Road Safety Overview

The scale of the problem
Evaluating levels of safety
Sustainable safety strategies
Advice on the Business Case

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Acknowledgements

SWOV (Institute for Road Safety Research, NL):
  Dr Fred Wegman, former Director
  Dr Divera Twisk, Road Safety Researcher
Further reading:
Global Status Report on Road Safety (WHO.org, 2013)
Advancing Sustainable Road Safety (SWOV.nl, 2006)
The Road Safety Problem

An enormous social and economic burden:

- World Health Organization ranks injuries due to road crashes as the 9th leading epidemic
- Will be 3rd worst by 2020 at current trends
- Age group at highest risk: 0 to 40 years old

- Costs 2 to 5% of Gross Domestic Product
  - Hospital costs, damage repair, lost wages, delays
  - Productivity, congestion

CHANGING DIRECTION: POTENTIAL OF A DECADE OF ACTION FOR ROAD SAFETY

Do nothing
Decade of Action

Global RTI Deaths

Reduction Target


MONITORING A DECADE

• UN GA resolution 54/255 in 2010 called for a Decade of Action for Road Safety (2011–2020).

• Status reports to be used as a monitoring tool for the Decade.
GLOBAL STATUS REPORT ON ROAD SAFETY 2013

- Made possible through funding from Bloomberg Philanthropies.
- Country-based, multisectoral, consensus process used to gather information.
- 182 participating countries
Every year, there are 1.24 million road traffic deaths worldwide. Young adults aged between 15 and 44 years account for 59% of global road traffic deaths. 92% of road traffic deaths occur in low- and middle-income countries. These countries have only 53% of the world's registered vehicles. Vulnerable road users account for half of all road traffic deaths globally. Pedestrians, cyclists, and riders of motorized two-wheelers and their passengers are collectively known as "vulnerable road users".

Progress can be made if there is sufficient political commitment. At the global level, the number and severity of deaths has remained unacceptably high. More must be done to reduce the number of road traffic deaths.
FOR EVERY PERSON WHO DIES, 20 ARE INJURED

• For every 1 person who dies in a road traffic crash, 20 are injured.
• 1 in 20 of those injured are left with a disability.
• Only 111 countries have a universal national access emergency number.
• Only 59 countries have an ambulance service able to transfer over 75% of injured patients.
• Less than 2/3 of doctors and <50% nurses are trained in emergency care in LMICs.
35 COUNTRIES PASSED NEW LAWS BUT ONLY 7% OF THE WORLD'S POPULATION IS COVERED FOR ALL 5 RISK FACTORS
FEW COUNTRIES RATE THE ENFORCEMENT OF LAWS AS "GOOD"

"Good" enforcement defined as 8 or more on a scale of 0 to 10.
A framework for the Decade

International coordination/
strengthening global architecture

- Increase global funding
- Advocate for road safety at the highest levels
- Increase awareness of risk factors and prevention
  - Provide guidance to countries on:
    - strengthening management systems
    - implementing good practices
    - trauma care
- Improve the quality of data
The 5 Pillars of the Decade

<table>
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<th>Pillar 1</th>
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<tr>
<td>Road safety management</td>
<td>Infrastructure</td>
<td>Safe vehicles</td>
<td>Road user behaviour</td>
<td>Post crash care</td>
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<td>Lead agency</td>
<td>Improved road design</td>
<td>Global harmonization</td>
<td>BAC laws</td>
<td>Prehospital care</td>
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<td>Strategy</td>
<td>for all users</td>
<td>vehicle standards</td>
<td>Seat-belts &amp; child</td>
<td>Trauma care and</td>
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<td>Targets</td>
<td>Road infrastructure</td>
<td>NCAP</td>
<td>restraints</td>
<td>rehabilitation</td>
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<tr>
<td>Funding</td>
<td>rating</td>
<td>All cars equipped with</td>
<td>Motorcycle helmets</td>
<td>Quality assurance</td>
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<td></td>
<td></td>
<td>seat-belts</td>
<td>Speed management</td>
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<td>&quot;Intelligent&quot; vehicles</td>
<td>ISO 39001</td>
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<td>R&amp;D safety for VRU</td>
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Traditional Engineering Response to Road Safety

Reactive - in ‘reaction’ to an existing road safety problem history – injury, death, damage

1. Identify the site as hazardous, and rank it for treatment
2. Diagnose what the problem is, and ways to solve it
3. Remedy to eliminate the safety problem

Has been effective where applied, but not ‘sustainable’!

Requires a history of crashes, to be noticed, and then budget to fix – meanwhile human suffering

We can do better than react after the fact!
TRADITIONAL RESULTS:
TOO MANY ROAD TRAFFIC DEATH RATES

Decade of Action for Road Safety 2011-2020: saving millions of lives

Year

Number of deaths (millions)
0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

5 million lives saved

Projected increase without action
Projected reduction if action taken
Engineering sustainably safer systems

Proactive – before anything is built, to preclude road safety problems - injuries and death - from happening at all

– Done during planning stages of land use and transportation projects
– Through application of empirical predictive tools that quantify level of road safety of each project

Allows for permanent, sustainable solutions of safer roads and communities = **Sustainable Safety**
1.1.2. Man is the measure of all things in an integrated approach

In the analysis of and approach to preventing crashes or reducing the severity of consequences of dangerous situations, human capacities and limitations are the guiding factors: “man is the measure of all things”.

Stat: Over 90% of all crashes are due at least in part to driver error! 10% due to vehicle failure, and 30% due to road environment failure.
An Integrated, Systems-based Approach: Driver, Vehicle, Road

Taking into account these human characteristics as the starting point, sustainably safe road traffic can be attained by an integral approach to the components ‘man’, ‘vehicle’ and ‘road’. This means that the infrastructure has to be designed such that it meets human capacities and limitations, that the vehicle supports the performance of traffic tasks and provides protection in the event of a crash, and that the road user is well informed and trained, and is controlled wherever necessary in the correct performance of the traffic task.
## Five Central Principles of Sustainable Safety

<table>
<thead>
<tr>
<th>Sustainable Safety principle</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Functionality</strong> of roads</td>
<td>Monofunctionality of roads as either through roads, distributor roads, or access roads, in a hierarchically structured road network.</td>
</tr>
<tr>
<td><strong>Homogeneity</strong> of mass and/or speed and direction</td>
<td>Equality in speed, direction, and mass at medium and high speeds.</td>
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<tr>
<td><strong>Predictability</strong> of road course and road user behaviour by a recognizable road design</td>
<td>Road environment and road user behaviour that support road user expectations through consistency and continuity in road design.</td>
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<tr>
<td><strong>Forgivingness</strong> of the environment and of road users</td>
<td>Injury limitation through a forgiving road environment and anticipation of road user behaviour.</td>
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<td><strong>State awareness</strong> by the road user</td>
<td>Ability to assess one’s task capability to handle the driving task.</td>
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So it is a SYSTEM solution: A Safe System Approach to Road Safety!
Self-Educating/Enforcing Road Design

Encourages correct expectations in users to prevent crashes

1. Design & layout of road type evokes the right user expectation & behaviors (Theeuwes & Godthelp, 1993)

2. Design continuity & consistency permanently supports user expectations (Lamm et al., 1995), especially regarding speed behavior to minimize differential speeds in traffic stream
## Example: Design to Manage Your Speed

<table>
<thead>
<tr>
<th>Road types combined with allowed road users</th>
<th>Safe speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads with possible conflicts between cars and unprotected road users</td>
<td>30</td>
</tr>
<tr>
<td>Intersections with possible transverse conflicts between cars</td>
<td>50</td>
</tr>
<tr>
<td>Roads with possible frontal conflicts between cars</td>
<td>70</td>
</tr>
<tr>
<td>Roads with no possible frontal or transverse conflicts between road users</td>
<td>≥ 100</td>
</tr>
</tbody>
</table>
Figure 1.4. *Probability that a pedestrian will die as result of a car crash as a function of the impact speed of the car.*
Figure 1.5. *Functional categorization of roads according to Buchanan (1963).*
Additional support is required . . .

Since it is unrealistic to rely exclusively on the intrinsic motivation of all road users, the road user’s immediate environment has to incite the desired spontaneous behaviour in sustainably safe road traffic.

Since this causes other road users to comply with the norm, the (unconscious) social influence of imitating others works in the right direction. We should also look into the extent that we can improve the explicit communication of rules.
User – State Awareness

Balance Their Task Capability & Task Demands
Design Road System to maintain: 
Task Capability > Task Demands

In sustainably safe road traffic, task difficulty should always be kept at an optimum level for safety. By always keeping task capability higher than the task demands, serious errors can, largely, be prevented. Ideally, task difficulty can be adapted in two directions: firstly by reducing task demands, secondly by improving task capability. The problem is that road users are not a homogeneous group
New & Old Drivers are High Risk

At the ‘lower end’ of the distribution, we find, amongst others, inexperienced drivers and the elderly. These have a lower task capability because of underdeveloped competences in the first case and the deterioration of certain functions in the second. To improve competences, education has a fundamental and important role. It is particularly important that the road user learns to assess if he or she is capable of taking part in traffic, given the capacity of the individual
Strategies in use

• Re-training, ITS assists for older drivers
• Zero tolerance for distracted driving
• Graduated licensing for new drivers
• Zero tolerance for alcohol
• Defensive driving training
• Visibility at intersections
• ITS speed management
• Forgiving road design (because, nobody is perfect!)
Forgivingness

For the infrastructure, the application of the new principle of forgivingness is mainly a matter of road shoulders, especially on rural distributor roads. A vehicle that leaves the road should not collide with any obstacles or road furniture, resulting in severe injury. There is already sufficient knowledge to completely apply this principle to the Netherlands' infrastructure. However, additional research is needed to answer questions such as: when are roadside safety structures needed and which criteria should they meet?
Translation of 5 Principles into Sustainably Safer Roads & Transport
Cycling and walking are very important means for children, school pupils and the elderly to participate in Dutch traffic. In sustainably safe traffic, these vulnerable road users should be separated from other traffic as much as possible. If this is not possible, there is the 'safe speed' of 30 km/h or less (homogeneity). To limit severe injury, vehicle adaptations also remain important (forgivingness).

- the physical separation of vehicles with major differences in masses, speeds and directions;
- the measure of directing mopeds onto the carriageway inside urban areas;
- the implementation of 30 and 60 km/h zones;
- the obligatory side-underrun protection for new lorries;
- the development of a pedestrian-friendly car front.
Who rides these?
Motorized 2-wheelers

Riders of motorized two-wheelers: motorcycles, mopeds and light mopeds have high crash rates. They move at high speeds and sometimes car drivers do not see them. Moreover, their own vehicle provides practically no protection in a crash. Thus, with regard to the homogeneity principle, motorized two-wheelers do not actually fit Sustainable Safety.

There are no measures imaginable that could make motorized two-wheelers fit into sustainably safe road traffic and bring their death rates to levels of motorists' death rates. However, there are measures that could reduce their crash rates.
A special infrastructure for heavy goods vehicles has many advantages:

- Traffic on main roads becomes safer for cars and vans with the virtual disappearance of incompatible heavy lorries.
- There are no more problems with joining and exiting main roads with the lack of column-forming by lorries.
- Main roads are relieved of congestion so that fewer new roads and less road widening is necessary.
- Wear and tear of the main roads is greatly reduced because there is hardly any corrugation; 'light-roads' become a fact.
- Road construction design can become more focussed.
- Rollovers will no longer occur, provided the lorry infrastructure is narrow and has physical barriers on both sides.
- 'Lorry roads' can eventually be used for computerized, probably unmanned transport of containers, tank and bulk transport, and city boxes, for example.
Other translations . . .

• Keep road design homogeneous, simple to understand, and cognizant of user expectations;
• The smallest proportion of the trip should occur on the least safe portion of the network;
• Design roads of each function to be unique, understandable, and recognizable to users;
• Reduce speed on approaches to and within potential conflict points or locations
Other translations . . .

- Physically separate different transport modes, and different road functions;
- Prevent conflicts with crossing traffic and pedestrians;
- The shortest and safest routes should be the same;
- Avoid obstacles alongside the roadway;
- Prevent conflicts with opposing traffic;
- All trip lengths should be minimized; and,
- Conduct before/after studies to ascertain effectiveness of investments; learn from mistakes!
A Sustainably Safer System also integrates with Land Use Planning!

- SRS program manuals for community and transportation agencies have now been released, including full engineering and planning requirements for urban areas (See CROW).
- Traffic-restrained residential areas should be continuous, densely-zoned, and of large cores;
- Avoid the need for travelers / visitors to do extensive searches when nearing destinations;
- Limit the number of engineering solutions and road types.
• Reliable, empirical assessment tools
  – Assessment of planned LU & T developments
  – We take STS theory, RS statistics, Community-statistics – produce models
• More reliable empirical tools for decision makers
  – Stronger leadership, better informed
• Leadership requires a vision of where we want to go
  – models can help predict future outcomes of those decisions, and set goals by which we can measure progress/success
There are 1.3 million reasons to work for safer traffic

Around 1.3 million people are killed in road traffic accidents every year. This is one of the leading causes of death worldwide. Road accidents result in more than 500,000 injuries every year.

In addition, there are between 20 million people injured in road traffic accidents in the United States alone. The economic cost of these accidents is estimated to be around $1 trillion per year.

Our project aims to improve road safety by using instrumented bicycles to collect data on traffic conditions and cyclist behavior. This information will be used to develop safer roads and promote active transportation.
Critical Success Factors for Sustainable Communities

1. Energy sources (Renewable)
2. Net emissions (Neutral)
3. Waste management (Zero waste)
4. Land uses (Mixed & dense)
5. Public gardens (Everywhere)
6. Food sources (Local)
Sustainable Communities also have . . .

7. Prosperity (Vibrant local economy)
8. Sense of Community (Happy, involved)
9. Transportation (Transit, bike, walk)
10. Buildings & houses (LEEDs)
11. Leadership (Strong, inclusive & transparent)
Why is Fused Grid Sustainable?

Fused Grid neighborhoods reduce 60% of crashes

Fused Grid?!  Can you tell why?
Traditional Neighborhood Road Patterns: Are they Sustainable?

- Grid Network
- Culs-de-sac
The Fused Grid is Sustainable because:

Peer-reviewed research from Planning, Health, Psychology, and Engineering:

<table>
<thead>
<tr>
<th>Category</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health:</strong></td>
<td>Quieter, cleaner air, more walking, playing and detente</td>
</tr>
<tr>
<td><strong>Safety:</strong></td>
<td>Lower traffic, lower speeds, fewer crossings, separated traffic streams</td>
</tr>
<tr>
<td><strong>Wellbeing:</strong></td>
<td>Nearby nature, delight, detente, more socializing</td>
</tr>
<tr>
<td><strong>Efficiency:</strong></td>
<td>High yields, Low infrastructure cost, density</td>
</tr>
<tr>
<td><strong>Environment:</strong></td>
<td>More permeable, greener, public gardens</td>
</tr>
<tr>
<td><strong>Budgets:</strong></td>
<td>Lower lifecycle costs, more tax revenue</td>
</tr>
</tbody>
</table>
Peace and Quiet

A Fused Grid Neighbourhood

Predictable, local traffic only

Assigns district traffic to the perimeter

Urban Pattern Associates
Peace and Quiet

Short lengths and turns – lower speeds

- shielding potential
- Partly separate paths
- No street crossing, possible
Step 1: Traditional Continuous Grid, but at New Scale (transit)

The Fused Grid model

1/2 mile

1.2 min of travel
Step 2: New Discontinuous Grid, but at Traditional scale (pedestrian)

TWO

260 feet or 1.2 min of walk
Step 3: A Fusion of Grids
- Two locomotion types (Human & Vehicular), Two scales
Step 4: Fused Grid with Green Space Connectors - Replicable Quadrants

Priority on pedestrian movement
BUT IT ALL COMES DOWN TO DATA: 
RSM SYSTEMS IN MOST COUNTRIES REMAIN POOR

- Most countries (71%) rely on Police data systems only, few (17%) combine databases.
- 50% of countries use a 30-day definition.
- Only 104 countries reported robust data (in terms of coverage and completeness).
- For 78 countries comparative estimates had to be generated using a statistical model.
ADVICE ON BUSINESS CASE

1. Think BIG, but be realistic in your expectations – even with a good business case, road safety improvement will take time – try to anticipate barriers, and aim to overcome early – be pre-emptive in your thinking, networks, and business case cost / benefit content.

2. Stick to two or three key messages – e.g.’s:
   1. #9 worst epidemic; #3 by 2020 unless we change things.
   2. For every 1 death, 20 more are injured – over 50% of which are our kids!
   3. For each $1 invested in road safety, we save ## lives per YEAR!

3. It takes a generation or three to change land use/development form and travel habits; in developing countries, survival is top priority, poverty/equity/water/food/disease – AIDS, Ebola – so lower budgets

4. Therefore KISS – practical, easy to implement, self-educating/enforcing – minimal admin and low-hanging strategies!
Good Summary Documents

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   www.ubc.ca/okanagan/engineering/faculty/gordonlovegrove.html