Intelligent Transportation Systems


CESA Sustainability Conference

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If we could . . .

“See” what is going on
Communicate what we see in real time
Apply cutting-edge analytics and modeling

We could . . .
Create smarter management and control actions
Give travelers timely and valuable information to help them make smarter travel decisions
Allow everyone to travel more safely, smoothly, and sustainably

Source: USDOT
The Internet of Things
Definition of ITS

• “The term intelligent transportation system (ITS) refers to efforts to add information and communications technology to transport infrastructure and vehicles in an effort to manage factors that typically are at odds with each other, such as vehicles, loads, and routes to improve safety and reduce vehicle wear, transportation times, and fuel consumption”

• ITS America
In general, the objective of ITS is to improve travel conditions by using technology.
ITS Objectives

Specifically,

• Monitoring traffic
• Reducing recurrent congestion
• Minimize duration and severity of nonrecurring congestion through optimisation
• Maximize efficiency and improve public safety
• Provide travellers with information needed to make informed choices
Average time lost in traffic between 2009 and 2016

- Cape Town, 35%
- Johannesburg, 30%
- East London, 29%
- Pretoria, 26%
- Durban, 22%
- Bloemfontein, 18%

Source: Joubert A, KPMG
The percentages indicate the increase in overall traffic time, compared to a free flow situation.

3 most gridlocked cities:

1. Cape Town
   - 42 minutes per day
   - 163 hours per year

2. Johannesburg
   - 37 minutes per day
   - 141 hours per year

3. East London
   - 32 minutes per day
   - 121 hours per year

Source: Joubert A, KPMG
## Crashes and Casualties

<table>
<thead>
<tr>
<th>Number of RTCs</th>
<th>Fatal</th>
<th>Major</th>
<th>Minor</th>
<th>Damage only</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of RTCs</td>
<td>11 144</td>
<td>40 117</td>
<td>132 609</td>
<td>648 560</td>
<td>832 431</td>
</tr>
<tr>
<td>Number of persons</td>
<td>13 591</td>
<td>62 520</td>
<td>202 509</td>
<td>1 429 794</td>
<td>1 708 414</td>
</tr>
</tbody>
</table>

Table 6: Number of RTCs and casualties 2015, adjusted for underreporting.
# TOTAL COST OF CRASHES

## Table 11: Total RTC costs by cost type, category and element (Rand)

<table>
<thead>
<tr>
<th>Cost Element</th>
<th>Internal (uncompensated victim)</th>
<th>External (private uncompensated others)</th>
<th>External (public sector) (uncompensated public)</th>
<th>Insurance (private) (compensated victim &amp; others)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human Casualty</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost productivity</td>
<td>34 528 657 739</td>
<td>6 017 632 169</td>
<td></td>
<td>5 513 262 664</td>
<td>46 059 552 571</td>
</tr>
<tr>
<td>Pain, suffering and lost quality</td>
<td>35 121 533 212</td>
<td>4 390 191 652</td>
<td></td>
<td>1 978 009 509</td>
<td>41 489 734 373</td>
</tr>
<tr>
<td>Medical treatment</td>
<td></td>
<td></td>
<td>9 354 315 159</td>
<td>1 058 420 917</td>
<td>10 412 736 076</td>
</tr>
<tr>
<td>Funeral</td>
<td>157 329 394</td>
<td></td>
<td></td>
<td>27 796 615</td>
<td>185 126 008</td>
</tr>
<tr>
<td>Work place re-occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>883 185 558</td>
</tr>
<tr>
<td><strong>Sub-total: Human Casualty Cost</strong></td>
<td>69 807 520 344</td>
<td>11 291 009 379</td>
<td>9 354 315 159</td>
<td>8 577 489 705</td>
<td>99 030 334 587</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vehicle Repair</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle repair</td>
<td>12 334 550 509</td>
<td></td>
<td></td>
<td></td>
<td>21 325 577 157</td>
</tr>
<tr>
<td><strong>Sub-total: Vehicle Repair Cost</strong></td>
<td>12 334 550 509</td>
<td></td>
<td></td>
<td></td>
<td>21 325 577 157</td>
</tr>
</tbody>
</table>

Source: RTMC
# TOTAL COST OF CRASHES

<table>
<thead>
<tr>
<th>Cost Element</th>
<th>Internal (uncompensated victim)</th>
<th>External (private uncompensated others)</th>
<th>External (public sector) uncompensated public</th>
<th>Insurance (private) compensated victim &amp; others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>144 838 047</td>
</tr>
<tr>
<td>Emergency response</td>
<td></td>
<td></td>
<td>24 403 256</td>
<td>120 434 791</td>
<td>144 838 047</td>
</tr>
<tr>
<td>Legal</td>
<td></td>
<td></td>
<td>5 209 274 099</td>
<td>5 209 274 099</td>
<td>5 209 274 099</td>
</tr>
<tr>
<td>Vehicle related</td>
<td></td>
<td></td>
<td>3 379 716 014</td>
<td>3 379 716 014</td>
<td>3 379 716 014</td>
</tr>
<tr>
<td>RTC management</td>
<td></td>
<td></td>
<td>1 903 953 544</td>
<td></td>
<td>1 903 953 544</td>
</tr>
<tr>
<td>Infrastructure damage</td>
<td></td>
<td></td>
<td>1 978 138 540</td>
<td></td>
<td>1 978 138 540</td>
</tr>
<tr>
<td>Delay congestion and emissions</td>
<td></td>
<td></td>
<td>9 978 752 945</td>
<td></td>
<td>9 978 752 945</td>
</tr>
<tr>
<td>Sub-total: Incident Cost</td>
<td>9 978 752 945</td>
<td>3 906 495 340</td>
<td>8 709 424 905</td>
<td></td>
<td>22 594 673 190</td>
</tr>
<tr>
<td>Total Cost</td>
<td>82 142 070 853 (57% of total)</td>
<td>21 269 762 323 (15% of total)</td>
<td>13 260 810 499 (9% of total)</td>
<td>26 277 941 258 (18% of total)</td>
<td>142 950 584 934</td>
</tr>
</tbody>
</table>

Source: RTMC
Projection of Future Earnings

\[
\text{Earn}_{a,b} = \sum_{k=a}^{100} \left\{ P_{a,b}(k) \times Y_{k,b} \times \left( \frac{1+g}{1+d} \right)^{k-a} \right\}
\]

- \(a = \) age
- \(b = \) gender
- \(P_{a,b}(k) = \) probability of gender \(b\) to survive from age \(a\) to age \(k\)
- \(Y_{k,b} = \) average annual earnings/production (including fringe benefits) of gender \(b\) at age \(k\)
- \(g = \) productivity growth rate (eg 0.01 for earnings, 0.0 for unpaid work)
- \(d = \) discount rate

Source: RTMC
History of ITS in South Africa

• Pre 2000 – mostly awareness
• Intelligent Transport Society for South Africa established in 2001
• First major ITS project initiated in 2002 by National Roads Agency
  – Pilot project on freeway section (21 km)
• Soccer World Cup 2010 real impetus
  – Freeway management systems in 3 major metropolitan areas
  – Bus Rapid Transit programmes in 6 major metropolitan areas
  – Event management

Source: Anderson, 2015
Figure 3-3 Transition from the Linear Systems Life cycle to the Vee Technical Development Model
Various Engineering Disciplines

• Civil
• Structural
• Traffic and Transportation
• Electronic
• Electrical
• Systems and Software
• Project and Asset Management
Intelligence – The Brains of ITS

• Computers . . . of course
• Databases – On Dedicated Servers and in the Cloud
• Data Mining and Big Data Analytics
• Specialized and Sophisticated Management and Control Software
Basic ITS Elements

• Closed circuit television (CCTV) cameras

• Vehicle Detection Systems (Radar)

• Variable message signs (VMS)

• Communications Media - interconnecting devices to the Traffic Management Centre and other agencies (internet, website, SMS’s, Twitter & telephone etc.)
Basic ITS Elements

- Advanced Traffic Management Systems (ATMS)
- Advanced Traveler Information Systems (ATIS)
- Advanced Vehicle Control Systems (AVCS)
- Commercial Vehicle Operations (CVO)
- Advanced Public Transportation Systems (APTS)
- Electronic Payment Systems (EPS)
- Security and Safety Systems (S&S)
Vehicle Detection Systems (Radar)
Traffic Data Collection

**Vehicle Data**
- Speed: 107 kph
- Lane: 3
- Length: 6.5 m

**Lane Data**
- Volume: 137 vehicles
- Classification: 14 trucks, 123 cars
- Headway: 2.2 seconds
- Gap: 2.0 seconds
- Occupancy: 32%
- Average Speed: 91 kph
- 85th Percentile Speed: 100 kph
Traffic Data

Information gathered from VDS’s which are strategically positioned.

Information Summarised as following:

- Speed
- Volume
- Lane Occupancy
- Vehicle Type/Classification

Speed Data

ATMS has the functionality to report on the various sections covered on speed within the section. This is indicated by the affected section being highlighted.

- RED – Congestion - 24 km/h
- ORANGE – Very Slow - 25 – 50 km/h
- YELLOW – Slow - 51 – 79 km/h
- GREEN – Moving Well - 80 km/h
VARIABLE MESSAGE SIGNS
Improved traffic management can play a key role in resolving this challenge, due to ITS that integrate sophisticated communication networks into the freeway infrastructure. ITS applications offer the benefits of reduced traffic congestion, increased freeway efficiency and safer roads. A concerted effort has been made to work to add functionality to the ITS applications, facilitate their integration and adopt these applications by various departments.
Traffic Management Centre

- Operations – 24/7 (365 days)
- Three-8hr shifts @ 5am, 1pm & 9pm
Freeway Management Systems
Intelligent Vehicles: The future is here!!
THANK YOU