E TRANSPORT INDICATORS

The study identified from a list of 28 possible indicators only 8 that can be used in the Namibian environment to gauge and monitor the state of the environment in regard to the transport sector. These indicators measure trends in three fields of application namely policy (how committed is Government to sustainable practices), infrastructure management (how committed are the parastatals in implementing national policy both for infrastructure development and maintenance), and operations (how does the public respond to environmental sustainability when utilising the transport sector).

It must be stressed that there are a large number of indicators available that were developed in countries with higher population and vehicle densities or for areas that are subject to serious emission and congestion problems. These are not relevant for the Namibian situation and have been discarded.

The indicators listed in this report have been refined as far as possible and based on the following principles,

- The information must be readily available in simple format;
- The information must be relevant, efficient and reliable; and
- The information must provide a direct linkage between the sector and the environment.
-
- operations (how does the public respond to environmental sustainability when utilising the transport sector).

The reader is referred to the main study text for more information as the reasons for discarding the 20 other indicators.

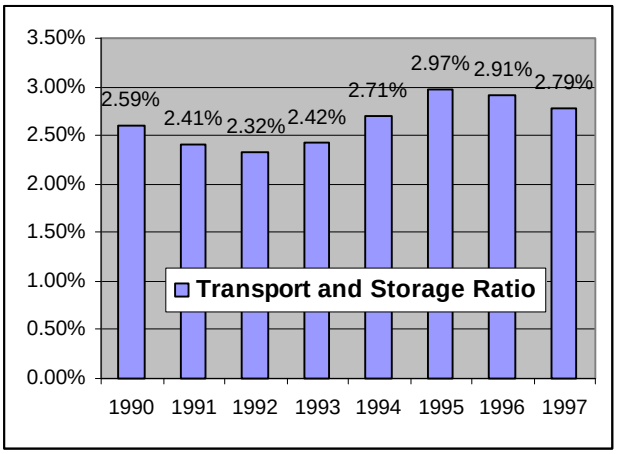
INDICATOR E1: TRANSPORT SECTOR CONTRIBUTION

<table>
<tr><td>INDICATOR NAME</td><td colspan="2">TRANSPORT SECTOR CONTRIBUTION (%)</td></tr>
<tr><td>DEFINITION</td><td colspan="2">Net contribution of the Transport Sector to the Economy</td></tr>
<tr><td>MEASUREMENT</td><td colspan="2">The % portion of the Gross Domestic Product represented by the Transport and Storage Industry</td></tr>
<tr><td colspan="3">SIGNIFICANCE OF THE INDICATOR</td></tr>
<tr><td colspan="3">PURPOSE: This indicator measures the overall importance of the Transport Sector to the Namibian economy.</td></tr>
<tr><td colspan="2">RELEVANCE: This indicator presents a helicopter view of the importance of the Transport Sector as a whole to the economy. In this regard it can measure changes in the sector relative to the economy.</td><td>LINKAGES TO OTHER INDICATORS:</td></tr>
<tr><td colspan="2">UNDERLYING VARIABLES AND DEFINITIONS: This indicator is a combination of the Transport and Storage Activity and the Gross Domestic Product as defined in the 1993 System of National Accounting.</td><td rowspan="2">MEASUREMENT OF THE INDICATOR:
There is presently no policy that provides a national target for this ratio.</td></tr>
<tr><td colspan="2">LIMITATIONS OF THE INDICATOR:
1) The indicator would be more meaningful if separate data sets for the four different sub-sectors under review were available.
2) The indicator would also be more meaningful if all the cost currently expended by Government in this Sector, is reflected under the Transport and Storage Activity.</td></tr>
<tr><td colspan="2"></td><td>RED FLAG:</td></tr>
</table>

E1.1 Past Performance

The Central Statistics Office has from 1990 divided the Transport and Communication Activity into Transport and Storage and Post and Telecommunications. In 1990 the Transport and Storage Activity measured 2,59% of the Gross Domestic Product. This level of importance has been increasing slowly and in 1997 stood at 2,79%.

Over the same period the combined growth in the primary and secondary industries as a % of Gross Domestic Product remained at 43%. This shows that growth in the Transport Sector is reliant on growth in industry activities.



E1.2 Interpretation

The past eight years shows that the transport sector is not an independent growth vehicle and is reliant on other industries to make it grow. Its position as a tertiary activity is therefore justified.

It must however be noted that the development of primary and secondary industry is dependent on a reliable and well-maintained transport sector. Poor road quality for example will lead to higher vehicle operating costs and eventually higher commodity and consumer goods prices.

E1.3 Data Requirements

All the data is available in the National accounts published annually by the Central Bureau of Statistics in the National Planning Commission. The specific location is Table B3: Gross Domestic Product by Activity.

E1.4 Calculation and Future Updating of Indicator

The ratio is calculated as follows:

Value of Transport and Storage Activity, at current prices and in N$ million

DIVIDED BY

Gross Domestic Product, at current prices and in N$ million

AND THE RESULT TIMES 100

INDICATOR E2: PORTION OF NATIONAL NETWORK DEVELOPED AT LEAST AT GRAVEL ROAD STANDARD

INDICATOR NAME	Portion Of National Network Developed At Least At Gravel Road Standard (%)
DEFINITION	Total lengths of paved and gravel roads as a % of the national road network
MEASUREMENT	The % ratio of the sum of paved and gravel roads as to the total length of the national road network

SIGNIFICANCE OF THE INDICATOR

PURPOSE: This indicator measures the quality of roads that makes up the national road network. It can also be used as a proxy to measure access to well developed roads.

RELEVANCE: This indicator provides a measure of the standard at which the national network is developed. The better the average development standard of the network, the more "useable" the network is.

LINKAGES TO OTHER INDICATORS: This indicator should be read with **Paved Road Quality.** This indicator provides an overview of the development standards while the Paved Road Quality indicator provides an overview of the riding quality of the paved roads, i.e. those roads that carry at least 75% of all traffic.

UNDERLYING VARIABLES AND DEFINITIONS: This indicator is a combination of the following variables;

1) the length of the national road network, and
2) the length of the paved and gravel roads that are part of the network.

The national road network consists of all proclaimed roads in Namibia excluding proclaimed farm roads.

The Minister responsible for Transport has the authority to proclaim roads as part of the national network.

MEASUREMENT OF THE INDICATOR: There is no specific value described in policy or vision statements. Namibia should however aim for 100% in the long term. In the short term the indicator value should not decrease over time. The closer the indicator comes to 100%, the closer will Namibia be to the goal of having the whole national network developed to roads that have very high accessibility.

LIMITATIONS OF THE INDICATOR

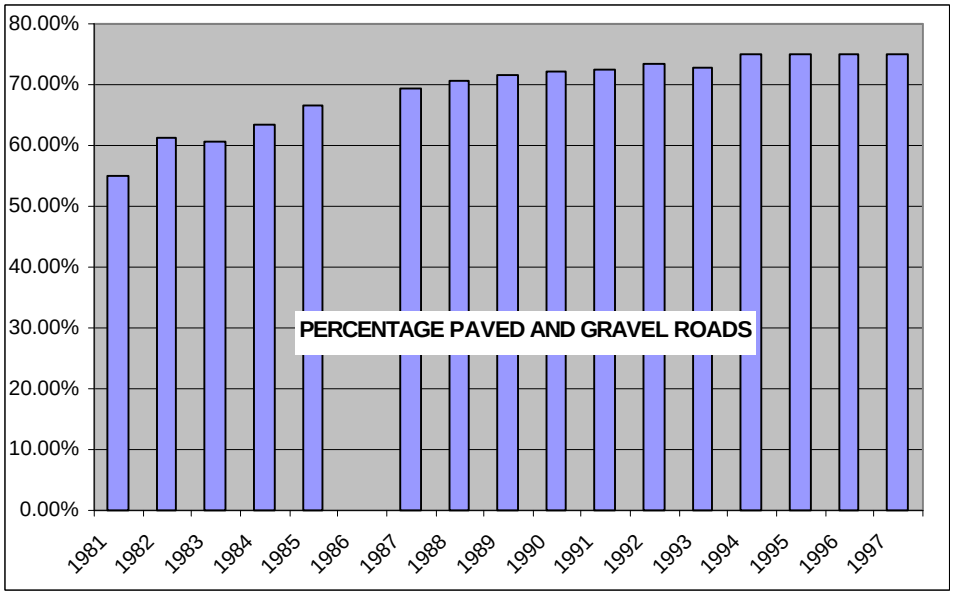
Current information does not allow for easy disaggregation between regions to highlight possible deficiencies among regions.

RED FLAG: ANY DECREASE IN THE TREND. This will show that the network quality is decreasing.

E2.1 Past Performance

The national road network has over the past sixteen years been developed extensively. In 1981 22 882km or 54,9% of the network consisted of gravel or paved roads. In 1997 31 926km or 75,1% of the network consisted of gravel or paved roads.

As funding became more constrained in the last number of years, this increase in network quality has slowed down. It is the intention to ensure that at least roads that must be upgraded for economical reasons will receive that funding once the road user charging system is put in place later this year.



E2.2 Interpretation

The past performance shows that the road network quality is improving all the time. This has resulted in the introduction of improved transport services and improved accessibility to the areas so affected. Currently there are several planned proposals for further improvements, but constraints on funding have slowed the implementation of these improvements. This directly impacts on the quality of accessibility.

E2.3 Data Requirements

The variables that make up this ratio are the following:

X = The sum of the total paved and gravel road lengths that are part of the national road network.

Y = The total road length proclaimed as part of the national road network

These variables are found in unpublished data kept with the Directorate Infrastructure Planning and Transportation in the Department of Transport of the MWTC. The information is updated annually and can be obtained free of charge from the Deputy-Director: Planning.

Once the Roads Authority is established, the data would also be available from there.

E2.4 Calculation and Future Updating of the Indicator

The indicator is calculated as follows:

The sum of the total paved and gravel road lengths (X) , in current figures

DIVIDED BY

The total road length (Y), in current figures

AND THE RESULT TIMES 100

INDICATOR E3: PAVED ROAD QUALITY

INDICATOR NAME	Paved Road Quality
DEFINITION	The % of the total paved road network that has a riding quality of Fair or Good.
MEASUREMENT	The summed lengths of paved road with a fair and good standard as a percentage of the total paved network length.

SIGNIFICANCE OF THE INDICATOR

PURPOSE: This indicator will immediately show the road quality of that portion of the national road network that is carrying more than 75% of the traffic**.**

RELEVANCE: This indicator is most useful as a guideline to the cost of using roads. The better the riding quality, the lower the vehicle maintenance cost and the cheaper the overall vehicle operating cost. This impacts on the whole economy, as Namibia is dependent on road transport for most imports and exports. Poor roads will therefore directly affect commodity and goods prices.	**LINKAGES TO OTHER INDICATORS:** This indicator should be linked with the indicator **Portion of National Road Network Developed at least at gravel road standard.**
UNDERLYING VARIABLES AND DEFINITIONS: This variable is dependent on the road quality measurements that the DOT undertakes regularly. For years where no measurements are made, the indicator cannot be calculated. It is also dependent on the length of paved road in each quality category as well as the total length of the paved network.	**MEASUREMENT OF THE INDICATOR:** There is no specific value described in policy or vision statements. Namibia should however aim for as high a percentage as possible in the long term. In the short term the indicator value should not decrease over time.
LIMITATIONS OF THE INDICATOR: The indicator would be more useful if the road quality could be coupled to the traffic volumes carried by the specific road link. This disaggregation will split the paved road network according to traffic volume and will highlight whether riding quality problems exist on the most travelled road links.	**RED FLAG: Continuous decreases over time will point to deteriorating road quality and a potential for increased prices**

E3.1 Past Performance

The paved road network are, although old, still in a very good condition overall. As the paved network aged, the % good roads have been deteriorating steadily. The maintenance efforts have over time covered most of the maintenance requirements in the "Poor" and "Warning" categories. The deterioration has therefore been slow.

YEAR	PAVED ROAD CONDITION (%)	
	POOR AND WARNIN	FAIR AND GOOD
1985	3	97
1988	2	98
1991	4	96
1994	8	92
1997	11	90

E3.2 Interpretation

The table shows a steady decline in road quality since 1988. Taking into account the new paved roads that have been completed since 1990, the decline is even more rapid.

E3.3 Data Requirements

This indicator is fully dependent on the frequency of road inspection that the Department of Transport undertakes. The table above shows that these statistics are only available for years during which such inspections were made.

The raw data is captured and converted into the table format above by the Division: Laboratory Services and Materials of the Department of Transport. The information is available free of charge from the said Deputy-Director.

E3.4 Calculation and Future Updating of Indicator

The indicator can therefore be determined without any calculation.

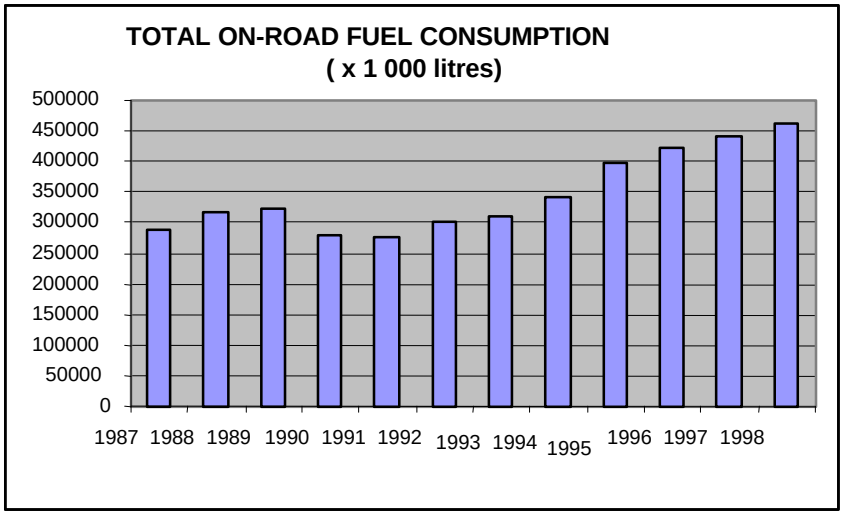
INDICATOR E4: ANNUAL FUEL CONSUMPTION

<table>
<tr><td>INDICATOR NAME</td><td colspan="2">Annual Fuel Consumption</td></tr>
<tr><td>DEFINITION</td><td colspan="2">The annual total amount of fuel consumed by road users</td></tr>
<tr><td>MEASUREMENT</td><td colspan="2">A summation of the annual total petrol and diesel consumption of road users.</td></tr>
<tr><td colspan="3">SIGNIFICANCE OF THE INDICATOR</td></tr>
<tr><td colspan="3">PURPOSE: This indicator measures the volume of fuel consumed by road users annually. As most economic activity in Namibia depends on road transport, this can also be used as a coarse proxy for economic activity.</td></tr>
<tr><td colspan="2">RELEVANCE: This indicator has two areas of specific relevance namely,
1) To act as an indication of the actual utilisation of roads in Namibia. The more fuel used in a period, the more kilometres travelled during that period.
2) To provide a quantity measure of the emission problems that exist in Namibia due to road use. In this regard it presents a highly aggregated picture only.
A third but smaller area of relevance is the growth in economic activity. Namibia's economy is dependent on road transport and changes in economic activity will also be seen as changes in fuel consumption patterns.</td><td>LINKAGES TO OTHER INDICATORS: This indicator can be linked to Access to vehicles. They both attempt to measure the impact of road utilisation.</td></tr>
<tr><td colspan="2">UNDERLYING VARIABLES AND DEFINITIONS: This variable consists of two variables namely, the total volumes of petrol and diesel sold to road users annually.

As regards diesel, only about 44% of the national sales is consumed on-road, the rest is consumed by the mining, fisheries and agricultural sectors as well as Transnamib in the rail sector.</td><td>MEASUREMENT OF THE INDICATOR: The indicator is used to represent road use and its environmental effects in a highly aggregated way. The study showed that Namibia does not experience pollution problems from road use yet and the development of more focused indicators are not relevant yet.</td></tr>
<tr><td colspan="2">LIMITATIONS OF THE INDICATOR: This indicator could be applied on a local authority level should disaggregated data be available.</td><td>RED FLAG: None, but the road sector should be reviewed every five years to determine if more focused indicators should not replace this indicator.</td></tr>
</table>

E4.1 Past Performance

This indicator shows a significant increase in fuel consumption since Independence. The years before Independence are inflated because of the South African war effort in Angola. The growth rate for the years 1987 to 1988 shows the same trend. From 1991 to 1998 this trend is represented as an annual compound growth rate of 8,86%.



E4.2 Interpretation

This is faster than the annual growth rate in Gross Domestic Product but in line with growth rates experienced by similar developing countries around the world.

E4.3 Data Requirements

The variables for the determination of this indicator are presently collected from two Ministries. The Ministry of Mines and Energy collects all data around fuel sales, while the Ministry of Finance maintains a register for all economic sectors that may request fuel subsidies.

The to be established Road Fund Administration will however collect all the data in the format required to develop the indicator. As the RFA will be established this year still, this section will be forward-looking and will describe the data requirements as if the RFA is already in place.

The variables are as follows;

X = The total annual volume of petrol sold

Y = The Total volume of diesel sold for on-road use.

These quantities will in future be part of the annual reporting system of the RFA as these figures form the basis of road user charging revenue collected through fuel sales.

E4.4 Calculation and Future Updating of Indicator

The indicator is calculated as the sum of X an Y for each year.

INDICATOR E5: ANNUAL UNLEADED MARKET PENETRATION

INDICATOR NAME	Annual Unleaded Petrol Market Penetration
DEFINITION	The volume unleaded petrol sold as a % of the total petrol sales.
MEASUREMENT	The % ratio between total unleaded and total petrol sales annually

SIGNIFICANCE OF THE INDICATOR

PURPOSE: This indicator measures the extent of unleaded petrol penetration in the market. . It is therefore a measure of national concern as ambient lead is a major agent causing lead poisoning.

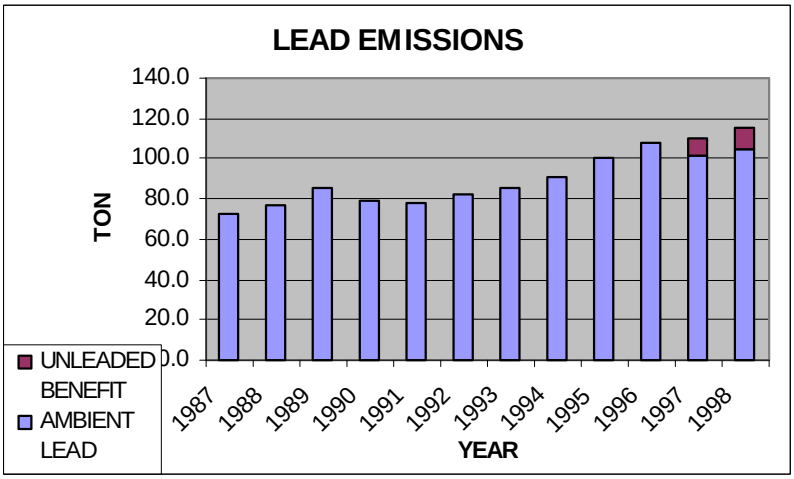
RELEVANCE: The indicator gives a highly aggregated measure of the health risks involved in the use of leaded fuel.	**LINKAGES TO OTHER INDICATORS:** This indicator is not linked to other indicators.
UNDERLYING VARIABLES AND DEFINITIONS: The indicator is relying on the total volume of leaded and unleaded petrol sold annually in Namibia.	**MEASUREMENT OF THE INDICATOR:** Practice around the world shows that this indicator is usually measured in the concentration of lead in the atmosphere, usually is congested city centres. Namibia does not have problems with high lead concentrations yet. This indicator therefore measures the trend in petrol sales annually.
LIMITATIONS OF THE INDICATOR: This indicator could be applied on a local authority level should disaggregated data be available.	**RED FLAG: Any decreases**

E5.1 Past Performance

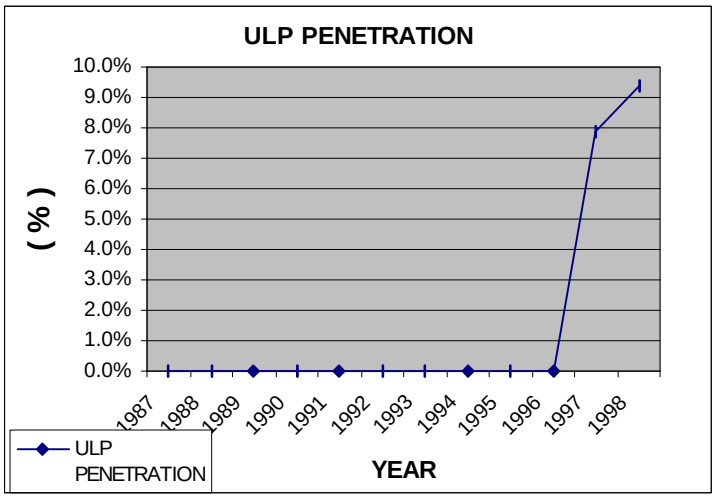
The Ministry of Mines and Industry facilitated the introduction of unleaded petrol into Namibia in 1997. This was done mainly in support of the latest engine technology where more and more engines are designed to run on unleaded petrol only.

Total lead emissions increased steadily from just over 72t in 1987 to over 107,8t in 1996. With the introduction of unleaded petrol in 1997, lead emissions decreased to 101,7t, a decrease of 5,7%.

The net result of the introduction of unleaded petrol is still small, but the health benefits of unleaded petrol have not yet been explained as part of media campaigns. Should the negative effects of ambient lead be explained to the general public, the total phasing out of leaded petrol will become reality.



A more relevant measure for Namibia would be the percentage penetration that unleaded petrol sales achieve over time. This will be a direct measure of public acceptance, an issue that has not been fully exploited by especially the Ministry of Health and Social Services and the DEA.



E5.2 Interpretation

The net result will be that an increase in the amount of unleaded petrol sold in Namibia will lead to a cleaner environment.

E5.3 Data Requirements

The Ministry of Mines and Energy collects fuel sales data from the petroleum industry. Therefore all data requirements can be satisfied in the Directorate of Energy of the MME who supplies the information free of charge.

The required information is as follows:

X = The total volume of Leaded Petrol sold, in litres

Y = The total volume of petrol sold in Namibia, in litres.

E5.4 Calculation and Future Updating of Indicator

The % penetration that unleaded petrol has achieved per period is calculated as follows:

The total volume of Leaded Petrol sold, in litres (X)

DIVIDED

The total volume of petrol sold in litres (Y)

TIMES 100.

INDICATOR E6: ROAD SAFETY

INDICATOR NAME	Road Safety
DEFINITION	The average number of deaths per capita caused by road traffic accidents.
MEASUREMENT	The total number of accident deaths divided by the total population, both in current figures.

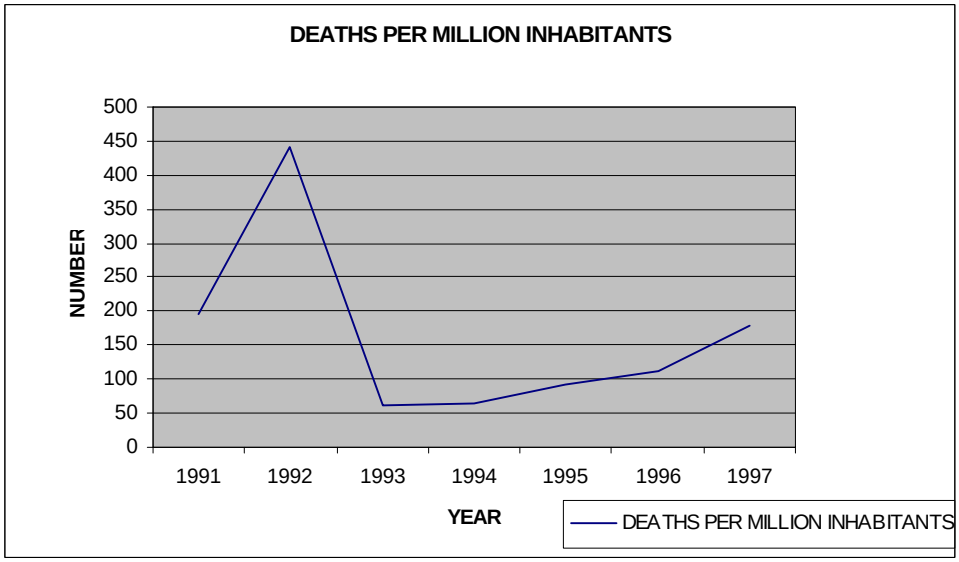
SIGNIFICANCE OF THE INDICATOR

PURPOSE: This indicator measures the average risk for the Namibian population in terms of their use of the road network.

RELEVANCE: In the absence of information to develop more focused indicators, this indicator is a proxy of the average safetyof Namibian roads.	**LINKAGES TO OTHER INDICATORS:** This indicator can not be linked to other indicators.
UNDERLYING VARIABLES AND DEFINITIONS: This indicator is dependent on the accident statistics and population numbers.	**MEASUREMENT OF THE INDICATOR:** There is no norm for this indicator. Internationally it is measured by all countries to determine the effectiveness of road safety.
LIMITATIONS OF THE INDICATOR: Currently all accident statistics are unreliable. Should this not improve, the indicator will remain unreliable.	**RED FLAG:** Any increase

E6.1 Past Performance

Namibia has not become as safety conscious as traditional first world countries, but through the efforts of the Namibian Road Traffic Safety Council there is already an awareness for road safety. The official statistics are not reliable so it is very difficult to comment on the graph below. A conservative estimate would be that these figures represent only that part of the statistics that were collected. The picture could be much worse.



E6.2 Interpretation

Any increase in the indicator number will show a decrease in road safety whereas a decrease will show that there are fewer road deaths for that period.

Currently the number of deaths is on the increase. The traffic policing function in Namibia is not managed efficiently and the lack of traffic law enforcement could be a major contributor to this increase.

E6.3 Data Requirements

The Central Statistics Office of the National Planning Commission projects population figures from known census data. The Namibian Road Traffic Safety Council collects accident statistics. These statistics include statistics on road deaths.

The required information is as follows:

X = The total number of deaths for a specific period

Y = The projected/actual population

E6.4 Calculation and Future Updating of Indicator

The total number of deaths (X)

DIVIDED

The total population (Y)

TIMES 1000 000.

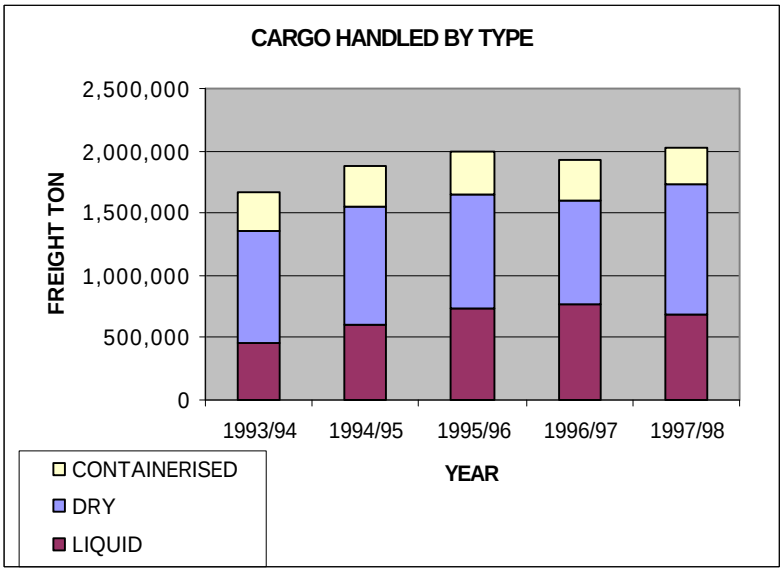
INDICATOR E7: ACCESSIBILITY TO PORTS

INDICATOR NAME	Accessibility to Ports
DEFINITION	The total volume of cargo handled.
MEASUREMENT	The sum of all cargo handled through port operations, summed in ton
SIGNIFICANCE OF THE INDICATOR	
PURPOSE: This indicator measures the size of port operations to provide a proxy for accessibility. This is a poor indicator but the participants at the 14 June workshop recommended its inclusion.	
RELEVANCE: It provides an indication of the size and volume of operations handled by the prots of Namibia	**LINKAGES TO OTHER INDICATORS: It has no linkage to other indicators.**
UNDERLYING VARIABLES AND DEFINITIONS: The variable is the actual volume of cargo handled in the ports in metric tonnes.	**MEASUREMENT OF THE INDICATOR:**
LIMITATIONS OF THE INDICATOR: It is not linked to any environmental concern, but gives a first warning of major changes in this sub-sector.	**RED FLAG: Any dramatic or sustained change in annual figures.**

E7.1 Past Performance

The Namibian ports have over the last six years shown an average growth rate of less than 5% in cargo handling. There is still a huge amount of available capacity which Namport hopes to exploit in the medium to long term.

There is also a need to discern between environmentally problematic and non-hazardous cargoes. Currently this information is either not available or the quantities are so small that the development of an indicator at that level is not feasible.



E7.2 Interpretation

As cargo volumes increase, so should the awareness that more and larger ships are visiting Namibian ports. With this comes the knowledge that pollution may increase and that the chances for oil spills are increasing.

As this is a development indicator, future work should focus on the possible review of the input data to make the indicator more relevant. Currently it may be seen as an advance warning only. With current growth rates and the existing capacity such a review may only be necessary within the next 15 to 20 years.

E7.3 Data Requirements

The data used in this indicator is available as is in the Namport Annual Reports.

The data requirement is

X = Total cargo handled at the ports of Walvis Bay and Lüderitz, in ton

E7.4 Calculation and Future Updating of Indicator

The indicator is calculated as follows:

The Total cargo handled at the ports of Walvis Bay and Lüderitz, in ton (X)

INDICATOR E8: AVIATION SAFETY

INDICATOR NAME	Aviation Safety
DEFINITION	The total number of deaths per passenger transported.
MEASUREMENT	The total number of accident deaths divided by the total passenger count, both in current figures.

SIGNIFICANCE OF THE INDICATOR

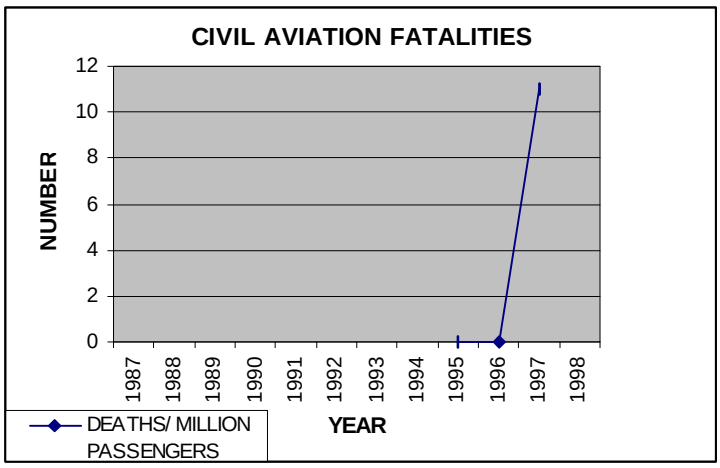
PURPOSE: This will measure the relative safety of the aviation industry in Namibia. This is a weak indicator but the participants at the 14 June workshop recommended its inclusion.

RELEVANCE: Only a small number of people dies while using civil aviation. The current status may make this indicator meaningless	**LINKAGES TO OTHER INDICATORS:** There is no link to other indicators
UNDERLYING VARIABLES AND DEFINITIONS: This indicator combines the total number of civil aviation deaths with the number of passengers transported in the sub-sector during the same period	**MEASUREMENT OF THE INDICATOR:** There is no specific norm but the vision should be to decrease the number over time. This ensures a safer environment.
LIMITATIONS OF THE INDICATOR: It measures a small aspect of the civil aviation industry and is not a proxy for the other aspects.	**RED FLAG:** Any Increase

E8.1 Past Performance

The nature of the civil aviation industry in Namibia is also reflected in the type of accidents that do occur. Almost all scheduled passenger flights are international while domestic flights are undertaken in small and mostly, propeller-driven aircraft. Accidents therefore involve small planes only and result in small numbers of fatalities when they occur. This indicator is therefore a combination of passenger volumes on international flights and risks in using domestic flights. As the sector expands, it will be necessary to review this indicator.

The current database maintained by the DCA starts in 1995. Since then only seven people died, all in 1997.



E8.2 Interpretation

This indicator is a development indicator. The database is extremely limited to develop trends of any kind. The civil aviation industry in Namibia is also so small that this indicator will not produce any meaningful results unless the industry expands by several hundred percent.

E8.3 Data Requirements

The data required for this indicator is all collected by the Directorate: Civil Aviation (DCA) of the MWTC. Accident statistics as well as passenger totals are collected annually and reported to ICAO.

The required information is,

X = The total number of deaths per annum

Y = The total number of passengers per annum

E8.4 Calculation and Future Updating of Indicator

The indicator is calculated as follows:

The total number of deaths per annum (X)

DIVIDED BY

The total number of passengers per annum (Y)

TIMES 1000 000