

# A SYSTEMS APPROACH TO IMPROVING PEDESTRIAN SAFETY IN RURAL COMMUNITIES

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## ABSTRACT

Pedestrian behaviour is influenced by many factors which may result in pedestrians being involved in accidents and could increase the risk and vulnerability of pedestrians. There is no simple universal solution that will reduce pedestrian accidents or the severity thereof. Pedestrian safety is everybody's concern and we should all work together to find solutions to the problem. A systems approach to improving human behaviour suggests that we need to address the problem at different levels by simultaneously implementing engineering, enforcement, education and encouragement interventions.

This paper consists of a literature review of pedestrian behavioural studies carried out internationally and outlines a longitudinal study that consists of three phases, namely:

1. a before-study;
2. a phase where community pedestrian safety projects are implemented (including a community road safety forum and community road safety officers that will educate learners and either start a 'walking school bus' or scholar patrol, improvement of pedestrian facilities and increased enforcement); and
3. An after-study.

Each phase consists of four aspects namely: Engineering, Education, Law enforcement, and Encouragement. The *before study* includes a road safety assessment of the pedestrian facilities, pedestrian accident statistics for the last three years, and a human behaviour 'before' questionnaire. The questionnaire was used to test the knowledge and attitude of pedestrians. The *after-study* consists of a review of the pedestrian facilities and pedestrian statistics, and a post-project questionnaire conducted on the same respondents, in order to determine if there was a measurable change in behaviour of pedestrians and an increase in road safety knowledge.

This paper also reports on the implementation of the above proposed methodology as part of the Olifant's River-Water-Resources-Development-Project: Phase 2. The Olifant's River-Community-Road-Safety-Project consists of road safety education at seven schools over a 12 month period, pedestrian safety audits and pre- and post-implementation questionnaires. The paper concludes by summarizing strengths and weaknesses of the project and highlighting lessons learnt to be implemented in future projects.

## 1. INTRODUCTION

Many different factors influence pedestrian behaviour, cause pedestrian accidents and impact on the increased risk and vulnerability of pedestrians. There is no simple universal solution that will reduce pedestrian accidents or the severity of pedestrian injuries. Pedestrian safety is everybody's concern and we should all work together to find solutions to the problem. A systems approach to improving human behaviour suggests that we need to address the problem at different levels by simultaneously implementing engineering, enforcement, and road safety education interventions.

The paper consists of a literature review of pedestrian behavioural studies carried out internationally and outlines a longitudinal study that consists of three phases, namely a before-study; a phase where community pedestrian safety projects are implemented (including a community road safety forum and community road safety officers that will educate learners and either start a 'walking school bus' or scholar patrol, improvement of pedestrian facilities and increased enforcement); and lastly an after-study. Each phase consists of three aspects (engineering, education and enforcement).

The before study includes a road safety assessment of the pedestrian facilities, pedestrian accident statistics for the last three years, and a human behaviour 'before' questionnaire. The questionnaire was used to test the knowledge and attitude of pedestrians. The after-study consists of a review of the pedestrian facilities and pedestrian statistics, and a post-project questionnaire of the same respondents, in order to determine if there was a measurable change in behaviour of pedestrians and an increase in road safety knowledge.

The paper also reports on the implementation of the above proposed methodology as part of the Olifant's River Water Resources Development Project Phase 2. The Olifant's River Community Road Safety project includes safety education at seven schools, for the duration of 12 months, and pedestrian safety audits and pre and post implementation questionnaires. The paper concludes by summarizing strengths and weaknesses of the project, and highlighting lessons learnt for future projects.

## **2. PEDESTRIAN ACCIDENTS**

In South Africa pedestrians contribute to the cause of accidents in the following types of accidents: Jay walking (40%), Hit and run (10%), and Pedestrians under the influence (1%). Accident statistics in developed countries indicate that, pedestrian fatalities on roads where a vehicle is involved, contribute to between 12 and 20% of the total number of fatalities. In South Africa, this number is significantly higher with 34% of our road related fatalities being pedestrians. The percentage of pedestrian fatalities in the rest of Africa looks even worse and is recorded at being between 40-50% of the total number of road fatalities.

South Africa faces the same challenges as other developing countries namely poor land use development and higher order roads adjacent or running through rural communities. There is a need to formalise pedestrian crossings as well as addressing the lack of education of pedestrians.

## **3. A SYSTEMS APPROACH TO IMPROVING HUMAN BEHAVIOUR**

Ottino (2003) stated that "*Complex systems cannot be understood by studying parts in isolation. The very essence of the system lies in the interaction between the parts and the overall behaviour that emerges from the interactions. The system must be analysed as a whole*". For this very reason, a systems approach will imply the following when improving human behaviour of road users:

- Studying human behaviour changes,
- Improvement of human behaviour in terms of factors like jay walking, choice of where to cross the road etc.,
- Use of pedestrian facilities,
- Improvements of pedestrian accidents,
- Injuries and fatalities, and
- Knowledge and attitude towards road safety.

As stated earlier, there are several factors that influence pedestrians and have an impact on the increased risk and vulnerability of pedestrians without a simple universal solution. Safety of pedestrians on our roads is everybody's concern and requires that we all work together in finding solutions.

A systems approach to improving human behaviour therefore also means that we need to address the problems at different levels and that we need to work together - engineers, educators, law enforcement officials and other stake holders like community leaders, employers and health care and other emergency services.

This paper and methodology focuses on four aspects that impact on road safety system (4 E's of road safety). The four aspects are:

1. Engineering
2. Education
3. Enforcement, and
4. Encouragement.

The interventions could be performed on each aspect as listed below:

### **3.1 Engineering**

There are a number of engineering interventions that could be undertaken in order to improve road safety. Some of these interventions are:

- Providing safe walking facilities.
- Traffic calming such as priority for pedestrians, raised pedestrian crossings and implementing specific interventions to prevent road traffic injuries.
- Illuminating pedestrian crossings, bus bays and walkways.
- Visual enhancement of pedestrian crossings by means of high quality road markings and road signs and carefully selecting the position of the pedestrian crossing to ensure maximum sight distance.
- Providing pedestrian crossing measures at signalised junctions.
- Measures suitable for use in residential areas (reducing speed limits, traffic calming and ambient lighting)
- Measures suitable for use in shopping areas (pedestrian walkways and formal pedestrian crossings).
- Measures suitable for use outside schools
- Measures suitable for use in historic areas with high pedestrian and vehicle usage (pedestrian walkways and formal pedestrian crossings).
- Measures suitable for use on mixed priority routes by separating motorised vehicles with non-motorised vehicles.

### **3.2 Enforcement**

There are a number of law enforcement interventions that can be undertaken in order to improve road safety such as:

- Ensuring that road users and vehicles comply with the Road Traffic Act and Regulations
- Speed law enforcement
- Implementation of scholar patrol
- Enforcing the use of seatbelts
- Visible policing

### **3.3 Education**

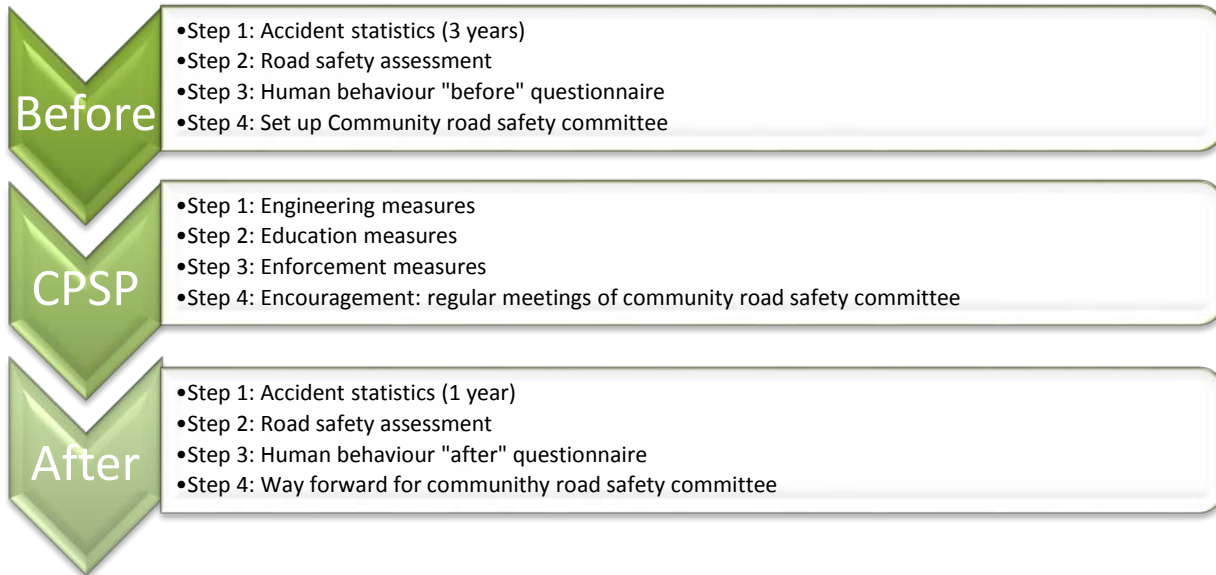
There are a number of education interventions that can be undertaken in order to improve road safety:

- Informing and educating road users could improve knowledge about the rules of the road.
- Education can help bring about a culture of concern and develop sympathetic attitudes towards effective interventions.
- Most programmes do not work in isolation and need to be linked or used in combination with other measures.
- There is a need for a balanced approach to the role of education, taking into account evidence from research on behavioural change.
- On-going re-examination of road safety education is an essential aspect of research including being cautious and avoiding focusing on only road safety education.

The Miami Dade Pedestrian Education Demonstration Project (Zeegar, 2008) is an example of such a systems approach. In this study only pedestrian injuries were analysed in four areas over a number of years. Pedestrian safety interventions (or counter measures) contained engineering, enforcement and education interventions. A before-study consisted of obtaining and analysing 3 year accident statistics. After the pedestrian safety interventions were introduced (a number of them are listed in the study under engineering, enforcement and education), the accident statistics were again recorded over a period of three years. The after-study revealed that the greatest crash reductions were found among children and adult pedestrians.

#### 4. METHODOLOGY FOR THE LONGITUDINAL STUDY

The project consists of three phases, namely a before study, a phase where community pedestrian safety projects are implemented and lastly an after study. Each individual phase consists of four steps. The three phases with four steps each, (illustrated in Figure 1 below) align with the systems approach.



**Figure 1: Summary of the Methodology of Systems Approach Study.**

Table 1 below contains a summary of the three phases and what is included in the steps.

**Table 1: Summary of Phases of Systems Approach Methodology**

<b>Before project implementation</b>	<b>Pedestrian safety interventions</b>	<b>After project implementation</b>
<b>Accident statistics</b>	<b>Enforcement interventions</b>	<b>Accident statistics</b>
Collect 3 year accident data and details of pedestrian accidents.  Analyze data and accidents to observe trends.	Implement scholar patrols at schools, visible policing, speed reduction enforcement  Involved in community pedestrian safety meeting with community.	Collect next year accident data and details of pedestrian accidents.  Analyze data and accidents to observe trends.
<b>Pedestrian safety assessment</b>	<b>Engineering Interventions</b>	<b>Pedestrian safety assessment</b>
Road conditions. Pedestrian facilities. Pedestrian desire lines. Observations (number of pedestrians and vehicles, pedestrian conflicts).	Pedestrian bridge. Street lighting. Pedestrian walkways.	Road conditions. Pedestrian facilities. Pedestrian desire lines. Observations (number of pedestrians and vehicles, pedestrian conflicts).
<b>Human behavior questionnaire</b>	<b>Education and Encouragement Interventions (CPSP)</b>	<b>Human behavior questionnaire</b>
Develop 'before' questionnaire. Train CPOs to conduct surveys. Analyze questionnaires.	Establish steering committee with community stake holders. Train community members. 'Walking school bus'. Classes in 7 schools. Award ceremony at each school.	Develop 'after' questionnaire. Train CPOs to conduct surveys. Analyze questionnaires.

#### **4.1 Community Pedestrian Safety Project (CPSP)**

The Community Pedestrian Safety Project (CPSP) (Groenewald, 2012) involves the local community in such a way as to liaise and train local members of the community to actively participate in road safety, especially pedestrian safety education in schools. The CPSP aims at not only improving road safety knowledge amongst children but for the children to also actively implement road safety in order to change behaviour. Changing the behaviour is being achieved through reinforcement with songs, art and role playing (drama). Community Pedestrian Officers (CPOs) are selected from the community and trained in order to implement the CPSP in the Olifant's River community area. The implementation of the CPSP consists of teaching learners from the schools in the community about road safety and more importantly, pedestrian safety. The aim of the programme is to involve and educate learners on road safety in a fun manner, to empower the selected local community officials on road safety, to create a number of employment opportunities and for official to gain experience. The establishing of a Steering Committee also involves a number of role players where they work together to solve road safety challenges and specifically pedestrian safety in the community.

### **5. IMPLEMENTATION OF THE OLIFANTS RIVER COMMUNITY ROAD SAFETY PROJECT**

The Olifant's River Water Resources Development Project Phase 2 (ORWRDP-2) is implemented in the following Local and District Municipalities:

- The Greater Marble Hall Local Municipality
- The Greater Sekhukhune District Municipality
- Mookgopong Local Municipality
- Waterberg District Municipality
- Lepelle-Nkumpi Local Municipality, and
- The Capricorn District Municipality.

Pedestrian safety concerns at various places in this area have been identified through various forums, accident statistics and hot spot analyses. The implementation of the Olifant's River Community Road Safety project (OCRSP) include amongst others, safety education at schools for a duration of 12 months and a pedestrian safety audit and conducting pedestrian safety questionnaires before and after the road safety education. The purpose is to study the effects of a systems approach to pedestrian safety in rural communities on the human behaviour of pedestrians.

#### **5.1 Education and Encouragement Interventions**

The status quo of education and encouragement interventions are as follows:

- Steering committee with community stakeholders were established and regular meetings held.
- Two CPO's were trained for each school.
- The CPO's are teaching Road Safety Education in the schools
- Walking-school-bus or scholar patrol are being implemented
- An award ceremony at each school planned for June 2014

## **5.2 Pedestrian Safety Assessment**




A pedestrian safety audit essentially investigates the pedestrian facilities or the lack thereof, in other words the engineering aspects of pedestrian safety. The audit process is mindful of the interaction of the roadway with the pedestrian and with the other road users but still focuses, and attempts to influence, the roadway environment itself with regards to the provision of adequate pedestrian facilities.

Pedestrian safety assessments were conducted at all seven schools in the Olifant's River region. The seven schools chosen are all located within the ORWRDP-2 area. These schools are in the Steelpoort area and along the R551 and R555. All the schools are located right next to a busy provincial road with half of the learners having to cross the road daily in order to get to school. Only one school had an active scholar patrol. Some schools had one raised pedestrian crossing or a painted zebra crossing.

Suggested improvements were forwarded to the municipality and the contractor. Amongst other suggestions, more road signs were requested, repainting of Zebra crossings and moving a raised pedestrian crossing to a location identified by the investigating team where the learners cross the road frequently.



**Table 2: Photos of the Olifant’s River Community Road Safety Project Pedestrian Safety Assessment**

Description	Photo
<p><b>Photo 1:</b> Painted zebra crossing on R555 at Maramele Primary School. The Zebra crossing was not painted to the Road Traffic Signs Manual standard and not visible due to poor maintenance and no regulatory and warning signs.</p>	
<p><b>Photo 2:</b> Many learners walk along R551 in close proximity of vehicles travelling at relatively high speeds.</p>	
<p><b>Photo 3:</b> The raised pedestrian crossing has not been constructed to any specifications but is effective in lowering the speed of approaching vehicles. The lack of maintenance on the road markings makes this obstacle a road hazard as the crossing is not visible at all. The learners were observed crossing the road at the pedestrian crossing.</p>	

**Photo 4:** Learners from Mash Primary cross the R551. They were observed to run to the road, patiently waiting for a safe time to cross and running across the road. When a pedestrian is running across a road, the chances of them falling are higher especially carrying a heavy backpack.



The learners were observed to understand the importance of looking carefully before crossing the road even though they run up to and across the road once it appeared safe to cross. There seems to be a healthy culture of walking with a friend or a sibling to home.

### **5.3 Analysis of Pedestrian Safety Questionnaires**

Pedestrian questionnaires, also called roadside intercept surveys, were completed in July 2013 as part of the pedestrian safety assessment. The questionnaires related to demographics of the respondents, the nature of the trips, the number of trips per week and suggestions on improving pedestrian safety in the area. The questionnaires also contained questions regarding knowledge of road signs and rules of the road, as well as a level of understanding of what is safe pedestrian behavior. One positive outcome of conducting the questionnaires was the sensitization of the community regarding the implementation of the road safety project.

The 138 questionnaires analyzed revealed that only 15% of the community had a valid driver's license and only 15% owned vehicles. The community identified themselves as a deep rural community. It was evident from the survey that only 73% of the community was currently employed and that 90% walked to their destinations on a daily basis. These pedestrians stated that their primary source of transport was either walking or public transport. Only 30% made use of minibus-taxis weekly or monthly. Buses were also seldom used (27% used a bus monthly).

Only 51% of the participants indicated that they used the pedestrian facilities (raised pedestrian or zebra crossings) while 47% stated that they felt unsafe walking next to the road. The latter appears to be a combination of road safety as well as personal safety concerns. 91% thought that road safety education would be useful. The importance of pedestrian facilities was also tested. The responders rated the shortage of different facilities between 75% and 92% (from pedestrian phases at traffic signals to raised pedestrian crossings). When asked what pedestrian facilities they suggest should be implemented, 75% requested more road signs, 62% more speed humps and 36% asked for more zebra crossings.

The questionnaire also revealed that the knowledge on road signs and rules of the road were high - 89% got the road signs correct while 86% were on the mark on rules of the road. The majority of the respondents (83%) also understood the importance of pedestrian safety. Interesting observation was that 26% however did not think that sidewalks would improve road safety and 23% thought that taxi and bus lay byes were not safe either. It is suggested that the post-project questionnaires further explore some of the findings from the baseline study (pedestrian questionnaires).

It is also suggested that the questionnaires be repeated in an urban low income community in order to determine whether there is a difference in the knowledge of the road signs and rules of the road, as well as in understanding the effects on pedestrian safety.

#### **5.4 Strengths and weaknesses of proposed methodology**

Sustainability and affordability of the methodology are continuously reviewed. The aim of the creation of a Steering Committee is to create a community road safety forum that should meet on a regular basis. The aim of starting a walking-school bus or scholar patrol is to ensure that the community or school continue with this initiative after completion of the project.

The road safety education project is aimed at school children and it is expected to have a less reliable outcome in assessing children of a young age at their increased knowledge and attitude towards road safety. There are no road safety initiatives planned for the other high risk groups yet such as adults who abuse alcohol especially on weekends, or the elderly (another vulnerable road user).

Rural communities are very open to new ideas and it is expected to find little knowledge on road safety initially but a marked improvement after the intervention. Measuring only the reduction in pedestrian accidents and the reduction in the severity of injuries will not give a full reflection of the impact of the road safety education intervention applied. The road safety education material is value-driven and it is expected to have greater influence on the children's attitude towards other safety risks once they grasp the concept of the value of "*I am important and therefore I make safe choices*".

The project is linked to the construction of a water pipeline and not particularly linked to municipal or provincial road infrastructure spending. For this reason only limited pedestrian infrastructure improvements can be expected. Limited pedestrian infrastructure improvement is expected and therefore infrastructure improvements that are proposed are realistic and cost effective.

## **6. CONCLUSIONS**

Pedestrians are vulnerable road users. Children are especially vulnerable road users. International studies have shown that a systems approach, which gives attention to engineering, education, law enforcement measures and addressing human behaviour of pedestrians, to be the most beneficial as it addresses the problem at different levels.

The longitudinal study proposed consists of three phases, namely a before-study; a phase where community pedestrian safety projects are implemented (including a community road safety forum and community road safety officers that will educate learners and either start a 'walking school bus' or scholar patrol, improvement of pedestrian facilities and increased enforcement); and lastly an after-study. The paper also reported on the implementation of

Olifant's River Community Road Safety project includes safety education at seven schools, for the duration of 12 months, and pedestrian safety assessments and pre implementation questionnaires.

The sustainability of the CPSP is always questionable regardless of the formation of a community road safety forum. The community (and schools) will need to continue with the Walking school bus or scholar patrol after the completion of the project. The other high risks groups, alcohol abuse of adult pedestrians and vulnerable elderly pedestrians, are not yet addressed. Measuring only the reduction in pedestrian accidents and the reduction in the severity of injuries will not give a full reflection of the impact of the road safety education intervention given. Limited pedestrian infrastructure improvement is expected and therefore infrastructure improvements that are proposed are realistic and cost effective.

## 7. REFERENCES

Groenewald M et al, 2012. Solving road (and pedestrian) safety problems through sustainable job creation in our communities. Southern African Transport Conference 2012.

GRSP SA Board meeting 5 June 2012.

Martin A, 2006. Factors influencing pedestrian safety: a literature review. TRL. PPR241

Ottino, JM, 2003. Complex Systems. AIChE Journal. Volume 49, Issue 2. Pages 292-299.

Thomson, J. Tolmie, A, Foot, H.C, McLaren, B, 1996. Department for Transport (Funder) Child development and the aims of road safety education.

Thomson, J. and, Department for Transport, 1997. A community approach to road safety education using practical training methods: the Drumchapel project.

Zeegar, C. Henderson, Z, Blomberg, R. Marchetti, Masten, LS, Fan, Y, Sandt, L, Brown, A., Stutts, J, and Thomas, L, 2008. Evaluation of Miami Dade pedestrian education demonstration project. National Highway Traffic Safety Administration.