This study suggests a new technique approach to assess the road safety achievements in a country by developing the Road Safety Development Index (RSDI). This index will put large amounts of information from different sources into measurable indicators, which will be then an easier format to rank the road safety progress in different countries/regions across the globe. The proposal concerns particularly developing countries where the issues are challenging. The methodology will be used to calculate RSDI is similar to that used by United Nations for their Human Development Index (HDI).

**RESEARCH BACKGROUND**

Traffic accidents are a worldwide economy and public health problem. To address national development in the area of traffic safety, it is desirable to view road safety level in an international context. However, the complexity of road safety situation increases the complexity of research and the necessity to examine new theories and models in order to compare different countries and regions' achievements in the field of road safety, especially with the high-involved number of accidents factors and indicators. The research on aggregated road accidents data was already progress internationally by Smeed's law (Smeed, 1949), Harman factor model (Harman, 1970), Rumar descriptive model (Rumar, 1987), Koornstra's function (Koornstra, 1992), Navin Model (Navin, 1996) and Trinca model (Trinca, 1998). These models used normally to compare countries' road safety performance by means of risk indicators such as fatalities per vehicles, fatalities per population, fatalities per vehicle kilometres or the number of passenger miles. Special cases of comparisons in previous models are presented when few indicators are considered together and when they interact with each other. However, road safety development in a country is not only measured by the parameters just given, it is more effective where there are a large number of factors involved and when they can be described and converted into direct and quick measurement. Quick understanding of the problem will help governments to take decisions and set targets according to the results from other country development, and to monitor different applied measures in road safety in own country.

Human Development Reports, since the first in 1990 have measured a country's achievements by using Human Development Index (HDI), according to: Life Expectancy Index, Standard Living Index, and Education Index. Since then three supplementary indices have been developed: the human poverty index (HPI), gender-related development index (GDI) and gender empowerment measure (GEM). However, the concept of human development does not end there and is much broader than the HDI and these supplementary indices (UNDP, 2003).

The above discussions led us to propose the Road Safety Development Index (RSDI), which might become a significant factor in determining road safety level in a country besides being developed to be as a supplementary index to the Human Development Index (HDI). There is
potential need to tell why what is achieved in one country in road safety is far from the reach of another, especially in developing countries.

**RESEARCH PURPOSES**

The main purposes are the following:

- To provide new approach in ranking countries on the wider indicators of road safety by using RSDI, rather than on accidents rates.
- To explain the interrelations between the road safety variables and varieties or its risks at international perspective.
- To design standard road accident data system, collection, treatment and comparisons.
- To examine and compare national statistics in traffic safety from different angles in several developing countries with those of the developed countries.
- To show how two countries with the same level of accident rates can end up with such different road safety development outcomes (RSDI levels).

**METHODOLOGY**

One particular concern in designing road safety development index (RSDI) is to come up with a comprehensive measure - or even a comprehensive set of indicators- which includes as possible all the main interesting parameters in road safety of human-vehicle-road-environmental-regulation, instead of considering isolated factors such as accident rates per population, vehicles or kilometre driven. In addition, this index should be as relevant as possible for different world’s countries, especially developing countries. The assessment of RSDI in a country must be based on information that affects that development. The choice of accident and exposure variables is necessary to what is available in international data and what is considered necessary for meaningful comparisons. Commonly, frequencies of annual numbers of vehicles, accidents, injured and killed people are relevant quantification and relatively easy to define and to measure in different countries, but differences in definitions, non-collection data, no reliability of data, underreporting, underestimates the real data, etc are problems for effective measurements of road safety. RSDI will allow data to be converted into common standards; countries will be divided into homogenous country conditions, levels of mobility and risks: e.g. road user risks and vehicle risks.

The study focuses on nine dimensions that are important in road safety situation and there are about 14 indicators identified in this index, which are important to explain and predict accidents situation in countries and regions with different levels of motorization (vehicles per population). Each dimension includes one or more indicators. The selected indicators relate to important variables for each dimension for all countries as possible and availability of data. The dimensions chosen are specified downwards, which are: Traffic Risk (X$_1$), Personal Risk (X$_2$), Health Index (X$_3$), Education Index (X$_4$), Vehicle Safety Index (X$_5$), Roads Situation Index (X$_6$), Road User Behaviour Index (X$_7$), Standard of Living (X$_8$) and Urbanization (X$_9$):

- Traffic Risk (X$_1$): road fatalities per vehicles (I$_1$).
- Personal Risk (X$_2$): road fatalities per population (I$_2$).
- Health Index (X$_3$): combines two indicators, severity index (fatalities per casualties) (I$_3$) and life expectancy index percentage (I$_4$) (already calculated by HDI).
- Education Index (X$_4$): adult literacy (I$_5$) (already calculated by HDI).
- Vehicle Safety Index (X$_5$): vehicles trend (new registration) (I$_6$) and two wheels percentage (I$_7$).
- Roads situation index (X$_6$): paved roads (I$_8$) and total road expenditure per vehicles (I$_9$).
Road user behaviour index \((X_7)\): Traffic fatalities in alcohol-related crashes \(%\) \((I_{10})\), Traffic fatalities in speed-related crashes \(%\) \((I_{11})\), and seat belts usage percentage \((I_{12})\).

Standard of living \((X_8)\): GDP per capita \((I_{13})\) (which will be used in similar way to that used by HDI).

Urbanization \((X_9)\): urban people percentage of total population \((I_{14})\).

In calculating RSDI, each indicator will be tested for statistical significant if it should be added or not and then to see how they correlated with each other. In principle, the proposal will be giving each indicator equal weight and the dimensions given equal weight (one-ninth) in the final RSDI, which will be calculated as the simple average of dimensions just as in the HDI. For instance, in country \(j\) with respect to each dimension \(X_i\), index will be as:

\[
I_{ij} = \frac{\max(X_{ik}) - X_{ij}}{\max(X_{ik}) - \min(X_{ik})}
\]

The road safety development index (RSDI) will be defined as an average of nine dimensions for country \(j\) as:

\[
RSDI_j = \frac{1}{9} \sum_{i=1}^{9} I_{ij}
\]

The results will be tested for reliability and it might be that the assumptions been modified to new formula by giving different weights to indicators. The weightings given to each indicator will be calculated by a statistical process such as Principal Components Analysis and then be simplified. In the case of big absence of statistical data, weightings can be determined based on expert’s judgment and experience.

All countries will be classified into three groups by achievements in RSDI ranged from 0 till 1: high road safety development (with an RSDI of 0.75 or above), medium (0.5 till 0.75) and low (less than 0.5). The methodology will be used to calculate RSDI is similar to that used by United Nations for their Human Development Index (HDI). The results can then be presented by each region (e.g. Africa, South East Asia, OECD countries, etc), which will be similar to that used by United Nations for their Human Development Index (HDI).

The RSDI will be comparable over time series and the years were chosen in this study are: 1980-1985-1990-1995-2000. Each RSDI value can show how far a country has to be developed to provide safer roads. It shows the progress it has made toward the maximum possible level of road safety development. All countries are developed to some degree in road safety so no country will get 0 score, also the criteria will be chosen to make 1 score as a target that there is potential progress ahead for all countries in road safety development, for instance vision Zero.

**THE MAIN SOURCES OF DATA**

Data is based on international statistics, which came from a variety of organizations and statistical databases such as:

- Annual Human Development Index Reports, United Nation Development Reports (UNDP).
- Annual Reports from International Road Federation (IRF).
- Statistics from International Road Traffic and Accident Database (IRTAD).
- Statistics from World Bank.
- Time Series Data from RetsNet project (Regional Traffic Safety Network), Sweden.
- Different research and data reports.
DIFFICULTIES OF DATA

The main difficulties facing this study are addressed as follows:

- Not all countries have sufficient data available, especially in developing countries.
- Definitions vary from one country to another regarding some items as vehicles, accidents, injuries, and fatalities.
- Time series data are often short in developing countries for present purposes.
- For some countries, where data are missing or unreliable for one or more dimension, so the RSDI will be hard to calculate or estimate.

PRELIMINARY RESULTS

By examining RSDI, different dimensions were tested for some selected countries for which data were available and of acceptable quality and in different regions with different level of motorization and development. There was clear interaction of traffic risk measures deaths per vehicle, personal risk as deaths per person, and motorization as vehicles per person. At early stages of motorization personal risk has a small value while the traffic risk will be large. At second higher stage of motorization, traffic and personal risks increased. The other extreme is a completely motorized country in which traffic and personal risks decrease. The change between the three levels is partly due to better engineering of vehicles and roads and greater understanding of the system by the road users. One acceptable result for fatalities is obtained by using the predicted motor vehicle kilometrage multiplied by the predicted fatality rate per kilometers. But this measure is still not available in developing countries. To allow comparability levels across countries, the Road Safety Development Index (RSDI) was tested for a number of key indicators. In continuing effort to improve RSDI, data from different countries was introduced to determine whether the country has sufficient data to be included in the RSDI or not. Results shown that high-motorized countries (HMCs) have high RSDI such as Sweden (est. 0.92), developing countries have low RSDI as Malawi (est. 0.26), and rapidly motorized countries such as emerging economies in south Asian countries or reform economies in Eastern Europe show medium levels of RSDI, even number of deaths in those countries are generally increasing in which vehicle use has risen both quickly and relatively recently (e.g. Estonia (RSDI: est. 0.72)). These preliminary results show that RSDI correlates well with the national Human Development Index (HDI)!
REFERENCES


Asmussen, E, Kranenburg. (1982) “Analysis of the traffic safety phenomenon” SWOV.

Broughton, J (1986) “A study of causation factors in car accidents” Statens väg- och transportforskningsinstitut, VTI konferens, Sweden


IRTAD 2000, International Road Traffic and Accident Database, Federal Highway Research Institute (BAST), Germany.


