facilities to simplify the driver’s tasks and which are designed to protect the vulnerable human being as effectively as possible;
- Road users, who are adequately educated, informed and, where necessary, guided and restricted.

A road safety system based on this framework can be combined with transport policies that consider walking and cycling as a mode of transport, such as the one written down in UK’s White Paper “A New Deal for Transport: Better for Everyone” (Department for Transport, 1998).

The main consequences of the necessary framework and new concepts for road planning and design are:

- Motorised traffic with a flow or distribution function must be segregated from non-motorised transport;
- A network of main traffic routes must be created for pedestrians and cyclists.
- A fair balance between motorised and non motorised traffic for priority facilities at crossings should be achieved;
- The maximum speed of motorised traffic should be limited on roads where it mixes with non-motorised traffic.

The White Paper also details specific measures that are needed to realise the above mentioned traffic system, related to road and traffic planning, and road design. In addition, other measures identified that could improve the safety of pedestrians and cyclists in the UK are:

- Improvement of the visibility of pedestrians and cyclists;
- Pedestrian- and cyclist-friendly design of cars and heavy vehicles;
- Bicycle Helmets;
- Education and training.
In Emerging Economies, it must be remembered that the uses for bicycles are much more varied than in Europe (e.g. to carry freight; to carry paid passengers), which many of the recommendations developed for European countries are not compatible with.

Pedestrian safety measures that are the most comprehensive and most closely associated with urban planning and policy philosophies are:

- Area-wide speed reduction or traffic calming schemes;
- Provision of an integrated walking network.

These are two complementary measures, which can be implemented together without conflicting. Area-wide schemes (e.g. 30 km/h zone) are aimed at reducing vehicle speeds and thus at allowing for a safer mingling of pedestrians with motor traffic. Integrated walking networks serve to remove and/or reduce conflicts between pedestrians and vehicles and to provide or improve crossing points (Wittink, 2001).

The same basic planning principles that apply for pedestrians apply for cyclists. Because cycling is suitable for travel over greater distances than walking, it is necessary to distinguish a flow and an access function. As is the case with motorised traffic, a network for the flow function is required. However, this network cannot follow the network for through-motor traffic easily, since the mesh of the routes of the cycling network is smaller. Provisions for cycling should therefore not simply be seen as additional features of the traffic structure for motor traffic. Rather, they require a network of their own (Wittink, 2001).

Cycling England, which is an independent expert body, established in 2005 by the UK Department for Transport, has developed an advisory document which outlines the measures and issues which should be taken into consideration in new development plans to encourage the use of cycles (Cycling England, 2010).

When facilities for cyclists are being designed, five criteria are important if their needs are to be met (CROW, 2007):

- **Safety**: for large parts of the population in Europe road safety problems is a key reason for not cycling. Improvement of the safety of cyclists on the road is therefore a precondition for promotion of cycling;
- **Coherence**: continuity, consistency of quality, recognisability and completeness. It is obvious that cycling will be restricted if the cycle network is not complete or coherent.
- **Directness**: mean travel time, detours and delays;
- **Comfort**: smoothness of road surface, curves, gradients, number of stops between starting point and destination, complexity of rider's task;
- **Attractiveness**: visual quality of the road, survivability, variety of environment and social safety.

### 3.3. Land Use and Transport Planning Guidance in Europe and beyond

In Europe, there are a cluster of EC funded projects which investigate the areas of urban mobility, including land use, transportation and the environment, known as the Land Use and Transport Research (LUTR): Policies for the Cities of Tomorrow. The findings of these projects are based on best practice drawn together from countries across Europe. The two projects with relevant results are PROSPECTS and TRANSPLUS, which are described further in this section. Also, a number of guidelines related to transport planning are described, including the UK’s Planning Policy Guidance 13: Transport (PPG13) and also the Food and Agriculture Organisation of the United Nations (FAO) guidelines for land use planning.
3.3.1. PROSPECTS Methodological Guidebook

The project PROSPECTS\(^2\) (Minken et al., 2003), co-financed by the European Commission, provided cities with a methodology to generate optimal land use and transport strategies to meet the challenge of sustainability in their particular circumstances.

PROSPECTS was designed to help city authorities meet the challenges set in “The Common Transport Policy” which advocates the achievement of sustainable mobility. The project allowed to:

- identify the decision making needs of cities;
- assess and enhance evaluation tools to aid decision making;
- assess and enhance forecasting and analysis tools for the land use/transport system;
- publish a Decision-Makers Guidebook\(^3\) and supporting Methodological\(^5\) and Policy Guidebooks;
- disseminate the results and exploit the three Guidebooks and the enhanced tools.

The Methodological Guidebook\(^4\) presents a coherent but flexible general approach to planning for a sustainable urban land use/transport system and offers methods of carrying out the steps of that logical structure.

The guidebook offers a choice of methods and approaches, all compatible with general rules of good planning and with the overarching sustainability objective. The project also proposed a logical method of appraising land use/transport strategies with respect to sustainability, and on optimising with respect to sustainability.

Even if not specifically focused on land use and transport planning for vulnerable road users (main focus is on sustainability in general), the methodology proposed by PROSPECTS could be adapted to safety issues of VRUs.

The logical structure of the planning process foresees the following steps (also see Figure 5) which are listed in the various chapters of the PROSPECTS Decision Makers Guidebook (chapter number in brackets):

- scenario description and definition of objectives (2.3, 2.4, 2.5);
- problems identification basing on objectives (2.6);
- definition of instruments to overcome problems identified (2.7);
- definition of barriers to implementation (2.8);
- development of strategies as combination of instruments to reduce impact of barriers (2.9);
- prediction of impacts of instruments or strategies (through models) (2.10);
- comparison of results with an appraisal method (2.11);
- identification of possible instruments and strategies improvements (2.7, 2.9);
- identification of better strategies (e.g. optimisation techniques) (2.12);
- implementation of instruments and assessment against the objectives (2.13);
- periodic monitoring of changes in problems (2.13).

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\(^2\) PROSPECTS - Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems

\(^3\) http://www.enviplans.net/guidelines/reading/mobility/prospects_guide_05_en.pdf

\(^5\) http://www.infra.kth.se/courses/1H1402/Litteratur/pr_del14mg.pdf
Figure 5: Logical structure of the PROSPECTS Methodological Guidebook

In addition to the general outline of planning described in Figure 5 (more details about each step can be found in guidebook), the authors proposed an appraisal framework that can be used for the strategic planning for urban sustainability.

The appraisal framework is a matrix, with one row for each impact and one column for each alternative being considered. Its main purpose is to provide participants in decision making process with the information which they need to rank strategies, to select a single best strategy or a set of preferred strategies (by eliminating useless, unacceptable or dominated strategies).

The appraisal framework calls for quantitative models to assess impacts of strategies. In general, similarly to the road safety space described in D2.2, the sustainability issue (but the concept can be adapted also to VRUs safety issue) is considered to have three aspects: economic, social/cultural and environmental sustainability.

There is no single theory that can predict system responses to strategies and the economic, social and environmental impacts that these responses might have. There are several bodies of theory, each covering some aspects and each with its strengths and weaknesses. The

guidebook proposes a brief review of the relevant theories and of the most commonly used
types of models.

A section of the guidebook is also dedicated to walking and cycling benefits, in order to put in
evidence their importance for transport and land use strategies. The ways in which the
strategies influence health consist of the health impact of air pollution from transport,
production and housing, the accident impacts, and the impacts of physical exercise in the
form of walking and cycling. If a city wants to focus the health implications of transport/land
use strategies, an indicator consisting of these three elements may be formed and reported.

3.3.2. TRANSPLUS Project

The research project TRANSPLUS - Transport Planning, Land Use and Sustainability
(Transplus, 2003)\(^6\) aimed to identify best practices in the organisation of land use and
transport (LUT) policies in order to achieve a sustainable pattern of transport and land use in
European cities and regions, promoting economic, social and environmental improvement.

Similar to PROSPECTS, the focus of the TRANSPLUS project was not specifically on road
safety or on VRUs safety. However, the results of TRANSPLUS can still provide useful
indications.

The project has identified two major approaches to define and implement integrated land use
and transport strategies:

- **land use policies aiming to reduce the need to travel** – these are mainly "forward"
policies (or "city of tomorrow" policies) which create new centres or regenerate
brown-field sites, changing the urban fabric and limiting the sprawl of dwellings,
workplaces etc.;

- **transport policies aiming to improve accessibility with a wider range of transport
alternatives** – these are mainly "backward" policies (or "city of today" policies) taking
the existing urban fabric as a datum, and changing the transport system in order to
improve accessibility by alternative transport modes (public transport, walking &
cycling, flexible transport services, car sharing etc.) and stimulating the revitalisation
of high-density and mixed-use neighbourhoods within the city.

One of the results of the project was to provide a set of recommendations on how to design
and put in practice a variety of integrated LUT strategies.

The first recommendation refers to the choice between mono-centric or poly-centric strategy
to be adopted. The first puts the focus on revitalisation strengthening of the city centre, while
the second concentrates investments in the development of well located sub-centres. The
choice of the strategy depends on the city size. The mono-centric approach is more indicated
for smaller cities, while larger ones should opt for the polycentric approach.

TRANSPLUS puts the emphasis also on the integration of strategies which is considered as
a multidimensional task involving policies, methodologies, planning and organisation of
processes or structures.

The implementation of a land use and transport strategy usually implies the combination of
several policy measures. The assumption behind combining different measures is that the
objectives can be achieved more effectively by using packages of policies, whereby the
combination of complementary and mutually supportive measures facilitates their
implementation and/or intensifies the respective impacts.

To implement a land use and transport strategy does not simply require identifying a suitable
a list of policy measures. It also involves the integration of several processes and actions

\(^6\) [http://www.transplus.net/TrDoc/T_inglese.pdf](http://www.transplus.net/TrDoc/T_inglese.pdf)
needed to realise any substantial policy (deliberation, implementation, monitoring, evaluation, identification of complementary policies, coordination between authorities at different levels of government, participation of private actors, citizens and stakeholders) into a coherent, comprehensive and enduring framework where the single processes may reinforce one another in meeting the objectives, and in overcoming barriers to the successful output and outcome of the policy.

A number of key-factors influencing the successful implementation of integrated LUT policies, as well as the main types of barriers and ways to avoid or overcome them, have been identified in TRANSPLUS. The recommendations reported in Table 1 synthesise the main findings on how to improve the implementation process of LUT policies.

**Table 1: Main Recommendations of TRANSPLUS**

<table>
<thead>
<tr>
<th>Identify the problem</th>
<th>Be aware of the barrier “problems” and take the initiative to find solutions.</th>
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<tbody>
<tr>
<td></td>
<td>The accurate specification of a problem may sometimes allow attention to be focused on the kind of solution that might be used.</td>
</tr>
<tr>
<td></td>
<td>Search for solutions able to remove barriers that are contingent (i.e. they can be removed) and hinder the implementation of the policy (output barriers) or the realisation of the sustainability goals (outcome barriers). Most barriers are interconnected and may not be immediately identify explicitly. However, the identification and recognition of the existence of a barrier constitutes the first step towards a solution.</td>
</tr>
<tr>
<td>How to support the implementation process?</td>
<td>According to the case studies analysed within TRANSPLUS research, many different and innovative ways are being adopted in order to improve the implementation of integrated LUT policies. The basis for good implementation practices, in all cases, are:</td>
</tr>
<tr>
<td></td>
<td>• Adopt a broad strategic concept for the city which integrates sectoral policies in a comprehensive strategy;</td>
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<tr>
<td></td>
<td>• Strengthen co-operation and co-ordination between the different administrative departments within the city and across different tiers of government (municipal, regional, in some cases even national), and increasingly between public and private actors;</td>
</tr>
<tr>
<td></td>
<td>• Promote the involvement of stakeholders and inhabitants in the development of a vision for the City of Tomorrow and the planning processes</td>
</tr>
</tbody>
</table>
Progressive or massive implementation?

Often relevant policy changes cannot be implemented at once in the whole city. This may be caused by a number of reasons, and thus only a step by step implementation process seems to be an effective way to proceed. Usually, the measures can be limited to a specific area where more favourable circumstances enable (or more stringent needs require) the implementation of LUT integrated concepts.

A positive aspect of a step by step implementation process is that it prevents stakeholders from being confronted with extensive projects that disrupt their usual patterns of mobility and, thus, does not threaten acceptance.

3.3.3. Planning Policy Guidance 13: Transport

In 2001, the UK Department for Communities and Local Government (updated in 2011)\(^7\) published a guidance document setting out objectives to integrate planning and transport at the national, strategic and local level to:

1. Promote more sustainable transport choices for both people and for moving freight;
2. Promote accessibility to jobs, shopping, leisure facilities and services by public transport, walking and cycling;
3. Reduce the need to travel, especially by car.

Guidance is also given for local authorities to achieve these objectives in the areas of:

- Managing urban growth patterns;
- Accessibility of day to day facilities;
- Location of housing;
- Providing choice of alternative transport modes;
- Location of services in rural areas in focal points;
- Strategies within a plan should complement each other;
- Use of parking policies;
- Greater priority for pedestrians, cyclists and public transport in centres;
- Consider the needs of the disabled;
- Protect sites and routes which could be critical in developing infrastructure.

The guidance provides planning policies for a number of key areas, of which the ones most relevant to VRU safety are:

- Accessibility - facilities should be accessible by public transport, walking and cycling;
- Linking planning and transport - should have complementary strategies;
- Transport assessments - should be undertaken to identify the transport implications;

\(^7\) http://www.communities.gov.uk/documents/planningandbuilding/pdf/1758358.pdf
• Design, safety and mix of uses - the design should consider VRU safety and the implications of mixed land use from the start;

• Mobility issues - meeting the needs of disabled people, including those who have to travel by car.

The document also outlines guidance for managing traffic demand, particularly those related to interchanges, parking issues, demand management, public transport, walking and cycling. For walking and cycling local authorities are encouraged to:

• Review existing provision for pedestrians/cyclists, particularly in areas where the needs and safety of pedestrians/cyclists is key (e.g. outside schools, town centres, interchanges, etc.);

• Pay attention to design, location and access arrangements for promoting walking and cycling;

• Promote high density mixed use traffic in centres and interchanges;

• Provide safe and secure cycle parking and facilities at interchanges and centres;

• Ensure cycle routes and priority measures are provided in new developments;

• Ensure cycling provision can become part of a national/local cycle network;

• Promote and protect local facilities which are close to housing;

• Create more direct, safe secure routes in high pedestrian areas;

• Address personal security issues of pedestrians.

Walking and cycling should also be promoted through:

• Wider/more space for pedestrians;

• Provide more space for cyclists, through reallocation of carriageway;

• Reducing traffic volumes on particular routes;

• Provision of traffic calming measures;

• Providing more priority at junctions and improving links;

• Improve and maintain off-carriageway routes;

• Pedestrian friendly road crossings and avoid footbridges and underpasses;

• Traffic calming measures in key pedestrian use areas;

• Encourage health/education providers/employers to promote walking/cycling (e.g. travel plans);

• Consideration of pedestrianisation schemes in centres/shopping areas;

• Encourage more use of public right of ways;

• Partnership with local health authorities;

• Maximise pedestrian safety and security on pedestrian routes.

The document finishes with some guidance for implementing the planning policies, in terms of planning conditions, planning obligations and the adoption of travel plans.

3.3.4. Guidance on Transport Assessments

As outlined in Planning Policy Guidance Note 13: Transport (2011), where a new development is likely to have significant transport implications, a Transport Assessment
should be prepared and submitted with a planning application for the development. The UK Department for Transport has published guidance on the Transport Assessment (Department for Transport, 2007)\(^8\), which assists stakeholders in determining whether a Transport Assessment is required and if so, what scope or level is needed. If a development has relatively small transport implications, only a Transport Statement is required. If a Transport Assessment is required, the following information regarding the site is needed:

- **Existing conditions:**
  - Existing site information (e.g. site location plans, existing land uses, existing site access layout and constraints);
  - Baseline transport data (e.g. quantification of person trips, public transport facilities and usage, parking facilities, VRU facilities, VRU movements, traffic flows, accident records, etc.).

- **Public transport assessment:**
  - Identify the analysis period; estimate modal split; establish total person trip generation; identify relevant public transport services; estimate existing capacity of each service type; estimate currently level of usage and spare capacity; identify measures to address shortfalls.

- **Cycling/walking assessment:**
  - Accessibility of walking and cycling; assess available capacity of existing cycle/footway network; identify enhancements that may be required to network.

- **Road network assessment:**
  - Assessment of available vehicular capacity in vicinity of site; identify potential impacts on vehicle travel, likely mitigation measures required to sustain development, parking availability and impacts of this.

- **Traffic data and traffic forecast:**
  - Recent traffic counts at peak periods and at critical junctions; manual turning counts, automatic traffic counts (ATC), queue length surveys at signals, journey time surveys, abnormal load counts, VRU counts.

- **Safety considerations/accident analysis:**
  - Identify important road safety issues; analyse recent accident history; identify critical locations; determine whether proposed development will intensify or reduce existing safety problems; undertake inspections of the current site.

If only a Transport Statement is required, then only information regarding the existing conditions is required.

The proposed transport development should also be described as part of the Transport Assessment and should include:

- a site plan;
- a description of all proposed land uses;
- the scale of the development;
- the size of the site;

\(^8\) [http://www.dft.gov.uk/pgr/regional/transportassessments/guidanceonta](http://www.dft.gov.uk/pgr/regional/transportassessments/guidanceonta)
• hours of operation;
• proposed access;
• servicing arrangements;
• traffic impacts during development;
• proposed parking strategy;
• development phasing.

For the Transport Statement, less detailed information regarding the proposed development is required.

The impact of the proposed transport development should also be appraised in terms of the five objectives for transport as outlined in "A New Deal for Transport" (Department for Transport, 1998), which are:

• Environment - impact of noise/ vibration/ air quality/ greenhouse gas emissions; impacts on areas of landscape importance/nature/heritage/historical sites/water environment/townscape/physical fitness/journey ambiance;
• Safety - Potential for accidents in vicinity of the site, perception of insecurity in/around the site;
• Accessibility - access to the transport system and local area; community severance;
• Economy - government regeneration objectives; VRU journey times; motorised users journey times; user costs; costs of the development itself (including subsequent maintenance costs);
• Integration - between transport modes; between development proposal and wider Government policy issues such as environment/health; between proposal and land use policies at all levels; between communities (social inclusion/exclusion).

The number of assessment years and the period of analysis for the development is also outlined in Planning Policy Guidance 13: Transport, along with information regarding analysing the number of person trips generated from the new development. These can be categorised into new trips, pass-by trips, linked trips, diverted trips and transferred trips.

Transport for London (TfL) also has similar guidance called Transport Assessment Best Practice - Guidance Document, which was first published in 2006 and updated in 2010 (TfL, 2010)\(^9\): This document includes a checklist for the transport assessment which includes a list of topics which should be essential/optional when analysing the scope of the proposed transport development.

### 3.3.5. FAO Guidelines for Land Use Planning

In terms of land use planning, the Food and Agriculture Organization of the United Nations (FAO) has produced guidelines which are aimed at all those involved in commissioning and adopting land use plans\(^10\). They provide guidance for assessing the physical, societal, and financial factors to assist land users to use the land in the most efficient, productive and sustainable way for the whole of society. The guidelines include the following step by step process for planning land use:


\(^10\) [http://www.fao.org/docrep/t0715e/t0715e00.HTM](http://www.fao.org/docrep/t0715e/t0715e00.HTM)
Step 1. Establish goals and terms of reference. Ascertain the present situation; find out the needs of the people and of the government; decide on the land area to be covered; agree on the broad goals and specific objectives of the plan; settle the terms of reference for the plan;

Step 2. Organize the work. Decide what needs to be done; identify the activities needed and select the planning team; draw up a schedule of activities and outputs; ensure that everyone who may be affected by the plan, or will contribute to it, is consulted;

Step 3. Analyse the problems. Study the existing land-use situation, including in the field; talk to the land users and find out their needs and views; identify the problems and analyse their causes; identify constraints to change;

Step 4. Identify opportunities for change. Identify and draft a design for a range of land-use types that might achieve the goals of the plan; present these options for public discussion;

Step 5. Evaluate land suitability. For each promising land-use type, establish the land requirements and match these with the properties of the land to establish physical land suitability;

Step 6. Appraise the alternatives: environmental, economic and social analysis. For each physically suitable combination of land use and land, assess the environmental, economic and social impacts, for the land users and for the community as a whole. List the consequences, favourable and unfavourable, of alternative courses of action;

Step 7. Choose the best option. Hold public and executive discussions of the viable options and their consequences. Based on these discussions and the above appraisal, decide which changes in land use should be made or worked towards;

Step 8. Prepare the land-use plan. Make allocations or recommendations of the selected land uses for the chosen areas of land; make plans for appropriate land management; plan how the selected improvements are to be brought about and how the plan is to be put into practice; draw up policy guidelines, prepare a budget and draft any necessary legislation; involve decision-makers, sectoral agencies and land users;

Step 9. Implement the plan. Either directly within the planning process or, more likely, as a separate development project, put the plan into action; the planning team should work in conjunction with the implementing agencies;

Step 10. Monitor and revise the plan. Monitor the progress of the plan towards its goals; modify or revise the plan in the light of experience.”

Although these FAO guidelines are focussed mainly on rural land, these steps could be as relevant when applied to urban locations.

3.3.6. Traffic Calming Guidelines
The increasing volume and use of motor vehicles in towns and villages result in more space being turned over to parking or moving vehicles, with less space for other activities, with increased danger, noise and fumes. Vulnerable Road Users are most affected and can be, almost literally, forced off the road. Traffic Calming Guidelines developed by Devon County
Council in the UK (1992) details discussion of different traffic calming methods including: vertical shifts in the carriageway, lateral shifts in the carriageway, carriageway restrictions, roundabouts, small corner radii, priority management, road markings, electronic enforcement, optical width, narrow carriageways, occasional strips, surface changes, entrances and gateways, shared surfaces, central islands, footway extensions, planting and greenery, street furniture and lighting.

Many roads can offer space for people to meet, rest and enjoy the open air and should not be places people avoid because of traffic. Transport and traffic policy in built-up areas has to be aimed at improving safety and environmental quality rather than accommodating more and more fast traffic. Segregating traffic from sensitive areas can be successful in some areas but often is not possible, so traffic calming can offer a solution especially in residential and shopping areas. Traffic calming aims to maintain direct access whilst deterring ‘rat runs’. Speed limits are often not respected and effective enforcement requires considerable police resources. Traffic calming attempts to adapt the volume, speed and behaviour of traffic rather than adapt streets to the demands of motorised traffic. More constant, lower, traffic speeds also reduces the amount of braking and acceleration and so reduce noise and pollution. Land use policy and development control should work in tandem with traffic calming objectives. Land use which generates high traffic volumes should be located near ‘traffic priority’ roads. The Traffic Calming Guidelines also details case studies where traffic calming has been introduced into areas, including in UK (Devon, Sheffield, Plymouth, and London) as well as sites in Germany and the Netherlands. It also provides a classification of classification of roads in terms of speed and road user priority, which can be used to determine not just the traffic function of the road but also on the speed management.

3.3.7. Streetscape Guidance

Within the UK there are some cities/areas that have produced their own specific guidelines. For example, in London, the document ‘Streetscape Guidance’ (Transport for London, 2009) has been developed to provides advice and information to the staff of Transport for London (TfL) who are involved in the design, upkeep and appearance of London’s roads.

This document details specific guidelines (including data on layouts, and so on) for London streets, including the design process and key design principles. The design principles include holistic approach, sustainable design, understanding the requirements, design for people, consistency and clarity, integration and coordination, reduction of crime and disorder, function and safety, materials and maintenance, access for all, recognition of local context and distinctiveness. There are specific guidelines on sizes/colours/materials etc of kerb stones, paving, street furniture, signage, bollards, planting, and other technical guidance. The document lists good practice and technical guidelines for footway surfaces, shared surfaces, tactile paving, inspection covers, kerbs and drainage, footway cross-over, side road entry treatments, road markings, bus lands, cycle lanes and cycle tracks, subways, parking and loading bays, at-grade pedestrian crossings, as well as street furniture and signage.

3.3.8. London’s Great Outdoors

“London’s Great Outdoors” (Mayor of London, 2009) is a manifesto for public space compiled by the Mayor of London. In the manifesto, it is stated that public spaces should allow pedestrians and cyclists to feel that the space belongs to them as much as to cars and design/redesign of public spaces should aim to:

- reconnect severed neighbourhoods;
- contribute to revitalising and strengthening town centres and high streets;

12 http://www.london.gov.uk/greatoutdoors/docs/londons-great-outdoors.pdf
• enhance the quality of life;
• encourage walking, cycling and increased use of public transport;
• open up neglected water places for public use;
• improve London’s transport hubs and busiest interchanges;
• improve the quality of green spaces and access to them, and enhance their biodiversity;
• remove barriers and create spaces that are accessible for everyone;
• reduce the impacts of climate change and enhance sustainability;
• be flexible, providing the potential for a variety of activities and events;
• be comfortable, encouraging all types of use;
• be accessible, catering to all users;
• be safe throughout the day, night and year;
• be sustainable and durable;
• be beautiful and well designed, rich in texture and well executed;
• be integrated with their surroundings and respectful of the characteristics of their locality.

This manifesto is supported by two documents which outline how to achieve these aims, which are “Better Streets” and “Better Green and Water Spaces” (Mayor Of London, 2009).

3.3.9. Transport Analysis Guidance

Transport Analysis Guidance (WebTAG) is part of the UK Department for Transport’s website for guidance on the conduct of transport studies (Department for Transport, 2003)13. It is based on the “New Approach to Appraisal” (NATA) framework introduced by the then UK’s Department for Transport, Environment and the Regions in 1998, which is used to appraise transport projects and proposals. WebTAG offers advice on modelling and appraising major highway and public transport schemes and provides guidance on:

• Setting objectives and identify problems;
• Developing potential solutions;
• Creating a transport model for the appraisal of the alternative solutions;
• How to conduct an appraisal which meets the DfT’s requirements.

The guidance builds on that of the Design Manual for Roads and Bridges (Highways Agency, 2010) in terms of the physical fitness of a solution. TAG requires a structural approach to provide an audit trail of the policies considered and judgements made. The policies should be divided into local, regional and national and a judgement made as to the extent to which the proposal is integrated with land use and with transport proposals and policies. The assessment is based on a 3-point textual scale - Neutral, Beneficial, and Adverse. Local plans now include Local Transport Plans. Assessments must be made of the extent to which the proposal is integrated with land use proposals and policies and with proposals and policies concerning transport (all modes). The assessment of proposals in the context of national, regional, strategic and detailed local planning policies is included in current recommended appraisal practice. In particular, it also covers transport policies and proposals (all motorised and non-motorised modes, not just road-based), and proposals by operators and others as well as those proposed by planners.

3.3.10. World Class Places

Walking and cycling should become the norm, not driving, according to the document ‘World Class Places’, which has been developed by the UK Government (Department for Communities and Local Government, 2009\textsuperscript{14}). By improving the sustainability of spaces it improves the quality of these places for everyone. Quality of place has four factors that shape it: the range and mix of homes, services and amenities, the design and upkeep of buildings and spaces, provision of green space and green infrastructure, the treatment of historic buildings and places. Connections between buildings are as important as the buildings themselves but are often not thought of as being “designed”, even though they are the result of decisions made that can be very important. The layout of streets, the materials and signs, accessibility for disabled and older people, all help to influence the feel of an area and how it functions. Maintenance and upkeep are as important as the original design.

3.3.11. Home Zones

A number of guidance booklets have been published by the Institute of Highway Engineers (IHE, 2002) to provide practical advice on good practice to designers and others involved in planning, designing or approving Home Zones in the UK\textsuperscript{15}. Home Zones are residential streets in which the road space is shared between drivers of motor vehicles and other road users, with the wider needs of residents (including people who walk and cycle, and children) in mind. The aim is to change the way that streets are used and to improve the quality of life in residential streets by making them places for people, not just for traffic. Changes to the layout of the street should emphasise this change of use, so that motorists perceive that they should give informal priority to other road users. Whilst aspects of Home Zones are not appropriate to all areas (>10mph (16kph) speed limits) aspects of the design could be considered when designing other roads and streets, with specific guidance on ‘designing for people and vehicles’ that could be considered for other roads and streets. However, there are some groups for whom shared spaces (a staple of Home Zones) cause more problems, especially the blind and visually impaired (Nyvig, 2006).

Transport must be seen as being part of the design of an area to encourage shorter journeys, less use of the car and greater use of public transport, walk and cycle. Clear guidance is needed on density, settlement size, provision of local services and facilities, mixed land uses, proximity to public transport accessible developments (Transport Development Areas or Transit Oriented Developments), and limited availability of parking. Best practice, benchmarking and strategic guidance would all help here. At the neighbourhood level (and in city centres), design standards should be used to encourage ownership of the local environment by residents and other stakeholders, so that its quality is maintained and improved. Residential, shopping and even commercial space should be very clearly designated for different priority uses (perhaps varying by time of day – for schools, or day of week – for markets), so that people and slow traffic have priority. Similarly, local facilities and services raise levels of accessibility so that travel distances to shops, schools and health centres can be reduced. Through design it is possible to lock in the benefits of lower transport emissions levels (Banister, 2007).

3.3.12. Manual for Streets 1 and 2

Manual for Streets (Department for Transport, 2007) and Manual for Streets 2 (Chartered Institute for Highways and Transportation, 2010) provides guidance for planning, designing and modifying streets with the aim of creating streets for people rather than just motorised

\textsuperscript{14} http://www.communities.gov.uk/documents/planningandbuilding/pdf/1229344.pdf
\textsuperscript{15} http://www.homezones.org.uk/public/guidance/index.cfm
traffic. This work is supported by charities such as Living Streets\textsuperscript{16}. Although the documents are relatively new, the documents contain best practice guidelines which are well established in the UK and have contributed to improving the quality and safety of roads and centres since the 1990's (see Figure 6 for example, reproduced from www.cabe.org.uk\textsuperscript{17}), but at the same time are still continually evolving.

\textbf{Figure 6: Case Study in Nottingham, UK, where the Principles now Established in Manual for Streets 2 were applied to a City Ring Road in 2004}

It is crucial to consider streets in context, and to consider layout and connectivity, quality places, street users’ needs, street geometry, parking, traffic signs and markings, street furniture and lighting, materials, adoption and maintenance of the streets (Manual for Streets, DfT, 2007). Manual for Streets (2007) traditionally focuses on residential areas and areas with low traffic volumes, whereas Manual for Streets 2 (2010) concerns the wider application of the principles outlined in Manual for Streets (2007), to include busier streets such as arterial roads and town centres. This therefore bridges the gap between Manual for Streets (2007) and the Design Manual for Roads and Bridges (trunk roads and motorways). The need to balance movement and place functions in all areas is key. Manual for Streets 2 discuss a variety of contexts and street types, including:

- Multifunctional streets and spaces in town/city centres;
- Arterial routes/high streets in urban and suburban areas;
- Relief road/ring roads, which primary function are to carry traffic around outside of urban centre;
- Boulevards;
- Interchanges, where various transport forms meet (e.g. bus/tram/rail stations, stops or routes);
- Village centres;
- Residential streets;
- Shared space in urban/rural settlements.

Manual for Streets 1 and 2 both include a number of important principles when approaching the design, construction, adoption and maintenance of urban streets. These principles help the planner/designer to determine which of the above contexts/street types are most relevant for the scheme under evaluation:

- Applying a user hierarchy;

\textsuperscript{16} http://www.livingstreets.org.uk/

\textsuperscript{17} Commission for Architecture and the Built Environment (CABE) - http://www.cabe.org.uk/
• Emphasising a collaborative approach;
• Recognising the importance of the community function of streets;
• Promoting an inclusive environment;
• Reflecting and supporting pedestrian and cyclist desire lines;
• Developing master-plans and preparing design codes;
• Establishing a clear vision and setting objectives;
• Striking a locally appropriate balance for different user group needs;
• Provide permeability and connectivity in routes;
• Avoid hierarchies of standard road types;
• Developing street character types on a location-specific basis;
• Encouraging innovation;
• Using quality audit processes;
• Designing for low speed limit where there significant pedestrian movement;
• Use the minimum of highway design features necessary.

These principles then draw on earlier guidelines, including the idea of “better balanced streets” (Better Streets, TfL, 2009) being those where the designer understands the function of the street, is able to imagine a blank canvas and what might be done, carefully justify items that should be preserved or removed, decide the degree of separation of the street’s users, reflect and preserve the character of the surrounding area, use quality materials, and avoid over-elaborate designs. The main design processes in determining the street design/redesign should be (TfL, 2009 - CIHT, 2010):

1. Tidy up;
2. Declutter;
3. Relocate/merge functions;
4. Rer-think traffic management options;
5. Recreate the street.

3.3.13. SOLUTIONS project

The EPSRC (Engineering and Physical Sciences Research Council, UK) funded SOLUTIONS project (Sustainability of Land Use and Transport In Outer Neighbourhoods) was completed in 2008. The research project focused on spatial policy, in terms of design, transport systems and built form, in outer city areas of the UK that were experiencing or are likely to experience growth pressures in the future. Amongst the stated outputs was the production of a Best Practice Guide, aiming to make the conclusions of urban spatial research and outputs usable by practitioners and decision-makers. This would enable the decision makers to enhance their understanding of the alternatives and the likely consequences of choosing them. The Best Practice Guide would also give recommendations specific to the case study cities used within the project.

3.3.14. Transport Planning in the USA, Canada and Australia

Transport planning in the USA is described as a proactive public participation process conducted by the Metropolitan Planning Organisation (MPO), state Department of

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18 http://www.suburbansolutions.ac.uk/Findings.aspx
Transportation (state DOT), and transit operators. Transport planning includes a number of steps:

- Monitoring existing conditions;
- Forecasting future population and employment growth, including assessing projected land uses in the region and identifying major growth corridors;
- Identifying current and projected future transportation problems and needs and analysing, through detailed planning studies, various transportation improvement strategies to address those needs;
- Developing long-range plans and short-range programs of alternative capital improvement and operational strategies for moving people and goods;
- Estimating the impact of recommended future improvements to the transportation system on environmental features, including air quality;
- Developing a financial plan for securing sufficient revenues to cover the costs of implementing strategies.

3.3.14.1. Transportation for a New Generation

In a draft strategic plan “Transportation for a New Generation” (DOT, 2010) it is proposed that pedestrian and cyclist fatalities and injuries can be reduced through “complete streets” policies, where streets are designed and operated to enable safe, attractive, and comfortable access and travel for all users. Transport planners and designers need to consistently design streets with these users in mind, in order to improve safety for pedestrians, cyclists and drivers. The National Complete Streets Coalition (2010) proposes ten elements essential to an idea complete streets policy:

- Include a vision for how and why the community wants to complete its streets;
- Specifies that ‘all users’, includes pedestrians, cyclists and transit passengers of all ages and abilities, as well as service vehicles and cars;
- Encourages street connectivity and aims to create a comprehensive, integrated, connected network for all modes;
- Is adoptable by all agencies to cover all roads;
- Applies to both new and retrofit projects, including design, planning, maintenance, and operations, for the entire right of way;
- Makes any exceptions specific and sets a clear procedure that requires high-level approval of exceptions;
- Directs the use of the latest and best design criteria, and guidelines while recognising the need for flexibility in balancing user needs;
- Directs that complete streets solutions will complement the context of the community;
- Establishes performance standards with measurable outcomes;
- Includes specific next steps for the implementation of the policy.

In Australia and the USA transit oriented development is a new trend for creating vibrant, liveable communities. It aims to create compact, walkable communities centred round high quality train systems. This makes it possible to live a higher quality life without complete dependence on a car for mobility and survival. These schemes may have impact on future developments for road systems and transportation and it is not clear how these developments link with, for example, the Complete Streets programme.
3.3.14.2. Child- and Youth-Friendly Land Use and Transport Planning Guidelines

The Centre for Sustainable Transportation (Gilbert & O’Brien, 2005) prepared specific guidelines for land use and transport planning addressed to young people in Ontario. The document includes a set of 27 guidelines addressed to municipalities.

Young people are considered especially vulnerable to adverse effects of automobile use. The safety issues of the young people are also addressed in these guidelines but they are not the main focus.

The proposed guidelines concern land use as well as transport because land use is a key factor in determining the transport patterns of young people as it is for adults.

The 27 guidelines are grouped into six categories concerning:

- putting young people first in land use and transport planning;
- providing for them as pedestrians, as cyclists, and as transit users;
- school buses;
- young people’s travel in automobiles;
- how to reduce the impacts of all transport activity on young people.

Several barriers to addressing concerns about young people and transport are noted, and how they might be overcome. Opportunities for including young people in decision-making about transport and land use are noted, and further pointers towards application of the guidelines are elaborated.

3.3.14.3. Public Transport – Guidelines for Land Use and Development

Another example of land use and transport planning guidelines (Department of Transport, 2007), not dedicated to vulnerable road users, has been prepared in Australia by the Department of Transport (DOT) of Victoria State.

The Guidelines address the transport planning process and design requirements generally. They do not set requirements which would apply in each and every circumstance. While the Guidelines indicate design parameters that facilitate the provision of public transport services, there may be particular planning or policy issues which warrant additional or altered requirements at some sites. These may include topographical constraints, existing infrastructure and the requirements of the State Government’s transport and liveability statement.

The Guidelines also assist in addressing the public transport aspects of:

- Structure plans and other strategic planning documents;
- Integrated Transport Plans (ITP);
- Layout of new subdivisions and major developments.
4. Recommendations for Best Practice Guidelines for Land Use and Transport Planning focussed on VRU Safety

The aim of this report is not to develop a brand new set of best practice guidelines for land use and transport planning. It is to recommend best practice from existing European guidance and knowledge and to compare this with local conditions in India and Brazil and consider its feasibility.

From reviewing the guidance and documents outlined in Section 3 of this report, the three main recommendations for best practice land use and transport planning, taking into account VRU safety, including their original, are as follows:

1. Ensure the relevant stakeholders are involved in the planning process and an effective level of participation is determined (from TRANSPLUS - see section 4.1);
2. Ensure that principles which consider VRU safety as a priority are taken into account during the planning process (principles from Manual for Streets 2 - see section 4.2);
3. Ensure that a well defined step by step planning process is used to develop the plan and that each step is considered (logical structure from PROSPECTS guidebooks - see section 4.3).

There are also a number of additional recommendations which are to be taken into account as part of the recommended transport planning process and should help to achieve the aims of considering VRU priority. The foundations of these recommendations are sourced from a number of best practice guidance outlined in section 3, but particularly “Planning Policy Guidance 13: Transport” and “Guidance on Transport Assessments” and are taken into account in sections 4.2 and 4.3:

1. Ensure there is accessibility for all, particularly for walking and cycling, but also consider mobility issues for the disabled (see Guidance in Planning Policy Guidance 13);
2. Integrate strategies/policies with similar objectives (e.g. safety, sustainability, economy, environment...), but whatever the main overall objectives, safety for VRUs should not be ignored (consider a policy integration matrix, such as outlined in the PROSPECTS guidebook – see Table 4);
3. Ensure that possible future nearby developments are considered and that there is scope to seamlessly continue and expand accessible and safe routes for VRUs (i.e. direct routes, following desire lines, provide national/regional cycle networks) (see Planning Policy Guidance 13);
4. Consider the existing needs of VRU’s, but also motorised users (which could affect VRUs), in any transport plan. What is the current integration between transport modes? (see Guidance on Transport Assessments);
5. Consider the future needs of VRU’s, but also motorised users, in any transport plan. What will be the current integration between the various transport modes? For example, by encouraging more people to walk and cycle through the improvement of the infrastructure, how will this affect the safety and accessibility considerations for the area? (See Guidance on Transport Assessments).

The guidebooks developed as part of the PROSPECTS project, particularly the Methodological Guidebook, contain well structured, logical guidelines for land use and transport planning aimed at planning professionals, which provides detail on objectives, indicators, targets, strategies and barriers. Alongside the Decision Maker’s guidebook, also developed in PROSPECTS, which provides guidance on making decisions for a sustainable
urban land use/transport system, these two documents are ideal to form a basis for the best practice model to be developed and evaluated in this report.

However, the principles in the guidelines Manual for Streets 2 (CIHT, 2010), which provides guidance for all types of roads that are likely to be impacted on by the SaferBrain project (i.e. those regularly used by VRUs), are also be taken into consideration in the model, alongside a number of policies, measures and methods previously outlined in Section 3.

The main Recommendations will be laid out in the following way (see Figure 7).

First, a brief description of those that should be involved in the planning process is provided. This is followed on by outlining a list of the VRU principles which should be considered when developing a transport/land use plan. The third section describes the step by step process of undertaking a land use/transport plan. Inputted into the second and third sections are specific policies, measures and methods, plus case examples, sourced from guidance documents, particularly from the UK.

4.1. Stakeholder Participation in the Transport Planning Process

Participation and communication at all stages of the land use and transport plans has become increasingly important to their success over recent years. There are advantages and disadvantages to having a large number of stakeholders involved in a planning process, so careful consideration is needed to ensure the correct balance between having an ‘open’ process and having fixed objectives is achieved.

Having stakeholder participation in the planning process helps towards an improved quality of plan, effective implementation, ensures common objectives and guidelines, helps to avoid and/or solve any potential conflicts, helps to raise awareness and change behaviours. However, participation can lead to greater costs, a slower process, a greater difficulty in managing the needs of all stakeholders and may create conflicts which would not have
arisen without participation. However, with a carefully balanced level of stakeholder participation, the benefits can outweigh any potential detriments to the plan.

The TRANSPLUS project recommended 3 stages to improve the effectiveness of participation, which are:

- Define what the basic objectives and issues of involvement are, and provide a starting document;
- Clarify who is supposed to be participating, and prepare them for the process;
- Provide an open response to participation and avoid “consultation fatigue”.

The project also provided a scheme which outlines the main stakeholders and actors who should be involved in the land use and transport planning process. This is reproduced in Figure 8 (from TRANSPLUS\textsuperscript{19}).

![Figure 8: Relevant Stakeholders in Land Use and Transport Planning Policies](http://www.transplus.net/TrDoc/T_inglese.pdf)

Involving the stakeholders in the planning process can be initiated in one of 3 typical ways (TRANSPLUS, 2003):

- Basic framework (continuous dialogue between authorities and the stakeholders);
- Short-term framework at the neighbourhood or district level (e.g. local community forums);
- Short-term framework at the city or sub-regional level (e.g. mass information and consultation, mediated participation, planning through discussion with/among individual citizens/stakeholders).

4.2. Principles for Developing a Transport Plan Aimed at VRU Safety

The Manual for Streets 2 guidelines begin with a list of principles which should be implemented when approaching the design, construction, adoption and maintenance of urban streets. It is recommended that these principles are adopted and adapted for use as

\textsuperscript{19} http://www.transplus.net/TrDoc/T_inglese.pdf
part of the SaferBrain best practice model for transport planning for VRU safety, as outlined in the second recommendation listed at the start of Section 4. Each principle should be considered when formulating the transport plan and incorporated into the planning process which is outlined in Section 4.3 (Process for Transport Planning). The principles are as outlined in Table 2 (based on Manual for Streets 2 Principles) and described further in this section.

1. Apply a user hierarchy;
2. Emphasise a collaborative approach;
3. Recognise the importance of the community function of streets;
4. Promote an inclusive environment;
5. Reflect and support pedestrian and cyclist desire lines;
6. Develop master-plans and prepare design codes;
7. Establish a clear vision and set objectives;
8. Strike a locally appropriate balance for different user group needs;
9. Provide permeability and connectivity in routes;
10. Avoid hierarchies of standard road types;
11. Develop street character types on a location-specific basis;
12. Encourage innovation;
13. Use quality audit processes;
14. Design for a low speed limit where there significant pedestrian movement;
15. Use the minimum of highway design features necessary.

Table 2: Principles for Developing a Transport Plan Aimed at VRU Safety

1. **Apply a user hierarchy to the design process with pedestrians and cyclists at the top.** Therefore the safety needs of pedestrians and cyclists in all parts of the process should come first. Road user hierarchies have been a part of transport planning and policy for over two decades. In 1990, York City Council in the UK introduced a road user hierarchy to help implement transport policies\(^\text{20}\). This gave priority to road users in the following order:

   - pedestrians;
   - disabled people;
   - cyclists;
   - public transport passengers;
   - commercial/business vehicles requiring access;
   - coach passengers;
   - car occupants.

   When the hierarchy was first introduced, bias towards car travellers was identified. However, over the years, initiatives using the road user hierarchy has meant that York is

now one of the UK’s premier cycling cities\textsuperscript{21} and the city achieved national road casualty reduction targets set by the national government\textsuperscript{22}.

2. **Emphasise a collaborative approach to the delivery of streets – working as a multidisciplinary team and researching other similar places that work well.** All stakeholders involved in the planning process should work together at all stages of the planning process. A national archive of case studies should be established and monitoring procedures developed so that data from previous transport plans can be used to develop future plans (i.e. learn what works from past plans and strategies). Organisations such as the Cycling Touring Club (CTC)\textsuperscript{23} and Cycling England\textsuperscript{24} contain on their websites an archive of past planning policies which have involved cycling strategies. Also, the UK Department for Transport published a companion document to “Walking and Cycling – An Action Plan” which included 50 successful case studies from across England.

3. **Recognise the importance of the community function of streets as spaces for social interaction – integration, not segregation, of communities.** Lyndhurst town in the UK is a popular town for visitors, increasingly the vehicular traffic through the town centre considerably. In 2001, an improvement scheme, which aimed to improve the perception of pedestrian safety, increase pedestrian activity and influence driver behaviour, including widening pedestrian footways, led to reduce traffic speeds, greater pedestrian volumes and a low pedestrian casualty rate.

4. **Promoting an inclusive environment that recognises the needs of people of all ages and abilities.** Accessibility for all road user types is an important factor in most UK transport policies. For example, Planning Policy Guidance (PPG) 13: Transport (2001) includes planning policies related to mobility issues, ensuring that disabled people are able to use the transport network as both pedestrians, public transport users and also drivers without any barriers\textsuperscript{25}

5. **Reflecting and supporting pedestrian and cyclist desire lines in networks and detailed designs.** The Shoreditch Triangle Scheme\textsuperscript{26} in London (see Figure 9) involved the reversal of a one-way traffic gyratory system. The Scheme was analysed to evaluate the impact of pedestrian movement and safety. The scheme was modified to increase the number of pedestrian crossings, relocate them along desire lines and to widen pavements. The evaluation of the new measures resulted in pedestrian crossing being used more and crossing away from assigned crossing areas falling, leading to a decrease in accident risk.

\textsuperscript{21} http://www.york.gov.uk/cycling/
\textsuperscript{22} http://www.bettertransport.org.uk/campaigns/traffic_reduction/examples
\textsuperscript{23} http://www.ctc.org.uk/DesktopDefault.aspx?TabID=4384#section2
\textsuperscript{24} http://www.dft.gov.uk/cyclingengland/engineering-planning/integration-within-policy-and-strategy/
\textsuperscript{25} http://www.communities.gov.uk/documents/planningandbuilding/pdf/155634.pdf
\textsuperscript{26} http://www.intelligentspace.com/projects/10168.htm
6. **Developing masterplans and preparing design codes for larger scale developments, and using design and access statements for all scales of development.** The Commission for Architecture and the Built Environment (CABE, 2004) has developed a guide for those wishing to develop successful masterplans. It includes a number of case studies where masterplans have been developed for major towns and cities.  

7. **Establishing a clear vision and setting objectives for schemes, which respond to the more complex and competing requirements in mixed use contexts.** PPG1 3: Transport outlines policy for design, safety and mix of uses. Places that work well are designed to be used safely by all of the community and to take into account the variation in traffic types (motorised and non-motorised) throughout all times of the day and days of the week.

8. **A locally appropriate balance should be struck between the needs of different user groups.** Although pedestrians and cyclists should be at the top of the safety hierarchy, consideration should also be given to the main uses of the road. In Manual for Streets 2 (CIHT, 2010), a variation of road types are considered and each will have their own considerations. For example, it is generally not appropriate to introduce traffic calming or shared space schemes onto arterial roads or relief/ring roads, as this would greatly affect vehicular traffic and congestion levels. The needs of vulnerable road users would be better approached by using crossing facilities location at appropriate locations (i.e. desire lines), which provide safety on roads with higher vehicular traffic (see example in Section 3.3.12).

9. **Creating networks of streets that provide permeability and connectivity to main destinations and choice of routes.** The London Cycle Network is a network of radial and orbital routes around the whole of London which has been in development since 2004. The most recent of these is the Cycle Superhighway which is due to be complete in 2012, although a number of the routes have been open since 2009. The aim is to encourage cycling to be more socially inclusive across the city and provide routes that are fast, safe and comfortable to use.

10. **Moving away from hierarchies of standard road types based on traffic flows and/or the number of buildings.** Instead of this, Manual for Streets 2 (also

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described in Manual for Streets 1 – 2007)\(^{29}\) proposes a new approach to defining street hierarchies, based on their significance in terms of both place and movement. A street becomes a ‘place’ when it has local distinctiveness, visual quality and propensity to encourage social activity (DfT, 2007; CIHT, 2010). Movement is related to how much movement goes on along a street, not just by motorised traffic, but also non-motorised traffic too. For example, a motorway would have a high movement status, but a low place status. Whereas a high street would have a high movement and place status. The safety measures for various road types will depend on their movement and place functions.

11. **Developing street character types and a location-specific basis and requiring a balance to be struck between place and movement in many of the busier streets.** This follows on from the previous principle, where movement and place functions are discussed. On arterial roads, movement has traditionally been the predominant function, with place being little regarded. Although in recent years, a rebalance of movement and place has been attempted at these location types, priority still has to be given to the movement function over the place function because of the density of motorised traffic generally using this road type, but compromises have been met in terms of removing poor quality subways with at-grade crossings, as an example.

12. **Encouraging innovation with a flexible approach to street layouts and the use of locally distinctive, durable and maintainable materials.** Organisations such as CABE\(^{30}\), which advise the government on architecture, urban design and public space, ensure that the most innovative designs and layouts are used, but which are also the most appropriate to the road function. Also, Oxford Circus in London is a good example of where innovative design has led to improved safety and congestion by allowing twice as many pedestrians to be able to cross the road at once, and also has led to increased footway space for pedestrians without being detrimental to carriageway allocation for motorised vehicles (see Figure 10, reproduced from http://www.london.gov.uk/greatoutdoors/list/).

\(^{29}\) http://www.dft.gov.uk/pgr/sustainable/manforstreets/pdfmanforstreets.pdf

\(^{30}\) http://www.cabe.org.uk/home
13. **Using quality audit process that demonstrate how designs will meet objectives for the locality.** Quality audits are processes where a series of evaluations within the design process of a scheme. It could include a road safety audit, cycle audit, access audit, walking audit, non-motorised user audit, community street audit, visual quality audit and place-check audit

14. **Designing to keep vehicle speed at or below 20mph (32kph) in places with significant pedestrian movement unless there are overriding reasons for accepting higher speeds.** Where appropriate, reducing speeds to 32kph can reduce pedestrian casualty rates significantly. However, it can only work in the appropriate road environments and not in locations such as arterial roads and ring roads. In the mid 1990’s Hull City Council in the UK introduced 20mph zones in many urban areas. The results were that crashes fell by 56% and KSI rates fell by 90%. Child pedestrian injuries reduced by 75%.

15. **Using the minimum of highway design features necessary to make the streets work properly.** Begin with nothing and then add only what is necessary in practice. As mentioned earlier in this report, Better Streets (Mayor of London, 2009) and also Manual for Streets 2 (CIHT, 2010) outline five practical steps (see Figure 11, reproduced from Better Streets) to developing better streets, which are:

   a. Tidy up - Remove unnecessary road markings and kit that can be easily removed.

   b. De-clutter - Justify each piece of equipment/obstruction and presume that it should be removed unless there is a strong case for keeping it.

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31 [http://www.ciht.org.uk/download.cfm/docid/F84895AF-00B5-4061-A21927600E8B762C](http://www.ciht.org.uk/download.cfm/docid/F84895AF-00B5-4061-A21927600E8B762C)


33 [http://www.london.gov.uk/greatoutdoors/docs/better-streets.pdf](http://www.london.gov.uk/greatoutdoors/docs/better-streets.pdf)
c. Relocate/merge functions - Make multiple pieces of equipment work together (e.g. lighting on adjoining buildings, multiple signs on one pole, etc.).

d. Rethink traffic management options - Consider how motor vehicles and VRUs use the area and rebalance priorities. Impacts of such changes should be considered;

e. Recreate the streets - Once the unnecessary equipment has been removed, this will provide opportunity to totally remodel the area for maximum functionally efficiency and safety.

Figure 11: An Example of a High Street in the UK where the Five Practical Steps were Implemented

To help achieve these principals, it is recommended that the guidance outlined in the PROSPECTS Decision Makers and Methodological guidebook is followed. The following section provides an overview of this guidance, but for greater detail, these Guidebooks should be referred to.

4.3. Process for Integrated Land Use and Transport Planning

Expanding on the logical structure of the PROSPECTS Methodological Guidebook, first described in Section 3.3.1 and reproduced in Figure 12, each stage of the planning process can be explained in more detail to consider transport and land use planning specifically for vulnerable road user safety. This takes into account the third recommendation outlined at the start of Section 4, which states ‘Ensure that a well defined step by step planning process is used to develop the plan and that each step is considered’.
4.3.1. Setting Objectives and Identifying Indicators

At the start of any transport or land use plan, the clear objectives of the plan should be defined. The main objectives for developing sustainable land use and transport strategies, according to PROSPECTS, are as follows:

- Provide economic efficiency;
- Ensure liveable streets and neighbourhoods;
- Provide protection of the environment;
- Equity and social inclusion;
- Promote safety;
- Promote health;
- Contribute to economic growth;
- Provide intergenerational equity.
All of these objectives can help towards the objective of promoting walking and cycling. However, only the safety objective itself can help to improve the safety of the pedestrians and cyclists. Specific safety objectives could include:

- Reduce number of VRU accidents;
- Provide unobstructed safe routes for pedestrian;
- Improve unobstructed safe routes for bicyclists.

Personal security is also an area of safety that is to be considered for pedestrians and bicyclists, although it is beyond the scope of SaferBraIn to go into further detail about this.

Closely related to the objectives are the indicators, which can help to quantify the objectives. Indicators can be environment, economic or social-related and there are different types of indicators:

- **Input indicators** – quantified by how much goes into a strategy (e.g. expenditure);
- **Output indicators** – quantified by what has been done, actions taken (e.g. length of bus lanes installed);
- **Intermediate outcome indicators** – quantifies how the transport system is responding (e.g. number of bus users);
- **Outcome indicators** – quantified by what comes out of a strategy (e.g. casualty numbers).

For each of the main set of objectives, PROSPECTS identifies 19 main types of indicators to use to quantify each of the objectives. For the “safety” objective, two indicators are identified, which are:

- Accident cost indicator - the cost of accidents at the site if the proposed plan did/didn’t go ahead;
- Accident indicator - the number and type of accidents that could occur at the site if the proposed plan did/didn’t go ahead.

Local accident data about the current site should be sourced and compared with local average rates.

In addition to this, other potentially useful indicators for evaluating VRU needs are:

- Vulnerable user accident indicator (“liveable streets and neighbourhoods” objective);
- Local activity index (“liveable streets and neighbourhoods” objective);
- “Accessibility for those without a car” indicator (“equity and social inclusion” objective).

Non accident-related indicators could be quantified using the transport assessment methods outlined in the “Guidance on Transport Assessment” (Department for Transport, 2007), which recommend pedestrian/cyclist counts and traffic counts, along with current flow analysis of all road user types.

### 4.3.2. Constructing Scenarios

Scenarios are defined as conditions that apply to the area being evaluated at various future points in time. These conditions could be political, economic, demographic or technological-related. Potential future scenarios should be considered alongside the main objectives, as the former will have a direct effect on the success of achieving the latter. PROSPECTS outlines the major factors which should be considered for inclusion in potential scenarios, which are:
• Population growth;
• Household income growth;
• Economic growth and employment rates;
• National policy (including those of neighbouring areas);
• Car ownership rates;
• Vehicle technology changes and the resulting composition of the vehicle fleet;
• Effects on travel demand of new technologies (e.g. e-work).

Constructing scenarios involves making predictions about how these factors could affect the success of the plans being considered. In terms of VRU safety, all of these factors could play a role in scenarios where safety is affected, either positively or negatively. For example, household income growth could affect the variation of the traffic type on the road, as more people own cars, therefore there are fewer pedestrians. Alternatively, a recession could lead to more road users finding alternative means of transport to a car, such as public transport, cycling or walking. All these factors should be considered in potential scenarios to identify VRU safety issues.

4.3.3. Problem Identification

A clear identified list of problems is the best way of identifying solutions. The problems themselves can be best identified using the list of main objectives that has been developed for the transport plan. If there is a high likelihood that any of the objectives will not be met, these are where the problems lie.

Potential future problems can be identified by looking at the possible future scenarios and assessing these for potential problems.

There are a number of methods of identifying current or potential future problems in a plan:

• Consultation - problems encountered by people when travelling. This is best for identifying current problems;
• Objective analysis - Adopting a set of appropriate indicators or targets. These indicators/targets can be used to measure or predict any differences between the threshold and a condition. If differences are found, then there is/could be a problem. Ranges of thresholds can also be set to grade the problems by severity;
• Monitoring - Regular monitoring, using similar indicators/targets as used in the objective analysis approach, can help to identify not just problems, but also trends over time, which enables problems which are getting worse over time to be highlighted.

For example, with the pilot roads being developed in SaferBraIn, a consultation process could be used to identify current problems at the chosen sites. While for predicting potential future problems once the pilot site is developed, an objective analysis could be undertaken using indicators related to accident rates or accessibility.

Also, the Transport Assessment process (Department for Transport, 2007) can help to identify potential problems for pedestrians or cyclists in terms of accessibility or potentially poor desire lines for pedestrians or cyclists, which may lead them into high risk conflicts with motorised traffic.
4.3.4. Developing Policy Instruments

Policy instruments are tools which can be used to overcome problems and achieve objectives. These tools can include aspects such as new infrastructure, traffic management, pricing policies, attitudinal changes and use of information technology.

Policy instruments can be implemented on a large scale (e.g. throughout a town/city), a more focused scale (e.g. a particular area) or at a particular time of day (e.g. 09:00-17:30), at varying intensities.

In the Appendix of the Methodological Guidebook is a comprehensive list of possible policy instruments that can be used to help overcome problems and achieve objectives. They are categorised into six different types:

1. Land use measures;
2. Attitudinal and behavioural measures;
3. Infrastructure provision;
4. Management of the infrastructure;
5. Information provision;
6. Pricing.

For types 3 to 6, the instruments are further categorised into measures which:

- Influence car use;
- Influence public transport use;
- Provide for cyclists and pedestrians;
- Provide for freight.

Policy instruments specifically focussed on providing for cyclists and pedestrians include:

- Infrastructure measures – cycle routes, pedestrian routes, pedestrian areas;
- Management measures – Cycle lanes and priorities, cycle parking provision, pedestrian crossing facilities, safe routes to school (e.g. “walking bus services”);
- Information provision – Static direction signs, tactile footways.

How well these policy instruments perform in terms of overcoming problems and achieving objectives can be assessed by investigating the changes in the system which can manifest itself in one of three ways:

- Changes in the demand for travel;
- Changes in the supply of transport facilities;
- Changes in the cost of provision and operation of the transport system.

Users of the system (i.e. the road user) could respond to a new policy instrument or a change to an existing one in a number of different ways (e.g. combine journeys, change destination, departure time, route, mode, home, etc.), which could therefore change the overall demand for travel at a specific location. Also, initial responses to the changes can lead to secondary responses (further changes) and each change will affect the performance against the previously defined objectives.

The Decision Makers Guidebook contains suggestions for which policy instruments are likely to contribute most to particular objectives, for different location types (city centres, inner suburbs, outer suburbs and smaller urban areas). Contribution of policy instruments to different objectives are rated using a star rating system from 1 to 5, 1 being a minor
contribution and 5 being a major contribution, which could be a useful exercise to undertake during the SaferBrain pilot studies.

4.3.5. Barriers to Implementation

Barriers are obstacles which prevent a given policy instrument from being implemented, or limits its implementation. PROSPECTS identified four main barriers:

- Legal and institutional – lack of legal powers or authority to implement;
- Financial – budget restrictions to all or part of a strategy to be implemented;
- Political and cultural – lack of political or public acceptance, attitudes to enforcement (e.g. disregarding speed limits), social status;
- Practical and technological – problems with land acquisition, technology or expertise availability.

Barriers can be dealt with in the short term or the long term. The use of groups of policy instruments (see Section 4.3.4) can help overcome barriers in the short term, particularly for financial and political/cultural barriers. In addition, effective participation and effective approaches to implementation can also help. Barriers will be easier to overcome if a strategy is being developed for implementation over a longer timescale (e.g. 15-20 years), as there is more time to overcome these barriers. However, there could still be issues, particular if barriers (e.g. institutional/political) get worse over time rather than better. Therefore these issues should be seriously considered even in a much longer term plan.

As an example, particularly strong cultural barriers to promoting cycling in urban areas has been observed in the UK and have been described in the report “Attitudes to Cycling 2008 Research Report” (Stone and Gosling, 2008). Attitudes towards cyclists from non-cyclists was found to be particularly negative and over 50% of those surveyed considering cyclists to be ‘dangerous’ in their actions. To improve these cultural barriers will involve a long term plan to change attitudes and improve the profile of inner-city cycling to non-cyclists.

4.3.6. Strategy Formulation

An integrated package of instruments that reinforce each other in meeting objectives and overcoming barriers are needed, including the integration between transport and land use. Identifying instruments which might achieve synergy is a key element of successful transport planning.

There are four key elements to any urban transport strategy:

- Reducing the current and future need to travel;
- Reducing the amount of travel by car;
- Improving the public transport system;
- Improving the appearance of the road network generally.

Each type of policy instrument contributes to one or more these four key elements, as shown in Table 3 (reproduced from PROSPECTS Methodological Guidebook).

<table>
<thead>
<tr>
<th>Key strategy element</th>
<th>Reducing the need for travel</th>
<th>Reducing car use</th>
<th>Improving public transport</th>
<th>Improving road network performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use</td>
<td>0000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 4 (reproduced from PROSPECTS: a methodological guidebook) shows a broad guide to the policy instruments that are likely to complement each other, by reinforcing the benefits of each other, by overcoming financial or political barriers, or by providing compensation to the losers.

Table 4: A Policy Integration Matrix

<table>
<thead>
<tr>
<th>Policy instruments</th>
<th>Land use</th>
<th>Infrastructure</th>
<th>Management</th>
<th>Information</th>
<th>Attitudes</th>
<th>Pricing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use</td>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>ad</td>
<td>b</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>ad</td>
<td>abd</td>
<td>a</td>
<td>abd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td>a</td>
<td>ab</td>
<td>abd</td>
<td>a</td>
<td>abd</td>
<td></td>
</tr>
<tr>
<td>Attitudes</td>
<td>ab</td>
<td>ab</td>
<td>ab</td>
<td></td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>Pricing</td>
<td>ad</td>
<td>acd</td>
<td>acd</td>
<td>cb</td>
<td>a</td>
<td></td>
</tr>
</tbody>
</table>

Key: a Benefits reinforced  b Political barriers reduced  c Financial barriers reduced  d Compensation for losers

Once the highest level strategy is clear, it is possible to address other issues.

There have been many high-profile transport strategies in the UK over the years, including “Better Streets”, “London’s Great Outdoors”, “A New Deal for Transport: Better for Everyone” and “Transport Ten Year Plan 2000”.

4.3.7. Predicting Impacts

Once the strategy has been formulated, consisting of a package of policy instruments and their timing, with the scenarios it should work within and any barriers, it is necessary to test how this performs against the defined objectives. Some effects may take years to occur, but analyses are often helped by a model of the land use and transport system. Advice is given on three types of model:

- Policy explorers - providing a very simplified representation of the city, to understand what types of impacts a policy might have;
- Sketch planning models - representing the main interactions between demand, supply and land use at a strategic level;
- Land use-transport interaction (LUTI) models - representing transport networks and land use patterns and interactions in greater detail.
In addition to these three models, there are also two other models, network and transport planning. Figure 13 (reproduced from PROSPECTS Decision Makers’ Guidebook34) shows the models in order of their complexity and ease of use.

PROSPECTS identifies that there are limitations on using models for predicting impacts. For example, they can be over-used and under-used. Additional costs and the need for specialist skills to develop the model mean that they can be under-used. Sometimes the results from models can be mistrusted, along with the experts undertaking them, particularly if the model has been used as the whole process and other issues have not been considered. Therefore, these issues should be considered as part of the strategy, but it is recommended by PROSPECTS that a model is developed as it will make it easier to plan and estimate the effects of a strategy with one than without one.

Impacts on VRU safety can also be predicted using the assessments set out in the Guidelines for Transport Assessment (Department for Transport, 2007). Five areas should be considered when appraising the impact of a proposed development:

- Environmental – e.g. journey ambience (does the townscape encourage cycling/walking?);
- Safety – e.g. potential for VRU accidents/perception of personal security;
- Economy – e.g. VRU journey times, motorised users journey times, upkeep costs;
- Accessibility – e.g. quality of links to the wider transport system for VRUs, continuous journey links for VRUs, community severance;
- Integration – e.g. social inclusion, not exclusion (no barriers separating communities).

### 4.3.8. Appraisal and Evaluation

In the Guidebooks, appraisal is the process of deciding how well a scheme or strategy performs, and evaluation is the specific application of appraisal to the assessment of completed projects. An appraisal can help to:

- Assess the seriousness of a problem;
- Compare possible solutions;
- Improve a solution;
- Decide between alternative designs;

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• Decide the best policy instruments;
• Decide the best way to combine policy instruments;
• Evaluate how well a scheme has performed.

Both appraisal and evaluation are used to assess how well a scheme or strategy meets the set objectives. For each objective or sub-objective a performance indicator is required. They should measure what they say they measure and be computable from the model output or other performance data available. All strategies must be judged against the same standards. The results may be presented to decision makers for them to decide which is best, or processed by combining indicators into an objective function (e.g. cost-benefit or multi-criteria), which can be used to rank all strategies. Alternatively targets can be set for the indicators and a record made of whether or not the strategies meet their targets.

An appraisal framework can be used to consider each objective or indicator separately and determine for each one, what scheme or strategy option should be used, as shown in Figure 14 (reproduced from the PROSPECTS Decision Makers Guidebook).  

An appraisal framework can be used to help make decision in two ways. First, a cost-benefit analysis uses money as the comparator (e.g. costs vs benefits-savings). Secondly, a multi-criteria appraisal can use a variety of criteria as the comparator and each can be assessed using a weighted score.

For improving VRU safety and accessibility, the seriousness of the problem can be related to the seriousness of the injury outcome of any potential accidents, but can also be related to cost-benefits of a scheme in terms of the savings made by the lives saved and injuries prevented.

4.3.9. Optimisation

Optimisation is finding the best solution to a given set of transport problems, or the best strategy to meet a given set of objectives, particularly when there are constraints imposed, which there often are in real world transport plans. PROSPECTS define three main types of variables to be optimised:

• Continuous variables only;
• Discrete variables only;
• Mixed continuous and discrete variables.

Chapters 7 and 18 of the Methodological Guidebook provide more detail on the different types of approaches to optimisation and the methods involved, including the ‘downhill simple
method (Amoeba) and the “regression approach”. The methods outlined for these approaches appear to be complex in nature for those who are not involved regularly in planning strategies for land use and transport. Therefore, undertaking optimisation as part of developing sites for VRU safety for SaferBrain is beyond the scope of the study. However, it should be considered for further studies which follow-on from SaferBrain.

4.3.10. Implementation

A complete analysis of the barriers to implementation of the chosen policy instruments is a key factor to try and prevent problems during the implementation stage, with stakeholder participation prior to implementation being essential. The sequence that a strategy involving several policy instruments is very important, as some may need to be in place before others can be implemented. The analysis of a strategy has to consider carefully the costs and benefits of alternative sequences and timescales for implementation.

The implementation sequence, as recommended by PROSPECTS, should be:

- provide essential capacity first;
- then manage demand;
- introduce gradually where possible;
- implement those requiring substantial funding later;
- but implement the whole strategy.

For example, if trying to reduce car usage (e.g. restricting or charging for parking), encouragements for public transport usage, cycling or walking should be implemented first. If the more acceptable elements of a strategy are introduced first, there is a danger that the less acceptable elements will never be introduced and therefore the whole strategy will fail to be implemented.

4.3.11. Evaluating and Monitoring Performance

There is the opportunity to learn from experience with every new scheme, and to improve understanding of the performance of the policy instruments used. This requires effective before and after surveys which identify the effects of the strategy on the key performance indicators and against the main objectives. Before and after surveys can take some time or only be performed after some time has elapsed, to allow the full effects of the implementation to become apparent. Regular monitoring of conditions will also help assess whether problems are being overcome, or new problems are emerging, and provide the context for the next review of the strategy. Monitoring should be based on an agreed set of performance indicators, which should be readily measured and easily interpreted.

In terms of VRU safety, the best way to monitor performance of the new scheme is to look at the accident rates and injury severity and compare how rates and accident types have changed compared with the rates/types before the scheme was introduced. Also, in terms of accessibility, performance could be monitored by, for example, measuring levels of traffic congestion or density of bicycle traffic using cycle lanes.
5. Identification of Safety Implications

This section synthesizes the main safety implications that the use of the guidance and recommended best practice guidelines for land use and transport planning (Section 4) would have on VRU safety. Safety implications are intended as potential consequences on safety of VRU (both negative and positive effects) that a guidance has when transferred to Emerging Economies.

Some of the reviewed guidance tools present a general methodological framework for land use and/or transport planning, so it is difficult to identify which consequences may have on VRU safety. Moreover, policies and measures included in a guidance can be quite complex (objectives can be conflicting) so it is not easy both to quantify and to generalise about their effects on VRU safety. If available, general results from scientific literature are included (Elvik et al., 2009). In the following, the main effects on road safety, especially for VRUs, expected from the application of policies and measures included in the best practice recommendations are described. References to specific guidance in Section 3.3 are also reported.

Sustainable Mobility

Sustainable mobility aims to promote more sustainable pattern of travel considering three aspects: economic sustainability, social sustainability and environmental sustainability. As walking and cycling are the most sustainable transport modes, policies focusing on sustainability aims at promoting mainly walking and cycling taking into account also road safety. However, if not highlighted as an objective, pedestrians and cyclists safety may be overlooked (Ref. PROSPECTS Methodological Guidebook, Planning Policy Guidance 13: Transport, FAO Guidelines for Land Use Planning).

Priority on Pedestrians and Cyclists

When developing a transport plan, safety needs of pedestrians and cyclists in all phases of the planning process should come first. In this way emphasis of the entire process is focused on VRU safety allowing choosing strategies that maximize VRU safety (Ref. Manual for Streets 2).

Stakeholder Participation

Safety implication of the involvement of stakeholders in planning for VRU safety is quite difficult to assess. Stakeholder participation should give the plan higher quality and effective implementation, focusing on local needs, including pedestrians and possibly cyclists. However, as highlighted in section 5, involvement of stakeholders is not a priority in EE countries and forces against an open planning process exist (Ref. TRANSPLUS Project).

Accessibility Enhancement

Jobs, shopping, leisure facilities and services should be accessible by public transport, walking and cycling. By improving accessibility, a shift towards other transport modes is expected. Changes from individual travel to safer transport modes (i.e. public transport) may increase safety. Problems for pedestrians and cyclists could arise if the effect of increased number of pedestrians and cyclists is not properly considered in the planning process (Ref. TRANSPLUS Project, Planning Policy Guidance 13: Transport).

Changes in Modal Split

The risk of injury varies considerably between different means of transport, and is particularly high for pedestrians and cyclists. Changes in the modal split of travel contribute to reducing the total number of injuries in traffic by encouraging people to use the modes of travel that have the lowest expected number of injuries for a given travel distance. A transition from individual to public transport in large cities may reduce the number of injury accidents. In a
study (Elvik et al., 2009), it is reported that pedestrians, cyclists and people on mopeds and motorcycles could reduce their risk by using public transport. However, falls when walking to or from public transport stops contribute substantially to the total risk of door-to-door journeys using public transport. This is due to the fact that the increased walking distance to and from bus stops will lead to more falls, if public transport is used. Short distances between bus stops can reduce walking distances and thus the number of injuries. Better road maintenance, especially during the winter, can also reduce the number of falls (Ref. PROSPECT Methodological Guidebook, Planning Policy Guidance 13).

**Land Use Measures**

A variety of land use factors affect travel patterns including density, land use mix, roadway connectivity and design, parking facility design, and building design. Land use measures refers mainly to location of roads, residential areas, workplaces, shops and other facilities in order to concentrate activities, minimise traffic volumes and travel distances. Land use measures can influence traffic safety in a number of different ways: by affecting the amount of travel (reducing the need for travel), the distribution of traffic on different types of roads (from higher to lower risk roads), the modal split of transport (from higher to lower risk transport modes), and the accident rates on each road. Relocation of business affects in particular the reduction in trip distance increasing non-motorized modes (i.e. walking and cycling) (Ref. Planning Policy Guidance 13; Transport, Home zones)

**Area Wide Traffic Calming Measures**

Traffic calming measures are intended to remove through traffic from residential areas and direct it on main streets. These streets need to be enhanced to carry increased traffic without an increase in the accident rate. Traffic calming measures generally have a positive effect on road safety. Most of the reduction in the number of accidents in residential streets is due to reduced traffic. The reduction in the number of accidents on main streets is largely due to a reduced accident rate. Lower speeds and reduced traffic may encourage walking and cycling. As drivers in Emerging Economies may not be used to this kind of measure, awareness campaigns and educational interventions should be considered (Ref. Traffic Calming Guidelines, Planning Policy Guidance 13: Transport).

**Management of the Infrastructure**

These measures involve a wide range of approaches. With reference to cyclists and pedestrians these include: cycle lanes and priorities; cycle parking provision; pedestrian crossing facilities; and safe routes to school. On roads with cycle lanes there are fewer accidents than on roads without cycle lanes. However, at junctions the total number of accidents is greater on roads with cycle lanes. Possible explanations include increased numbers of cyclists and increased speed among cyclists. Available studies indicate that having a pedestrian crossing, without any other measures, leads to more pedestrian accidents. It is likely that the explanation for this can be found in behavioural changes among road users. Pedestrians may become less careful when crossing the road and the car drivers may not become correspondingly more considerate. Introducing school crossing patrols can lead to fewer accidents involving pedestrians who cross the road. Moreover, it has been found that training children in the right way to cross a road can reduce the number of accidents involving children who cross the road by 10–20%. Training is based on teaching children simple rules to follow at specific places where they walk regularly (Ref. PROSPECT Methodological Guidebook, Planning Policy Guidance 13; Transport).

**Infrastructure Measures**

These measures involve additions or enhancements to the existing transport infrastructure. This means for cyclists and pedestrians: more space for pedestrians and cyclists (pedestrian routes, cycle routes, pedestrian areas). Several studies report a decrease in pedestrian
accidents after the implementation of pedestrian routes and pedestrian areas. Cycle routes do not seem to improve safety for cyclists. Along stretches of road, a significant decrease of accident numbers was found, while accidents at junctions increase. A possible explanation for the accident increase at junctions is that the physical separation of cyclist and motor traffic makes cyclists and drivers pay less attention to each other. (Ref. PROSPECT Methodological Guidebook, Planning Policy Guidance 13; Transport).

Information Provision

These measures involve improvements in the information available to transport users and operators, i.e. for pedestrians: static direction signs and tactile footways. Studies about the effect of static direction signs on VRU safety are not available. Specific pavement markings indicating possible oncoming traffic to the pedestrian (e.g. triangles/arrows or "Look left/Look right" road markings) could help pedestrians in localizing possible hazards especially when moving from right-hand traffic to left-hand traffic country or vice-versa. The presence of tactile paving is important to guide visually impaired people and to warn them of the presence of a pedestrian crossing. The effects of tactile paving on VRU safety are not known (Ref. PROSPECT Methodological Guidebook, Planning Policy Guidance 13; Transport).

Pricing

Road pricing is an economic concept that means that motorists directly pay for driving on a particular roadway or in a particular area. The objective is to ensure that road users make their travel behaviour choices based on the best available information of the social costs, which their choice entails. Many categories of road pricing exist, from road toll to cordon fees, to congestion charging, to distance-based fees. The main implications are on traffic volumes and speed, with a favourable effect on pedestrians and cyclists safety. (Ref. PROSPECT Methodological Guidebook).
6. Comparison of Local Conditions against Best Practice Recommendations

The aim of this section is for the local SaferBrain partners (from India and Brazil) to evaluate and compare the local conditions against the main areas of transport planning recommended for best practice outlined in Section 4. Local partners were asked to evaluate the best practice recommendations, using their experience and knowledge of the local conditions, and consider the questions:

- What aspects of the best practice could be feasible to implement in Brazil/India?
- What aspects could be difficult to implement in Brazil/India?
- What aspects could be beneficial to VRU safety in Brazil/India?
- What aspects could be detrimental (or make no difference) to VRU safety in Brazil/India?

Where possible, methods to evaluate the transferability of the best practice, such as those described in SaferBrain Deliverable 2.2, were also encouraged.

6.1. Brazil

This sub-section discusses the implementation feasibility of the recommended best practice and potential positive and negative impacts on VRU safety in Brazil, considering the four questions outlined above.

6.1.1. Aspects of the Best Practice Recommendations that would be Feasible to Implement in Brazil

6.1.1.1. Identification and Involvement of Stakeholders in Planning for VRU Safety

The participation of stakeholders is known to occur in planning initiatives in Brazil. As a rule, the level to which stakeholders’ are open to be involved in the planning process in Brazil is normally left to be defined by local authorities. Exceptions to the rule are the legal requirements for public consultation concerning projects with relevant environmental impact and also the formulation of general urban development plans (known as Director Plans in Brazil). Some local authorities tend to minimise the consultation involvement and also the level of conflicts that can be generated, while other local authorities go beyond this and elevate public involvement to budgetary decisions and project approval (sometimes required by municipal laws).

For major developments, the Statute of City or City Act (the major federal law on urban ordinance) has foreseen the need of a Neighbourhood Impact Study or Assessment (to be regulated by local laws), including the requirement for publicity (not consultation or participation). However, it is usually carried-out as an internal bureaucratic study. Points to be analysed are, at least, those related to:

- Population densification;
- Urban and community facilities;
- Land use and occupation;
- Increase in land value;
- Increase in traffic and public transport demand;
- Ventilation and lighting;
- Urban landscape and natural or cultural inheritance.
One major drawback is related to the application of these local laws. Even publicity is often not widely achieved, not to mention discussion and deliberation with the public.

Experiences with strong community involvement generally tend to be isolated initiatives and are not the general rule.

6.1.1.2. Application of the Principles of the Manual for Streets to Promote VRU Safety

Often, general principles are not clearly understood until translated into practical actions, but the principles seem to be largely relevant and applicable. The idea of a user hierarchy and inclusive design, the recognition of community function along with the access to large scale developments, the support to desire lines of non-motorized users and to permeability and connectivity to main destinations or routes, the balance of all users needs in roads including place and movement needs, among others, all seem to offer an attractive approach. However, a clearer view on how the principles will be translated into practices is needed before a detailed evaluation can be undertaken. The application of these principles can be seen as a valuable option for demonstration projects, given the potential for improving VRU safety and the urban environment.

6.1.1.3. Application of the Process of the PROSPECT Guidebook to Promote VRU Safety

In Brazil, the requirement for a general urban development plans (Director Plans, as called in Brazil) is included in the Constitution of 1988, for cities with more than twenty thousand inhabitants. The Statute of City or City Act (the major federal law on urban ordinance) enlarges this requirement, setting goals, conditions and tools applicable to urban policies, including a wider consultation process.

This general setting can be taken as positive for the implementation of improved planning methods. However, Brazil has not a strong tradition on establishing technical guidelines for planning studies. As example, no clear requirement for assessment methods, as those favoured by the PROSPECT Guidebook, was set on the legal framework or its regulamentation. Planning methods can be selected by each body and city, based on the preferences of their personnel.

The PROSPECTS Decision Makers Guidebook can’t be used alone to promote such a specific goal as VRU safety. VRU safety is one of a number of relevant urban problems that needs to be addressed. Warranting attention to general policy design, such as at the level of the examples provided in Table 3 and Table 4, would be beneficial. The clear concern with the evaluation of benefits from safety and liveability should be mentioned as a contribution of the proposed approach (the same applies to other goals not directly related to SaferBrain, such as environmental effects).

6.1.2. Aspects of the Best Practice Recommendations which could Encounter Difficulties if Implemented in Brazil

6.1.2.1. Identification and Involvement of Stakeholders in Planning for VRU Safety

Under Brazilian conditions, none of the legal requirements for promoting stakeholders involvement seem to show promise of being effective. Political forces are more effective for periods of greater or smaller public information, consultation or participation. Forces against an open planning process seem to be strong (e.g. professional politicians eager to manage public resources as their weapon; groups interested in benefiting from corruption in the public government). Public interest in participation also varies and cannot be taken as warranted. Even if present, public interest in Brazil is not as supportive of VRU safety as is probably the case in Europe.
There is a need for careful assessment of the potential effectiveness in this area as a tool for promoting VRU safety. In some cities, there are stringent requirements on provision of infrastructure for pedestrians and sometimes even cyclists. Even so, the situation is not clearly favourable to VRUs. The City of São Paulo is an example: by law, there are clear requirements for provision and maintenance of sidewalks (by citizens, as a rule) and provisions for cyclists are required in new roads and public spaces (by the municipality, as a rule). Nevertheless, the reality is different. As a rule, local organizations are weak in Brazilian cities, with the exception of associations in more affluent areas and associations ruled by business interests. Cyclist activism is present and growing, although lagging the worldwide movement.

Some successful demonstration cases showing the benefits of stakeholder participation would be of help in motivating road users and citizens.

6.1.2.2. Application of the Principles of the Manual for Streets to Promote VRU Safety

The following points will be made by taking the traditional application of traffic calming to residential areas (that seems to be akin to the principles laid-out in the Manual for Streets) in mind, even recognizing that the application to higher level roads is more needed in Emerging Economies (as a higher proportion of the accidents and fatalities are occurring there).

Although recognising its effect and value, no clear commitment to the wide application of principles similar to those listed in Manual for Streets has been seen in any Brazilian city or region. No clear support from the governments or from the population has been observed in Brazil. Experiences reveal that its implementation highlights the conflict between mobility and safety. As the interests of VRUs are weaker in an Emerging Economy, the support to the safety goals is smaller than observed in Europe or other more developed areas. Despite this, the potential benefits could be potentially larger.

6.1.2.3. Application of the Process of the PROSPECT Guidebook to Promote VRU Safety

The adoption of any general planning framework (such as the one proposed by the PROSPECT Guidebooks) would depend on the voluntary decision of local bodies or on its enforcement by some high level government or financing body. The promotion of the approach by some recognised institution could also be possible. How to warrant that the general approach can be used to favour VRU safety needs to be considered further. For comparison, design practices for lighting pedestrian crossings, installing cycle lanes, segregating pedestrian crossings or cycling flows, seem all easier to promote. Specific design practices will be considered further in Task 4.3 (to be reported in D4.2).

6.1.3. Aspects of the Best Practice Recommendations which could be Beneficial to VRU Safety in Brazil

6.1.3.1. Identification and Involvement of Stakeholders in Planning for VRU Safety

The positive effects of stakeholder participation on VRU safety is uncertain, but one can expect that the wider involvement of local communities can favour local needs (such as the needs of pedestrians and perhaps cyclists too). It is unclear whether local needs would overcome the pressure of non-local needs in most portions of the road system. However, there is strong public pressure against traffic problems in several cities in Brazil, although these are often aimed at improved traffic conditions for motorised vehicle users. However, these can help to justify the need to control traffic flows for the benefit of all road user types.

Successful demonstration cases involving stakeholder participation could be beneficial in convincing road users of the overall benefits of protecting local needs without sacrifice to
non-local ones (or with acceptable sacrifice). This would also help to evaluate benefits to VRUs.

6.1.3.2. Application of the Principles of the Manual for Streets to Promote VRU Safety

The principles are clearly guided towards elevating the position of local needs and VRUs against motorised traffic. So the principles are potentially effective in promoting VRU safety if it is to achieve wide application. The benefits of the final principle (“using the minimum highway design features necessary to make the streets work properly”) depends on achieving a viable balance between local and non-local needs, which attracts political support to ensure effectiveness. It is not clear what levels of VRU safety will result. Benefits to the urban environment and the residents should also be taken into account.

6.1.3.3. Application of the Process of the PROSPECT Guidebook to Promote VRU Safety

A wide approach, such as that outlined in the PROSPECT Guidebook, could be valuable in achieving wider results that can be conditioned to the VRU safety problem, such as reducing travel distances (i.e. promoting local interactions) or car use (and traffic flows). Assuming these conditioning factors are relevant, this would also make the wide approach just as indispensable, even crucial. In addition, the mentioned explicit consideration of safety and liveability among main goals can favour VRUs as well.

6.1.4. Aspects of the Best Practice Recommendations which could be Detrimental to VRU Safety in Brazil

6.1.4.1. Identification and Involvement of Stakeholders in Planning for VRU Safety

Being open to the involvement of stakeholders can lead to openness towards the action of pressure groups mandated by economic interests and middle class needs, instead of promoting VRUs safety and mobility needs. The asymmetric social structure of Emerging Economies should be taken into account when discussing where and how to introduce the requirements of consultation and participation, in addition to information publicity. It seems that lower levels of government are less attractive to powerful pressure groups and more open to community involvement. But no clear effect on VRUs safety would be foreseen even in this favourable setting.

6.1.4.2. Application of the Principles of the Manual for Streets to Promote VRU Safety

Depending on the scale of application, transition to treated areas could be a concern to VRUs safety and perhaps be a frustration to drivers too. Impact on traffic congestion would also have to be evaluated, possibly on a case by case basis, and can influence acceptability.

6.1.4.3. Application of the Process of the PROSPECT Guidebook to Promote VRU Safety

A wider approach can easily favour higher interests and investments (e.g. on public transport or road infrastructure). Despite the explicit consideration of community goals previously mentioned, the overall process can be biased against local needs.

6.1.5. Other Considerations

6.1.5.1. Identification and Involvement of Stakeholders in Planning for VRU Safety

More specific actions could possibly be related to this procedural requirement of stakeholder identification and involvement, as a way to achieve the goal of promoting VRU safety. For example, upgrade the infrastructure to non-motorised road users in community sub-centres or in the access to major community attractors.
6.1.5.2. Application of the Principles of the Manual for Streets to Promote VRU Safety

The approach could possibly ask for a wider policy setting (e.g. the promotion of local needs or polycentric patterns) that can reduce long distance travel and traffic.

6.2. India

This sub-section discusses the evaluation of implementation feasibility of the recommendations and potential positive and negative impacts on VRU safety in India. As an addition to the evaluation, Transferability Audit (TA) scores (first developed in SaferBraIn D2.2 and overviewed in Section 2.2) based on the SaferBraIn Indian partner’s view of the local conditions have been provided in Appendix 1, which supplements the discussion in Sections 6.2.1 to 6.2.4 and attempts to estimate the potential transferability of both the best practice recommendations outlined in Section 4, and also the list of transport planning-related guidance documents in Section 3.3.

The scorings for the guidance documents in Section 3.3 show that most of the reviewed guidance would be most beneficial to pedestrians, but there was found to be some degree of difficulty in transferring most of the guidance to the local conditions in India. The four guidance documents which mainly form the best practice recommendations outlined in Section 4 (PROSPECTS, TRANSPLUS, Planning Policy Guidance 13 (PPG13), Manual for Streets 1 and 2) were considered to be not too difficult to transfer in terms of user acceptability and implementation into the existing environment. However, it was considered that some difficulties would be found with regulating the use of PROSPECTS, TRANSPLUS and PPG13. For all four of the guidance documents (including Manual for Streets 1 and 2), it was thought that there would be difficulties in getting political support for their implementation. However, it was considered that it would not be extremely costly to implement or too difficult to acquire the correct level of technical skill to implement guidance such as these.

The TA scorings were based on the experience of the Indian partner in SaferBraIn to provide an estimate of the transferability of the best practice. In the work following on from this, to be reported in SaferBraIn D4.2, the transferability of the specific measures which could form part of these best practice guidelines will be further investigated using the TA scorings. The aim will be to organise a relevant expert panel from India and Brazil to provide more detailed scorings for these measures and practices.

6.2.1. Aspects of the Best Practice Recommendations that would be Feasible to Implement in India

The main aim of Manual for Streets is to create streets for people and this can be achieved by balancing movement and place functions. Most of the aspects of the best practice recommendations can be implemented in India as long as they are adapted to the local context.

The following are the most feasible best practice recommendations to implement in the local context (India):

- Promoting an inclusive environment that recognises the needs of people of all ages and abilities;
- Applying user hierarchy to the design process with pedestrians at the top;
- Recognizing the importance of the community function of streets as spaces for social interaction-integration, not segregation of communities.

Promoting an inclusive environment is important as it creates a sense of belonging and safe environment which can be used equally by everyone and further expand to accommodate
diverse range of users, thus helping to break down the barriers and exclusion felt by certain group of people and certain modes of transport and thus in turn help in achieving a good solution.

An inclusive environment is not just limited to streets and low traffic roads but has a wider application as it can help in creating beautiful and functional environments thus developing character of a space.

It also offers people the freedom to choose how they access it and use it and allow them the choice to participate equally in all activities it may host.

India has the second largest road network in the world with over 3 million km of roads, of which 46% are paved. These paved roads carry an estimated 60% of freight and 80% of passengers and they make a vital contribution to India’s economy. The road traffic contains an incredible mix of pedestrians, animal drawn vehicles, bicycles, motorcycles, cars, buses and trucks. On the whole the facilities for the large number of non-motorised road users are poor and the 40 million vehicles using the roads have a terrible toll on human life. In India, accident rates are the highest for this category of commuters across all the major cities. According to Central Road Research Institute, almost 80% of road fatalities involve pedestrians. Studies based on hospital records suggest that 22 to 35% of road deaths are pedestrian deaths. These crashes not only cause considerable suffering and hardship but they also have a major impact on the country’s economy, costing an estimated Rs 300 billion or more than 3% of India’s GDP every year.

Quality of mobility for pedestrians is not merely about roads and paths but safety and protection. However all the focus is showered upon creating big ticket infrastructure projects; focusing on mobility; not for pedestrians, but for the vehicles above them in the ‘food chain’. It can be compared to a scenario where ‘everybody wants to eat meat, but nobody wants to do the farming’.

In India, roads are not merely transport nodes. For pedestrians, they are also places where they stop and catch their breath; eat street snacks and drink water; pay reverence to the roadside tree-temples; and are a way of life and means of living for many street side vendors. There is a strong economy that runs by the roadside, where pedestrians play the most important role.

The above text justifies the need for applying user hierarchy with pedestrians on the top, recognising the importance of the community function of streets.

6.2.2. Aspects of the Best Practice Recommendations which could Encounter Difficulties if Implemented in India

As seen from the logical structure of the PROSPECTS Methodological Guidebook, the principles mentioned are all interrelated. Hence it is difficult to segregate some specific aspect of the recommendations, as there will be a certain level of difficulty in each of them during implementation. Some of the aspects of the recommendations which will be difficult to implement in India are:

- Establishing a clear vision and setting objectives for schemes which respond to more complex and competing requirements in a mixed use context;
- Developing master-plans and preparing design codes for larger scale developments, and using design and access statements for all scales of development;

35 http://www.grsroadssafety.org/page-india-27.html
36 http://www.grsroadssafety.org/page-india-27.html
37 http://www.ijanaagraha.org/content/hierarchy-mobility
• Using quality audit process that demonstrates how designs will meet objectives for the locality;
• Encouraging innovation with a flexible approach to street layout and the use of locally distinctive, durable and maintainable materials.

Cities in India vary considerably in terms of their population, area, urban form, topography, economic activities, income levels, growth constraints, etc. Accordingly, the design of the transport system will have to depend on these city specific features. Further, transport planning is intrinsically linked to land use planning and both need to be developed together in a manner that serves the entire population and yet minimizes travel needs. In short, an integrated master plan needs to internalise the features of sustainable transport systems.

In India there is a National Urban Transport Policy (NUTP) which is propagated by the Central Government. The actual decision making responsibility for management of urban areas (and thus urban transport) rests with the State Governments and it further varies according to the local municipal corporations. Involvement of the stakeholders is not given so much of a priority.

There are some common barriers, outlined below, which can cause the difficulties:

• Legal and institutional barriers: The responsibility for the planning and implementation of urban transport systems rests with the State Governments and the municipal bodies. However, since the problems associated with urban transport are of relatively recent origin in India, having surfaced only from the early 1990s, the ability to fully understand and deal with these problems is yet to fully mature (NUTP). Once the policies are implemented it is important to evaluate it by doing a before and after survey and regular monitoring. There are not many specialised institutions in India to make scientific assessments;
• Financial barriers: There is always a percentage allocated in the country's annual budget for infrastructure projects and there will be various projects/instruments competing with one another. Generating revenue is always a major issue;
• Political and cultural barriers: In case of India where decisions about the policy, instruments and strategy are taken at state level, there can be some differences found in relation to the national policy. At times there is a complete lack of political will for implementing certain instruments. Also there are differences to be seen between the politician want to appease his vote bank and the bureaucrats wanting their way. Added to this scenario there are local pressure groups and Non-Governmental Organisations (NGO's) who can cause the hindrance.

There is a need to have behavioural and attitudinal changes in the masses as urban transport policies cannot succeed without the fullest co-operation of all the city residents. Such cooperation can be best secured if the objective of any initiative is made clearly known to them. It is, therefore, necessary to launch intensive awareness campaigns that educate people so that there is an acceptance level is high. Presently there is a lack of education, enforcement and monitoring.

There are some aspects of the recommendations which are too technology oriented, and since in India a common man does not use too much of technology it will hard for him to appreciate the recommended aspects.

6.2.3. Aspects of the Best Practice Recommendations which could be Beneficial to VRU Safety in India

While dealing with VRU safety, the best practice recommendations cannot be looked at in isolation, as all the principles recommended are important. However, some of the principles would need to be given more priority, including:
• Promoting an inclusive environment, the reasons which are already mentioned in Section 6.2.1;
• Reflecting and supporting pedestrians and cyclist desire line in the networks and detailed design;
• Policy instruments and strategy formulation.

India started its liberalisation policy in the early 1990’s, seen by a rapid economic growth. This has led to a market driven unplanned diversification often resulting in non-sustainable patterns of development. A large number of rich middle class has emerged which has a lot of spending power, and from a transport related point of view, this has led to an increase in personal vehicles on the roads coupled with limitation on the amount of road space. For example, on average, while the population of India’s six major metropolises increased by approximately 1.9 times during 1981 to 2001, the number of motor vehicles went up by over 7.75 times during the same period (NUTP), thus marginalising the pedestrians and cyclists. Non-motorised modes are also exposed to greater risk of accidents as they share a common right of way with motorised vehicles.

Non-motorised modes need to be given their share in the transport system as they are more environmentally friendly and affordable and they help in shaping the character of the place/space. Hence safety concerns of cyclists and pedestrians have to be addressed by encouraging the construction of segregated rights of way for bicycles and pedestrians. Apart from improving safety, the segregation of vehicles moving at different speeds would help improve traffic flow, increase the average speed of traffic and reduce emissions resulting from sub-optimal speeds. Such segregated paths would be useful not only along arterials to enable full trips, but also as a means of improving access to major public transport stations. Such access paths, coupled with safe bicycle parking places, would contribute towards increasing the use of public transport. Creative facilities like shade giving landscaping, provision of drinking water and resting stations along bicycle corridors would also be encouraged as they can mitigate, to a large extent, adverse weather conditions. The use of the central verge along many roads, along with innovatively designed road crossings, seems to offer promise for being developed as cycle tracks (NUTP).

It has been the experience that many such cycle tracks and pedestrian paths do not get used as initially envisaged. However, a view has been that this is because these facilities are designed badly and without fully recognising the limitations and problems faced by cyclists or pedestrians. It would, therefore, be essential that such facilities be constructed after an open debate on the designs with experts and the community that is expected to use them (NUTP).

Any special changes which need to be undertaken for VRUs have to be integrated into the main policy and not applied as an add-on or an afterthought. Once the policies are implemented, strict monitoring needs to be carried out.

6.2.4. Aspects of the best practice Recommendations which could be Detrimental to VRU Safety in India

The aspects which would make little difference to VRU safety in India would be related to those which have no clear objectives followed by no quick implementation, enforcement and monitoring. All the aspects recommended have to be adapted to local context so that the people can relate to them. For example there will be no point in installing equipment such as electronically-sensed signalized crossings (Puffin), detectors for pedestrian waiting, countdown for pedestrians, Vehicle Activated Signs (VAS) for VRU safety if the road users they are aimed at don’t know how to use them or what their applications are.

The same can be said for some of the feasible aspects mentioned above. For example, even if permeability and connectivity is provided, the created network might be underused
due to the need for changes in users’ attitudinal behaviour; or there is no clear awareness from the point of view of the user towards the laid out network.

In the same way, there is little use providing design interventions which keep vehicle speeds at or below 20mph in places with significant pedestrian movement if the vehicle owners are not educated and made aware about the concept and how it is helpful to the society, including the vehicle owners themselves.

The aspects which can be detrimental to VRU safety in India would be related to too much reliance on the best practice models. It could be detrimental to rely too much on technology without first educating people about its use.
7. Conclusions

The aim of the work outlined in this report was to recommend best practice for integrated land use and transport planning that could be applied to Emerging Economies based on a review of existing guidance in Europe. A particular emphasis was made towards taking into account VRU safety and the implications for safety for VRUs of any recommended best practice.

From the review of existing European guidance, it appears the many existing land use and transport planning guidance are aiming to encourage more walking and cycling as part of the process, particularly as sustainability appears to be an important part of many recent strategies and policies. However, they don’t always appear to consider safety in the first instance, in terms of the increase of more VRU’s in the area being developed (e.g. will it lead to changes in driver attitudes, adequate capacity for increased pedestrian numbers?).

For the scope of this report, which was planned to be a short report, it was not possible to look at anything more than general 'top level' guidance. So this report has focussed on the planning process rather than specific measures that help towards the successful implementation of the plan.

From the review undertaken, a summary of best practice recommendations was identified which could potentially be transferred to Emerging Economies. All these recommendations were linked to the guidance documents that deal with these issues.

Three main areas were recommended, firstly the consideration of stakeholder participation, secondly that a step by step planning process should be developed and thirdly that VRU specific principles should be taken into consideration during the step by step process.

Other recommendations included ensuring accessibility for all, integration of policies, consideration of potential future development impacts, and consideration of existing and future needs of all road users, but from the point of view of VRU safety.

There were found to be potential positive and negative impacts to applying the best practice recommendations to India and Brazil.

The success of the transferability of the best practice for influencing VRU safety depends on a number of areas, including sustainable mobility, giving priority to the VRUs, ensuring participation from relevant stakeholders, optimal accessibility, consideration given to changes in modal split, what type of land use measures are considered, consideration towards traffic calming in relevant locations, infrastructure management and the infrastructure measures themselves.

In Brazil, bias towards more affluent areas and business interests was highlighted as a barrier to the successful implementation of best practice. Also, the overriding support amongst the general public for the motorised vehicle user over the pedestrian and cyclist was another issues identified. However, the wider approach taken in these guidelines would benefit wider results, such a reducing travel distances and car use (i.e. promoting local interactions). Also the application of the general principles would benefit demonstration projects, which would help in the long run to improve VRU safety by increasing the support for it.

In India, the main issues were related with the technical aspects of the best practice and issues with the lack of political support for implementing guidelines unless they are seen as beneficial to the politician. A positive impact would be related to the fact that in India, many roads are already seen as more than routes on which to travel; they are places where all
types of community activities take place, so the benefits of implementing the VRU principles would be considerable.

In order for any European best practice to be successfully adapted in Emerging Economies, barriers within the institutional infrastructure need to be overcome, particularly related to support for policy implementation, successful completion of construction projects, regular maintenance once in use and availability of appropriate skills. But there are also barriers related to road user’s unfamiliarity with modern road measures and the ever changing road environment and road user mix that need to be considered.

Further work investigating specific measures and other practices that could be undertaken as part of the best practice transport planning process and help to overcome these barriers will then be referred back to and any identified measures or practices will be linked to the already developed stages of the best practice model reported here, providing further detail to the more general view looked at in this study.

This has proven a useful first insight into the potential issues that come with trying to develop a best practice land use and transport plan based on existing European knowledge that will not always in the first instance transfer effectively to countries such as Brazil and India. Further, more detailed analysis would enable more comprehensive findings about the wide range of specific measures and strategies that can, and do, potentially form part of an integrated plan. The further analysis to be undertaken will to some degree, but to look at transport and land use planning in the most detailed way goes beyond the scope of this SaferBraIn task, which original aim was to provide summary information in a compact report. Future detailed investigations which look at specific real world case examples would enable these initial findings to be evaluated even further.
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### Appendix 1: Transferability Audit Scores for India

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<th>Institution</th>
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### Figure 15: Transferability Audit Scores for Principles Listed in Section 4.2

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<tr>
<th>Description</th>
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<td>Apply a user hierarchy to the design process with pedestrians and cyclists at the top.</td>
<td>W: 1 2 1 2 1 3 1 4 1 3 1 2 17</td>
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<tr>
<td>Emphasise a collaborative approach to the delivery of streets – working as a multidisciplinary team and researching other similar places that work well.</td>
<td>W: 2 3 2 2 2 3 2 3 2 3 2 3 33</td>
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</tr>
<tr>
<td>Recognise the importance of the community function of streets as spaces for social interaction – integration, not segregation, of communities.</td>
<td>W: 1 1 1 2 1 3 1 3 1 4 1 2 16</td>
<td></td>
</tr>
<tr>
<td>Promoting an inclusive environment that recognises the needs of people of all ages and abilities.</td>
<td>W: 1 2 1 3 1 4 1 5 1 3 1 2 20</td>
<td></td>
</tr>
<tr>
<td>Reflecting and supporting pedestrian and cyclist desire lines in networks and detailed designs.</td>
<td>W: 1 3 2 3 1 3 1 4 1 2 1 2 21</td>
<td></td>
</tr>
<tr>
<td>Developing masterplans and preparing design codes for larger scale developments, and using design and access statements for all scales of development.</td>
<td>W: 1 2 4 2 4 2 4 2 4 3 4 2 41</td>
<td></td>
</tr>
<tr>
<td>Establishing a clear vision and setting objectives for schemes, which respond to the more complex and competing requirements in mixed use contexts.</td>
<td>W: 1 3 4 3 4 2 4 4 4 3 4 3 58</td>
<td></td>
</tr>
<tr>
<td>A locally appropriate balance should be struck between the needs of different user groups.</td>
<td>W: 1 3 4 2 4 2 4 2 4 2 4 3 45</td>
<td></td>
</tr>
<tr>
<td>Creating networks of streets that provide permeability and connectivity to main destinations and choice of routes.</td>
<td>W: 1 2 2 2 2 3 2 3 2 3 2 2 27</td>
<td></td>
</tr>
<tr>
<td>Moving away from hierarchies of standard road types based on traffic flows and/or the number of buildings.</td>
<td>W: 1 3 1 3 1 4 1 5 1 4 1 3 23</td>
<td></td>
</tr>
<tr>
<td>Developing street character types and a location-specific basis and requiring a balance to be struck between place and movement in many of the busier streets.</td>
<td>W: 1 3 4 4 4 3 4 3 4 3 1 3 53</td>
<td></td>
</tr>
<tr>
<td>Encouraging innovation with a flexible approach to street layouts and the use of locally distinctive, durable and maintainable materials.</td>
<td>W: 1 3 4 3 4 3 4 4 1 3 1 2 49</td>
<td></td>
</tr>
<tr>
<td>Using quality audit process that demonstrate how designs will meet objectives for the locality.</td>
<td>W: 1 4 1 2 1 4 1 4 1 3 1 3 21</td>
<td></td>
</tr>
<tr>
<td>Designing to keep vehicle speed at or below 20mph (32kph) in places with significant pedestrian movement unless there are overriding reasons for accepting higher speeds.</td>
<td>W: 4 3 4 2 4 4 4 5 4 2 4 2 70</td>
<td></td>
</tr>
<tr>
<td>Using the minimum of highway design features necessary to make the streets work properly. Begin with nothing and then add only what is necessary in practice.</td>
<td>W: 4 3 4 4 1 3 4 4 1 4 1 3 55</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Society</td>
<td>Institution</td>
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<td></td>
<td>People</td>
<td>Environment</td>
</tr>
<tr>
<td>Objectives, Indicators and Targets</td>
<td>1 3 3 3 3 4 1 5 1 3 1 2</td>
<td>35</td>
</tr>
<tr>
<td>Problem Identification</td>
<td>1 2 1 3 3 3 1 4 1 2 1 2</td>
<td>23</td>
</tr>
<tr>
<td>Policy Instruments</td>
<td>1 4 1 3 1 3 1 3 1 2 1 2</td>
<td>18</td>
</tr>
<tr>
<td>Barriers to implementation</td>
<td>1 3 1 2 1 3 1 4 1 3 1 2</td>
<td>18</td>
</tr>
<tr>
<td>Strategy Formulation</td>
<td>1 2 1 2 1 2 1 3 1 2 1 3</td>
<td>15</td>
</tr>
<tr>
<td>Predicting Impacts</td>
<td>1 3 1 4 1 3 1 3 1 3 1 3</td>
<td>20</td>
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<tr>
<td>Appraisal</td>
<td>1 4 1 3 1 3 1 4 1 2 1 3</td>
<td>20</td>
</tr>
<tr>
<td>Optimization</td>
<td>1 4 1 3 1 4 1 3 1 3 1 3</td>
<td>21</td>
</tr>
<tr>
<td>Implementation, Evaluation, Monitoring</td>
<td>1 5 1 3 1 4 1 5 1 4 1 4</td>
<td>26</td>
</tr>
</tbody>
</table>
Reasons behind Transferability Audit Scores for India

Transplus Project:
This project has a more holistic approach rejuvenating and regenerating the existing cities with a primary focus on migration/ relocating people and activities from over burdened spaces to new well designed spaces. One of the main barriers of this project is, its not time bound thus can have issues during implementation especially in the political context (change of government). The second barrier in local context is more emphasis is given on the cities if tomorrow rather that cities of today.

Planning Policy Guidance 13: Transport
This is an integrated transport policy with the main focus to extend choice in transport and secure mobility in a way that supports sustainable development, i.e. by shaping the pattern of development and influencing the location, scale, density, design and mix of land uses, planning can help to reduce the need to travel, reduce the length of journeys and make it safer and easier for people to access jobs, shopping, leisure facilities and services by public transport, walking, and cycling.

The policy guidelines are simple to understand, practical and innovative. The guidelines are flexible as it allows changing the emphasis and priorities in the provision between different modes of transport. Some of the guidelines will be easy to adapt and welcomed in the local context.

Since policy was implemented in 1998, the UK government had then published Transport 2010, The 10 Year Plan. It will be interesting to look at the results as they may be available by now.

Guidance on Transport Assessments
It is not a statement of government policy. It is a document which guides stakeholders in determining whether as assessment may be required, if so what will be its scope of level. It provides guidance on the content and preparation of transport assessments and transport statements by the developers. In the local context, since it is not a government policy it will be very hard to implement it also there will always be a cloud of suspicion on its content as it is meant to be prepared by a private body. Also since it is going to be just a guidance document and fulfilling its requirements would not necessary give the transport permission, it won’t be taken seriously. Though the masses might understand the reasons behind it, some may call it waste of finances.

Traffic Calming Guidelines
As mentioned in the document, the term traffic calming is open to interpretation, but it conveys the basic objective, which is to control the adverse effect of road traffic.

It has a utopian approach and some of the principles mentioned in the guidelines such as giving priority to public transport, road classification, parking, changing people perception of street environment, need to change etc. The main barrier of this policy in local context would be too much use of technology, education and enforcement of the principles.

Streetscape Guidance
The primary objective of this guidance is to enable those responsible to create excellent streetscapes through the application of specific design principles. Again this is more of a city specific guidance so can be used only as a reference as many of the principle mentioned will not be identified by the masses in the local context. On the other hand there are some good
principles such as recognition of local context, function and safety, access etc which can be used in the local context as references. As mentioned in the guidance itself, it can only act as a gateway to good practice.

**London’s Great Outdoors**

This is a city specific (London) vision put forth by the Mayor. Due to this it will be very hard to relate it in the local context as there is a vast cultural, demographical, economical differences. So though the concepts of land use such as better green and water spaces, better streets, Initiatives, partnerships and prizes, etc are good, but they are not feasible in the local context.

**Transport Analysis Guidance**

This was a very exhaustive study done reflecting the UK Government’s aim of providing a more balanced approach to transport appraisals as a whole. There are many elements mentioned in the ‘New Approach to Appraisal’ (NATA) which also follow the same logical structure as in PROSPECTS and will be helpful in the local context. Some of the elements are specially needed in the local context such as dividing policies into local, regional and national level and assessing them on the three point textual scale. But since a lot of the elements and regulatory oriented policy are related, they could face opposition from the politicians if they can’t see its usefulness. There can be a clash of opinion between the officials and the politicians.

**World Class Places**

This document is more of country specific, i.e. the U.K, and has a lot of political overtone (New labour policies). The primary focus in this document is given to build environment. There are some good concepts in the document, such as empowering the masses to shape places for themselves, engaging them in decision making process. The ideas mentioned here cannot be directly implemented in the local context but can only be used as a point of reference.

**Home Zones**

Also called a woonerf, this concept was pioneered in the 1970’s in the Netherlands and adapted throughout Europe. This primary is a micro level based intervention done at neighbourhood / community level, which can be a barrier in the local context. It requires a lot of changes in the existing fabric by the communities themselves which again will be hard to implement in the local context. Many of the suggested guidelines are at the prerogative of the users, whether he respect the Home zone or not. Also since it is a community based imitative monitoring can be difficult. But it also has some very good concepts such as having eyes on the street which can lead to more secure communities. Some of these concepts are unknowingly followed in the local context and are successful.

**Manual for Streets 1 and 2**

This Manual has a collaborative approach by means of having a comprehensive set of design principles dealing at different levels of a residential and light traffic street. There are some good concepts such as inclusive design, use hierarchy in which pedestrian are considered first, giving increased consideration to the place function of street, i.e. street character. One of the barriers for these guidelines is that it is very detailed and at times it can be too technical, such as the introduction of minimum stopping sight distance (SSD’s) which can be hard to explain to the general people. Again the principles need to be adapted to the local context and not just directly implemented.
SOLUTIONS Project
This project is primarily focused on spatial policy and has an integrated approach. It’s a very specialized type of project, more of an academic oriented and too technical.

Transportation for New Generation
This is also a very country specific policy, more of a vision of the U.S. President, as it has a lot of political overtone. However, it is based on some good concepts such as liveable communities, environmental sustainability, but there is no relation to these polices in the local context.

Child and Youth-Friendly Land Use and Transport Planning Guidelines
These Guidelines primarily focus on children and that too school going children and this can be the biggest barrier in the local context. Some of the guidelines such as (guideline no.4) to identify where children want to go and provide a way to get there can be interpreted as creating separate routes for them or as in guideline 9 which states to create sidewalks suitable for children’s bicycles. Such kind of guidelines may cause more segregation than integration and they will be hard to implement in the local context due to the lack of space/land along the road. The guidelines also focus on the quality of air inside the vehicles and need to stay outside, but this in the local context again won’t work as the air inside the vehicle many a times is better than outside.

Public Transport – Guidelines for Land Use and Development
The main focus of this policy is on delivering a good public transport and reshaping the land use and eventually creating safe places and modes for the people. It has good use of land use planning principles which can be adapted to the local context and implemented. The guideline also gives some good concepts on how public transport can be more viable and preferable alternative to car travel without massive intervention in the existing fabric. This again is an integrated policy which can be related and adapted to the local context.