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Evaluation of Pedestrian Priority Zones in the European area

Report to the Korea Transport Institute KoTI

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Contents

Background to the project

In 2008 Dr Sangin Han commissioned the Centre for Transport Studies at UCL to produce a report on European practice in evaluating pedestrian priority zones (PPZ).

The background to this request was concern about a high pedestrian fatality rate in Korea. During 2006, there were 2232 pedestrian fatalities, which correspond to about 39% of all road accident fatalities in Korea, equating to a pedestrian death rate of 5.28 per 100,000 head of population. By comparison, in Great Britain there were 572 pedestrian fatalities during 2008, which constituted 23% of all road accident fatalities and equated to a pedestrian death rate of 0.97 per 100,000 head of population.

The Government of Korea has introduced legislation to help local authorities reduce the number of pedestrian being Killed on the road. This legislation is Article 18 in the Transport Convenience Promotion Law for the Mobility Handicapped.

Objectives

The objectives of the work are:

1) To summarize UK and other European practice of PPZ evaluation, and
2) To supervise the development of PPZ evaluation in Korea through contributions to each of the
   - Framework for evaluation
   - Methodology of evaluation

This document is one of the outputs for Objective 1.

Collection of evaluation reports, papers, and other relevant case study materials on the following Pedestrian Priority Streets/Zones:

1) UK, Home Zone, Traffic Calming, 20 mph Zone
2) Netherlands, Woonerf, Zone 30
3) Tempo 30
4) other relevant European projects

A range of evaluation reports have been collected, in electronic form where this is possible. In some cases licensing restriction preclude direct transfer of documents. In these cases references have been provided. In some cases there may be overlap between the specified types of PPZ, for example traffic calming may include use of 20 mph zones.

Commentary on a range of case studies of the evaluation of PPZs in Europe has been undertaken. The areas covered for each case study (where available) are:

1) Background and purpose: why the PPZ was implemented. Evaluation framework, i.e. the approach to evaluation (the structure of the evaluation, and whether it was simple or complicated).

2) Evaluation methodology: how the qualities and quantities were calculated (for example field studies, simulation, interviews etc).
3) Measures of effectiveness: what were the criteria used for this, are they to be detailed (e.g. CO levels) or broad brush (e.g. first year rate of return).
4) Result of evaluation: was the PPZ a success according to the evaluation.
5) Suggestions made after evaluation: lessons learned and advice for others.

Some additional commentary on the issues/quality/appropriateness of the evaluation has been added where appropriate.

Explanation of successful measures applied in Pedestrian Priority Streets/Zones in terms of:

1) Type of PPZ (a description of what the PPZ was and what it was for)
2) Purpose for which the PPZ was implemented. (e.g. safety, political reasons such as local pressure, accessibility)
3) Installation guidelines (e.g. prescriptive, flexible, guidance, statutory)
4) Cost-effectiveness: (e.g. speed, accidents, accessibility, FYRR)

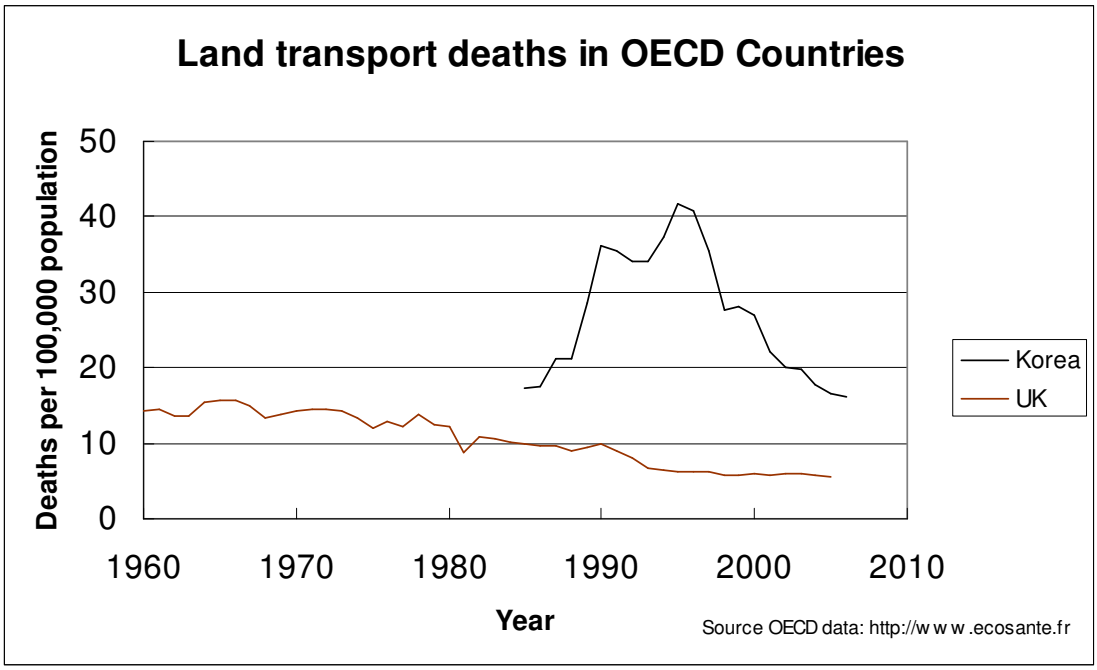
This section was planned to provide a brief commentary on what aspects of PPZs work well together with the reasons why some measures work well.

Example photographs of a range of measures and examples are also provided.

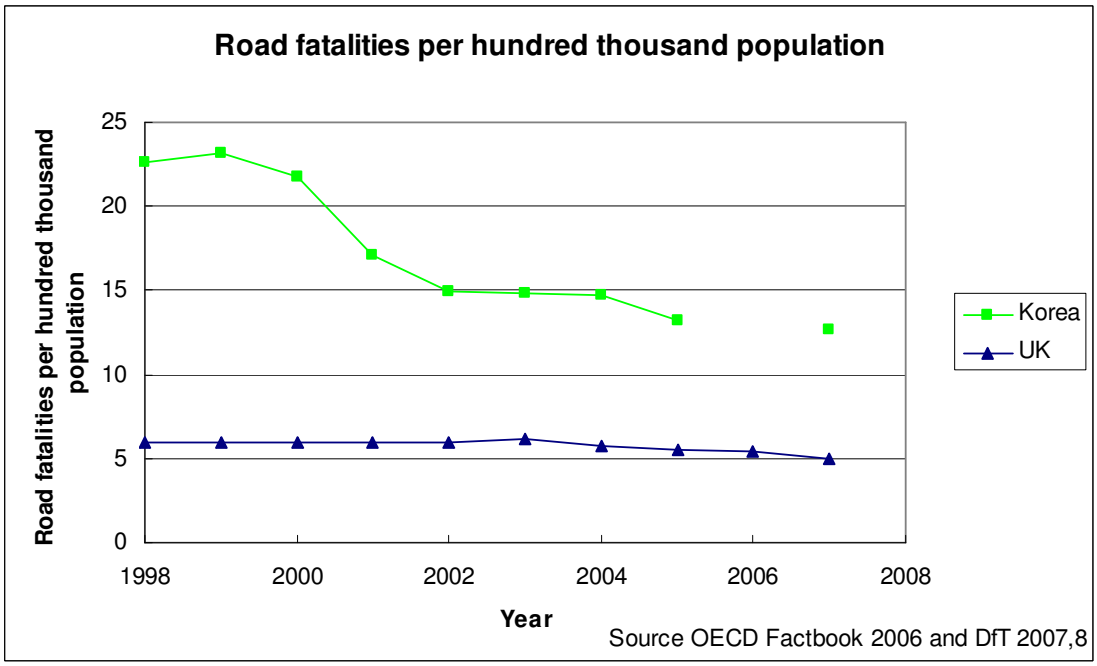
Road casualties

During the process of mechanisation and the increasing availability of motorised transport in a country, there is usually a period of substantial growth in road casualties. This is followed by a reduction as the use of motor transport becomes more widely available and the authorities implement greater controls on the design of the road system and the ways in which it is are used (Oppe and Koornstra, 1990).

Below is shown a plot of casualties per 100,000 population for the UK and for Korea. It can be seen that Korea is having great success in reducing its casualty rates (fatalities per 100,000 head of population) and is now approaching levels that the UK was experiencing in the mid 1960s. The steep post-peak reduction in road casualties usually reduces, after which greater effort is needed to achieve further reductions in casualty rates. Note that reported land transport deaths include road transport deaths as well as others.



The Figure below shows road fatalities for Korea and for the UK between 1998-2007.



Description of PPZs by country.

Introduction

This report presents elements of practice in some European pedestrian priority zones and their evaluations. The main part of this is a description of recent UK practice. This is supplemented with some additional material from other European countries, principally France with additional material from Switzerland, the Netherlands and Belgium.

UK

Pedestrian priority zones.

Areas within the road system may have different levels of priority given to pedestrians. At one end of the scale, pedestrians are not permitted on some kinds of road (e.g. motorways) and at the other end of the scale only pedestrians are permitted, for example pedestrians areas in towns where essential vehicles are permitted only at certain times of the day.

In the UK, the closest approximation to the pedestrian priority zone is the Homezone. These are areas in which the role and status of the pedestrian is elevated and the role and status of motor vehicles is reduced by modification of the design of the road and surrounding environment coupled, in some cases, with additional restrictions on vehicles such as speed limits and parking restrictions.

The authors were asked to consider 20 mph zones as part of the remit and this has been done later in this document. However, at this stage we consider the relationship between 20 mph zones and Homezones. A 20 mph zone is specifically an area that has a 20 mph speed limit. It may also have some supporting infrastructure to encourage or enforce that limit on motorists. The table below shows that while the 20 mph zone and Homezones are independent in the UK, a 20 mph zone may be incorporated within a Homezone. Furthermore, there is no specific legal status to differentiate the status of a pedestrian in a 20 mph zone than on an ordinary road, though the lower speeds may enhance the pedestrian experience.

Table 1: The relationship between 20 mph zones and Homezones

	Homezone	
20 mph	No	Yes
No	Ordinary road	Is sometimes implemented
Yes	Sometimes found in Residential area Shopping area School zone	Frequently implemented as part or all of a Homezone

Pedestrianised areas are places that have traffic excluded from them by the use of Traffic Restriction Orders that may apply to certain days/times or in some cases certain classes of vehicle. Unlike a number of other counties in Europe there is no specific legal definition of Homezone.

Background and purpose,

Homezones in the UK are residential areas with streets that are designed to be places for people rather than cars. The UK Department for Transport (DfT, 2009) has the following description on its website.

> "Home Zones are residential streets in which the road space is shared between drivers 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."

The descriptions vary (for example Gill, 2005) principally in their emphasis on pedestrian priority. Other types of pedestrian priority measures may be implemented in leisure/recreation, shopping and commercial areas. However, the DfT (2006) has produced a set of regulations and guidance that describes Homezones from their perspective. The Transport Act 2000 allows an area to be designated as a Homezone after which speed limits and Use Orders that do have legal standing may be applied: the Use Order limits the permitted uses of roads in the Homezone to ones other than through passage.

The DfT (2005) good practice guide states that "There is no blueprint for a Home Zone. While individual projects may use similar elements, each project needs to reflect the community's aspirations."

The first case study is the evaluation of 9 Homezone projects in the England and Wales. These 9 Homezones were part of a pilot study to evaluate Homezones in the UK. The evaluation of these Homezones were undertaken by TRL and reported in a number of reports during the period of evaluation followed by a report summarising the projects (Webster, Tilley, Wheeler, Nicholls and Butress, 2006). The areas in the pilot study were in Manchester, Leeds, Magor, Plymouth, Peterborough, Nottingham, Sittingbourne, and the two London boroughs of Ealing and Lambeth

What was implemented

Webster et al (2006) identified the following measures as being implemented in at least some of the 9 Homezone pilot areas.

- 20 mph speed limits
- Replacing parallel parking with echelon parking
- Gateway features at entrances to the zones using traffic calming measures such as speed humps and chicanes
- Shared surfaces for pedestrians and vehicles
- Community areas
- Planting trees, shrubs and flowers

- Public art
- Renewal/upgrading of streets.
- Controlled parking
- Road closures/one way streets

Some further measures were implemented in specific areas as follows:

- Demolition and creation of new ‘green streets’ (Manchester)
- Controlled parking zone and a road closure (London Borough of Ealing)
- Introduction of a one way street to control traffic movements (Magor)
- Cinema on the wall (Leeds)

UK Homezone signs (left and centre) and 20 mph zone (right)

Gateway features at entrance to zones.
The gateway features are designed to identify that there was a change in the way that the road should be viewed by drivers. Gateways narrow the road typically to 5-6m width.

Hartington Road, West Ealing, London
One of the streets in the West Ealing Five Roads Home Zone. Modified form of original photo. Note relatively few changes to infrastructure but a controlled parking zone has been introduced. A resident's parking permit is visible in the windscreen of the car in the foreground.

Signage was erected at the entrances to Homezones. As well as the name of the Homezone, speed limit signs are used where appropriate, in some locations together with a blue square showing a picture of adults, children, a house and a car, similar to the signs associated with PPZs in Europe. Where multiple languages were in used (e.g. Welsh in the case of Magor) the signs at the entrance to the Homezone are written in both languages. In some cases the signs are composites of other signs, e.g. name of the Homezone, text identifying that it was a Homezone, a triangular sign with red border and white centre with a picture of adult with child all on a yellow background with a cartoon drawing of children. The example below is at Sittingbourne in Kent.

Cavell Way Sittingbourne, Kent. Entrance to Homezone showing combination of blue sign and drawings. Also visible are shrubs planted in raised beds that form a gateway and also the base of the signs, a speed hump, coloured and textured surfaces. A play area can be seen in the distance.

Methley Drive, Leeds, Entrance to the Homezone, a 20 mph area. Note that an advertising sign has been illegally affixed to the speed limit sign on the left of the road. Note the use of coloured surfaces. A car can be seen passing over a road hump.

School Lane, Chapel Allerton, Leeds. Entry to Homezone. Note the gateway treatment with sign and coloured and textured surface as well as the ramp to bring the road surface flush.

Parking treatments.

Replacing parallel parking (vehicle parallel to the kerb) with echelon parking (angled, usually at 45 degrees), sometimes on alternating sides of the road, helps to slow traffic and improve pedestrian conditions. Angled parking bays were provided in some areas and in some areas cars could park in undesignated areas. The use of the parking bays helped break up the straight alignment of the road leading to slowing of the traffic. Stone or metal bollards can be used to prevent traffic accessing certain areas. In some cases the stone bollards are made using old granite kerbstones placed in an upright position.

Magor. Homezone. Note use of texture and at grade parking ad footways. Parallel parking can be seen in the foreground and echelon parking can be seen on the right of the picture.

Traffic calming

The term "traffic calming" covers a wide range of measure and Homezones themselves might be regarded as a form of traffic calming.

Traffic calming is intended to help drivers to make their speeds appropriate to local conditions, through measures that are self-enforcing. There are some legal bases to the implementation of traffic calming measures. DfT (2009) provides an explanation of the Highways (Traffic Calming) Regulations 1993, and offers guidance on the use of the measures prescribed in the regulations. Speed humps have a separate set of regulations. Other measures which are permitted to be used on highways such as selection of carriageway width or provision of roundabouts may be used in traffic calming projects but are not covered specifically by the traffic calming regulations but by other sets of regulations.

Traffic speeds can be slowed to within the legal limit by using physical methods such as humps and speed cushions. Road humps extend the full width of the road whereas speed cushions are square or oblong raised areas taking up part of the carriageway. Speed cushions may appear single or as a number abreast depending on the width of the road. Speed tables are raised areas with a ramp at each end. Flat-topped tables are a raised section of the road, flat on top with a ramp up and down; these also provide an at-grade pedestrian crossing. Examples of a range of these measures are shown below. There are specifications for the dimensions of these features which can be found in DfT (1990) documents. As a broad outline, the height should be between 50 and 100mm, and round-topped humps should be 3.7m long in the direction of travel.

Speed table. Note the flat top and use of bollards on the pavement (footway). Road marking have been used to make the hump more readily visible to drivers. Reproduced by permission of CEGE Department, UCL.

Gledhow Valley Road, Leeds. Flat top speed hump with coloured crossing area. Note the use of railings and of signs and road markings to make this installation more readily visible to the driver.

Upper Bucklebury, West Berkshire. Pinch point. While not in the evaluated projects, this picture demonstrates the principle of a pinch point. Note the use of a built out kerb, 'ghost island' road markings and a dropped kerb to facilitate pedestrians crossing. The pale coloured paving at the edge of the crossing is 'tactile' paving often used in the UK to indicate a crossing point in a way that is apparent to sight-impaired pedestrians. Traffic signs and retro-reflective surfaces to the bollards increase the visibility of this installation.

Tipton, Sandwell, Great Britain. Speed cushions. Note road marking in front of approaching car, which are associated with a speed camera, just visible as a yellow box on the right hand edge of the image.

Hatfield Hertfordshire. Pedestrian refuge with coloured road surface. This pedestrian refuge has illuminated bollards and a coloured surface treatment. Note that the pavement (footway) is set back from the carriageway with a grass verge. Details of design of pedestrian refuges and other crossing places are covered in the DfT (1995a, b). Reproduced by permission of CEGE Department, UCL

In some areas, public art is used to help form chicanes to help moderate traffic speed. In Manchester, large 'globes' were used for this purpose in conjunction with angled parking bays. The use of public art as a traffic calming measure meant that the measures blended with the overall impression of the area rather than appearing to drivers to be a specific piece of engineering designed to slow vehicles. Road narrowing can also be used for this: in some areas substantial buildouts were used to alter geometry and reduce street width whilst in others pinch points were used.

20 mph speed limits were introduced in some areas whilst in others (e.g. Plymouth), 10 mph signs were installed at the entrance to Homezones.

Traffic management measures were also used. Examples include the use of one-way streets and entry restrictions to some parts of the Homezone. The entry restrictions also helped to reduce "rat-running" (use of residential roads to bypass congested arterial or distributor roads).

Changes to surface texture

In some cases textures were provided by using different types of block paving and in others (e.g. Manchester)) a 'block paving effect' was created by applying a hot synthetic bitumen that was then imprinted using a mould to simulate a block paving effect. In Plymouth, coloured areas were installed to designate specific types of road use and leaflets were produced to explain the colour coding. In this city, grey areas were shared surfaces and through routes, yellow identified pedestrian, community and play areas. Bright red showed vehicle over-run areas to be kept clear to allow large vehicles to turn corners, dark red/grey border identified parking bays in shared surface areas. The use of colour in the different towns in the pilot project (as, more generally, with towns using coloured surfaces in other contexts) was not consistent.

London. At-grade road with changes in surface texture.
Reproduced by permission of CEGE, UCL

Westmoreland Street, Burnley. Entrance to Homezone. Note the use of surface texture and the shared surface with metal bollards. Planters with flowers are used to narrow the road and form a chicane.

Shared surfaces for pedestrians and vehicles

These areas were often designed so that what had originally been grade-separated areas for cars and for pedestrians are now at-grade. Colour and texture of the surface has been used to change the users' perceptions of the street. Planting of trees and flower beds has also been used, and 'knee rails' (low metal guard rails at about 30-50cm) are used to protect the trees and plants from incursion by vehicles. A ramp up to the shared areas also helped to identify to drivers that there was a change in the ways that the area should be used. Not all parts of a Homezone incorporated shared surfaces.

Community areas

One of the strategies used was to make an area stand out as being a residential area by including features that might not be found in a main thoroughfare and to make residents more aware of their community. The types of approach included planting trees, shrubs and flowers sometimes at road level and sometimes in raised beds with stone/brick surrounds. Streets were renewed and upgraded with new street furniture and lighting together with the use of public art, sculptures, and murals.

Sittingbourne High Street. Street art in a mixed-use area. Note use of textured surfaces bollards and the carriageway at the same height as the pavement.

Junction of Pinderfield Road and Lower York Street in Wakefield
Homezone: note the use of shared surface, community space, garden and street art.
Metal bollards prevent vehicle access to some areas.

Road restriction to pedestrians and cycles in Hertford to prevent 'rat running.' Note used of concrete bollards and a planted area with shrubs to prevent the passage of motor vehicles. Pedal cycles and pedestrians are allocated separate areas.

Evaluation framework

In the UK pilot study of the 9 areas (Webster et al), several evaluation measures were used, though not all were used in every area. These measures included

- Before and after attitudinal surveys of adults and children living within each Homezone. These were the key measures for the evaluations.
- Traffic speed and traffic flow data
- Accident data analysis
- Parking
- Video surveys, static and drive-through to record street activity

The following analyses were only taken in one area (Leeds)

- Air quality surveys
- Noise surveys

In the UK Homezone pilot project, the approach to evaluation was a before (2000) and after (2002/2004) study with a mix of qualitative and quantitative data. Not all measurements were taken at every location. Two of the areas being studied were not completed in time for Webster et al to report on the 'after' data from them.

In addition to the data collected by the research team, each local council had a number of criteria by which their local project was judged. Two of the areas had no after surveys as the works had not been completed within the monitoring period and could not be included in the full evaluation.

The evaluation methods were a mix of quantitative and qualitative methods. The evaluation of the pilot projects were considerably more detailed than evaluation of many subsequent installations. In a number of cases, evaluation has been based on a self assessment by the developers (see for example the self assessments in IHIE Homezone website www.homezones.org.uk).

Evaluation methodology

Attitudinal surveys of adults and children living within each Homezone. These were the key measures for these evaluations. These surveys were detailed and included:

- Demographic data
- Perceived traffic speed, flow, noise and pollution
- Access to private transport
- Frequency of journeys by mode and journey purpose.
- Safety on the road and safety from crime.
- Involvement in traffic accidents or near miss incidents
- Priority given to pedestrian or cyclists by drivers
- What on-street activities people undertook in the Homezones
- Where children play in Homezones
- Safety on-street for playing

In additional the following objective variables were analysed:

- Traffic speed and traffic flow (using automated counters with tube detectors, various locations in the Homezone in a 3 week period after surveys were, as far as possible conducted in the same locations)
- Accident data (collected from STATS19, the UK's road accident national data source)
- Parking surveys
- Street activity (measured by Video surveys, static and drive through). These were undertaken at up to 5 locations at each site and analysed for traffic and pedestrian counts as well as activity. They were subsequently deemed to be unreliable as a quantitative measure of activity as changes in street activity viewed by the cameras was small.

Not all these measure were deemed to be useful; for example the video analysis as undertaken in these surveys were not felt to be sensitive enough to changes in behaviours.

Measures of effectiveness

Webster et al's evaluation was intended to assess the effectiveness of the Homezones in allowing all road users to coexist in a pleasant and safe environment. In additional the evaluation was to identify if further legislation was required and to disseminate good practice. Many the variables measured in the surveys were the perceptions of the respondents to questionnaires in the areas. Sample sizes for the interview surveys were in the order of 50-100 per area.

The main success criteria set out by the local authorities were as follows:

Improve quality of life and appearance of the streets for residents

This was measured by attitude survey. Of the residents who responded, 73% thought that that the appearance of the street had improved, and 64% were in favour of the Homezones. About half thought that there was sufficient consultation. This emphasises the need to consult residents to ensure that the design of the area meets their requirements. As many as 74% thought that the Homezone was safer for adults walking or cycling from hazards caused by motor traffic.

Reduce speeds in the Homezones

This was measured by speed surveys undertaken before and after implementation. The observed data was supplemented by survey data on resident's perception of vehicle speeds.

While vehicle speeds (mean and 85%ile) were fairly low before the Homezones were

introduced, they were reduced by between 2 to 9 mph in the after period compared to the before. At least some of this reduction will have been associated with the inclusion of 20 mph zones in some areas.

This was reflected by the results of the residents' opinion surveys. On average, 47% perceived a reduction in speed and 42% no change, though 11% thought there had been an increase in speed.

Divert non-essential vehicles (including through traffic)

Traffic in the Homezone areas was reduced as measured by traffic counts. This was thought to be the result of traffic calming measures and traffic management. Half of respondents to the surveys did not perceive a change in traffic levels. This demonstrates the need for quantitative, observed data as well as qualitative data for evaluation of a project.

Improve pedestrian safety (especially for children and for older people)

There were few accidents in the before period. No formal analysis was reported, but indications were that it would be difficult to demonstrate a significant reduction is casualties due to the small numbers in the before period. The report by Webster et al (2006) indicated that the outcome of improving pedestrian safety had been judged to have been met had been met. This was conclusion was probably arrived at on the basis of the survey question about perceived road safety.

On the basis of the information in the report there is insufficient evidence to support the proposition that road safety in terms of casualty or accident numbers has been improved. Of equal importance is that the intervention has not made safety worse.

In terms of driver behaviour, 38% of respondents felt that motorists were more considerate in the after period.

Design for structured car parking

Parking was changed in the Homezones but for residents in a number of the areas there were still unresolved issues so that although Webster et al's report indicated that the objective had been met, it did not meet the needs of all the residents. In over half of the areas, many residents felt that the Homezone had caused parking problems.

Change the activities of the community (for example by enhancing social activity)

There was a slight increase in the time spent outside the home, and walking in the Homezone was thought to be more pleasant. The report viewed these two aspects as being linked. It also reported that there was an association between the proportion of respondents who thought walking in the Homezone was pleasant and the proportion that were in favour of the Homezone.

Reduce air pollution and noise

There was little change in perceived noise and air pollution except for Ealing where there were reductions in these adverse indicators, showing that there had been an improvement. There was little change in measured noise and air pollution in Leeds.

Improve street lighting to deter crime and improve community safety

Residents reported that they felt the danger from crime was the same or less. There was no indication in the report about actual changes in crime levels.

Not all authorities included all of these as evaluation criteria.

Result of evaluation

Broadly the Homezone met many of the criteria for success. There were some criteria (e.g. noise and pollution) that were not satisfied and some aspects such as the issue of parking which was perceived as a problem by and for a number of residents in some of the zones.

Suggestions for good practice have been identified and incorporated into Department for Transport (2005) guidance.

Suggestions made after evaluation

There are websites that provide resources for builder of Homezones including the sharing of best practice (see for example http://www.homezones.org.uk). The few case studies available at this site do have some limited self evaluation, which is largely qualitative in nature and gives a positive view of those developments.

Biddulph (2008) has commented further on the longer term outcomes of the Homezones in general in the UK and has identified a number of issues that have become clearer with the passage of time.

Since implementation of Homezones in the pilot areas, there have been more of these implemented in the UK including 61 retrofit zones which were part of the Homezone challenge in the early 2000's.

Biddulph noted that there had not been good monitoring/evaluation of projects once they have been installed. Biddulph suggests that the projects have been a conditional success. House prices appears to have risen more in treated areas than in untreated ones and there have been reports of improvements in perceptions of the treated area thought there is relatively little detail provided.

An issue about the impact of Homezones on the blind and partially sighted has been raised. It appears that in some Homezones these is insufficient guidance for sight

impaired people and that this can cause problems combined with the less formal layout.

Biddulph notes that while new-build Homezones are now being installed, there has been little research on evaluation of this kind of project.

A note on 20 mph zones in the UK

While they are not strictly a pedestrian priority measure, 20 mph zones form part of the range of traffic management measures that is available to the designer and are discussed here briefly. They were introduced in the UK in 1990 after a change in the law permitted the use of a 20 mph speed limit. The use of 20 mph zones in the UK was reviewed by Webster and Mackie (1996).

Hertford 20 mph zone in town centre. Note use of raised table and textured surface. For private motor vehicles, this road is effectively 1-way. For public transport vehicles and pedal cycles it is 2-way.
Image Copyright SA Robertson; used with permission.

According Webster and Mackie the early 20 mph zones were initially implemented as a temporary measure for a period of up to 18 months, then if the average speeds are below 20 mph the zone may be made permanent. The form that the 20 mph zone takes depends on the speed of traffic before implementation. The zones had to have permission from the Secretary of State, but since 1999 local authorities have been able to implement 20 mph zones without the requirement for special permission. There are, however, rules relating to how the zones must be implemented. Guidance is given in DfT Circular Roads 5/99 (DfT, 1999).

The 20 mph zone us usually installed in a residential areas in conjunction with traffic calming engineering measures such as hump. They may also be part of other measures such as Homezones or area-wide traffic calming. According Webster and Mackie the 20 mph zone has been successful in reducing accidents and in 60 of the applications that were reviewed, the reason quoted was for accident reduction. Most of these zones are in residential areas. Whilst at an individual level the casualty reductions in each area were small, the review of a large number of these measures allowed joint statistical modelling of results and it was reported that there was a 60% reduction in accidents in the 20 mph zones. The GLA (2009) noted that in London, 20 mph zones have had a beneficial effect on safety with a reduction in casualties of 42%.

France

France has recently (CERTU, 2008a) encouraged more use of pedestrian priority areas and enacted legislation in support of this.

Background and purpose,

The PPZs appear to be being implemented as a national strategy. CERTU (2008a) notes that the Code de la Rue (street use code) programme took its inspiration from the Belgian example. The Code de la Rue programme is designed to raise awareness of the Code de la Route (French equivalent of the UK Highway Code) as applied to urban areas and, where necessary, to modify regulations by adapting them to the practices of those using public space.

The intention was to improve the way in which public space is shared between all types of users. It was intended additionally to improve user journey safety, particularly for the most vulnerable. The intention was also to encourage sustainable options as an alternative to car journeys.

Development of guidance and laws in relation to PPZ have been made through a consultation process that involved representatives from institutions and associations involved in the "Code de la Rue" project. This was developed experience and best practice and had also been stimulated by developments in Belgium in 2002-2004.

According to CERTU (2008a), in Decree No. 2008-754 of 30 July 2008, the principle of prudence towards vulnerable users was accepted and introduced. Article R412-6 of the Code de la Route now states that the drivers "must, at all times, behave in a prudent and respectful manner towards other road users. In particular, motorists must show increased prudence towards the most vulnerable users."

The changes also included a legal redefinition of specific traffic zones in urban environments that confer particular benefit to pedestrians. The concept of the pedestrian priority zone was created and defined. Finally, two-way cycle traffic in 30 km/h zones and pedestrian priority zones is generalized (except in specific cases).

France. An example of street treatment. Note used of coloured and textured surfaces, metal poles/bollards and the carriageway at the same level as the pavement.
Image from CERTU (2008a).

Three specific kinds of zone were thus created:

- Pedestrian area,
- Pedestrian priority zone (meeting zone/encounter zone), and
- 30 km/h zone.

Each of these designs has its own set of rules as defined in the Code de la Route. The most recent changes were introduced by the decree of 30 July 2008.

According to CERTU (2008a), the **pedestrian priority zone** is a new feature in France. The pedestrian priority zone is open to all forms of transport but pedestrians have priority over all other forms of transport except trams. Pedestrians can move with complete freedom across the entire width of the road, i.e. becomes a shared surface. Motorised vehicles are limited to 20 km/h and may only stop and park in designated areas.

France. Example of a pedestrian priority zone. Note the use of coloured and textured surfaces, bollards, metal poles, planters with small shrubs, and the same level for carriageway and pavement.
Image from CERTU (2008a).

French signs for pedestrian areas


Sign for pedestrian area

Sign for pedestrian priority zone

Sign for 30 km/h zone

According to CERTU (2008a) a **pedestrian area** is an area dedicated to pedestrians who have priority over all vehicles except trams. Only authorised vehicles are permitted in the area, including cycles and must move at walking speed. Motorised vehicles only use these zones on exceptional occasions and according to specific traffic regulations as set out by the local mayor of the town or village. Authorisation is only granted if the vehicle is serving the pedestrian area itself. Parking is not permitted in these areas. The **pedestrian priority zone** is a new feature that is open to all forms of transport. However, like the pedestrian zone, pedestrians have priority over all other forms of transport except trams. Pedestrians can move with complete freedom across the entire width of the road. To make this possible, motorised vehicles are limited to 20 km/h. Motorised vehicles may only stop and park in designated areas.

In the **30 km/h zone**, vehicles are limited to a speed of 30 km/h. This new regulation requires specific planning that is consistent with the speed limit and generalisation of two-way cycle traffic (except in specific cases). This is a form of traffic calming. In this area, cyclists and pedestrians benefit from improved safety. Pedestrians are allowed to cross at any point as long as they do so with appropriate care.

France. A pedestrian priority (encounter) zone. Notes use of bollards, road markings, textured surfaces and level surfaces.
Image from http://transportsetmobilitebrest.blogspot.com , Transports et mobilité à Brest

What was implemented

The approaches used in France are summarised in CERTU (2008b-d).

Evaluation framework

It appears that evaluation is informal or qualitative and appears to have been done in the consultation process. See next section for further detail.

Case studies appear to be largely descriptive (for example the use of two-way cycling) (CERTU, 2008a-d).

Evaluation methodology

CERTU (2008) indicated that there has been some evaluation of the PPZs undertaken but we have not yet obtained a detailed description of the evaluation. Generally, the information available indicates that the development of the regulations was as a result of consultation with experts and organisations with an implication that some evaluation had been part of that process, but had not necessarily been formalised.

Comments from colleagues in France have suggested that a more qualitative approach to evaluation has historically been taken in France. The process of evaluation in France appears, therefore, to be based on expert opinion prior to the implementation of the plans, calling on previous experience. There seems to be little by way of a formalised before and after approach. However the expert opinion provides a way of evaluation that allows longer term experience to feed into the future design process.

Measures of effectiveness

It was unclear what measures of effectiveness have been used in the evaluation process.

Result of evaluation,

The decision to pursue the use of the 3 kinds of PPZ indicates that the French government viewed the outcome of the consultation with experts and organisation as indicating that positive outcomes were likely.

Suggestions made after evaluation,

Guidance and legislation have been developed as described earlier. As mentioned before, the overall approach to design and evaluation does not appear to correspond directly to the UK model.

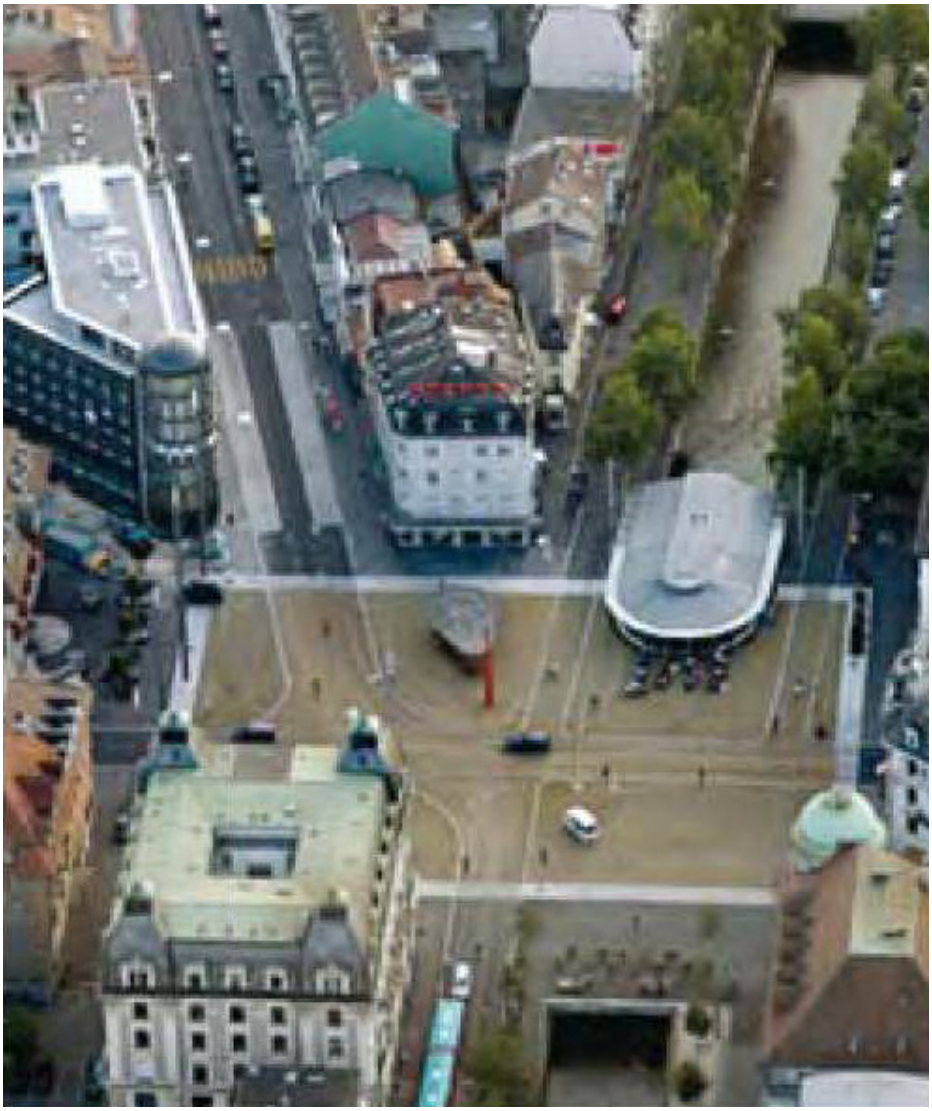
Switzerland

Background and purpose,

In Switzerland, Begegnungszonen (Encounter Zones) (see http://www.homezones.org.uk/documents/Begegnungszonen.pdf) are the equivalent of the pedestrian priority zone. These are part-way between a pedestrianised area and a Tempo30 zone (30 km/h zone). Some 20 km/h zones also exist. The Encounter zones have 20 km/h speed limit, and shared surface with pedestrian priority.

Pedestrian priority zones appear to be of the same broad categories as in France. They seem to be popular (see, for example, http://www.zonederencontre.ch/home/index.aspx) but it has been difficult to identify any formal evaluation framework for this kind of project.

As we have not located specific case studies, we have provided an overview of pedestrian priority zones in Switzerland.



Switzerland. Encounter zone.
Image from Anon (2008).

What was implemented

Encounter zone. Image from OFROU (2003)

A Swiss government document (OFROU, 2003) describes a range of treatments that may be implemented in more detail. Smith (2008) has translated a Swiss document that comments on encounter zones. Some glimpses of the effects of the zones are given in different contexts, but not enough detail is given to use it as other than a broad qualitative evaluation.

Pedestrian priority zones appear to be widely implemented in Switzerland. Local areas pass this information on to drivers. An example of a local implementation can be seen at the website for the area Plan-les-Ouates (http://www.plan-les-ouates.ch/node/1267), which describes the different zones. A broad translation of the instruction is shown below.

The encounter zones give priority to pedestrians. The road is a shared surface but pedestrians must, even if they have priority, pay attention to the traffic and not obstruct vehicles unnecessarily. The drivers of vehicles (car, motor bike, bicycle, child's scooter, etc) must drive with caution because in the event of confused situation of priority or danger, it is wisdom at the wheel which is paramount. The legal regulations are:

- Maximum speed is fixed at 20 km/h
- Pedestrians have priority and there are no specific crossing places for pedestrians
- Parking is allowed only in specified places.

Zones 30 give priority to the vehicles. The drivers must drive with care and attention careful. Vehicles must give priority to the pedestrians who want to cross the roadway. Drivers should pay attention to the children playing in the street and the elderly. Pedestrians need to look before crossing in order to establish visual contact with a driver. The principal legal regulations are:

- Maximum speed is fixed at 30 km/h
- The vehicles have right of way.

Belgium

Background and purpose.

Encounter zones, also known locally as shared space are also used in Belgium. It appears to be mainly aimed at improving the quality of living areas.

Belgium: Shared area. Note crossing, use of textured and coloured surface, bollards and road markings.
Image from Le Code del Route.

A broad translation of an extract from the Belgian Code de la Route gives the following description of aspects of PPZs. Just like the residential zones, the zones of meeting (encounter zones, pedestrian priority zones), which include shopping, tourism, craft, and school, are zones easily recognizable by their installations. In these zones, the pedestrians can use the full width of the public highway and playing is also authorized. The drivers are not permitted to endanger pedestrians, nor to obstruct them; if needs be, drivers must stop. Motorists must especially careful in the presence of children. Pedestrians cannot block circulation without reason. The Speed limit is 20 km/h. Parking is prohibited except in authorized places. Mutual prudence and respect are essential once again.

The Netherlands

Background and purpose

The Dutch concept of the woonerf (plural *woonerven*) was developed initially in the 1970's. These are found in the Netherlands and Flanders. A woonerf is a street or group of streets in a town or city where pedestrians and cyclists have legal priority over motorists.

By 1999, the Netherlands had over 6000 Woonervens in place. Under Article 44 of the Dutch traffic regulations, motorised traffic entering a woonerf is restricted to a speed limit of "walking pace". The woonerf has a specific legal status. The Dutch highway standards have an English translation CROW (1998).

Delft, Netherlands. An example of a woonerf. Note use of textured surfaces. Bollards prevent cars parking in some areas.

The term woonerf can be broadly translated as "residential yard" and conceptually the idea was to reduce the speed of vehicular traffic, and so to give pedestrians use of the full width of the roadway. Additionally, planting trees and making public lighting in consistent with the streetscape. This would provide giving inhabitants a small semi-private zone on house frontages with greenery and benches. Over the years the concept of woonerf has extended to other types of erf (yard) CROW (1989).

Schepel (2005) in an article examining the way that woonerven developed over time makes the point that this was an incremental process that involved "learning by doing." This is an interesting perspective and suggests for some types of development and planning, a standard before and after evaluation may not always be the most appropriate tool.

Delft, The Netherlands. An example of a woonerf. Note the textured paving in the area which is used for walking and cycling.

Signs for a woonerf in the Netherlands

Entry to woonerf

Exit from woonerf

The Netherlands. Entrance to a woonerf. Note the separate cycle lane, gated entrance feature, no grade-separation and use of planters.

What was implemented

A range of measures have been implemented. These have since been adopted in large part in UK current practice for Homezones and are described there.

Evaluation framework

It is understood that there was evaluation for the woonerven in the 1970's and 1980's but details of this have been difficult to locate.

The woonerf has been implemented in the Netherlands for about 30 years and it could be considered that this long term use indicates that they meet the expectations and requirements of the local communities. Many of the ideas implemented in the woonerven have been adopted in a range of pedestrian priority measures in other parts of Europe, including in the UK. While the original woonerf concept was applied to specific localities, this has been extended over the years to a wide-area approach. Kraay (1987) gave a summary of the findings on the early woonerven in which he identified that accidents had been reduced by 50% (but that this not quite at the 5% level of significance with the data that were available). It was also reported that the in some areas there had been no effect on moped accidents. The original date underlying

these claims were not presented. In general, residents supported of the woonerven. Behavioural studies (e.g. in Gouda, but no reference was quoted for the figures given) showed that the pattern of activities was more varied in woonerven than in other, normal residential streets.

Other PPZ studies

Shared space

"Shared Space" is a name used for a particular design style, rather more radical than other PPZs in that there is space with an absence of conventional traffic signals, signs, road markings, humps and barriers. The surfaces are usually at-grade. In this context the term "shared space" is used as a description for a design style that is applied to an entire urban area and not just areas that are used by more than one type of road user. Projects with some characteristics of "shared space" are evident in several European countries.

The driver in shared space is viewed as becoming an integral part of the social and cultural context. Behaviour (such as speed) is then, it is suggested, controlled by everyday norms of behaviour. This approach was developed and refined by people such as Hans Monderman and Ben Hamilton–Baillie.

A project involving seven European partners from five countries are sharing knowledge on shared space, was reported on the "Shared Space" website. The European partners were the Dutch authorities of Emmen, Haren and the Province of Friesland, Oostende in Belgium, Bohmte in Germany, Ejby in Denmark and Suffolk County Council in the UK. A document is available on the website (Shared Space, undated) reporting an evaluation of the work, though this gives little detail (http://www.shared-space.org/). The evaluations seem to be primarily a description of what was implemented by the partner organisations. There was little information about evaluation of the changes to road safety or user behaviour.

Meta analyses

Elvik and Var (2004) have published a book on road safety measures that includes meta analyses of various road safety measures. The descriptions of the measures do not always correspond directly to PPZs and in some cases various measures are grouped together in other categories. Many of the studies included were in languages other than English. The following sections draw on Elvik and Var (2004).

Environmental streets

According to the description of "environmental streets," these include some elements of PPZs and are designed to encourage low speed and high alertness for drivers. This looked at studies primarily in Germany and the Scandinavian countries. A reduction in injury accidents of between 29 and 47% was estimated. Environmental streets led

to lower speeds in urban areas, but the changes were not recorded in detail. Speed had increased on some roads outside urban areas where environmental streets had been installed. Evaluation of pollution effects were found to be contradictory. Noise reduction was reported in some studies as being typically 1-3dB and up to 6dB, though according to the Homezone study, small changes in noise level are unlikely to be noticed by residents.

Pedestrian streets

Elvik and Var identified pedestrian streets as those where vehicles are not permitted, broadly similar to the concept of a pedestrianised zone. The studies quoted were, however mainly from the 1970's- 1990's so may be outdated. The analyses indicated that in the pedestrianised areas, injury accident fell by between 20 to 80%, best estimate 60%, but in streets adjoining the pedestrianised areas accidents changed by between a 15% reduction and 30% increase with a best estimate of an increase of 5%. The combined change was a decrease of between 10% and 40% with a best estimate of 25%. A few studies included noise measurements and in one study the reduction of noise was 6-9dB and in the other the reduction was 4-8db, but in surrounding streets the noise level increased by about 3dB. No details of methodology were given and no cost benefit analyses of pedestrianised streets had been found.

Urban Play streets

These are streets with no through traffic and are designed to encourage play. Elvik and Var identify these as having originated in the Netherlands. The majority of 'play streets' were reported as being part of a bigger, area-wide traffic calming intervention. The four studies quoted were primarily from the late 1980's from the Netherlands, Norway, Germany and Denmark. Injury accidents were reduced by between 5% to 45% with a best estimate of a 25% reduction. Motor vehicle speeds in the streets were reduced to the range 10-15Km/h and the proportion of people who spent time relaxing outdoors (as opposed to waking somewhere) increased).

Evaluation systems

There are some evaluation systems available that allow a structured assessment. An example of this is the TRL PERS system is a software tool designed to provide an assessment of the walking environment, (TRL2009a, b) (see http://tinyurl.com/n7atj9 (1) and http://tinyurl.com/lsfavo (2). For an expansion of these TinyURL addresses, see Appendix C). The latter webpage points out that "There is little defined best practice in the evaluation of pedestrian provision". While the PERS system is not designed to do a before and after study of the impacts on all road users of an implemented measure, it is an example of a structured approach to assessing the pedestrian environment and could be used as a data collection tool in a before and after context. TfL (2006) have used the PERS system and describe its use (http://tinyurl.com/qckeg9 3) From that description it is clear that PERS uses a mixture of qualitative and quantitative methods in a clearly structured form. The

assessments can be made consistent provided that those undertaking them have had suitable training and are applying the briefing documentation correctly.

The DISTILLATE project (http://www.distillate.ac.uk/about/about.php) has taken a high level approach to the effectiveness of design and implementation of sustainable urban transport and land use. Forrester et al (2005) have commented on the types of indicators that might be included in an evaluation (albeit at a substantially wider level than a single type of road safety or road use intervention) and commented upon how these might be useful. More importantly the document considers the features of performance indicators and evaluation criteria that make them useful and factors in selecting them appropriately.

Discussion

Explanation of successful measures applied in Pedestrian Priority Streets/Zones

This section provides a brief commentary on which aspects of PPZs work well together with the reasons some measures work well. More detailed information is presented in the body of this report according to the country of implementation.

The main findings are that the design of a pedestrian priority zone should match the needs of the urban area and the national ethos of the road uses in the country in which it is implemented. For example, in Homezones in the UK, consultation with local residents has been found to be an important part of the process and the designs: those that are perceived to work well appear to be tailored to the wants and needs expressed by members of the local community.

Kinds of PPZ

In Europe, pedestrian priority zones are broadly of 3 kinds:

1. Pedestrianised zones

2. Shared areas/encounter zone/meeting zone where all road users share the space and pedestrians have priority

3. Low speed zones such as the 20 mph zone in the UK and 30 km/h zones in continental Europe, where traffic speeds are substantially reduced.

These zones are often linked with a range of traffic calming techniques to reinforce behaviours.

Purpose for which the PPZ was implemented. (e.g. safety, political reasons such as local pressure, accessibility)

PPZs appear to be introduced primarily to improve the street environment and local living conditions more generally. Safety is often mentioned in descriptions, but there seems to be relatively little evidence to support this either in terms of numbers of casualties before implementation or measured improvements in road safety. However, residents' perception of safety is often improved. Safety seems rarely to be the primary reason for installation of a PPZ, but the 20 mph zone in the UK is installed primarily as a safety measure, and this will confer benefits on pedestrians.

Installation guidelines (e.g. prescriptive, flexible, guidance, statutory)

Installation guidelines have a mixture of statutory and flexible guidance. For example road signs are usually statutorily defined in terms of their content and positioning, but the layout of an area is often the form of a more simple guidance.

Measures of effectiveness

The measures of effectiveness in reports are frequently summarised to the point where the details and specific results are not available. Appendix A describes measures of effectiveness that have been identified and, where possible, units and equations have been included.

Measurement Methodologies

Safety

There is a range of measurement methodologies for safety. These fall into two broad categories: Objective and Subjective.

Objective measure are ones that can be described numerically, for example number of casualties. Subjective (qualitative) measures are those which are perceived by an individual or group and may rank situations in a different order Than objective measures.

Objective measures of safety are usually the numbers of casualties or accidents with at least one injury. These may be disaggregated into various classes or types. Usually casualty or accident statistics are collected for a national reporting body which gives a consistent approach over time. Casualties arise relatively rarely and their distribution is frequently regarded as following a Poisson distribution. In practice this means that analysis of accidents or casualties requires at least 3 years before data and 3 years after data. Additionally there may be ongoing downward national or local trends in casualty numbers. Ideally, to assess the true effectiveness of a measure, a comparison with a similar area that has had not treatments or with national statistics should be used. In practice this may not be possible often due to evaluation not being prepared at a sufficiently early stage in the project. Many reports quote simple headline figures without detail of the underlying analysis or even information as to whether an analysis was done. It should also be noted that the if a measure is implemented where there has not previously been a problem with accidents, then no safety benefits van accrue.

Road accidents and casualty reporting may have reliability problems and if the way in which reporting is changed during the course of an investigation this may distort the results. It has to be accepted that the casualty data will not be perfect and any analysis must take this into account. For longitudinal studies where changes in accidents/casualties over the years is being investigated, consistency of the data for that period is important. This is particularly so in the stages of the development of the road system where casualty numbers are at levels where relatively small changes to numbers can affect the outcome of an analysis

Sometimes casualty rates will need to be analysed to take into account the changes in exposure, for example the number of vehicle miles driven or the size of a local population.

Subjective measures of safety are generally the road users' perceptions of the road environment and are usually obtained via a questionnaire survey or interview. Subjective assessments of safety are especially important where an intervention is implemented as a result of public pressure.

Perceptions of safety may also influence behaviour. For example if a road is perceived as being particularly dangerous, pedestrians may not attempt to cross it. Therefore exposure will be low and the number of casualties may be low or zero. There is then a mismatch between observed safety and perceived lack of safety.

The effect of road safety measures will be different in different circumstances. For example in the 70's and 80's in the UK safety measures were targeted at specific locations where typically problems with road layout or design led to clusters of accidents. These were easily treatable and large savings could be obtained fairly easily. Over the years many of these high risk accident sites have been eliminated and the accidents are spread more diffusely so require different and often more expensive treatments per casualty saved. Area wide approaches are now required..

Measurement of end user experience.

The evaluation of end user experience usually relates to the specified goals of a project. This type of evaluation is often done by surveys or interviews of a sample of residents with questions designed to elicit information about the perceptions of changes that relate directly to the specific goals of the project or to proxies for them. In some cases surveys of road use/pedestrian activity surveys may be used to supplement and confirm interview data as stated experience/preference may not always be consistent with what is revealed by objective measures.

Environmental measurements.

The only details of environmental measures that we have identified as being documented were for the UK Homezones. These are as follows:

Noise

Noise measurements were taken in one area. Measurement was at a single site.
The LA_{10} LA_{90} method uses 'A' weighted decibel scale (Layfield et at 2003). $LA_{10,\,18}$ hr is average of 15 min sampling periods 06:00 - 00:00 (daytime noise) where the A-weighted noise exceeds this level for 10% of the period, ($LA_{90,t}$ is the level that is exceeded by noise 90% of the time during the period t of observation) $LA_{10,\,6}$ is average of 15 min sampling periods 00:00 - 06:00 (night noise) where the noise exceeds this level for 10% of the period. The use of a single site limits the usefulness of this measure.

Air quality.
These measurement were not taken at all areas in the UK Homezone evaluation. In Leeds, 4 kerbside sites were used Diffusion tubes were deployed for 2 weeks at a time between May and November at Methleys. (the sample period may vary depending on local conditions). The content of the diffusion tubes were measured by a mass spectrometer for the Benzene tubes and by UV spectrophotometer. Levels of Benzene and Nitrogen dioxide(NO_2) were measured at the kerbside. A control site was also used to allow comparison of what happened at the test sites with other changes in pollutant levels that were independent of the Homezone. In the before period Benzene was <5ppb so well within air quality standards and NO_2 was <40mg.m^3 so again well within air quality standards. There were small but not significant increases in the benzene pollutant levels in the after period and small but not significant decreases in NO_2 levels in the after period.

Cost-effectiveness:

It has been difficult to determine cost-effectiveness of the pedestrian priority projects. Because the numbers of casualties are usually low even before implementation there is little scope for substantial reductions in the number of casualties. There has been no mention of valuation of the other potential quantifiable benefits. The outcome measures tend toward the qualitative. The one exception to this is a mention by Biddulph that house prices tended to increase in areas where home zone treatments were applied in the UK, but did not quantify the change.

General discussion points

- High level information on the various pedestrian priority zones is generally available at a range of publicly accessible web sites.
- Low level design detail is less readily available.
- Little information is available on evaluation criteria, methods or results.
- Continental European approaches to evaluation appears to differ from UK ones.
- Continental European evaluation appears to be more qualitative
- In many cases, once a PPZ type has been ‘approved’ there is relatively little evaluation undertaken.

Conclusions

The key messages that have been identified are that:

- PPZs have been implemented in several European countries, generally with success
- Whilst many Europe countries have legally defined areas, in the UK (with the exception of Homezones) the guidance is to use existing powers to create an appropriate pedestrian priority zone
- In the UK, consultation is important. In the evaluation areas, dissatisfaction arose where there was not perceived to be sufficient consultation.
- Many different elements are used in detailed design, including visual elements, surface treatments, variations in levels, and street furniture of various kinds.
- Most usually, vehicle speeds limits are reduced to 20 mph or lower
- Benefits are often largely qualitative and may be difficult to quantify

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Appendix A Summary Table of measures of effectiveness.

This appendix contains the measures of effectiveness together with units and equations where appropriate.

Category	Measure of effectiveness	Unit	Equation	How measured
Behaviour	Activity on streets	Not specified	Not specified	Video survey
Behaviour	Activity on streets	Not specified	Not specified	Manual surveys, video surveys
Costs	costs	Various	n/a	Various
Environment	benzene	ppb	Concentration	Sampling devices.
Environment	NO_2	g/m^3	Mass per volume	Sampling devices.
Environment	Noise $LA_{10, 18}$	dB	Noise exceeds this threshold 10% of time	Noise surveys,
Environment	Noise $LA_{10, 6}$	dB	Noise exceeds this threshold 10% of time	Noise surveys,
Environment	Noise $LA_{90, 10}$	dB	Noise exceeds this threshold 90% of time	Noise surveys,
Environment	Noise $LA_{90, 6}$	dB	Noise exceeds this threshold 90% of time	Noise surveys,
Environment	Pollutants	ppm, ppb, g/m^3	Concentration, mass per volume	Measurements of various pollutants e.g. NO*x* benzene, particulates
Safety	Accident	Number (with maximum injury severity of)	Number/time	Accident data from national or local statistics

Safety	Accident migration	Casualties or accidents in surrounding roads	Number	Same measures as for corresponding roads in the project area
Safety	Accident rates	Accidents per unit of exposure	Number/unit of exposure	Number of casualties per unit time or per passenger, vehicle or vehicle mileage
Safety	Casualties (numbers)	Casualties, Killed, seriously injured , all casualties	number	Casualty data from national or local casualty statistics
Safety	Casualty rates	Casualties/ exposure measure	Number/time	Number of casualties per unit time or per passenger, vehicle or vehicle mileage
Safety	Near misses	Survey specific	Qualitative	Questionnaire surveys and/or interviews
Traffic engineering	Parking	Not specified	Not specified	Parking surveys, when, how long, availability of parking places
Traffic engineering	Pedestrian delay	Not specified, usually time	Not specified	Pedestrian/journey time surveys (manual counts)
Traffic engineering	Pedestrian flow	Not specified, usually per hour or per day	Not specified	Pedestrian flow surveys (manual counts)
Traffic engineering	Traffic delay	Not specified, usually time	Not specified	Traffic/journey time surveys (tube/loop detectors, manual counts)
Traffic engineering	Traffic flow (unspecified)	Not specified, usually Vehicles per hour or per day	Not specified	Traffic volume surveys (tube/loop detectors, manual counts) May be combine with speed survey tools.

Traffic engineering	Traffic flow all day	Mean 2-way vehicle flow	Vehicles/h	Traffic flow surveys (tube/loop detectors, manual counts)
Traffic engineering	Traffic flow pm	Peak hour afternoon flow	Vehicles/h	Traffic flow surveys (tube/loop detectors, manual counts)
Traffic engineering	Traffic speed	Mean	mph	Speed surveys, e.g. loop detectors in multiple location
Traffic engineering	Traffic speed	85%ile	mph	Speed surveys, e.g. loop detectors in multiple location
Traffic engineering	Traffic speed	Proportion of vehicles exceeding 20mph	Proportion	Speed surveys, e.g. loop detectors in multiple location
User activity	Number of different types of activities	Survey specific	Not specified	
User perceptions	Crime	Various e.g. Number of crimes	Not specified	National /local statistics
User perceptions	General acceptability of the measures	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perception of danger to children	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perception of driver behaviour	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perception of environment	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perception of noise/pollution	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perception of safety for walking/cycling	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perception of safety from crime	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews

User perceptions	Perception of traffic levels	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perception of traffic speeds	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perceptions of car parking	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perceptions of cycling in the area	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Perceptions of driving in the area	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Resident support for the project	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Satisfaction with the streets	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Sufficient consultation	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Support for measure	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews
User perceptions	Time spent in activities on the street	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews

Appendix B Measures of effectiveness and outcomes for some PPZs and similar implementations.

Measures of Effectiveness: Homezones

Measures of Effectiveness: Homezones: data from Webster et al (2006) and Layfield et al (2003)

Category	Measure of effectiveness	Unit	Equation	How measured	Before	After	Change	Notes
Behaviour	Activity on streets	Not specified	Not specified	Manual surveys, video surveys				Video records difficult to analyse, small samples
Safety	Accident	Number (with maximum injury severity)	Number/time	Accident data from national or local statistics	-	-	-	Numbers too small for statistically significant result and not enough after data
Safety	Casualties (numbers)	Casualties, Killed, seriously injured , all casualties	number	Casualty data from national or local casualty statistics	-	-	NS	Numbers too small for meaningful analysis
Safety	Near misses	Survey specific	Qualitative	Questionnaire surveys and/or interviews	-	-	-	Of limited value when sample size is small
Traffic engineering	Parking	Not specified	Not specified	Parking surveys, when, how long, availability of parking places	-	-	-	
Traffic engineering	Traffic flow all day	Mean 2-way vehicle flow	Vehicles/h	Traffic flow surveys (tube/loop detectors, manual counts)	919	695	-224 average for 7 areas, reductions in all but 1	Important to look at the flow profiles on individual roads within an area, Not possible to summarize as a single
Traffic engineering	Traffic flow pm	Peak hour afternoon flow	Vehicles/h	Traffic flow surveys (tube/loop detectors, manual counts)	129	88	-41	Average for 7 areas, reductions in all but 2

Traffic engineering	Traffic speed	Mean	mph	Speed surveys, e.g. loop detectors in multiple location	19.2	14.5	-4.7	Average for 7 areas, reductions in all
Traffic engineering	Traffic speed	85%ile	mph	Speed surveys, e.g. loop detectors in multiple location	24.4	18.4	-6	Average for 7 areas, reductions in all
Traffic engineering	Traffic speed	Proportion of vehicles exceeding 20mph	Proportion	Speed surveys, e.g. loop detectors in multiple location	42%	12%	-30%	Average for 7 areas, reductions in all
User perceptions	Perception of danger to children	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	-	32% decreased	
User perceptions	Perception of driver behaviour	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	--	38%more considerate 8%less considerate	
User perceptions	Perception of noise/pollution	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	-	67% no change , but reported as being a slight reduction.	
User perceptions	Perception of safety for walking/cycling	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews			74% of residents thought it was safe or very safe	
User perceptions	Perception of safety from crime	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews			~67% no change ~23% safer after home zone	in Plymouth &Ealing over 50% thought drivers were more considerate.
User perceptions	Perception of traffic levels	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews			16% increased, 31% decreased	
User perceptions	Perception of traffic speeds	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews			47% speed fallen, 11% increased	

User perceptions	Perceptions of car parking	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews			34% parking worse 46% no change, 20% fewer parking problems.	Results varied between areas. Issue perceived as unresolved in some areas.
User perceptions	Resident support for the project	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews		64% of residents were in support of the project .		
User perceptions	Satisfaction with the streets	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	3.9	3.9	None	In this case the 7 point rating scale was described in terms of a mean.
User perceptions	Sufficient consultation	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	52% of residents thought there had been enough consultation		
User perceptions	Time spent in activities on the street	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	-	12% more time outside home, 3% less time outside home	
User perceptions	Perceptions of cycling in the area	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	-	30% more pleasant, 10% less pleasant	
User perceptions	Perceptions of driving in the area	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	-	31%more pleasant, 28% less pleasant	20% reported driving more slowly
Environment	benzene	ppb	Concentration	Sampling devices.	Aggregate data not available	-	NS	Problems with theft of equipment
Environment	NO_2	g/m^3	Mass per volume	Sampling devices.	Aggregate data not available	-	NS	Problems with theft of equipment

Environment	Noise $LA_{10, 18}$	dB	Noise exceeds this threshold 10% of time	Noise surveys,	55.8	54.9	-0.9	See Department of Transport and Welsh Office(1988) Calculation of road traffic noise. TSO
Environment	Noise $LA_{10, 6}$	dB	Noise exceeds this threshold 10% of time	Noise surveys,	43.5	45.7	2.2	Increase at night in after period, possibly due to weather conditions)
Environment	Noise $LA_{90, 10}$	dB	Noise exceeds this threshold 90% of time	Noise surveys,	42	46.1	4.1	Increase in after period, possibly due to weather conditions)
Environment	Noise $LA_{90, 6}$	dB	Noise exceeds this threshold 90% of time	Noise surveys,	35.3	39.5	4.2	Increase at night in after period, possibly due to weather conditions)
Behaviour	Activity on streets	Not specified	Not specified	Video survey	-	-	.	Changes considered by evaluators too small to be reliable indicator.
Costs	costs	Various	n/a	Various	-	-	-	Cost per property, 733- 5530 average 2205, approx £1000 per metre of road.

Measures of effectiveness in Woonerven.

Data obtain via Kraay 1986,1987.

Table of measures of effectiveness in Woonerven

Category	Measure of effectiveness	Unit	Equation	How measured	Before	After	Change	Comments
User perceptions	Perception of traffic speeds	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews		-	2/3 of residents thought cars were slower.	Elderly people and parents perceive speed to high still
Environment	Noise $LA_{10,\ 18}$	dB	Noise exceeds this threshold 10% of time	Noise surveys,		-		No adverse effects outside the treated areas were reported.
Safety	Accident migration	Casualties or accidents in surrounding roads	Number	Same measures as for corresponding roads in the project		-		No adverse effects outside the treated areas were reported.
Safety	Accident	Number (with maximum injury severity of)	Number/time	Accident data from national or local statistics		-	50% reduction	Reduction in accidents greater in the experimental then in the control area. Greatest for pedestrians and moped riders in some areas worst for moped riders in others. But not quite statistically significant at 5%
Traffic engineering	Traffic flow (unspecified)	Not specified, usually Vehicles per hour or per day	Not specified	Traffic volume surveys (tube/loop detectors, manual counts) May be combine with speed survey tools.		-	12%reduction	Removal of rat-running traffic
Traffic engineering	Traffic speed	Mean	mph	Speed surveys, e.g. loop detectors in multiple location		13-25kmh	Not specified	Speeds in woonerven lower than other streets

Safety	Accident rates	Accidents per unit of exposure	Number/unit of exposure	Number of casualties per unit time or per passenger, vehicle or vehicle mileage	-	50% reduction in residential streets, 15% reduction in arterial and access roads. Overall, 20% reduction
User perceptions	Support for measure	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	70% in favour, 14% against
User activity	Number of different types of activities	Survey specific	Not specified		-	Greater range of activity types in Woonerven compared to traditional streets
User perceptions	Perception of traffic levels	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews	-	Residents in woonerf indicated that rat-running traffic had almost disappeared.

Measures of effectiveness in 20 Mph Zones

Table of measures of effectiveness in 20 Mph Zones. From Greater London Authority (2009)

Category	Measure of effectiveness	Unit	Equation	How measured	Before	After	Change	Notes
Traffic engineering	Traffic speed	Mean	mph	Speed surveys, e.g. loop detectors in multiple location	25.2	15.9	-9.3	
Safety	Casualty rates	Casualties/ exposure measure	Number/time	Number of casualties per unit time or per passenger, vehicle or vehicle mileage	243.4	95	-61%	significant
Traffic engineering	Traffic flow (unspecified)	Not specified, usually Vehicles per hour or per day	Not specified	Traffic volume surveys (tube/loop detectors, manual counts) May be combine with speed survey tools.			-27%	Increase of 12% in surrounding zone
Safety	Accident migration	Casualties or accidents in surrounding roads	Number	Same measures as for corresponding roads in project area	992.9	953	-4%	NS
Costs	costs	Various	n/a	Various				£100,000 to £200,000 per project
User perceptions	General acceptability of the measures	Survey specific	Qualitative (e.g. Likert rating scale)	Questionnaire surveys and/or interviews				Generally accepted. Some projects caused problems with in appropriate design for local resident needs. This was dealt with by modifying the measures accordingly

Appendix C Expansion of TinyURLs

1) http://tinyurl.com/n7atj9
(http://www.trl.co.uk/research_development/sustainability/sustainable_transport/walking_cycling/assess_and_improve_walking_provision_using_pers.htm

2) http://tinyurl.com/lsfavo
http://www.trl.co.uk/software/software_products/environment/pers_pedestrian_environment_review_system.htm

3) http://tinyurl.com/qckeg9
http://www.tfl.gov.uk/assets/downloads/businessandpartners/what-is-PERS.pdf