SOCIAL ACCEPTANCE OF RISKS AND THEIR PERCEPTION

Technical Committee C.3 Managing Operational Risk in Road Operation
The World Road Association (PIARC) is a nonprofit organisation established in 1909 to improve international co-operation and to foster progress in the field of roads and road transport.

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Any opinions, findings, conclusions and recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of their parent organizations or agencies.

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The strategic plan of PIARC assigned a new challenge to Technical Committee C.3, to define the framework of the operational risk related to roads. Social acceptance of operational risks and their perception is indeed something that was not studied in previous cycles. Risk perception has been an active area of research during the last 30 years and there is a wide literature on this field even though it often addresses topics not directly related to roads or transportation. Consequently, the Committee decided to have a first scientific approach to the subject by reviewing the literature and discussing with experts in the specific field. Existing studies were categorized, analyzed, and summarized. This report presents a comprehensive review of the existing literature and case studies available on social acceptance of risks and their perceptions with a focus on road operations. The key findings are presented and recommendations are drafted.
1. GENERAL APPROACH TO RISK

Risks exist in every field and situation, including the management of road infrastructures. However, not all risks affect and interest people; the attention focuses selectively on specific risks, while others are completely neglected, considered as unavoidable facts of life. Sometimes, the neglected risks are suddenly thrown into the limelight as a function of specific events and/or media campaigns. To grasp a good understanding on how people’s risk perceptions affect road operations and what the consequences of this are, one should become familiar with the different notions of risk and the factors that influence their perception.

Risk has its origin in the Latin word “risicare” which means “to dare”. People though, do not use the same definition of “riskiness.” Experts focus on quantitative assessments of likelihood and consequences which tends to associate risk with fatalities [113], [108], [34], whereas the general public’s reaction to risk incorporates additional qualitative dimensions and could be attributed to a sensitivity to technical, social, and psychological qualities of hazards that are not well-modelled in technical risk assessments (e.g. qualities such as uncertainty in risk assessments, perceived inequity in the distribution of risks and benefits, aversion to being exposed to risks that were involuntary, not under one’s control or dreaded, outrage, etc., see figure 1) [114], [34], [52], [99], [100]. The general public can be stricter or harsher in their assessment of risk if they lack trust in the institutions that perform technical risk assessments [48], [47].

![Figure 1 – Expert Versus Lay People Assessment of Risk](image-url)
What is the acceptability of a risk? Mary Douglas said this expression implies “social” acceptability [26], [27], [28]: there are in fact socially standardized conventions determining what risks are acceptable. In other words, it is the culture that takes the lead when it comes to consider some risks as being acceptable and others to be feared and therefore refused. It is impossible to design and report on the perception of risk without taking into account the overall reference context, moral, social and political. At the same time, press and lobbies often stress the unacceptability of certain risks. There is no question whether it is acceptable or not that a disaster with great probability could frequently occur. Specialists in risk perception attempted to systematically identify what makes one risk more acceptable than others and also to address the issue of different thresholds of tolerance of relevant hazards. Therefore, one should be clear about what he is trying to predict, how “risk perception” is defined, and what is actually being measured [66], [39]. There is neither absolute measure of risk nor overall level of safety that is tolerable, keeping the question, “How safe is safe enough?” [110], [118] a valid one [34].

With respect to road risks, and in particular to risks related to traffic safety, we can consider that travelling by car carries a significantly higher risk in comparison to flying. People who don’t feel comfortable with the statement above can quickly find comfort in the statistics of casualties. Nevertheless, in spite of statistics, fear of flying is widespread and flight is less tolerated. Conversely, the fear of a short trip by car appears ridiculous to the majority of people. Fear, therefore, is not always a good indicator of the hazard and vice versa: not all risks trigger the same range of interest and perception of people.

The nature of the association between objective (actual) risk and subjective (perceptual) risk is not well understood, in part because it is difficult to quantify these two patterns of risk [34]. Biases have been found in explanations given by both experts and lay people [111], [60], [78], [89]. Moreover, people do not make the same estimate when they rate the risk to themselves and to others [106], [107]. People tend to underrate their risks, an observation that can be attributed to cognitive and/or psychological factors such as risk denial [101]. This tendency is also strongly correlated with their perceived control of the situation (e.g. driving skill). Studies have shown that individuals systematically over assess small risks and under assess a range of truly consequential larger risks [135], [111]. Distinction needs to be made when inquiring risk perceptions as there may be differences between personal risk and social risk and conflicts between risks as seen by the individual and as being relevant to the community as a whole [6], [98]. This may at times hinder progress towards improving road safety and at other times work towards achieving it [98].

Psychological, societal and cultural factors influence risk perception [94], [52]. Risk perception has traditionally been studied from a cognitive stance and has been treated as a cognitive process where quantitative measures of perceived risk have
been produced with the use of psychometric scaling methods (i.e. psychometric paradigm [108]). Covello’s research in psychological sciences [10], [11], [12], [13], [14] has identified 47 known factors influencing the perception of risk; issues like control, benefit, and whether a risk is voluntarily assumed. The most important factor is trust. This can help to explain why citizens are concerned about food safety issues that scientists deem trivial. The actual risk does not change but the perception does; and in the domain of public policy, perception is reality [10]. People also judge risk according to their perception of the agencies that control it. If these controlling agencies have a track record of secrecy, or if they dominate regulatory bodies which are supposed to be independent and the public policy process, then people magnify the perceived risks [11], [12], [42].

The major factors identified in early psychological studies that affect risk perception are presented in figure 2 and summarized in table 1, following page.

![Diagram of factors affecting risk perception](image_url)

**FIGURE 2 – FACTORS THAT INFLUENCE RISK PERCEPTION REPORTED IN EARLY PSYCHOLOGICAL STUDIES**
### TABLE 1 - FACTORS THAT INFLUENCE RISK PERCEPTION REPORTED IN EARLY PSYCHOLOGICAL STUDIES

<table>
<thead>
<tr>
<th>Factor</th>
<th>What is of more concern to people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic potential</td>
<td>Fatalities and injuries that are grouped in time and space (e.g. airplane crashes) than those that are scattered or random in time and space (e.g. car crashes) [135], [108].</td>
</tr>
<tr>
<td>Familiarity</td>
<td>Unfamiliar risks (ozone depletion) than familiar risks (household accidents) [62], [108], [130].</td>
</tr>
<tr>
<td>Understanding</td>
<td>Poorly understood activities (exposure to radiation) than those that may be understood (slipping on ice) [135], [108].</td>
</tr>
<tr>
<td>Scientific uncertainty / knowledge</td>
<td>Risks that are scientifically unknown or uncertain (e.g. recombinant DNA) than risks well known to science (e.g. car crashes). People’s beliefs change slowly and are extraordinary persistent in the face of contrary evidence [108].</td>
</tr>
<tr>
<td>Controllability</td>
<td>Risks not under personal control (e.g. pesticides on food) than those under personal control (e.g. driving a car). Perceived controllability lead people to underestimate risks in driving [108], [18].</td>
</tr>
<tr>
<td>Voluntariness of exposure</td>
<td>Involuntary risks (activities where options are determined not by the individuals affected but by a controlling body and not by the individuals affected; e.g. additives in food) are roughly less than 1000 times to be accepted than voluntary risks (activities where the individual uses his own value system to evaluate his experiences; e.g. smoking cigarettes) [118], [108].</td>
</tr>
<tr>
<td>Impact on children</td>
<td>Risks perceived to disproportionally affect children [13].</td>
</tr>
<tr>
<td>Dread</td>
<td>Risks that have dreaded results (e.g. Creutzfeldt-Jakob disease is perceived as an undesirable way to die) [108].</td>
</tr>
<tr>
<td>Immediacy of effect</td>
<td>The extent of which the risk of death is imminent [108].</td>
</tr>
<tr>
<td>Institutional trust</td>
<td>Institutions not able to communicate efficiently their vision of the risks and events modulating the perception of the risk itself [114].</td>
</tr>
<tr>
<td>Media attention</td>
<td>A key element for the modulation and amplification of the risk perception on the public opinion. However, the mass media role in risk perception is under debate [106], [107], [13].</td>
</tr>
<tr>
<td>Attributability</td>
<td>Events that have a clearly attributable responsibility have a higher impact on population (e.g. car accidents resulting from driving under drug influence)[13].</td>
</tr>
<tr>
<td>Clarity of benefits</td>
<td>Technologies or measures that produce unclear benefits (nobody questions the use of house heating despite of the negative environmental impact with the related consequences) [13].</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Risks perceived to have potentially irreversible adverse effects are less readily accepted and perceived to be greater than risks posing no permanent, personal threat [13].</td>
</tr>
</tbody>
</table>
Several of these qualitative factors that influence risk perception are correlated with each other. Two sets of higher order characteristics of factors were identified to explain roughly 80% of the variance of the explanatory scales [113], [112]. These are:

- “dread risk” (uncontrollable, dread, global catastrophic, consequences fatal, not equitable, catastrophic, high risk to future generations, not easily reduced, involuntary);
- “unknown risk” (not observable, unknown to those exposed, effect delayed, new risk, risk unknown to science).

However, it does not mean that these higher order factors can also account for the perceived risk to the same extent [106], [107], [6]. Furthermore, care should be applied when interpreting results generated by the analysis of aggregate data to the individual’s behaviour [6]. Results of studies suggest that lay people’s risk perceptions cannot be based on aggregate data [102]. More recent psychological studies, and in light of the advancement of science and the new challenges and ethical issues that this creates, have identified a few more sets of higher order factors, in addition to the aforementioned ones, which account for differences in risk perception. These are:

- “social and personal exposure” which reflects the number of people exposed to the risk and the personal effect that the risk has [6].
- “unnatural and immoral risk” (or the “evaluation” factor as referred in some studies), which reflects tampering with nature (e.g. genetic engineering, mad cow disease) [106], [107], [77]. This factor mirrors the individual’s ability to discount the influence of their personal positions when they are asked to rate risk severity and appears to have a much stronger impact on individual’s demands for risk control [77].

Other factors such as biocidal potential and delay (persistence, trans-generational effects) seem correlated to the “unknown risk” factor [102].

As stated earlier, a key factor for the perception of risk is culture and generally the system of social values and beliefs [118], [58]. Lay people’s naïve causal explanations of accidents called heuristics (spontaneous explanations that spring from beliefs and representations without explicit reference to a known methodology such as those used by experts), as well as their perception of risks can shed light on their behavioural choices and their different reaction in the face of risk. Such expertise does not contradict technical expertise but can be a useful complement for enhancing our understanding of accident causes and adherence to safety measures [57], [58], [56], [108].
Causal explanations are biased from psycho-sociological processes whose nature may be:

- **motivational** (self – protection, self-esteem, overconfidence, desire for certainty),
- cognitive (availability of information, imaginability and memorability of the hazard),
- **normative** (need to conform to social norms, socializing influences).

These biases that are defensive or illusory by nature depend on the:

- victim’s characteristics such as hierarchical position (high: attributes responsibility to lower ranks; low: attributes accident to external factors such as organization, condition, time constraints, bad luck), age, gender, perception of risk.
- person analyzing the accident (e.g. operators attribute accidents to internal factors).
- seriousness of the accident.

Advertising the benefits of an activity may reduce the perceived risk and may increase the public’s acceptance of a greater level of risk [118], [130], [6]. Acceptability of a risk is negatively correlated with perceived social risk and positively correlated with perceived social benefit. A variable defined as “social trust” may influence perceived social risk (negatively) and social benefit (positively) as these factors are inversely correlated [6]. Whereas the technical assessment of risk is essential to decisions about competing designs or materials, it often fails to inform societal choices regarding technology [90].

A model proposed with attitude (accounting for ideology, values and beliefs), risk sensitivity and specific fear as explanatory variables in risk perception suggested that attitude is an important risk perception component [106], [107], [58]. This model is of different concept than that of the psychometric model. The latter is cognitive in its conception whether the former is a function of properties of hazards.

In the fields of health, environment and technological progress though, attitudes appear increasingly diffused in terms of simplistic cause-effect relationship, often without an analysis of the overall context of the problems, in spite of the complexity and the large number of factors involved. Results of statistical data processing, sometimes referring to non-representative samples, are often wrongly considered as a conclusion and not as a precondition for further investigation. Moreover, mass media may amplify ambiguous or misleading messages, often creating undue alarm, false expectations and frustration. In the long term all these lead to mistrust and confusion.

It has been argued that perceived risk measured on two dimensions (risk of being involved in an accident; perceived danger) which ask for cognitive judgment and an emotional response respectively, corresponds to the two fundamental ways people comprehend risk [113].
Culture has been identified as a major factor that influences risk perception. Because of the implications that culture has on risk perception in general and on road operations, it will be presented in more detail in subsequent sections of this report.

Authorities and Road Operators have to make choices and investments, discriminating between hazards with a reasonably high probability (upon a solid scientific base) and other possible hazards and consider the consequences of these.

The generality of the different factors presented above that influence people’s risk perception can also be extended to those involved in road operations. Hence, perceptions of the risk on the road affect driving and are also related to risk behaviour [38], [65].

Risks from automobile transportation are perceived as not dreadful, known, with a small personal effect, associated with high personal and social benefits and they are not perceived as unacceptable [6]. A study involving different groups of highway drivers showed that fatalistic beliefs influence risk perception and lead to risk-taking and to the neglect of safety measures [58]. A driver’s level of perceived risk has also been showed to be affected by demographic and socioeconomic factors, route geometry, traffic control devices, network level of service, traffic composition, and number of accidents involved or witnessed [41]. Studies suggest that people’s trust on the veracity of the reported road accidents is the highest among other types of risks (e.g. nuclear) [48].

In summary, a great deal of the empirical research on risk perception on road operations appears to have focused on driver factors: age, gender, personality factors, transient or impaired states, etc. Surprisingly little has focused on roadway factors: geometries, traffic control devices, traffic variables, and roadway environment. Although there are scattered facts, there is no clear body of results to suggest how various traffic engineering elements influence risk perception and the ultimate behavioural and safety consequences. Not only is there little agreement on how to measure subjective risk, there is not even much reasoned consideration of how to measure actual risk so that misperception can be characterized [31]. The literature does not seem to provide tools to allow any meaningful estimates of net safety benefits. In summary, despite their size, both the literature on driver risk behaviour and the literature on driver performance variability suffer important limitations. There are weaknesses in methodology and theory, large areas of limited knowledge, and inadequate tools to integrate findings, draw implications, and suggest improvements. This is especially the case when relating risk perception or performance variability to aspects of highway design and operations, since much of the existing work has been oriented toward human factors in driving and related countermeasures (training, licensing etc.), rather than roadway factors where an engineering approach is normally preferred.
2. KEY CATEGORIES FOR RISK PERCEPTION ON ROAD OPERATIONS

The case study and literature findings are next summarized. Because of the aforementioned limitations in case studies and literature findings relevant to perceived risks on road operations, the report discusses these as they relate to the following categories [3]:

- case studies that focus on the road users risk perception and behaviour at specific road elements. Examined elements include road tunnels, railway crossings, and other highway and road design elements;
- case studies that examine differences in risk perception as a function of road user population characteristics. Age, gender, occupation, personality, driving skills, and driving experience are among the examined characteristics;
- case studies that focus on drivers in general and specific road user categories such as pedestrians, motorcyclists and cyclists;
- case studies that focus on cross-cultural differences and beliefs in risk perception. Paradigms include Japan – United States, Brazil – Germany – Spain – United States, and Norway – Ghana comparisons. Risk perception studies of individual populations of countries such as Ivory Coast, Turkey, India and Malaysia have also been identified;
- case studies or articles that address different issues than the ones aforementioned. Identified articles include studies of the effect of risk perception on route choices, speeding, impaired driving, and seat belt usage.

2.1. ROAD ELEMENTS

Case studies relevant to risk perception related to road elements pertained to road layout/elements/characteristics, railway crossings and tunnels. In these studies, the notion of risk perception is defined in a way that relates more to hazard perception.

Road layout/elements/characteristics

Various road elements/characteristics affect risk perception. A study performed across U.S., Spanish, West German, and Brazilian drivers reported the following scene characteristics to have a positive influence (i.e. higher level of complexity results in higher risk-ratings) in the driver's risk ratings [105]: uncertainty, lane intrusion, environment, limited access roadway, preview distance, following distance, intersection, weather, road surface friction, country of the scene, vertical alignment, quick action, road delineation, speed, and horizontal alignment. Characteristics that resulted in risk rating to an unexpected direction (i.e. higher level of complexity results in lower-risk ratings) included complexity, the presence of bridge or tunnel, animals, and pedestrians or cyclists. The counterintuitive findings
were partly attributed to the relativity of the driver’s risk rating (i.e. pedestrians might be viewed as less dangerous than trucks). The risk ratings were unaffected by four scene characteristics: ambient illumination, density of traffic, stopped vehicles in the lane of travel, and overtaking.

Studies in the UK revealed the most underrated and overrated road locations [98], [132]:

- risk underestimated: suburban dual carriageway near a pedestrian bridge, a rural crest on a single carriageway, left turn off a rural road, a rural dual carriageway near a picnic area, and, rural cross-roads controlled by traffic lights;
- risk overestimated: hump-bridge on rural road, level crossing on rural road, suburban shopping centre, right turn onto rural dual carriageway, right bend at the end of rural dual carriageway.

Studies in Greece [51], [136] focused on risk perception of geometric elements at single carriageway curves. The following road elements were ranked according to their impact on perceived risk starting with the most influential: curvature, width, superelevation, sight distance and gradient. It was also observed that the difference in degree of curvature between two successive segments of the horizontal alignment and the warning signing also affect perceptual risk. The findings suggested that remedial treatments must be aimed at the overall upgrading of the design elements as isolated improvements can damage the consistency and affect risk perception in an undesirable way.

A traveller opinion and perception study performed in the US [32] identified that improved roadway lighting, additional use of roadway materials that increase traction, lengthening merge lanes, and providing emergency road information increase traveller satisfaction with safety. A major concern to travellers regarding hazard perception was the condition of highway and roadway surfaces.

Both drivers and motorcyclists in a UK survey about London streets reported that road signage can be inconsistent and unclear leading to confusion and misunderstandings about the rules [120].

Motorway scenarios were rated generally as being the riskiest followed by rural scenarios, with the urban scene scenarios rating the least risky in a New Zealand study [8]. The urban overtaking scenario (overtaking vehicles at street-side parking) was rated the riskiest, followed by the rural pass (oncoming traffic with potential pass from other driver) and motorway merge (traffic merging from left). The urban turn and approaching a vehicle at a “T” intersection were rated the least risky. Overall, driving situations involving trucks and motorcycles were rated as significantly riskier than other vehicles.
In a 2008 survey in New Zealand, the percentage of people (83%) characterizing road travel as very or fairly safe was identical with those who described the design and standards of the roads they use as very or fairly safe [74].

Road safety appears to be an area that provides good examples of difference in perception between common citizen and experts.

For instance it is commonly recognized by experts that the highest standards of safety are possible on motorways as compared to other roads. Moreover, motorways are capable of achieving better progress in terms of improving safety and reducing traffic accidents [4]. Despite facts acknowledged by experts, the clichéd perception of safety on this type of road continues to be widely spread. Answers to questions of this nature need to be investigated within the field of studies concerning the modalities of risk perception and consequent behaviour, more so than on safety statistics. The analysis of different accidents in motorways shows that on one hand users do not always have a correct perception of the risks to which they are exposed and that some features of the individual character and some personal specific situations could lead users to underestimate or overstate the risk [7].

Another example of false belief concerning the safety can be found in the widespread public belief that when driving over porous asphalt the speed can be safely increased. Pavements using porous asphalts prevent the aquaplaning effect and reduce splash and spray, but the road surface is still wet and, even if not clearly perceived by drivers, speed should be reduced. According to the 2005 statistics of the Italian operator ASPI 50% of accidents on wet pavement occurred despite the porous surface.

**Railway crossings**

Case studies involving railway crossings identified that there is evidence of motorist’s compensatory behaviour (speed reduction) in response to perceived risk with restricted visibility. Enhancing lateral sight distances at unprotected railway crossings reduced perceived risk but failed to produce a calculated net safety benefit [131]. Moreover, despite the fact that the design of railway crossings often does not accommodate the greater visibility needs of heavy truck drivers, familiarity with railway crossings may lead to complacency and dangerous heavy vehicle driver behaviour which results in underestimating risk [16].

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Tunnels

Generally people overestimate the risk of accident in tunnels [67]. Perception of risk in tunnels was studied using four cohorts [35]: professional fire-fighters, truck drivers, regular drivers and driving-school students. The main findings are summarized below with the relevant ranking in each situation in parenthesis:

- experience to risk was found to affect risk perception in the sense that having more experience with risk seems to lead to a greater perceived probability of its occurrence (higher estimates of risk: fire-fighters, regular drivers, student drivers, and truck drivers);
- there was evidence of comparative optimism: people perceived less risk for themselves than for others (fire-fighters, regular drivers, truck drivers, student drivers);
- an effect of perceived control on level of optimism was observed. People tend to overestimate their own power of control. Having experience with risk increased perceived control (fire-fighters, truck drivers, regular drivers, student drivers).

Overall, people exhibited strong level of awareness regarding safety devices and the more users frequented tunnels the more knowledge they had on safety devices but this did not necessarily lead to their spontaneous and efficient use or greater compliance. In fact it could lead to an underestimation of risk (i.e. truck drivers has the greatest awareness of safety devices but they were also the ones underestimating risk the most) [35], [55].

In general the false perception exists that in tunnels and in mountain highways the risk of accidents is higher than it actually is. Examples of the consequences of road accidents involving tunnels are provided in section 3.1.1, page 32.

2.2. POPULATION USER CHARACTERISTICS

Several studies have investigated differences in risk perception relevant to age and gender.

Age

There are several studies examining risk perception of young drivers. Many of these studies present comparisons of risk perception between young and older drivers. The consensus is that young drivers in general underestimate risk and overestimate their own driving skills [17], [33], [104], [123], [136], [72], [105], [9] despite the fact that they acknowledge higher accident involvement [18], [33], [88], [39]. Studies have shown that risk ratings are inversely related to ability ratings and that perceived risk and self-perceived driving abilities are interrelated [40], [68]. This suggests that we
need to distinguish the individual’s perception of risks with self-rating of their coping ability on the road [38].

Young drivers adopt a more dangerous style of driving [88] (this applies also to cross-cultural studies performed between Ghanaians and Norwegians [64]) and perceive their own risk to be less than that of their peers [18], [33], [36], [39], [40], [68], [8], [9]. This finding is supported by several studies for broader ranges of the population (illusory belief) [46], [39] but it is much more pronounced in young people. Taking risks is part of the teenage rite of passage [122]. These biases are greater for hazard perception skills than for vehicle control or driving skill in general. The discrepancy between general risk rating and own risk rating concurred by observation of inverse correlation between perception of risk and frequency of involvement in risky behaviour [63] may explain their risk-taking behaviour [33].

A study has reported that young drivers overestimate risk in low and medium risk situations [68]. However, they underestimate risk in situations involving tailgating, driving at night, speeding, driving on snow, driving after drinking, driving in inclined/declined curved roadways, and driving in rural environment [33], [68], [88], [123]. The use of seat belt in young drivers helped maintain the perception of risk which otherwise decreases with familiarity of the road [5].

When compared to older drivers, hazard perception skills of younger drivers were lower (smaller range of horizontal scanning, glance at objects and check the mirrors less frequently, fixate on fewer objects, look closer to the front of the vehicle) and this may be contributing to their higher accident involvement [17], [33], [87], [95]. Young drivers also reported higher levels of excitement-seeking, lower levels of altruism, greater perceived likelihood of an accident, and lower aversion to risk [88], [44]. It has been argued though that young driver’s lack of experience may also play a significant role in accident involvement [38]. Teens tend also to be less receptive to road safety messages. About 70% of teens in a UK study claim awareness to road safety messages from either advertising or other information sources [121].

A study involving young people up to 25 years old in the UK perceived “drinking and driving” as the most important cause for road accidents (from the driver’s liability point of view) followed by “drivers not paying attention” and “drivers taking risks.” They perceived “driver error” to be a more important factor in traffic accident causation than “faulty or poorly maintained vehicles” and lastly “poor road layout” [20]. Studies in the US and the UK have revealed though that the actual respective contributions of these factors are 94.8 %, 8.5% and 28% [98]. When asked which driving aspect they would like to have improved they answered “parking” (19%), “judging speed and distance” (15%), “gaining experience” (14%), “improving concentration and observation” (10%), “driving in busy conditions” (9%) and “motorway driving” (9%).
A study performed among Norwegian young drivers [96] found that cognition (rational aspects such as assessment of probability of accidents) was not an important predictor for self-report risk behaviour whether emotion (sensation seeking, normlessness indifference with regard to traffic safety) was. This finding was in agreement with study on pre-drivers and learners which reported that their assessment that someone is a good driver is not based on a cognitive assessment but on affective reaction [24]. Personality had small effects on risk perception but strong effects on risk behaviour. This suggests that in order to influence behaviour and enhance traffic safety in young drivers, measures should be directed at influencing emotional reactions to traffic hazards.

A study in Spain reported a distrust and criticism of public administration and a misconception about who benefits and how from fines and sales. Young people see media campaigns and educational programs as useless interventions and consider that an effective measure to reduce traffic injuries is to improve public transportation particularly at weekend and at night (a finding also supported by the European Action Plan recommendations) [88].

Older drivers perceive themselves at a comparable risk as their peers and perceive young drivers to be more at risk [33], [68], [126], [41], [83]. They have different perceptual patterns [125] and their risk perception is not affected by familiarity of the road or safety belt usage [5]. Compared to young drivers, they seem to perceive a higher risk for speed and a lower risk for surface friction [105]. Health-related factors are seen as very important in the context of driving. Older drivers are interested in educational modules that address health-related issues, rely on physicians to detect medical conditions that can affect driving behaviour as they are mostly interested in maintaining mobility [126].

A study in New Zealand reported that older drivers rate high and low risk situations as riskier than other drivers do [8]. From a driving behaviour perspective, the elderly are more likely to ignore red lights at controlled intersections and often fail to follow give away rules at intersections. In contrast, young drivers perceive inner city driving as less hazardous than older drivers, drive at higher speeds, make overtaking manoeuvres and accept smaller gaps when turning at intersections. The differences in these two perceptual and behavioural styles may explain why most crashes in New Zealand are reported in mid-afternoon, the time of the day when these two age categories share the same road the most.

**Gender**

Males in the early stages of their driving careers, like younger people, show overconfidence compared to females and older people respectively [23], [8]. Males indicate the greatest willingness to accept risk in driving situations and rate their
own driving skill as higher [8]. They are also more resistant than females in changing their driving habits [126].

In spite of the behavioural differences, case study findings are mixed when it comes to assess differences in risk perception. It seems that gender differences are revealed when comparing young males to young females. The former are more optimistic, and, in spite of having similar perceptions of concerning the frequency and accident likelihood of the risky behaviours as females have, young males perceive these behaviours as generally less serious less likely to result in accidents [19] with the most pronounced differences in assessing seriousness being driving without a seat belt, driving after drinking, and not making a full stop at a stop sign. Although no gender difference in ratings of driving ability was found [38], young female drivers provide higher risk ratings than males of the same age [40], [8] and do not underrate risk at traffic situations compared to their older peers as much as young males do [123], [40] but they underestimate risks at intersections.

Main effects of gender in risk perception on road operations were identified in studies from Israel and New Zealand that examined older age spans [95], [8]. In these studies females were found to exhibit in general higher levels of perceived risk than males. However, studies performed across different countries (U.S., Spain, West Germany, Brazil) failed to demonstrate significant gender effects in risk perception [105] and a study performed among Norwegian and Ghanaian drivers found gender differences only for Norwegians (however, it was argued that this was a consequence of the struggling for survival for Ghanaian drivers) [64]. A study in Jordan [41] reported that the population category with the lowest level of risk perception is male drivers with high income and that risk perception is more influential in female drivers of lower income, having more children, and being married.

Besides the age and gender population characteristics, a study performed in Ivory Coast investigated other population characteristics such as occupation, driving experience and accident history [55]. That study revealed that people explain road accidents in a self-defensive way and they overestimate the importance of road accidents regardless of occupation or accident exposure. The major findings are presented next.

**Occupation**

Students, driver trainees, professional drivers, highway patrolmen, city policemen, engineers, and ordinary driver were the population cohorts examined. Overall, the most important factors identified to influence risk perception were: pedestrians, weather, vehicle, driver, infrastructure, and fate. Professional drivers were more fatalistic and attributed risk to factors beyond the driver’s control (bad luck, infrastructure, pedestrian, weather) as opposed to highway patrolmen that attributed
risk primarily to road users (risk ranking: pedestrian, driver, vehicle, weather, infrastructure, fate). People who drive the least (trainees, students) and those who do not manage road hazards (professional drivers) were the most risk-taking. The least risk-taking and least fatalistic were the engineers. The study supports the conclusion that people’s occupation and their past exposure to road risks and accident prevention campaigns do affect explanations they give in a defensive way: accidents are ascribed more to external factors and less to internal factors that bear personal responsibility.

### Driving experience

People were categorized based on the number of years of driving experience. People with the least (0-2 years) and the most (more than 16 years) driving experience were the most risk-taking. Lack of knowledge and underestimation of risk were hypothesized to be the driving factors for the former group and fatalistic attitude for the latter. Overconfidence in their driving skills was common for both groups. Road accidents were the most dreaded risk. Other studies have shown that driving experience was more important than age in explaining differences in on-road speed and consequently accident liability [23], [22].

### Accident history

The Ivory Coast study did not find a correlation between accident history and risk perception except that it renders people more cautious. Frequent experience of risk without harm can reinforce one’s perception of control. However, studies have found inverse correlations between hazard perception skills and accident liability. This will be elaborated in more detail in subsequent sections.

### 2.3. USER CATEGORIES

Several studies have focused on driver risk perception. Most of them refer to car drivers although categorization is not always explicitly mentioned in all of them. A few studies have focused on specific categories of road users such as pedestrians, cyclists and motorcyclists. Inferences about heavy vehicle drivers were presented in section 2.1 of this report.

### Drivers

Several factors were identified to influence driver’s risk perception such as the presence of traffic signals, the degree of competing traffic flow, the competing pedestrian activity, the reduced sight distance, and, the unusual road layout [45]. Overall, as driving risks increase, a driver’s level of perceived risk increases [41].
A factor analysis showed that the subjects driving were thinking about risk along five dimensions which are not highly inter-correlated [39]. The major foci were:

- driving environment and road conditions;
- unexpected events occurring (car failures, pedestrians crossing, cars stopping and pulling out suddenly);
- problems with the drivers (fatigue, not paying attention, not knowing the road code);
- involuntary risky driving behaviours (speeding, driving in busy traffic, driving without caution in an emergency, driving after drinking a small amount of alcohol, overtaking, and driving near schools);
- voluntary driving risks (ill, fancy manoeuvres, too many passengers, speeding).

It is interesting that the subjects believed that speeding, driving in busy traffic, driving without caution in an emergency, driving after drinking a small amount of alcohol, overtaking, and driving near schools, as risky driving situations that are involuntary parts of driving [39].

A study in New Zealand [8] found that drivers with high driving error scores had the highest risk perceptions, were risk averse, rated their own driving skills lowest, and were most likely to see other drivers as posing a serious problem. In the same study, rural drivers rated high and low risk situations as riskier than urban and secondary urban drivers. It should be noted that driving scenes including trucks were the most consistently associated with high risk ratings.

No significant differences in risk perception between professional versus non-professional drivers were reported from a study performed in drivers of four countries (US, Spain, West Germany, Brazil) [105].

Drivers’ route choice decision-making process is also influenced by the level of perceived risk. A study in Jordan [41] reported that the factors that increase the level of risk perception in drivers and may result in change of route selection are: travel time and travel distance, congested transport network, presence of heavy vehicles and median island, route geometry (decreased route capacity), traffic control (unsignalized intersections and pedestrian crossings), and lack of public transit services (drivers have an increased level of exposure to risks which may increase their risk perception). These factors are more likely to influence the route choice of drivers of age 29-39.

Driver’s attitude, behaviour, knowledge and hazard perception are highly correlated with self-reported collisions [15]. Driver’s attitudes and behaviours are a predictor of collision involvement though their impact appears lower than exposure variables such as mileage, hours driven and having an aggressive personality [15]. This may suggest that efforts should be focused in promoting a safety culture and make use of education programs to improve driver related attitudes and behaviour. Hazard perception does
not appear to be a strong predictor of collision involvement. It is important though in underpinning attitude, behaviour, personality and exposure [15].

**Cyclists**

People perceive bicycling to be the riskiest mode of commuting, followed by automobiles and walking, with transit being considered the safest. Nearly one out of three travellers responding to a questionnaire in the US provided a failing grade to the road and transportation system for bicycle safety and mobility [32]. However, perceived safety improvements in bicycle transportation attract proportionally more people to bicycle commuting (have an aggregate elasticity value greater than one or in other words the proportional increase in the percentage of people commuting by bicycle is greater than the percentage decrease in perceived risk) [83].

Perceptions of risk for cyclists generally agree with aforementioned studies examining different characteristics in that they exhibit lower perceived risk with: age, not having been involved in a near-accident, and being a male [124]. Traffic intensity increases their levels of risk perception but the influence decreases as the bicycle volume increases.

A study [76] examining risk perception of cyclists in roundabouts (81% killed in roundabouts are cyclists or moped riders) reported that cyclist perception of risk was influenced by roundabout design factors where existence of cycle-facility reduced perceived risk. However, clear evidence of a safety effect of a cycle facility has not been established yet. Underestimation of risk and lack of knowledge about relevant traffic rules may explain the high percentage of cyclists killed in roundabouts. Cyclist’s perceived risk for entering and exiting cars was in agreement with actual risk.

Generally, cyclists’ increased level of perceived risk is also related to the low levels of perceived control and predictability that they exhibit [106], [107].

**Motorcyclists**

Motorcyclists generally underestimate accident probability [97]. The importance of the lived experience of riding encourages motorcyclists to downplay the potential of injury and death [78].

**Pedestrians**

Pedestrians are usually ignored by the drivers because the latter focus on the road ahead, are cocooned, and/or perceive pedestrians not to pose a significant threat. Risk perception varied between drivers and pedestrians with respect to the following situations: straight road with no need for manoeuvres, complex intersections,
right-hand turns and motorway merges, and left hand turns with poor sight lines and narrow bridges. When drivers become pedestrians they assess more accurately the road risks which they underestimate while driving [45].

In a UK study for London [120], walking was seen as the safest way of using the streets without being involved in an accident.

Child pedestrians are poor in identifying dangerous situations. They have not developed an adequate perception of risk. A study showed no difference in risk perception between males and females although actual statistics support the existence of these. This suggests that boys and girls may be looking at different aspects of the scene with boys focusing on physical environmental factors and girls on human factors [129].

Pedestrian safety and mobility is an issue that is important to travellers in the US who perceive that this issue has yet to be addressed adequately [32].

**2.4. CROSS-CULTURAL DIFFERENCES AND BELIEFS**

Culture is a key factor for the perception of risk. Attitudes to risk depend strongly on national characteristics and on the value attached to freedom of the individual in relation to the perceived seriousness of the prevailing road accident situation [98]. Demography, education, income (the lower, the higher the risk toleration [13], [84]), enforcement (most definite difference between developing and developed countries in terms of road safety [59]), and, motivation are all factors that influence risk perception [1], [92]. A more in-depth analysis of the influence of these factors is provided in section 3.5 of the report. A case study is presented in Appendix A (case study 2, page 68 to 77). Different cultures may adopt different approach to mitigate risk. However, cultural reason does not deny the role of technical reason; it simply extends it [86].

The importance of taking into account naïve causal beliefs of the target population when planning safety campaigns and communicating risk has been demonstrated [57]. Campaigns should be targeted and adapted to the culture and context of each group or organization [57].

Fatalistic beliefs and mystical practices influence risk perception, lead to more risk-taking in traffic and to the neglect of safety measures [54]. A study in Ivory Coast reported that fate was a significant factor in attributing road accidents. Subjects overestimated the mortality rate of road accidents and perceived higher risk from them compared to other calamities [55]. Professional drivers were the most fatalistic among all examined categories. Young drivers (less than 21 year old), those who had held their license less than two years, and professional drivers were among the most fatalistic. Fatalistic subjects attributed accidents more readily to factors out of the driver’s control, underestimated risk, and displayed a more risk-prone attitude. [55], [54].
A few studies examined differences in risk perception related to road operation across countries. These are summarized below.

A study investigated differences in risk perception for various road parameters among drivers in four countries: US, Spain (S), West Germany (WG) and Brazil (B) [105]. Statistically significant differences in risk rating among countries were identified in the following situations (in parenthesis the country that perceived the parameter as being among the most influential: lane intrusion (US, B, WG), urban environment (B), following distance (WG), country of the scene (B), quick action (US), speed (S), ambient illumination (B), complexity (S, WG), animals, pedestrians (US), and bicyclists (US). Perceived risk ratings generally differed with the US providing the lowest ranking of risk followed by WG, B, and S. Driver self-assessment was significantly different for the different countries [104] with the US drivers placing themselves more frequently in positive categories in general.

A study of differences in risk perceptions between US and Japan [43] examined four user categories (car drivers, motorcyclists, bicyclists, pedestrians) to the “dread” and “unknown” risk factors. The summarized findings are following:

- Japanese overestimate the risk of accident and see themselves as more likely to be at fault. The one-sided nature of fatal accidents in Japan where more “vulnerable” (i.e. cyclists, pedestrians) subjects are killed may have contributed to the higher observed dread of risk accidents;
- in interdependent societies like Japan, being ostracized from one’s group for failing to compensate those whom one hurts is a serious penalty. This concern for others may explain the Japanese driver’s higher dread. In independent societies, like North America, people emphasize their uniqueness and independence;
- risks for car drivers and pedestrians are higher for Americans whereas risks for motorcyclists and bicyclists were higher for Japanese;
- youngest and oldest motorcyclists, pedestrians and bicyclists experience high fatality rates in Japan. Younger and older drivers experience high risks in both countries;
- traffic-accident risks in Japan are greater for people not in an automobile (60%) whether the opposite is true for the US. This resulted in different risk-mitigation policies where Japan favours law-enforcement and education options whereas the US has more stringent vehicle safety regulation;
- differences in traffic environment can explain some of the cross-national difference of automobile risk perception. The Japanese buy car insurance mostly to cover damages and compensate harm done to others (result of higher number of non-car users being killed) whether Americans buy insurance to cover monetary losses from both collision and liability accidents (result of greater lethality of US traffic accidents) and to cover lawsuits.
A study comparing Norway and Ghana [64] in risk perceptions and attitudes towards traffic safety and risks found differences related to traffic risk perception, risk sensitivity and risk willingness between the two countries using a questionnaire previously validated and found suitable for measuring such attitudes [49]. Ghanaians perceived higher traffic risk than Norwegians (both involvement and consequences). The study argued that sensitivity to risk and perceived risk may be related to risk exposure as fatality rates per 10,000 vehicles are about 30 times higher in developing countries than in high-income countries (in 1998 low income countries accounted for 85% of all traffic fatalities globally [134]) and/or to struggling for survival. Only risk willingness contributed in explaining variance in driver behaviour in Norway. None of the risk perception measures contributed to explained variance in Ghana. This suggests that either the questionnaire was unsuitable for Ghanaian culture or that social cognition models claiming that attitudes are significant predictor of behaviour are less suitable for low-income countries. The study suggested that traffic safety campaigns should be developed locally instead of being imported from industrialized countries that do not account for cultural differences.

Other studies report differences in risk ratings and risk perceptions across countries. For example, studies have shown that Norwegians perceive risk similar to Americans but they tend to perceive less risk [37]. Hungarians rated traffic risks lower than the French or the Americans and Polish perceive lower risks from motorcycles, vehicles and bicycles than Americans [37]. Brazilians have a higher perceived risk than Chileans regarding hazards associated with transportation [6]. Overall, there is greater variation in risk perception between countries than between different regions in one country [37]. It seems plausible that objective differences in risk environments combine with cultural differences to produce cross-national differences in risk perception.

2.5. MISCELLANEOUS

Other topics relevant to road operations and safety were studied with respect to how risk perception affects these that do not fall into the categorization presented above.

Seat belt usage

Studies have showed how incorrect perceptions of risk which often spring from erroneous beliefs (e.g. from clichés or from incorrect and contradictory communication on safety and levels of risk) can become consolidated.

For instance, it appears to be a quite widespread opinion that in the event of an accident, the rear seats are safer and therefore people deem that it is not necessary to fasten rear safety belts. A recent statistical evaluation of the number of children killed in road accidents in Austria showed that half of them died while travelling as passengers in cars, usually their parents’ cars. Most of them were either not belted in
at all or were wearing incorrectly fitted belts. To this purpose, Austrian Authorities launched a specific communication campaign on the subject (see figure 3 and video available on²).

A study in Turkey [103] showed that the degree of perceived risk while travelling is an important factor related to seat belt usage and that there is a false perception that rear seats are safer in which one does not need to wear a seatbelt. A study in the US [80] reported that although about 95% of individuals agreed that they would want to wear their seat belts in case of accidents, however, nearly 25% of drivers exhibited strong fatalism reporting that if it is your time to die you will die. In New Zealand, 95% of the people interviewed also agreed that seat belt usage helps to lower the road toll and an 87% that seat belt enforcement helps to lower the road toll [74]. Pickup truck drivers were less likely to report safety belt use compared to other drivers. The study supported the more risk-prone behaviour of men and younger people compared to females and older people respectively, and revealed cross-cultural differences, consistent with case study findings reported in previous sections of this report. Generally, people with more years of formal schooling tended to be less fatalistic, less ambivalent about the injury reduction benefits of safety belts, and less self-conscious about going against group norms of non-use. Studies have reported that the risk of apprehension and its consequences from not using a seat belt may be of more import to people than the perceived risk of accident. [59].

**FIGURE 3 – AUSTRIAN MEDIA CAMPAIGN ON THE USE OF SAFETY BELTS IN REAR SEATS [61]**

Choice of transportation

Three general approaches have been trying to reduce risk in transportation.

- **Engineering approach**: assumes that straightforward engineering calculations on accident reduction will result in a direct reduction in accident rates. The primary drawback of this non-interactive approach is that it assumes that the risk taker does not react in any way to reductions in risk.

- **Economic approach**: attempts to redress this fault by treating risk (or safety) as a commodity. People seek to maximize their utility, which may involve trading off increased levels of safety for other goods. The general result of a reduction in risk will be some substitution of that reduction for other goods. This type of response to less risk is a compensating behavioural change that may offset or negate the desired risk reduction which could potentially increase the total societal risk.

- **Risk homeostasis** [133]: the basic premise of this theory is that people maintain the same target level of risk over time. Homeostatic control process similar to a temperature regulation mechanism in animals. Changes in the level of safety would induce a behavioural response mechanism to return to a desired target level of risk per unit of time. This implies that the only way to achieve reductions in accident rates is to develop policies that motivate individuals to reduce their target level of risk. It suggests more training in enhancing risk perception skills. However, studies claim that accident data do not support the theory [30], [44]. A case study relevant to risk homeostasis is presented in appendix A (case study 3, page 78 to 87).

There is evidence that increases in perceptions of risk of using a given transportation mode may reduce the probabilities of commuting by that mode (if the choice exists). When a change in the objective risk of a transportation mode triggers a change in perceived risk, there is a less proportional decrease in fatalities. This implies that “risk compensation” or partial offsetting does occur [91]. Reduction in commute travel fatalities do not fall proportionately with reductions in risk. This is also dependent on the relationship between objective risk and how risk is perceived. Reductions in transportation risk can have less than the expected impact on total transportation system fatalities, due to partial compensation for the risk reductions embodied by shifts between modes. The results are supportive of at least partial risk compensation within the transportation system and that perceptions of risk are significant in determining modal choice [83].

Risk or safety perception related to modes transportation can also be related to other environmental or surrounding factors. Hence, in a UK study [119], cars were considered a safer mode of transportation in London than buses which were considered safer than the underground. Factors that influenced this judgment included the reliability and the frequency of the service and the condition of the environment (well-lit streets and stations, discrete presence of police, waiting time, etc.). Well-maintained environments increase perception of security.
The general finding is that transportation modal shifts occur when risk perceptions for a given mode are changed.

**Speeding**

In industrialized countries speeding is a factor in around 30% of highway deaths [81]. In spite of the general support for speeding enforcement, an approximately 70-80% of drivers report speeding [45]. A 2008 survey in New Zealand reported that 17% of drivers do not acknowledge that speeding is risky [74]. Failure to acknowledge risk was more common among drivers who have had speeding tickets. People generally believe that in straight motorways with low traffic, the only risk in exceeding the speed limit is to get a fine (false perception of risk coming from the holding of a reduced attention). Studies in the US and Canada [81], [124] have reported that despite the fact that drivers feel that other driver’s speeding is a major threat to their own personal safety there is a general claim for higher speed limits (68% and 51% respectively for US and Canada). In New Zealand however, 86% reported that road speed limits were about right [74].

A study in Canada [124] reported that Canadians view speeding as dangerous and they associate it with increased risk of collision, injury and death. However, they believe that while they are technically speeding, they are not driving in a way that endangers either themselves or the others. Other findings include:

- **52% believe that people should keep up with traffic regardless of the speed limit.** People believe that is as dangerous to drive 20 km/h over the speed limit as it is to drive 20 km/h under;
- **top reasons for speeding: not to be late (57%), belief that speed limits are too low (51%), not paying attention (51%). Only one out of five speeds because they enjoy the feeling;**
- **30% of drivers fall in two distinct groups because of their tendency to speed more than other drivers or because they perceive less risk associated with it: “Risk-takers” (enjoyment) and “Pragmatic Speeders” (they speed for more practical reasons such as getting to their destination faster);**
- **people seemed far less concerned about other implications of speeding (i.e. economic impacts from increased gas consumption or environmental consequences with about half of people not believing that speeding contributes to the green-house effect).**

The study concludes that communication efforts should focus on trying to change the attitudes and behaviours of these two groups (and should be tailored for each of these audiences) as they pose the greatest danger.
Impaired driving

Impaired driving is the leading cause of deaths in highways. In a Canadian study [25] where half of the people interviewed had a past conviction for impaired driving, risk was defined as the probability of being apprehended or having an accident (generally and with bodily injury) while impaired. The factors identified to affect the way individuals perceive risks were age (the younger underestimate risk), the accumulation of violations during the year preceding the survey (people with accurate perception of risks commit fewer violations), knowing the legal alcohol limit for driving (more accurate risk perception in all three risks), agreeing with a possible amendment introducing zero tolerance for drinking-driving into the Highway Safety Code (overestimate general risks but underestimate the risk of a bodily injury; generally they have a less accurate perception of risk), and family income (low incomes overestimate risk of being arrested). Surprisingly, being a non-drinker did not have much impact on perceptual biases except of having a more accurate perception of the probability of being involved in an accident causing bodily injury. No gender differences were identified.

The risk perception variable was significant in predicting violations and demerit points accumulated but not in predicting occurrence of accidents (with or without bodily injuries).

In a 2008 New Zealand survey [74] despite that only 8% agreed that “there is not much chance of an accident when driving after drinking if you are careful,” 52% favoured lower legal blood-alcohol limits for driving with people over 25 years old favouring the reduction more that the younger.

3. IMPLICATIONS OF RISK PERCEPTION

3.1. IMPACT OF A MAJOR EVENT – MAGNITUDE AND SOCIAL AMPLIFICATION OF RISK

Perceptions of risk play a key role in a process labelled “social amplification of risk” which occurs in two stages: in the transfer of information and in the response mechanisms of society [113], [52]. Social amplification is triggered by the occurrence of an adverse event, which could be a major or minor accident, a discovery of pollution, an outbreak of disease, an incident of sabotage, and so on, an event that falls into the either risk-unknown or risk-previously-ignored category and has potential consequences for a wide range of people.

While risk analyses typically model the impacts of an event in terms of direct harm to victims (deaths, injuries, damages), through the process of risk amplification, the adverse impacts (monetary and nonmonetary) of such an event sometimes extend far
beyond the direct damages inflicted to victims and property and may result in massive collateral impacts such as litigation against a company or loss of sales, increased regulation of an industry, alienation from the community affairs, loss of confidence in institutions and so on. In some cases, all companies within an industry are affected, regardless of which company was responsible for the mishap.

Thus, metaphorically speaking, the triggering event can be thought of as a stone dropped in a pond. The ripples spread outward, firstly encompassing victims directly affected, then the responsible company or agency, and, in the extreme, reaching other companies, agencies, or industries [109], [110], [115], [116] (see figure 4).

Examples of events resulting in extreme higher order impacts include the chemical manufacturing accident at Bhopal, India, the disastrous launch of the space shuttle Challenger, the nuclear-reactor accidents at Three Mile Island and Chernobyl, the adverse effects of the drug Thalidomide, the Exxon Valdez and the recent Bay of Mexico oil spills, the adulteration of Tylenol capsules with cyanide, and the terrorist attack on the World Trade Centre and the deaths of several individuals from anthrax.

An important aspect of social amplification is that major indirect impacts can be triggered by relatively minor direct impacts resulting in consequences that may exceed direct costs by far. The seven deaths due to the Tylenol tampering resulted in more than 125,000 stories in the print media alone and inflicted losses of more than one billion dollars upon the Johnson & Johnson Company, due to the damaged image of the product. The ripples resulting from several deaths due to anthrax have been even more costly than the Tylenol incident.

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3.1.1. The case of road tunnels

Examples in road operations that can be of use in assessing the consequences on public perception following the extensive media coverage of road accidents include the financial implications and the triggering of regulatory action that road tunnel accidents resulted in.

Road tunnel accidents such as the Mont Blanc tunnel (France/Italy; 39 deaths – March 1999), the Tauern tunnel (Austria; 12 deaths – May 1999), and the St. Gotthard tunnel (Switzerland; 11 deaths – November 2001) occurred in the European road network. All these accidents have the common point that fire spread from heavy goods vehicles in a confined space. All three cases had a strong impact on the mass media and public and it can be seen that most of the features of risk amplification described above applied.

It is worth noting that fire accidents in tunnels have a strong emotional impact on the public and media, a shocking effect that often goes well beyond the registered damage. Fires in tunnels shake souls and fill the pages of international newspapers because of the nature, the rareness and maybe the exceptional dimension on the impact of the facts. On the other hand, the coverage of the total road death toll which may include twice, ten times or even more number of victims, is only weekly reported in the national press in the form of a short paragraph of chronicle.

For a long period the aforementioned events were under the media spotlight. As a consequence, the European Institutions decided to establish new provisions for the “minimum requirement of safety” for all European tunnels. According to the preliminary budget of the European Commission, the total cost coming from the Directive was in the range of 2.6 billion Euros to 6.3 billion Euros as of 2002 [29]. The refurbishment cost of the Mont Blanc tunnel was in the range of 300 million Euros, but even higher are the costs for the overall Italian and French economy because of the 3 years closing of the tunnel (estimated in 3-400 million Euros for each year^4).

Considering the events in tunnels regarding the different road factors that influence the perception of risk (see section 1) it can be observed that in the case of tunnel fires the following factors were primarily involved:

- **catastrophic potential** – The fires in the Mont Blanc tunnel (1999), Tauern Tunnel (1999) and St Gotthard tunnel (2001) showed the potential for significant loss of life, bodily injury, property damage and business interruption compared to standard

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^4 Valutazione degli effetti economici sui sistemi regionali e nazionali della chiusura del traforo del Monte Bianco, Prometeia, maggio 1999.
road accidents. On the other hand, people have no perception of the fact that, in the history of worldwide transportation, the short-list of fire accidents resulted in fatalities [85] accounts for an extremely limited number of events and, that only the three above listed accidents resulted in more than 10 fatalities each;

- **familiarity** – people are more concerned about unfamiliar risks. People are not frequently exposed to fires in tunnels, while almost every week when driving in a major town it is likely to encounter a car or motorcyclist accident;

- **controllability** – people are more concerned about risks which are not under personal control. When a major fire ignites in a tunnel, the physics of the phenomena could be out of human control;

- **voluntariness of exposure** – people are more concerned about risks that are imposed rather than voluntarily accepted; we can consider that speed related accidents are, to some extent, the consequence of a voluntary action, which is not the case in the event of a tunnel fire;

- **dread** – people are more concerned about risks that have dreaded results. It is not a perceived, accepted or imagined outcome to be burnt or to die from suffocation as a result of a tunnel fire;

- **media attention** – the attention of media is a key element for the modulation and amplification of the risk perception on the public opinion; even a minor event related to fire triggers the attention and quickly reach forefront of media worldwide. In figure 5 there is a pre-war vintage example: in March 1929 a New York rail fire in tunnel (9 fatalities) made the front-page on “il Mattino illustrato”, newspaper of Naples (Italy);

- **impact on children** – people are more concerned about risks perceived to disproportionally affect children; In figure 5, following page, we can observe that the painter of last century Ugo Matania, emphasized the event by putting several children in the illustration, one in the central position.
3.1.2. The case of fog accidents

Pile-up of cars in the event of extreme weather conditions such as “fog” (see figure 6), is an additional example of those events that, independent of frequency, are clearly perceived by the public and highly amplified by the media.

It can be observed that the attention and exposure of the media are not necessarily related to statistics. Similarly, sometimes the public’s attention is not necessarily driven by events similar in happening but by events similar in media coverage. In figure 7, a road fog accident which occurred in Italy in 2003 following a sudden, thick fog, received extensive media coverage (snapshots of BBC\(^5\) and VOA\(^6\) articles are reported) which also referred to links relevant to fire in tunnel events (the BBC news coverage on the fog crash of March 13\(^{th}\), 2003 links to news of October 24\(^{th}\), 2001 related to the fire accident in the Swiss tunnel of St. Gotthard).

The event of 2003 was extremely severe and resulted in several fatalities. However, “extremely severe consequences to human life” are not the only triggers for media attention. For instance, a pile-up collision resulting in a single fatality in Austria

\(^5\) [http://news.bbc.co.uk/2/hi/europe/2847995.stm](http://news.bbc.co.uk/2/hi/europe/2847995.stm) - BBC news: 12 dead in Italy’s car pile-up

garnered media broad attention (e.g. on Spiegel\textsuperscript{7}). A similar interest from media wouldn’t have occurred for a single fatality related to “ordinary” road accidents.

\textbf{FIGURE 6 – RESULTING PILE-UP FROM CRASH WHICH HAPPENED ON A21\textsuperscript{8} MOTORWAY, ON FEBRUARY 22\textsuperscript{ND} 2008}

\textbf{FIGURE 7 – CRASHES WITH CAR PILE-UP ARE EVENTS SHAKING MEDIA}

\textsuperscript{7} \url{https://www.spiegel.de/international/europe/0,1518,543351,00.html} Spiegel news: One Dead in 60-Car Pileup in Austria

\textsuperscript{8} Image from \url{http://www.ilgiornale.it/a.pic1?ID=243192}
3.2. ENFORCEMENT/AWARENESS OF THE POPULATION

The impact of extreme events across the globe is enormous [127]. It hinders the progress of the struggling developing societies and threatens most industrialized countries alike. People and societies are becoming more vulnerable to natural disasters due to their own activities that lead to increasing poverty, population growth and urban density, environmental degradation and climate change. Although natural and man-induced risks threaten every society, in practice they are proportionally more disruptive in developing countries where they tend to harm, most of all, the poor.

Information society and systems and public awareness programs have significant implications in promoting disaster reduction measures which are an essential component of sustainable development policies and programs. Road accidents are reported to be the main cause of death for young people between 15 and 25 years old [98], [95]. To most people property damage is undoubtedly secondary to loss of life and all but the most minor of injuries. The paradox here lies in the fact that methods for calculating costs of traffic accidents are driven by property damage figures. Standard prevention campaigns may be ineffective if they fail to account for the beliefs and the expectations of the targeted population [57]. The wider circulation of relevant information and data has the potential to inform and involve worldwide local communities, empowering individuals to affect change in their own society. This will in turn facilitate the overarching goal of making communities and nations resilient to natural disasters.

The anticipated outcome is to develop and foster a clear statement of political will and a concrete plan of action for achieving the goals of the Information Society, which should fully incorporate the topic of disaster risk reduction. Disasters related to natural risks can setback economic development many years. Exchange of information and communication practices play key roles in the realization of effective disaster risk reduction activities. Data availability is crucial for ongoing research, to monitor and assess risks. Integrating new developments in information management with established and more traditional methods can help create a better understanding about risk through, for example, public awareness programs. Effective information management and communication are also instrumental for early warning systems and effective mitigation efforts.

Traditionally, information on disasters focused principally on their impacts. The topic now requires the integration of a growing number of topics that need to be understood to reduce the risk of future events, as well as the involvement of a growing number of interested stakeholders, educational institutions, organizations and local community users. Websites, networks, multidisciplinary and professional
exchanges and other means of communication have emerged to disseminate information about disaster risks, and to seek new ways through which people can work together in reducing risks.

Information society and public awareness programs should account for people’s willingness to pay for reduction of correctly perceived risk. Improvement of information and communication channels is warranted so that people can learn more of what they can expect from others and what others may expect from them [57].

### 3.3. Policy Formulation and Regulatory Action

The implications of risk perception in regulatory action may be viewed in a broader political action context or a more targeted context relevant to road operation. The discrepancy between what experts deem most important and what the public demands of its government raises difficult political questions [128], [86], [113]. Approaching the regulatory action in a systematic way, we can say that the risk assessment and prevention focuses on nine main topics (importance, gravity, externalities, complexity, hardship, territoriality, dynamic, perception, willingness to treatment).

The effectiveness of such action, however, is conditioned by the existence of two pre-requisites: the political action, which is essential for the coordination and harmonization of all active interventions, and the legislative action.

In legislative action policies are often formulated after receiving input from the technical field. Risks are mostly considered in relation to the community as a whole, or to groups of road users, rather than to the individual. Yet, it is the risks as seen by individuals, either actual or perceived, which frequently determine the acceptability or success of countermeasures [98]. Moreover, legislative action is coordinated at several interdependent decisional levels such as the technical field, the provisions for the promotion of cooperation between public and private sectors, rules and regulations aimed at preventing and reducing the risks themselves, the operational rules for collaboration coordinated intervention from different bodies and rules on sanctions for immediate effect.

The substantiality of risk can influence the choice of proper investments and action plans [60]. Understanding how people perceive risk have significant implications in understanding phenomena regulating human behaviour (misperception, underestimation of risk). Cost-benefit analyses are used in the transport sector as a basis for comparing different development projects or the efficiency of regulatory action. Often in these analyses, the benefit is not much higher than the cost and conclusions regarding socio-economic profitability cannot therefore be made [91]. Furthermore, the human life’s worth greatly varies among the different countries.
This is attributed to the figures that the local authorities use when they calculate which road projects are socioeconomically profitable. It has been argued [91] that there is a need for new valuation studies aiming at achieving the methodologically most valid valuations in a way that covers all branches of transport, with the intention of applying them in cost-benefit analyses.

In road operations, a study indicates that policies that rely on changes in motorist behaviour tend to be most effective when they are first introduced, because at that time public awareness is high [79].

In road safety, formal targets are not always widely adopted but they are often implied. Considerable effort has been devoted to the application of cost-benefit and cost-effectiveness techniques in considering remedial measures. Nevertheless, there is much scope for further work in order to make the best use of these techniques. When considering remedial measures, the most effective remedy is not necessarily linked to the main cause of accident [98].

In summary, the regulatory action in the field of risk on one hand is addressed to the “technical” solution or prevention of the risk. On the other hand, the regulatory action could be effective in prevention or mitigation aiming at the “development of the collective consciousness”, i.e. to a change of behaviour of people towards the risk itself. Coordination between these two areas of legislation was in fact recognized as capable of producing real effects in terms of risk reduction.

3.4. ACCIDENT LIABILITY, DRIVER EDUCATION AND TRAINING PROGRAMS

Risk perception studies that examine the implications of risk perception in accident liability, are mostly referring to the hazard component of it. There are mixed results from existing studies as to where improved hazard perception skills are good indicators of subsequent lower accident liability. Training is shown to improve hazard perception skills [20], [23], [21], [71], [70], [96], [82] and decrease prejudice (underestimation of actual hazard) [53]. Not all studies though, report a clear correlation of accident liability with improved hazard perception skills. Studies [73], [136], [70], [87], [69] have shown that hazard perception skills relate to potential for crashes. Other studies [20], [21], [25] failed to demonstrate a significant statistical correlation. The latest studies though tend to support the fact that the higher hazard perception skills are, the lower the accident liability rate for some type of accidents in the first year of driving [82], [23], [96]. However, risk perception levels are reported to be higher in drivers involved in accidents [41].

Risk perception training resulted in increasing risk perception skills especially in situations involving driving in wet surfaces, sharp turns, speeding and getting on
and off lower road shoulders [95]. It is suggested that safe driving involves “perceptual learning” (driver’s skill at detecting and recognizing potentially dangerous situations) of the art of “reading the road”:

- self-awareness exercises may be effective in assisting young drivers to reflect on their own personality and how it influences their decisions rather to just emphasize the importance of following the road rules. It has been suggested that public road campaigns should focus on the development of interventions that strengthen a young driver’s appreciation of the impact of their actions to others [65];
- hazard and risk perceptions take several years to develop through “normal” driving experience [17].

Studies have shown campaigns promoting safe driving may result in risk perception changes [96], [95]. Failure to report similar findings from other safety campaigns may be the fact that they have not focused enough on perceived risk [95].

### 3.5. ROAD SAFETY PERCEPTION: DEEPENING THE IMPACT OF DIFFERENT CULTURES

The perception of risk plays a prominent role in the decisions that people make, in the sense that differences in risk perception lie at the heart of disagreements between technical experts and members of the general public regarding the best course of action. Culture is a key factor for the perception of the risk. Culture could significantly shift the attention from a particular risk to other risks or to induce to completely drop the attention from some specific risks.

Citizens in developing countries devote to some risks (e.g. to risk related to road safety) an attention that could be assessed as highly different when compared to developed countries.

This difference is reflected also in the road accident fatality rates from 1989 to 1993, where developed countries have maintained the ratio of deaths per 10,000 vehicles to less than two, while developing countries were at least three times higher [2], [50]. The discussion of the gap can begin by listing the differences between developing and developed countries: facts related to demography, education, income and enforcement underpin these differences. How do these factors influence road risk acceptance? Is a higher level always better? Next, we will take a look at each one of them.

### 3.5.1. Demography

Developing countries have the largest rate of population in the youngest and productive age. This means that they also have the largest rate of young motorists. In addition, this age group is mainly single, meaning they do not worry about the safety
of family passengers such as their own children. Being new on the road, young motorists still lack important skills such as maintaining attention, making split-second decisions, estimating speed and distance, recognizing potential risks etc, all factors which can be improved with experience. At the same time, they are more prone to speeding, tailgating and substance abuse to win peer approval, as displayed in the “mat rempit” phenomenon in Malaysia, where gangs of young motorcyclists perform dangerous stunts with fellow gang members on city streets.

Simply put, since the number of these young motorists is higher, the percentage of population with high risk acceptance is also high. Although young motorists in developed countries may also have the same characteristics, the young population is usually smaller therefore the perception of road related risk in driving is dominated by the majority of more experienced drivers.

3.5.2. Education

For the purpose of this paper, we shall concentrate on informal education for drivers. Without a doubt, education is a powerful tool in shaping good drivers. A driver’s earliest education starts at the driving school. With the large numbers of accidents in developing countries, authorities have now realized that basic how-to-drive education only is not enough to reduce losses. Unfortunately in developing countries, driver’s education is just one of the many programs that compete for the same limited public funding. In Malaysia for example, in recent years there has been a lot of debate regarding the introduction of defensive driving, but its implementation is only compulsory for traffic offenders at the orders of the court. Thankfully, various short-term road safety campaigns have been conducted to increase public awareness. Safety messages in the form of electronic advertisement, printed media and exhibitions are regularly promoted during festive seasons and school breaks, when mass traffic flow to and from hometowns can be seen throughout the country. Yet the shortage of funding prevents such education to be inculcated in a long-term, more aggressive, perhaps in-the-face manner. Consequently, risk acceptance in developing countries remains high.

3.5.3. Income

Income level is probably the most obvious difference between a developing and a developed country. However, for many people in a developing nation, financial freedom is a dream, even more so in this time of economic turmoil. For some breadwinners, having two jobs is essential. Even then, the household budget is mainly used for purchasing food, school necessities and utilities, resulting in a smaller share of the pie for other “unnecessary” items and family members just adopt the attitude of being more careful in terms of road safety. Although government road safety campaigns reach out to every level of society, extra income would rather
be spent on leisure activities and many are not willing to part with their hard-earned money to buy child car seats, install rear seatbelts, insurance policies or take up defensive driving courses. The inexistence of laws to impose those items further adds to the disinterest of the public and consequent promotion of willingness to tolerate risk. In a study, results of a questionnaire showed that the respondents were not sensitive to different risk reductions by different bus companies which charge according to their safety records [84]. In another example, many motorcyclists in Malaysia provide oversized adult helmets or game helmets to their children instead of buying proper helmets. These examples may provide insight regarding the fact that in 2002, head injuries accounted 55.3% of all injuries and in 2003, 60% of traffic deaths were made up by motorcyclists.

Developing countries provide a clear example of how conscience alone is not enough. Safety is the last item on their shopping list. There must be sufficient resources to cover their priorities before they are willing to execute the knowledge.

### 3.5.4. Enforcement

Perhaps the single most definitive difference between developing and developed countries in terms of road safety is law enforcement. In developed countries people obey traffic laws because of stricter enforcement; there are many officers to observe the motorists, even in small towns.

In developing countries there are many laws to protect their people on the road. Malaysia has mandatory seat belt law since the seventies and recently, it has been made compulsory for rear seat passengers to wear seat belts as well. Violation of this law will result in a fine of Malaysian Ringgit (RM) 300 (about 76.80 € (in 2012)). In spite of that, the actual amount of fine imposed can be negotiated with the police officer and in most cases it is reduced to RM 100. Often in rural areas, violators are given oral warning and advice from the police [59]. This sort of public knowledge somewhat gives relief to motorist instead of fear of getting caught by the law.

Undeniably, most of motorists are aware of the traffic laws in their country. However, enforcement is sometimes necessary to impose the right amount of “fear” and will indirectly build risk perception to drivers. A fearless driver is somebody accepting a high amount of risk.

### 3.5.5. Remarks on driver behaviour and attitude to risk

Being good in one aspect is not enough to make a good motorist. For example, an experienced motorist may not necessarily obey the law if not convinced of an efficient enforcement operated by traffic officers. The combination and degree of the factors determine what sort of culture a motorist is living in. Even more important, it also
determines the level of motivation of a driver: it is not self-evident that drivers decide to perform in the best way they are able to, if not properly motivated. Knowledge of how to control a car is not as critical to safety as individual motivation: strong motivation makes up for weak skills better than strong skills make up for weak motivation. Without strong motivation to reduce risk, advanced skill training can lead to more crashes, not fewer.

3.6. RISK EVALUATION AND RISK MANAGEMENT PROGRAMS

The traditional approach of considering risk as equal to the product of the probability of an adverse event to occur (hazard) times the magnitude of its consequences is viewed only from the side of harm these are likely to create. Yet, reality is more complex because some situations have a positive side which justifies their acceptance by a social group and this creates the concept of “acceptable risk” [56].

In several cases it may be necessary to use a combination of several management principles. Risk analyses, risk indicators and possible risk acceptance form the basis for decisions. There is a need to see these factors in a wider perspective that includes assessment of the various advantages and disadvantages of alternative solutions and measures [91].

Studies have shown that programs to evaluate and manage fire risks in tunnels will be more effective and long-lasting if the full representations and beliefs of tunnel users are given full consideration at the planning stage [35].

Recent research has identified three management principles for risk: a risk-based management principle, preparedness for eventualities principle and the discourse principle [91]. The latter involves decisions being made after a discussion without the use of formal risk analysis. Strategies must be developed to encourage awareness and trust.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. ACTION OF PIARC TECHNICAL COMMITTEE C.3

PIARC’s strategic plan 2008-2011 assigned to PIARC Technical Committee C.3 the task to:

- identify and evaluate studies of the public’s perception to risks in the road system;
- identify and assess the factors that affect those social reactions.

This technical report is the first answer to such a demand. The Technical Committee C3 launched a devoted working group (C3.3). The authors drafted this technical report in the form of an outlook of existing literature in the field of risk perception, looking for application examples of available research in the field of road operation.
This section summarizes the first conclusions and recommendations coming from the aforementioned activity of research and analysis.

4.2. CONCLUSIONS

Technicians normally assess the risk as the product of consequences of unfortunate events and relevant frequency. This kind of approach can cover both natural and manmade events.

This technical approach is typical of authorities and operators involved in the risk management process. In the specific case of roads, we refer to Authorities and Operators that are involved in the construction of or in charge of the operation of public roads.

Authorities and Operators often need to estimate the risks, in order to assume the most suitable set of measures (technical, technological, investments or organizational measures) aiming at preventing risks, keeping them under “acceptable” or “legal” thresholds.

Sometimes, the aforementioned process of assessment is strictly adopted as follows: analysis of phenomena/assessment of the risk/comparing risk with acceptable thresholds/defining mitigation or preventive measures.

In other cases, the procedures adopted for achieving the target level of risk through the prevention of root causes and mitigation of the consequences are not explicit: adopted measures may be coming from other kind of approaches, may be coming from past experience, or may be coming from the analysis of physical processes. In the last cases, the risk assessment process is in some way “hidden” inside the criteria and procedures, with the same goal.

Whatever the process can be, the main question that underpins the overall matter is: “when can a certain risk be considered as acceptable?”. Clearly, this question is never a “technical” one: in most of the cases the answer to this question underpins choices that have a direct impact on society. Reaching for an answer to this kind of question requires comparing the possible outcome of hazards with social drawbacks of a different nature. The most obvious drawback is the economic cost of preventive measures. Generally speaking, there is no “safety for free”. In fact, safety is (also) the result of preventive investments and, in the case of roads, it is the result of the public investment in infrastructures, education and training programmes, equipment and facilities for safety.

Cost is not the only possible drawback, others can raise, for example, the impact on the environment. A case in point could be authorities that have to decide whether to
build a second tube for a long mountain tunnel. On one side, we have high costs and impacts on a fragile environment. On the other side, we have an increased safety and a more efficient mobility. In turn, the question “when a certain risk can be considered as acceptable?” becomes “do we accept the current level of safety, knowing costs and impacts of the new construction?”.

Then, there is the question “what is the acceptability of a risk?”. Existing literature demonstrates that user’s risk perception may differ significantly from the expert assessment. This technical report elaborated further on this additional question.

Mary Douglas said “acceptability of a risk” implies a “social” acceptability: it is the culture that takes the lead when it comes to consider some risks as being acceptable and others to be feared and therefore refused. It is impossible to discuss on the perception of risk without taking into account the overall reference context, moral, social and political.

Thereby, the committee studied the issue of risk acceptance and perception trying to define a best practice approach for road stakeholders to handle these differences. Several actions such as information or education of users, revising of the design codes, approach to safety factors, traffic regulations or preparedness education strategy could be useful to best take charge of these phenomena according to the risk perception of people.

Understanding of risk perception is instrumental in understanding and anticipating public response, understanding dimensions of public concern, improving communication of risks between different categories of people (lay, experts, risk managers), and developing better methods for eliciting opinions about risk (societal decision making) [112].

1. The result of the research in the field of risk perception made self-evident that the user’s perception of risks is fairly different from the assessment of experts in many fields of human action, including the operation of roads; we can assess “normal” or “physiological” this fact if we consider that the mathematical and statistical approaches normally adopted by experts have nothing to do with the processes that underpin the social perception of risks.

2. Assessments aiming to define risk are part of the scientific approach relevant to the operation of roads. For some road related risks, it is easy (or at least possible) to have a reasonably accurate analysis and assessment of the risk, using probabilistic methods. For risks that are of rare occurrence, a strict statistical modelling of phenomena appears to be more difficult, but in all cases we can have a general assessment even if the events under analysis are described by a very low probability.
3. Culture leads the perception of risks. It influences the definition of risks considered acceptable and those feared and consequently refused by society. Different cultures could lead to different personal and social approaches to key risk influencing factors such as: national provisions, behaviour of users, level of enforcement of inappropriate attitudes, etc. In the fields of health, environment and technological progress, the attitude to resort to simplistic cause-effect relationship, often without an analysis of the overall context of the problems, in spite of the complexity and the huge number of factors in play appears more and more diffused. This is normally the case in the aftermath of major accidents or events with a high impact on population and the media.

4. Social behaviour and the media are the drivers of risk amplification, where the adverse impacts of a major event could extend its consequences far beyond the direct damages inflicted to victims and property and may result in massive collateral impacts such as litigation against a company or loss of sales, increased regulation of a road sector, and so on.

The perception of risk has two major areas where its consequences were identified as fields of interest for the operation of roads:

a. The field of major events.
b. The field of human behaviour.

The following paragraphs offer deeper insight into the two cases providing key guidelines for further research and direct action to authorities and road operators.
4.3. THE FIELD OF MAJOR EVENTS – KEY GUIDELINES

Rationale

Road Authorities and Operators need to make choices and investments evaluating hazards with a reasonably high probability of occurrence and other risks.

In fact, in order to be cost-effective from the perspectives of safety, the environment and public interest, road stakeholders need to disregard cases of “minor” hazards (or to postpone the course of action), when the preventive measures are expensive and the frequency of the expected adverse events is reasonably low (and consequently the practical return of the preventive investments to the safety or the environment is low). The perception of risk and the social amplification of major events can have a significant impact on the assessment process, bringing unpredictable results in assessment, provisions or remedial plans.

Subjective judgments, whether by experts or laymen, are a major component in any risk assessment. If such judgments are faulty, risk management efforts are likely to be misdirected [111]. Disagreements about risk should not be expected to evaporate in the presence of evidence [113]. Efforts should concentrate in trying to define the best practice approach for road stakeholders to handling differences between expert and lay people.

Tempering expert assessment of risk with important qualitative aspects of risk that influence the responses of lay people may improve the rendering of safety measures and policies. Research performed by the National Council of Norway [91] suggests that instead of providing too much power to a small group of experts, who implicitly have the power to decide on a form of objective risk, instead, the actual decision makers should brought more firmly into the picture.

![FIGURE 9 – INTERACTION OF DIFFERENT PROCESSES](image)
The choice of a particular driving action is determined by a decision integrator which operates by evaluating both the perceived level of risk and the desirability (utility) of various action options (see figure 9). Therefore, we cannot successfully contemplate reducing risky driving practices by concentrating on any single sub-process [68].

Knowledge of the perceived risk must be increased and it is essential to gain the cooperation of those who experience the threat to ensure that doubts and uncertainties are integrated into the political process of handling risk. In choosing strategies and working methods, the supervisory bodies must also decide what form of risk they can tolerate and which form of management principles are realistic [91].

Road stakeholders use cost-benefit analyses as instruments to forecast the economical effectiveness of the measures to be decided. Cost–benefit analysis is also often used by governments to evaluate the desirability of a given intervention. It is an analysis of the cost effectiveness of different alternatives in order to see whether the benefits outweigh the costs. The aim is to gauge the efficiency of the intervention relative to the status quo. In this case it can also be considered as an instrument to avoid the bias of risk perception.

The really difficult subject to tackle is emergency situations. In the event of a main emergency what is not easy to prevent is the social amplification of the risk. Literature demonstrates risk communication to be a key step in the process of risk/emergency management. Generally speaking, on one side, risk communication cannot solve problems and conflicts generated by issues, but on the other side, it is certain that the lack of communication or a poor communication process will very likely lead to failure of effective management. Risk communication is at the heart of the process of decision making on risk and it appears to be an intervention tool in the process of social amplification of risk to ensure better governance and more suitable decisions.

A specific case study on risk communication can be found in Case study 4 (Appendix A, pages 88 to 104). The following bullets summarize the main recommendations coming from the aforementioned annex:

- expectations and values of interested parties need to be taken into account by emergency managing authorities and operators;
- a climate of trust needs to be established: literature identifies trusted Authorities as a key factor in the risk perception of people;
- action/communication need to be proactive;
- the role of interested parties and stakeholders has to be defined. The full decision making process has to be clarified;
- the risk communication model needs to be consistent to the organization;
- organizational skills in risk communication need to be considered and developed.
4.4. THE FIELD OF HUMAN BEHAVIOUR – KEY GUIDELINES

Rationale

Understanding of the processes involved and appropriate risk perception by users is instrumental in the proper overall functioning of the road system and for the users to achieve a coherent approach. This is certainly true for the risk perception of professional operators, but when analyzed at the level of ordinary drivers it has an even greater impact in the field of road safety. The misperception or underestimation of risks can be considered as a key factor, affecting a good approach to driving.

Overview of the various case study findings throughout this report provides ample evidence that risk perception has significant implications in influencing individual’s choices and behaviours. The need for targeted campaigns (rather than general ones) adapted to the culture and context of each group or organization [57] has become apparent. Most risk perception studies have focused too much on “the public” in the aggregate and not enough on differences between individuals and groups, analyzed within specific social and institutional contexts. Such an approach has led to uniform guidance for risk communication strategies which are not necessarily adapted to the demands of different social groups. Risk communication would benefit from a shift in attention from message construction to audience analysis [66]. Messages should be specific, take into consideration naïve causal explanations, and be adapted to the beliefs of the target audience [35].

Attitudes to risk play a vital part in any proposed countermeasures [98]. Risk denial has been observed to be practiced by individuals for coping with unpleasant realities or facts [101]. Identifying the risk of accident or injury may not be directly indicative of the potential for reduction in risk because it assumes that the remedy will be equally effective in the future. Sound knowledge of risk perception attitudes, probable behaviour, and, expectations is most important to the success of planned road safety improvements, safety campaigns and communications as is an understanding of the extent to which road user behaviour is likely to adapt to the changed situation and defeat the intended safety benefit. The technical concept of risk is too narrow and ambiguous to serve as the crucial yardstick for policy making [52]. Preventive and safety measures, so long left solely up to safety specialists, could be fruitfully enriched by knowledge of perceptions and naïve explanations of ordinary people who come into contact with risks on a daily basis [55].

Culture is a key factor for the perception of risk. Attitudes to risk depend strongly on national characteristics and on the value attached to freedom of the individual in relation to the perceived seriousness of the prevailing road accident situation [98]. Demography, education, income (the lower, the higher the risk toleration [13], [84]), enforcement (most definite difference between developing and developed countries
in terms of road safety [59]), and, motivation are all factors that influence risk perception [1], [92].

Interventions must seek to counter the perception of exaggerated control by means that personalize the risk. It may be possible to modify the driver’s training procedure so that it aims to improve detection of certain types of hazards after training such as changing people’s perception of invulnerability. Standard educational efforts, warnings, and statistics are not likely to be effective [18].

Dismissing conclusions of the kind that “one of the common mistakes in attempting to codify the public attitudes about risk is to measure people’s responses to hypothetical questions because cultural rationality can only be understood when people’s cognitive behaviour is observed as they are threatened by a real risk event” claimed by some studies [86] on the ground of practical difficulties in observing real-time threats, it is suggested that further research should focus on how the specific factors that determine perceptions of risk relate to objective safety measures and which of these may influence modal choice and other elements of driving intensity.

The study of the findings from the case studies seems to imply that producing a uniform guidance that addresses the implications of risk perceptions may not be feasible considering the particularities and the different factors that affect risk perceptions. Moreover, the findings underscore the need for targeted campaigns that are adapted to the culture and context of each group or organization.

Different environments and cultures bring forward the need for countries to establish research and development programs through a panel of experts at a national level for addressing risk perception, when considering assuming corrective actions on road operations. National programs would benefit by utilizing the extensive collection of information and practice that has been gathered and made available through the PIARC website.

This development program will serve two main purposes:

a. adapt the collected experience and practice to the local particularities and context by actively involving road stakeholders and the actual decision-makers;

b. provide PIARC with the enriched local experience and feedback on applied approaches. In this way, new methods and research findings for considering people’s reactions to corrective measures relevant to road operations, as well as feedback on existing methods and adaptation or modifications of these, can be made available internationally.
A feedback loop (see figure 10) describes the situation when output from a past occurrence of an event will influence the development of the original phenomenon in the present or future. Under this concept, “risk perception” can be considered a process which provides feedback to the “attitude to driving”. Other processes such as culture and environment, enforcement, education and communication are working in the same way and can be helpful in reinforcing the feedback process.

5. GLOSSARY

If we consider both the current speaking and the scientific literature, some words such as “risk”, “danger” and “hazard” have fading borderlines in use and meaning. Descriptions of the meaning as summarized from the definitions available on Webster’s Online Dictionary [66] are following next:

Risk (Webster)
A source of danger; (environment) A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard, (health). The probability that something will cause injury or harm, (public administration 1) the expected number of lives lost, persons injured, damage to property and disruption of economic activity due to a particular natural phenomenon, and consequently the product of specific risks and elements at risk (public administration 2) the probability and extent of damage due to a particular hazard. Source: European Union.

Hazard (Webster)
A source of danger; an unknown and unpredictable phenomenon that causes an event to result one way rather than another; (Geological) A risk. An object or situation that has the possibility of injury or damage; (Health) A source of potential harm from
past, current, or future exposures; (Mathematics) In general, a word implying the existence of chance of risk. Specialised usage occurs principally in connection with life analysis of physical systems or components. (Medicine) A possible source or cause of an accident. (Meteorology & Standards) A set of conditions in the operation of a product or system with the potential for initiating an accident sequence. (Public Administration) The probability of the occurrence of a disaster caused by a natural phenomenon (earthquake, cyclone), or by failure of man-made sources of energy (nuclear reactor, industrial explosion) or by uncontrolled human activity (overgrazing, heavy-traffic, conflict); In a broader sense, includes vulnerability, elements at risk and the consequences of risk. A threatening event, or the probability of occurrence of a potentially damaging phenomenon within a given time period and area.

**Danger (Webster)**
The condition of being susceptible to harm or injury; a cause of pain or injury or loss; (Public Administration 1) A situation, an object or a substance that constitutes a liability, risk, peril or menace to well-being or life of persons or the integrity of buildings, land and the environment. (Public Administration 2) A threatening event, or the probability of occurrence of a potentially damaging phenomenon within a given time period and area.

**PIARC lexicon and background**
According to PIARC terminology “Hazard” and “Danger” are considered synonyms while “Risk” is considered as having a different meaning. Within last cycle technical committee C3.3 defined the risk in general, as a product of consequences and frequency of hazardous events, which include both natural and manmade ones.

Considering that the current definition reported above is not concise enough to the purpose of this paper, the following additional meanings (from the glossary of “EPA - Risk Communication in Action/the tools of message mapping”) are also integrated:

**Risk Perception (EPA)**
The subjective perception of risk/danger. Not necessarily correlated with actual risk.

**Risk Communication (EPA)**
An interactive process, in which, information and opinions are exchanged among individuals, groups, and institutions in response to an event or a risk.
6. REFERENCES


APPENDIX A – CASE STUDIES

The current section gives additional cases, ideas and foster on some specific topics addressed into the common paper of WG3.3. Five individual members of PIARC accepted to contribute to the current section.

The following four contributions, related to the social acceptance of risks and their perception have been collected as case studies in the field of managing the operational risk of roads.

• Yukio ADACHI (Japan)
  Case study 1
  Public demand of seismic resistency of road bridges

• Ashaari bin MOHAMAD (Malaysia)
  Case study 2
  Impact of different cultures on the perception of risk: the malaysian perspective

• Bianca Maria CECCHINI (Italy) and Paolo PIERANTONI (Italy)
  Case study 3
  Risk homoeostasis: a recommendation for safer roads

• Annie GROLEAU (Canada - Quebec)
  Case study 4
  Using risk communication as an instrument to mitigate the social amplification of risk
CASE STUDY 1 – PUBLIC DEMAND OF SEISMIC RESISTENCY OF ROAD BRIDGES

Study/Project/Activity Details

Country: Japan
Geographical Area involved: Japan
Type of Hazard (man-made, natural, or climate change): Seismic
Risk Classification: public survey on risk
Authorities/Operators involved: Tokyo Institute of Technology
Year of implementation: 2006

Short Description

In the seismic design of road bridges, it is important to set clear seismic performance criteria which fit the demand of the public. The basic concept of seismic design philosophy and performance criteria is more or less similar among the current codes worldwide as shown in table 1. The seismic performance is classified in terms of safety, function and reparability against 2 levels of earthquake. However the public demands have not been directly surveyed so far so that the seismic demands were usually determined by the experts and the code writers. There is an interesting public survey to know their demand on the seismic performance of bridges was conducted by Prof. Kawashima of Tokyo Institute on Technology, Japan [Kawashima 2006]. In this chapter, his survey method and survey results are introduced.

<table>
<thead>
<tr>
<th>Level of earthquake</th>
<th>Performance goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small to moderate earthquakes</td>
<td>Bridges should be no damage and should be open to traffic immediately after the event.</td>
</tr>
<tr>
<td>Large earthquakes</td>
<td>Bridges may suffer damage but no collapse.</td>
</tr>
</tbody>
</table>

Analysis/Results

Questionnaire Survey

A direct interview and questionnaire survey was conducted in September 2004 to the public who are nothing to do with construction industry on their understanding and demand for the seismic performance goals of bridges. The questionnaire survey included 9 items with the questionnaire back ground as follows.

The direct interview was conducted using the same question sheet at two shopping malls in Tokyo and the questionnaire survey was conducted by sending a sheet by
either mail or e-mail attachment to various regions in Japan. As a consequence replies were obtained from 862 individuals with age of 10-80s.

<table>
<thead>
<tr>
<th>TABLE 2 - QUESTIONNAIRE BACKGROUND AND QUESTIONNAIRE ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Questionnaire Background</strong></td>
</tr>
<tr>
<td>The condition that destructive damage occurred by a damaging earthquake in an urban area with over several thousand victims as well as seriously deteriorated functions in a wide range of area and facilities resulted by extensive damage of buildings, transportation facilities and utility facilities.</td>
</tr>
<tr>
<td><strong>Questionnaire items</strong></td>
</tr>
<tr>
<td>1) Experience of the past large earthquakes.</td>
</tr>
<tr>
<td>2) Recognition of seismic risk in the future earthquake.</td>
</tr>
<tr>
<td>3) Knowledge on the current seismic performance goals.</td>
</tr>
<tr>
<td>4) Anticipated risk by the damage of bridges.</td>
</tr>
<tr>
<td>5) How shortly do they want damaged bridges be repaired.</td>
</tr>
<tr>
<td>6) How much additional cost do they consider reasonable to build bridges which can maintain function immediately after the event.</td>
</tr>
<tr>
<td>7) How the seismic performance criteria should be.</td>
</tr>
</tbody>
</table>

The direct interview needed courage for the interviewers to ask people to stop and share time to reply to our questions. Shop peoples always first wondered them as suspicious look persons when we entered their shops. However most people were kind enough to share time for the questions once they understood the intention. Often some interviewers were served chairs to sit and they kindly replied to the questions by serving teas and cookies. Not so small number of people shared nearly an hour, and several people invited the interviewers inside their homes to ask their questions to the interviewers on the seismic risk around their homes. Thus, the direct interview was extremely useful to know their demand on the seismic performance of bridges.
Demand of Public on the Seismic Performance of Bridges Downtime

It was found that a large percentage of people anticipated that they would have to experience extensive damage around their residential areas when a significant earthquake occurred in the near future. Figure 1 summarizes replies from 862 individuals to the question on how shortly they want bridges which would suffer damage after a significant earthquake should be repaired no matter how temporarily (emergency repair). The largest reply was directed to “within 3 days (30.2%),” followed by “within a week (26.9%)” and “within a day (13.2%).” It is noted that 89.3% people expected that the bridges which would suffered damage should be repaired shorter than a week.

Based on the experience of direct interview, that they usually did not reply arbitrarily to this question but they replied after considering how long they can live based on the stock of food at home without new supply under suspension of electricity and transportation. It may be quite reasonable that they demand the downtime of bridges should not be longer than a week.

However the real downtime may be much longer after a significant earthquake. It took weeks to precisely survey and get information required for repair design. Temporarily access roads had to be constructed to start repair. Including the time to discuss with related organizations, it took a couple of months. It is obvious that real downtime of bridges is far longer than expected by the public.
Seismic performance goals

After explaining the current seismic performance goals of bridges as shown in table 1, the expected seismic performance goals was asked and the results were obtained as figure 2, previous page. It is important to note that the current goals of “avoid loss of lives (4.2%)” and “damage should be limited so that bridges can be repaired shortly after a significant earthquake (12.7%)” had limited support. On the other hand, the highest support was directed to “damage should be limited so that bridges can be repaired immediately (48%),” followed by “damage should be avoided no matter how construction cost increases (32.7%).” In total 80.7% peoples (48.0% + 32.7%) supported the higher performance goal than the current level.

The current performance goals has the background that the bridges do not suffer damage during a significant earthquake is economical unfeasible because of infrequent occurrence of a significant earthquake and to avoid excessive additional cost. Many demanded that bridges should be designed so that function of bridges is maintained immediately after a significant earthquake no matter how construction cost increases.

Impact on Safety/Mobility/Environment/Infrastructure

Cost increase validated for enhancing the seismic safety

Although the final goals of the seismic engineering is to enable to build bridges which maintain function immediately after a significant earthquake, there are two difficulties to achieve this goal; technical difficulty and economical constraint. After releasing to the public that there still have bridges which cannot be designed safe under the current technology, the next question was given to the public.

Figure 3 shows the replies of the public on how much cost increase can be validated for constructing bridges which does not suffer damage immediately after a significant earthquake. The highest support was given to “up to 30% increase (29.1%),” followed by “up to 50% increase (26.8%).” It is noted that although 7.3% replied that cost increase cannot be validated, 80.4% (= 29.1+26.8+11.5+1.6+11.4) replied that cost increase can be validated if it is less than 30% of the current level.
It is important to note based on the direct interview that the public did not arbitrarily reply this answer, but they replied recognizing the controversy on the safety enhancement and tax increase. It was impressive to know that there were many small business owners who replied that because they could afford to pay 10% more tax, they wanted to enhance the safety of transportation facility. There were peoples who insisted to build more reliable bridges for seismic effect because safety is not the issue of money.

**Considerations/Strategies/Conclusions**

Public perception on the seismic performance goal of bridges was clarified based on a direct interview and questionnaire survey to 862 individuals. The following conclusions are obtained:

1. 89.3% individuals demand that bridges which suffer damage should be repaired in less than a week. This expectation is based on their anticipated problem for daily life. However, real downtime of bridges in the 1995 Kobe, Japan earthquake is far longer than expectation by the public.
2. Only 16.9% individuals support the current seismic performance goals. The highest support was directed to higher performance goal than the current.
3. Only 7.3% replied that any cost increase cannot be validated. 80.4% replied that cost increase can be validated if it is less than 30% of the current level.
4. More attention and analysis have to be paid on the perception of the public, real downtime and cost vs. design force relation to set realistic seismic performance goals which fit the demand of the public.

CASE STUDY 2 – IMPACT OF DIFFERENT CULTURES ON THE PERCEPTION OF RISK; THE MALAYSIAN PERSPECTIVE

Study Details

Country: Malaysia
Geographical Area Involved: Urban & Sub-urban Area
Type of Hazard: Road User
Risk Classification: Risk Management
Authorities Involved: Public Works Department Malaysia
Year of Implementation: 2008

Abstract

Driving on the road is actually taking risk since accident occurs all the time, but how much risk are we facing on these roads? These are question that have different answers from different regions of the world. The perception of risk on the road depends on the attitude of the people and these attitudes will depend on the culture, education, environment and the way we are brought up.

Malaysia has one of the highest accident rates and casualties on the road in the world. The Malaysian government has been spending money on road safety campaigns but it does not seem to work. These show that the perception of risk for road users in Malaysia is very low and this is due to various factors such as culture, education, economic status and on law enforcement. This paper will give an in-depth view of the perception of risk on the road for the people of Malaysia.

Introduction

Over the past decade, concern over the risk and safety of public has resulted in a number of precaution and action plans being drafted and enforced by the authority from all over the world. The risk and safety precaution action plans have largely implemented in developed countries like United States, Britain, and most of the European countries.

On the contrary, the focused on the risk management at most of the developing countries are still far behind the acceptable standard of developed countries. In order to strengthen the public acceptance of risks and hazards concern, a physical action plan had to be drawn with the compliance to the local phenomenon. The perception of risk between the people of developed countries and developing countries will be taken into consideration.
In Malaysia, the road accident fatality rate was recorded at 3.7 per 10,000 vehicles in year 2007. Thailand, Vietnam, Brunei and Cambodia are also recorded as countries with high road fatality in Southeast Asia. This showed that the developing countries are sharing almost the same level of acceptance for the risks.

**Analysis/Results**

1. **The Difference in Culture**

Motorcycles are the majority group of the road users in most of big cities in Malaysia. Besides that, the ownership of the motorcycle is also recorded as the highest compare to other type of vehicles and keeps on increasing every year. The high numbers of motorcycle on road is influenced by few factors which can be listed as climate, power of purchase and convenience. A typical motorcycle rider is shown in *figure 1, following page*.

Malaysia with a hot and humid tropical climate has two major season changes per year. The warm temperature and high humidity create a conductive environment for motorcycle riding activities all around the year. The high annual precipitation in Malaysia does not deter the motorcyclists from travelling around because the period of rainfall in Malaysia is short.

Besides, the cost of owning and maintaining the motorcycle is relatively low compare to vehicles like car, MPV, and others 4 wheels vehicle. Motorcyclists which majority consists of middle low income class group are more affordable to buy a motorcycle compare to a car. The financial facility and scheme provided by the financial institutions and agencies have made the ownership of motorcycle become easier. This encouraging environment had made the group of motorcycles’ owners consist of mostly youngsters and fresh work forces in the market.

Motorcycles are the most favourable vehicle to travel in the cities where traffic congestion is really a headache to road users. The size of the motorcycle is an advantage while driving in traffic congestion. In Malaysia, the motorcyclists are able to move easily between the cars during peak hours as shown in *figure 2, following page*. Furthermore, parking availability is also a problem in town. Again, the easiness to park and move around has made motorcycles become an important and popular mode of transportation in Malaysia.
From the research results shown in *table 1, following page*, the young motorist age between 16 to 20 years old in Malaysia contribute most towards the road fatality rate. The fatality rate among youngsters age between 16 to 20 years old are the highest which recorded 30.6% compared to other age group.

Statistical data showed that the number of underage motorists who has not hold a legal driving license and new drivers who has less than 3 years driving experience is also a major contributing group to the road fatality. The fatality rate for young driver who has less than 3 years of driving experience is about 47.5% and is the highest among other age groups.
The high numbers of fatality among young motorcyclists is an alarm to national road safety. Motorcycle is considered as the mode of transportation with lowest safety features. The problem of mishandling while on the road may cause serious injuries to the rider and pillion. Besides, the consequence of being injured or dead is more likely compare to other vehicles. Therefore, the way of handling motorcycle on road is an important part to reduce the rate of fatality especially young motorists. More road safety campaigns, expo, advertisement, bylaw with the presence of education motive should be conducted to teach the young motorcyclist the proper way of handling motorcycle.

<table>
<thead>
<tr>
<th>Table 1 – Study of Motorcyclist Accident Profile &amp; Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Category</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Category</td>
</tr>
<tr>
<td>Riders</td>
</tr>
<tr>
<td>Pillion Passengers</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>16 - 20 years</td>
</tr>
<tr>
<td>21 - 25 years</td>
</tr>
<tr>
<td>26 - 30 years</td>
</tr>
<tr>
<td>&gt; 30 years</td>
</tr>
</tbody>
</table>

2. The Importance of Education

According to the statistic released by Ministry of Higher Education, 184,000 students will graduate with a first degree qualification each year and it only covers 0.7% of the Malaysia population. The acceptance level of new information for educated people is believed to be higher than non-educated people. The mentality, level of thinking and perceptions of those two different groups are different. For instance, the perception of risk on the road for the educated people is more sensible compared to the latter. Most of the educated people are living in big cities where the traffic impact and consequence of accidents is something that they might experience in their day life. Furthermore, the frequent exposure of road safety campaign through road shows or media had established their sense of danger.

Government has lead the road safety campaign and supported by NGOs to ease the awareness of road safety in Malaysia. Many aspects of road safety features had been identified and focused in with the aim of educating the road users. The perception of
risk in rural area is much lower compared to the urban area. Many of the rural road users are not well educated as most of the educated youngster has migrated to big city to earn their living. The most common traffic law disobeying case in rural area is not wearing a safety helmet.

Unfortunately, based on the statistic released by ministry, 66% of the motorcyclists’ fatality was directly attributed to head injuries. This statistic leads to the conclusion that the head is the most important part of the body that must be taken care of and the best ways to prevent head injuries is through the use of safety helmets.

Table 2 shows that 14.8% of the rural motorcyclists were not wearing safety helmet and 51% of them did not wear the safety helmet properly. Furthermore, research done by S.Kulanthayan et al. shows that riders less than 21 years old are more likely not to wear helmet properly and recorded as 62.8% of the group.

Table 2 – Observation results on helmet use compliance for motorcyclists and pillion riders

<table>
<thead>
<tr>
<th>Consumer Category</th>
<th>Proper Use Of Safety Helmets</th>
<th>Use Of Safety Helmets</th>
<th>Non Use Of Safety Helmets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent %</td>
<td>Number</td>
</tr>
<tr>
<td>Motorcyclist</td>
<td>350</td>
<td>48.4</td>
<td>616</td>
</tr>
<tr>
<td>Child pillion riders</td>
<td>10</td>
<td>15.9</td>
<td>14</td>
</tr>
<tr>
<td>Adult pillion riders</td>
<td>34</td>
<td>27.4</td>
<td>70</td>
</tr>
</tbody>
</table>

3. The Economic status

As a developing nation, the economic status plays a major role in determining the way people move from one place to the other. Most people want to live a comfortable lifestyle. Thus, spending extra money for their safety on roads is not in their priority list. According to Department of Statistics, 40% of household in Malaysia had income less than RM 2000 (USD 570) per month. Urban households with a monthly income of RM 2000 would find it very difficult to live comfortably based on the prevailing cost of living and can be considered as “Urban Poor”. With poor public transport system, most of the “urban poor” are riding motorcycle as their mode of transportation due to the financial restrain instead of a car. In the road accident statistic published by the Royal Malaysian Police as in table 3, following page, motorcyclists are the largest group recorded in the road accidents that cause fatality which is 58% of the total fatality. Thus, the risk of riding motorcycle is much higher than driving a car.
Other factors that trigger the use of motorcycles as the mode of transport are the ease of parking the motorcycle and the access to find the way through traffic congestions. In big cities the phenomena of using motorcycle to workplace is increasing. This shows that even though the risk is higher in using motorcycle compare to a car, the people are still taking this risk, thus showing they have a low perception of risk.

### 4. Law Enforcement

Every laws and enforcement activities carried out are meant to discipline the people. But in most cases especially in Malaysia, people will only obey the laws in the presence of enforcement officers. Most of the violators fear of getting caught and be fined instead of taking care of their own safety. Statistic by The Malaysian Institute of Road Safety (MIROS) showed that only 58% of the drivers will obey the laws when they are able to sense the enforcement activities.

Red light runners, speeding, driving under alcoholic influence, driving on the road shoulder and the poor condition of the vehicle are the common offences. There are also people driving on the road without driving license especially the motorcycle riders. During “Ops Sikap 19”, 4,594 cases of road traffic offenses were recorded involving 837 cases of jumping queue; 400 cases of overtaking on double line; 2,315 cases of running the red light, 86 cases of using emergency lane and 40 cases of using mobile phone while driving. This shows that Malaysian drivers’ perceptions of risk are not high as compared to western culture since most of the accidents that happens were considered as human fault. According to the Director General of Road Transport Department, 40% of road accidents in the country are caused by following the vehicles too closely, 26% with dangerous cornering, 13% on dangerous overtaking and 12% over speeding.

<table>
<thead>
<tr>
<th>Consumer Category</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian</td>
<td>650</td>
<td>683</td>
<td>675</td>
<td>601</td>
<td>595</td>
<td>636</td>
<td>3,840</td>
</tr>
<tr>
<td>Motorcycle Pillion/Rider</td>
<td>3,429</td>
<td>3,548</td>
<td>3,500</td>
<td>3,591</td>
<td>3,693</td>
<td>3,646</td>
<td>21,407</td>
</tr>
<tr>
<td>Pillion/Rider Bicycle</td>
<td>261</td>
<td>256</td>
<td>283</td>
<td>227</td>
<td>242</td>
<td>190</td>
<td>1,459</td>
</tr>
<tr>
<td>Passenger/ Driver Car</td>
<td>1,023</td>
<td>1,187</td>
<td>1,208</td>
<td>1,244</td>
<td>1,215</td>
<td>1,228</td>
<td>7,105</td>
</tr>
<tr>
<td>Driver / Attendant Van</td>
<td>156</td>
<td>138</td>
<td>101</td>
<td>111</td>
<td>103</td>
<td>133</td>
<td>742</td>
</tr>
<tr>
<td>Bus Passenger/ Driver</td>
<td>45</td>
<td>67</td>
<td>69</td>
<td>48</td>
<td>39</td>
<td>75</td>
<td>343</td>
</tr>
<tr>
<td>Driver / Lorry Attendant</td>
<td>197</td>
<td>226</td>
<td>233</td>
<td>197</td>
<td>229</td>
<td>204</td>
<td>1,286</td>
</tr>
<tr>
<td>Driver / Attendant Race 4 Wheel</td>
<td>74</td>
<td>91</td>
<td>84</td>
<td>107</td>
<td>110</td>
<td>99</td>
<td>565</td>
</tr>
<tr>
<td>Others Vehicle</td>
<td>56</td>
<td>90</td>
<td>75</td>
<td>74</td>
<td>61</td>
<td>71</td>
<td>427</td>
</tr>
</tbody>
</table>
The Malaysian Institute of Road Safety Research has found that in 2007 there had been 350 fatalities, 700 seriously injured and 2,100 lightly injured among rear seat passengers. Table 4 shows that the fatalities for unbelted rear passengers are 10 times higher compared to belted rear passengers. A new law of compulsory wearing rear seat belt was enforced on 1 January 2009 with six months of advocacy campaign. After a month of enforcing the law, it was found that the consciousness of wearing rear seatbelt for road user in Malaysia is still low where 6,069 summons were issued during January 2009. This shows that in Malaysia the perception for the safety of the rear passengers inside their vehicle are low. Therefore, to raise the awareness and better perception in this matter a more stricken enforcement and education will help.

**Table 4 - Comparison of fatalities among belted and unbelted rear passengers**

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Passenger Car</th>
<th>4WD</th>
<th>Van</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Belted</td>
<td>Unbelted</td>
<td>Belted</td>
</tr>
<tr>
<td>Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>11</td>
<td>127</td>
<td>0</td>
</tr>
<tr>
<td>2004</td>
<td>13</td>
<td>136</td>
<td>1</td>
</tr>
<tr>
<td>2005</td>
<td>19</td>
<td>173</td>
<td>4</td>
</tr>
</tbody>
</table>

Engineering aspects of vehicles, attitude of road users and condition of the road are an integral component of an effective road safety plans, strategies and programs. Even though Malaysia is a developing country, the roads and highways are of international standards. The enforcement of speed limit on road is to guide and give the road user warnings of the danger that they might face on the road. Malaysian road users seem to neglect the speed limit on the road. Their perception is that speeding is “acceptable” when the condition of the road is good and as such their perception on risk is low. Statistic in Table 5, following page, shows that the road accident fatality rate at federal roads in Malaysia is the highest among other roads.

All roads are designed to cater for drivers’ comfort-ness and safety, but, road users tend to travel at a higher speed on straight roads (non-junction sites). With high speed, the severity of the crash increases due to the higher force of impact. At greater speeds, riders have less time to react, have less control of the vehicle and need longer stopping distance. Almost 70% motorcycle crashes occurred on straight and curved roads due to speeding.
Traffic police team reported that 5,000 summons for speeding was issued nationwide each day and altogether 142,362 summonses were issued within the 15 days for all traffic offences. In a survey conducted on road accidents in Britain; less than 5% of accidents are directly caused by speeding. In total, less than 7.5% of accidents is caused by speeding either directly or contributed. This statistic showed that the perceptions of risk in speeding is far better for the British (in developed country) as compared to Malaysian (in developing country). In developing countries like Malaysia, strict law enforcement will help to reduce accidents as well as to increase the perception of risk among road users.

**Impact on Safety**

The safety of the motorcyclists are always being raised and concerned in the road safety campaign nationwide. Many researchers had done studies on the characteristic of Malaysian motorcyclists and ways of reducing the risk of the riders. There are few criteria identified that need to be refined and changed to raise the public safety perception especially the riders.
Education plays a vital role in shaping individual mentality. The parental education started at early age influence the characteristic and thinking of a person. Drivers and riders’ characteristic on road have direct relationship with the level of education. Educated drivers are easier to be influenced by the safety messages published on the media and yet, drivers who are not educated are less expose to the road safety messages. Therefore, the awareness of driving safe on the road has to be instilled in the heart of every road users no matter what the level of education they have. It is a clear message that by improving the people’s education level especially the sub-urban drivers could help to enhance the perception of risk on the road.

Government of Malaysia is passionate to become a developed country in year 2020. The vision of becoming a high income nation has been translated into few task forces such as New Economy Model (NEM), Government Transformation Plan (GTP), and The National Key Result Areas (NKRA) to govern the successfulness of Mission 2020. Following the missionary vision worked-out by the government, the living quality of the people should be improved tremendously. Efforts and road maps to increase the level of road safety must be driven by both government and NGOs parties to create a safer and sustainable developed country. The higher level of risk perception would contribute towards the growing of GDP. Furthermore, losses due to road accidents can be reduced to a minimal level.

Conclusions

The perception of risk on the road for the people in Malaysia is still very low. These are due to the attitude of the people themselves which is influence by various factors such as culture, education, economic status, law enforcement as well as age. The perception of risk can be raised by educating young people (while they are still in school), having strict law enforcement and raising their economic status. As the world is getting “smaller” with the influence of new technology and also getting nearer with the advanced in transportation, the difference in culture will be narrower. As such it is hope that the attitude of the people will also change and have better perception of risk. Young people will always have a different attitude (always willing to try new things) than the older group and this can only change with time.

References


CASE STUDY 3 – RISK HOMOEOSTASIS: A RECOMMENDATION FOR SAFER ROADS

Study Details

Country: **Italy**  
Geographical Area involved: **N.A.**  
Type of Hazard (man-made, natural, or climate change): **Human behaviour**  
Risk Classification: **Hazard Reduction**  
Authorities/Operators involved: **SIAS Motorways Group**  
Year of implementation: **2010**

Short Description

In 1994 Canadian psychologist Gerald Wilde elaborated a psychological model of risk compensation: the Risk Homoeostasis Theory (RHT), to explain why safety interventions have not produced long-term decreases in death rates. According to Wilde, individual acts are controlled by an homoeostatic self-regulation process. In any activity, people check the amount of risk they feel exposed to (subjective/acceptable risk). They compare this with the amount of risk they are willing to accept (target risk), and try to reduce any difference between the two to zero. If the level of subjective risk experienced is lower than is acceptable, people tend to engage in actions that increase their exposure to risk. So, unless the target level of risk changes, no permanent changes in safety can be attained. This theory, applied to the car-drivers, shows that the use of devices to make them safer would provoke an increase of the risky behaviours thereby eliminating, in whole or in part, the structural efforts to decrease the level of risk and to increase the road safety. Wilde himself shows that the ‘risk thermostat’ can be reset and the target level of risk for drivers reduced.

Analysis/Results

Every driver would like the philosophical project Vision Zero to become a reality and that no one would be killed or seriously injured within the road transport system. The strong ethical element to the Vision Zero concept (“*Life and health can never be exchanged for other benefits within the society*”) is followed by many countries such as Sweden, the UK, the Netherlands and in general by the European Union where the European Road Assessment Programme is bringing together a partnership of motoring organisations, vehicle manufacturers and road authorities to develop protocols for identifying and communicating road accident risk and to develop tools and best practice guidelines for engineering safer roads (Tingvall, 1998; Withelegg and Hag, 2006). Unfortunately, at least for the time being, road accidents are happening and are seen as inevitable in a mobile society where the traffic congestion
continues to grow. According to the Smeed’s Law (“there is a relationship between traffic fatalities and traffic congestion”), revisited by John Adams in 1987, we can reduce but not eliminate traffic accidents. The strategic keys, which Vision Zero also focuses on, are: education, awareness and vigilance. (Adams, 1987). Nevertheless, the fundamental approach of the politics of government and the industry is that it’s possible to reduce the rate and the gravity of road accidents by improving, first of all, the planning of the cars and the environments in which they are used. So, in the last few years, the biggest changes have been in road infrastructure and car design and safety. New road design has aimed to reduce the number of crashes by widening and straightening roads, but in many cases the results have been less satisfying than expected. These changes have a low impact on the severity of injuries because vehicle speeds increase. Why? In the majority of cases, because of driver ‘distraction’. For this reason it is important to consider cognitive psychology in road safety programs. This is not so simple. We know that the human factor is responsible for fatal road crashes in about 90% of the cases. A recent study by the U.S. National Highway Traffic Safety Administration concluded that 8 out of every 10 collisions are caused by driver distraction. (NHTSA, 2007). What does driver ‘distraction’ mean? According to Sheridan, “distraction of the human controller of a highway vehicle is regarded as a disturbance at various points in a classical feedback loop representation of control of a vehicle. The type and locus of the disturbance are determiners of the vehicle response, as are the frequency and duration of attention away from the driving task. Operationally, if there is no effect of distraction on control, there is no distraction” (Sheridan, 2004). So, ‘distraction’ is an interruption; an obstacle to concentration. The most common driver distractions are eating, drinking, smoking or dialling a cell phone. We can see that the drivers may be less likely to engage in these types of behaviours when driving task demands are high, for example, when negotiating a busy intersection, driving in poor weather conditions, at night-time, or on a busy multi-lane roadway. (Stutts et al., 2001). Of course the incidence of driver distractions and their role in crashes may vary as a function of roadway, environmental, and vehicle conditions but some research and statistic data shows that the risk behaviour increases on a large and well-built road, sometimes with low traffic: in two words a ‘safe road’ where, on the contrary, deadly accidents happen. Psychologists attribute this fact to the role of ‘risk compensation’, a limit of human driving performance and a ‘defect’ of behaviour caused by the safety of the road or also of the vehicle. Risk compensation is the tendency of road users to compensate for changes in the road system that are perceived as improving safety by adapting behaviour (Elvik and Vaa, 2004). So measures designed to improve traffic safety may bring along negative consequences in a way that individuals increase the riskiness of their driving behaviour because they feel safer (Dulisse, 1997).

Suppose that it is shown that a safety device reduce the injury risk in a car accident by X% for any given frequency and severity of accidents. The installation of these devices will not necessarily reduce the fatality rate expected by XY% because it
depends upon the response of drivers to the increased protection. If the driver increases his driving performance (speed or other) he may obtain less than the predicted XY%. As psychologists say, this behaviour represents a substitution of the marginal benefits of driving intensity for the reduced marginal cost of risk. It’s not trivial to consider that any system which aims to increase the safety on the roads could be less effective than expected or could even lead to more accidents. Several studies of driving behaviour recognised that individuals react to changes in driving conditions in a compensatory fashion such that riskier behaviours result from perceptions that the environment has become safer. In 1975 Peltzman evaluated the effects of regulation of mandatory vehicle safety devices hypothesizing the tendency of people to react to a safety regulation by increasing other risky behaviour, offsetting some or all of the benefit of the regulation. (Peltzman, 1975).

FIGURE 1 – RISK COMPENSATION ACCORDING TO PELTZMAN (1975)

“An Individual will accept a given level of risk in a given activity. If his perceived level of risk alters, his behaviour will compensate to place him back at his accepted level of risk.”

The ‘Peltzman effect’, a contributing factor in the explanation of Smeed’s Law, arises when people adjust their behaviour to a regulation in ways that counteract the intended effect of that regulation. For example, when the government passes a seatbelt law, some drivers may respond by driving less safely. In 1994 Canadian psychologist Gerald Wilde elaborated a more psychological model of risk compensation: the Risk Homoeostasis Theory (RHT), to explain why safety interventions have not produced long-term decreases in death rates. “People alter their behaviour in response to the implementation of health and safety measures - Wilde says - but the riskiness of the way they behave will not change, unless those measures are capable of motivating people to alter the amount of risk they are willing to incur (=target level of risk)” (Wilde, 1994). According to Wilde, an
individual acts as a homoeostatic controlled self-regulation process. In any activity, people check the amount of risk they feel exposed to (subjective/acceptable risk). They compare this with the amount of risk they are willing to accept (target risk), and try to reduce any difference between the two to zero. If the level of subjective risk experienced is lower than is acceptable, people tend to engage in actions that increase their exposure to risk. So, unless the target level of risk changes, no permanent changes in safety can be attained. This theory, applied to the car-drivers, shows that the use of devices to make them safer would provoke an increase of the risky behaviours thereby eliminating, in whole or in part, the structural efforts to decrease the level of risk and to increase the road safety.

While Peltzman’s theory does not predict the magnitude of risk compensatory behaviour, in the risk homoeostasis theory the compensation effect is virtually complete. According to Wilde, the number of accidents only depends on the accident rate which the population in a given country is willing to tolerate, and not on the specific measures taken, at least not over a longer period of time (Wilde, 1994). As a consequence, the only effective safety measures are those that alter the subjective/acceptable risk level of drivers. Anything that merely modifies the environment or that regulates driver behaviour without affecting the target risk level is useless (Hedlund, 2000). “The change led to a sudden surge in the level of perceived risk; this was now much higher than the level of risk accepted, and people drove more cautiously. This increased caution reduced the rate of road crashes. After some time, people discovered, through their own and others’ experience and through the mass media, that the roads were less dangerous than they had thought. Now, the risk was not as high as was tolerated, and people became less cautious in their actions, causing the crash rate to return to “normal.” When Iceland changed over to right hand traffic in 1968 it experienced a similar short term fluctuation in the rate of road crashes” (Wilde, 2002).

**FIGURE 2 – THE RISK HOMEOEOSTASIS THEORY (WILDE (1982) AND THE OPTIMAL LEVEL OF ACCIDENT RISK**
Wilde uses RHT theory to explain the results of research into the behaviour of Munich taxicab drivers (Wilde, 1994). In this study part of a taxi fleet in Munich was equipped with ABS. The drivers knew of the advantages offered by ABS and drove vehicles that were in all other ways the same as others in the fleet. Over a period of several years, these drivers were: over represented in crashes where they were at fault; more often recorded as braking extremely hard; made sharper turns on curves; were less accurate in their lane-holding behaviour; proceeded at a shorter forward sight distance; made poorly adjusted merging manoeuvres; created more traffic conflicts; drove faster and had more accidents under slippery driving conditions (Vrolix, 2006). The idea of risk homeostasis has garnered criticism (O’Neill and Williams, 1998). In 1986 Evans concluded that “there is no convincing evidence supporting it and much evidence refuting it” (Evans, 1986). Although Wilde’s theory is controversial, there seems to be a general agreement in the literature that road users do adapt their behaviour to certain risk-reducing measures (Assum et al., 1999).

**Impact on Safety/Mobility/Environment/Infrastructure**

Studies in the US by Hertz (1996) and in Canada by Grant and Smiley (1993) revealed results similar to those above. Road safety experts express varying opinions as to the reasons for ABS not reducing the frequency of crashes. Regardless, there seems cause for concern and caution. An OECD scientific expert group’s response to the Munich study was this: “**Behavioural adaptation of road users which may occur following the introduction of safety measures in the transport system are of particular concern to road authorities, regulatory bodies and motor vehicle manufacturers, particularly in cases where such adaptations may decrease the expected safety benefit. Some driver training experts argue the reason the safety benefits of ABS are not realised is that drivers are not taught how to use the braking system correctly. They say some drivers release brake pressure when they feel the pedal shudder (the effect of ABS being activated), and they lack the knowledge and skill to use the system properly**” (OECD, 1990). The Mannering studies stated that drivers drove an average of 8.5 cm closer and came within 1 meter 23% more often when a cyclist was wearing a helmet. In 1981 Adams showed that in the countries studied, which included states with and without seat-belt laws, there was no correlation between the passing of seat-belt legislation and the total reductions in injuries or fatalities. When all associated fatalities and injuries in road accidents were included, it appeared that some accidents were being displaced from car drivers to pedestrians and other road users (Adams, 1981). Other research has taken groups of drivers, including those who did and did not habitually wear seat-belts, and measured the effect on driving style in the habitually unbelted. The drivers were found to drive faster and less carefully when belted. (Janssen, 1994). Other experimental studies suggested that children who wear protective equipment are likely to take more risks. (Mok et al., 2004; Morrongiello et al., 2007).
Although the homoeostatic mechanism is confirmed, by several studies, it remains to be seen if it’s voluntary or unaware, or rather if this attitude of compensation, that conducts to the invariance of the risk in presence of safety measures, is attributed to the rational thought of the driver or if it is determined by an unintentional perceptive mechanism of ‘false safety.’ It may be useful to make reference to the concept of feedback reaction to a specific stimulus as definition of the systems that use information coming from the output of the same system to regulate its operation. the different conclusions related to the measure of adjustment of the behaviour can be explained by manifold factors that influence the onset of the behavioural adaptation, reassumed in a model developed by Weller and Schlag (Weller and Schlag, 2004).

The implemented measure has first to provide the objective possibility to change one’s unsafe behaviour. Schlag affirms that there is a real possibility to minimize, if not to delete, the homoeostatic process. It is possible to reduce the dangerousness of the driver giving him the possibility to perceive his own homoeostatic mechanism. Such perception depends above all on the communication of the information that is desired to transmit. In the case of the infrastructure it deals with coercive mechanisms of the view (more than signals of danger) or of artificial variation of the environment or the layout that prevents the adaptation and allows ‘to perceive’ the change as disadvantageous (maximum of utility). This system, also maintaining the safety characteristics of the infrastructure, may change the human psychological variables and inhibit the homoeostasis phenomenon (Schlag et al., 2008). The first aspect to be verified is if the infrastructure, perceived as safer, provokes the homoeostatic mechanism to start and induces drivers to delegate to the infrastructure their specific assignments and favouring the restoration of the native level of risk acceptability that the same infrastructure, on the contrary, should decrease. Some experimentations would seem to confirm the existence of this phenomenon on ‘safer’ infrastructures. It would imply that the road safety (as reliability of the flooring, amleness of the roadway, existence of illumination devices, etc.) is not by itself enough to lower the
level of necessary individual risk for road accidents reduction. On the contrary, some types of roads, technically unexceptionable, would favour the homoeostatic process by decreasing the individual adaptation time of it, increasing speeds (the first cause of serious accidents) and frustrating the benefits induced from the safer road (Weller, G. & Schlag, B. (2004).

If people perceive relevant changes in their environment they adapt their behaviour to meet the new challenges or to benefit from new chances. Humans modify behaviour to suit new conditions. They may try to act more cautious if changes are perceived as having dangerous impact or they may try to capitalize on new possibilities to meet own aims more effectively. In different fields of research, this is described as behavioural adaptation, risk compensation or risk homeostasis (Wilde, 1994), or rebound effect. Mainly studied in transportation science, high relevance have those cases where countermeasures against risk, eg driver support systems to reduce risk when driving, are counterbalanced by behavioural adaptations using the improvement to act more risky, eg to drive faster.

OECD (1990) defined behavioural adaptation in traffic as: “... those behaviours which may occur following the introduction of changes to the road-vehicle-user system and which were not intended by the initiators of the change; behavioural adaptations occur as road users respond to changes in the road transport system such that their personal needs are achieved as a result”. Whether the net outcome is positive or negative depends on the amount of not intended behavioural adaptations as shown in figure 3.

One could argue similar to risk homeostasis theory (RHT) that behavioural adaptation implicates that sole engineering measures would not result in a reduction of accidents. In fact there are publications supporting this assumption. Early evidence was found for technical measures such as antilock braking system and also for educational measures as slippery road training courses, more recently for adaptive cruise control and other in-car systems reducing workload and at least partly leading to adaptations such as fulfilling secondary tasks as using mobile phones more often when driving or speeding up.

When comparing data from a 14 year period (1984-1997) of 50 US states Noland (2003) found that the downward trend in fatalities is due to demographic factors, an increase in passive safety and improvements in medical technology. Improvements in infrastructure did sometimes even have negative effects suggesting behavioural adaptation. Noland (2003) concludes that “Results strongly refute the hypothesis that infrastructure improvements have been effective at reducing total fatalities and injuries.”
For improved car lighting (enhanced night vision system, adaptive lighting) however Schlag et al. conclude on the basis of an ample literature review that adaptation in fact occurs also in this case but that the effects are not strong enough to eat up positive impacts of such safety measures as improved lighting (2008).

The different findings concerning the extent of behavioural adaptation can be explained by the multiple factors that influence the occurrence of behavioural adaptation. These factors are summarized in a model developed by Weller & Schlag (2004) (figure 3). Similar aspects are named by Bjørnskau (1994, cited in Elvik & Vaa, 2004).

The implemented measure has first to provide the objective possibility to change ones behaviour in an unsafe way. Second, the driver has to perceive this possibility. Whether the change is perceived depends on the communication of the measure through media information or advertisements on one hand, and on direct feedback to the driver on the other hand.

To result in adaptation, the change in behaviour further has to be perceived as being advantageous for the driver (utility maximization). This function is different between different driver groups (eg, age groups) and different within the same driver group as well (eg driver being in a hurry or not). Independent of this chain of action (objective enhancement, subjective enhancement, utility maximization), there is a second path that leads to adaptation, namely direct change of genuine psychological variables. These changes are a direct outcome of changes in the environment (or the car) and the following changes in the nature of the driving task. When the driving task becomes more easy due to changes in the alignment (eg, straight instead of curved) workload might decrease and speed might be increased as a consequence.

**Considerations/Strategies/Conclusions**

Wilde shows that the ‘risk thermostat’ can be reset. There are four possible approaches to reducing the target level of risk for drivers: rewarding particular safe behaviours; rewarding drivers who have not crashed; punishing particular unsafe behaviours and punishing drivers for having crashed. The third option, which is used predominantly in most societies, has not been found to be particularly effective. However, incentives for crash-free driving have been shown to be particularly useful. The promise of free renewal of the driver’s licence in California in return for crash-free driving was followed by a 22% reduction in crashes in the first year and by a 33% reduction in the second. Norwegian beginner drivers, who were promised by their insurance company complete reimbursement plus interest on the insurance surcharge for young drivers, responded by a 35% reduction in crashes. German truck drivers who were given the prospect of a cash bonus for every half year of crash-free driving subsequently caused much fewer crashes; this incentive programme has been in effect for over 30 years without any dwindling in its power to prevent accidents. As
Wilde wrote, “the success of incentive programmes compares favourably with the more traditional countermeasures. The incentive approach would therefore seem to warrant much wider implementation in the promotion of safety and lifestyle dependent health” (Wilde, 2002). In conclusion, what can we learn from the homeostasis theory? Those who manage organisations should not assume that a direct safety benefit will result from safety initiatives. Where active safety features are added to vehicles, it may be better that drivers do not know about them. Where technology or features are introduced into fleets, drivers should participate in ‘familiarisation programs’ which should attend to the psychological dimensions of behaviour adaptation and provide participants with strategies to monitor and manage their risk taking behaviour (Vrolix, 2006). What’s the recommendation? “Wider realization that the traditional ways do not work may stimulate willingness to innovate. Wider awareness of the effectiveness of alternative approaches to health and safety may increase willingness to debate the merits of limited or even society-wide implementation of expectationist measures against lifestyle-dependent death and disease. (...) Waiting for Godot will draw to a close. Who knows, Godot may come. And if that does not happen, let it be because we, the nation’s people, have decided that Godot is not really all that welcome”. (Wilde, 1994).

Sources


• OECD (1990), Behavioural adaptations to changes in the road transport system. Paris: Organization for Economic Co-operation and Development; Road Transport Research, p. 5.


CASE STUDY 4 – WORKING ON RISK COMMUNICATION AS INSTRUMENT TO MITIGATE SOCIAL AMPLIFICATION OF RISK

Study Details

Country: Canada Quebec
Geographical Area involved: N.A.
Type of Hazard (man-made, natural, or climate change): Main events
Risk Classification: Mitigation of Social Amplification
Authorities/Operators involved: Québec Ministry of Transportation
Year of implementation: 2010

Short Description

It would be impossible to tackle the question of social perception of risks without taking into account risk communication. As a matter of fact, literature shows how the latter is a crucial step in the process of risk management. Although it cannot solve all the disputes originated by the stakes, when risk communication is missing or poorly performed, it certainly leads to a failure in the effective management of risks. Thus, it is the core of the risk decision making process.

Risk communication reveals to be a tool allowing to influence the process of social communication of risks in order to ensure a better governance and wiser decisions. Psychometric research actually provided a number of information on the way in which people perceive risks. In the light of such fresh knowledge, decisions are no longer taken based on scientific data. A more balanced method was adopted acknowledging both risk perception by the public and their views and values as essential elements in the risk-oriented decision making process and all related communications. The linkage between risk-based decision making and risk communication must be fully understood so to reach the goals of the risk management process and work out an effective public policy on risks.

The following text includes some recommendations to help use risk communication techniques at best.

Feedback on the concept of social amplification of risks

According to Renn et al.(1992)⁹, social amplification of risks is based on the assumption that risk-related events interact with the psychological, social, institutional, and cultural processes, to amplify or attenuate the single or social perception of risks and influence the behaviours connected to risks.

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Although it has been mainly investigated as a mechanism influencing perceptions, social amplification of risks was analysed even in a risk communication-oriented perspective (Renn, 1992). The amplification process actually entails a step of capture and decoding of information by individuals, who then weight and appraise it, and finally compare it to other messages received. Finally, specific beliefs are formed and internalized as rational. Such beliefs represent the rationale of intentions vis-à-vis future actions in line with the former.

Yankelovich (1991) argues that the public’s attitudes start as gross opinions to turn into judgments according to a complex process including sorting and conciliating opposed emotions, values and interests related to a given problem. As a matter of fact, Yankelovich identifies seven different stages in what he calls “the transformation of gross opinions into public judgments”.

1. Awareness raising stage
2. Feeling of urgency or need to act
3. Search of solutions
4. Reaction and resistance
5. Comparison of alternative solutions
6. Intellectual consent or decision at cognitive level
7. Full resolution - at moral, emotional, and intellectual level

Said concept clarifies the design and formulation of initiatives on risk communication. Each stage of the process poses a different challenge to the communicators, thereby asking for a reassessment of the objectives, messages, and methods employed to communicate risks.

These short facts from literature clearly illustrate that any information transmitted here and there on risks influence the perception of the public. At his level, it is interesting to tackle risk communication.

The role of media in the process of social amplification of risks

Media are often the main source of information on risks. Because of that, they play an important role in the process of, namely on account of their taste for conflict, blame, and painful news. They even influence all risk communication actions as they intervene in the development of public opinion.

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According to Yankelovich (1991), the media are a source of information helping the public form their own opinion on risks. They have a role to play because they can draw the public’s attention on diverse issues and, after all, contribute to the development of a sense of urgency on such issues.

The interest generated by the media towards current affairs is sometimes difficult to predict and explain. The term “snowball effect” is hereby used to describe a recurring topical question whose reports are increasingly frequent, thus pushing the media to compete in order to win the public’s interest. The “concentric wave effect” is another form of risk amplification generated when media reports initially concerning a single risk are extended to encompass related topics.

As for risk communication, partial or irregular translation of scientific information, along with the channel and media distortions, public’s perception (e.g., “fear-related” factors) and inaccuracy of information, pose problems, for instance when a considerable public debate on a given issue overcomes the efforts to manage such risk (i.e., social amplification of risks). Said problems often result from an information vacuum as risk managers devote no extra effort to make the public commonly participate in their assessment and their management decisions. Instead, the information vacuum is filled by other sources. In risky situations, a stakeholder can obtain strategic control over the public’s attention and the problem through efforts on risk communication. Failure to act proactively, a body or ministry may lose its strategic control over a given problem.$^{12}$

In short, because the public shapes their own perception of risks based on the information they can capture and because such information is often provided by media (and not necessarily as accurately as desired), it is of crucial relevance to catch on the communication sphere with a view to enhance risk management.

**Risk communication – some modern definitions**

In order to have a better understanding of the communication domain, it is crucial to remember that it has been further developed starting from the concepts of “risk analysis” and “communication domain”. Risk communication is only partially relying on the principles of communication theory.

Fischoff (1998) summarizes the evolution of risk communication in the last 20 years in eight steps, each of which is “characterised by a focused communication strategy that practitioners hope is effective, as well as by the lessons learnt on what strategy

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can achieve. *It should be noticed that each step chains up with the previous one, although it does not replace it*[^13].

**Fischhoff (1998)’s steps of the evolution of risk communication**

1. All we have to do is getting the right figures.
2. All we have to do is giving them the figures.
3. All we have to do is explaining the meaning of figures.
4. All we have to do is showing them they have already accepted similar risks in the past.
5. All we have to do is showing them the risk is worth taking.
6. All we have to do is treating them nicely.
7. All we have to do is turning them into our allies.
8. We have to go through all previous steps.

Technology and globalization are relevant factors in the evolution of risk communication strategies. The rapid evolution of communication tool technology has increased both the speed of sender-recipient transmission of information and the extent of the attention thereof. This results in an acceleration of the development of social attitudes and risk perception. Risk perception by the public is constantly mutating and evolving in parallel to the change in the dynamics of public opinion as a reaction to the environment.

The following table includes some modern definitions of risk communication.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Author or Reference</th>
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<tbody>
<tr>
<td>Bilateral exchange of information between stakeholders aimed at supporting decision making about the best way to manage risks.</td>
<td>Canadian Treasury Board Secretariat (2005)</td>
</tr>
<tr>
<td>Bilateral exchange of information occurring at all the steps of the risk management process, combined with the contribution of actors and a comprehensive dialogue between the risk managers and actors involved.</td>
<td>Canadian Standardization Association (CAN/CSA-Q850-97)</td>
</tr>
<tr>
<td>Interactive process of information exchange where a number of messages on the nature of risks are shared.</td>
<td>College of Agriculture - University of Kentocky</td>
</tr>
<tr>
<td>Dissemination of information and risk assessment by experts, practicians, interest groups, and the public.</td>
<td>Leiss (1996)</td>
</tr>
</tbody>
</table>

Exchange of information in relation to the nature, relevance, meaning and handling of risks among the parties involved, i.e., governmental agencies, enterprises or industrial groups, trade unions, media, scientists, professional associations, interest groups, communities, and citizens.

Covello (1994)

Interactive process of information and opinion exchange among private citizens, groups, and institutions on the nature of risks entailing decision sharing, active partnerships, and the management of environmental, health, and safety risks in an improved, trustful atmosphere among the parties involved.

Mulligan et coll. (1998)

The evolution in risk communication from an essentially unilateral communication form to a bilateral sharing of information becomes essential as scientific uncertainty is one of the predominant features of a risk. When the decisions on negative risk management and prevention are targeted, risk communication stresses, de facto, the likelihood of events.

In short, risk communication can take different forms: from the provision of information to the targeting of publics (above all unilateral) through a highly interactive commitment of actors and a dialogue with the citizens. Any choice made concerning risk communication strategies derives from the specific context.

**Recommendations for an effective risk communication**

Theories usually provide the knowledge needed to develop effective risk communication strategies. However, their implementation often depends on operational constraints and realities. In any case, the following recommendations might serve as a rationale to trigger a deep reflection in each agency operating in the field of transport networks.

**Recommendation 1 – Contemplating the needs, expectations, and values of the different stakeholders**

When designing a risk communication strategy, the first task to cope with is the identification of the different stakeholders (to whom do we have to speak? with whom do we have to interact?). According to the OECD (2002), the different publics targeted by risk communication include the general public, the main actors involved, and the media. They even include social and political institutions, decision makers, and various interest groups. The formulation of a risk communication program assumes the existence of effective relations between the parties representing the

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Criticalities of the risk communication network. The OECD even specifies that, because communicational approaches can vary according to the needs, expectations, and values expressed by different target publics, an accurate identification of the latter must be kept as crucial from the very beginning. As for the general public, for instance, the OECD suggests that the content of the message should be kept as simple as possible without eliminating the essential information. It is thus demanded to adjust communication to the needs of a target public, rather than to those expressed by the information source.

Because the relation between the public authorities and citizens has changed, most of the target publics show the primary need to be involved in the public debate on risks. For instance, Canadian citizens are willing to play an active role in the decision-making process influencing their lives, in the first place because they can be better informed and more prudent, but also because they have a feeling of disillusion vis-à-vis public authorities. Similarly, “Canadians do not automatically accept established power anymore... We are more passionate of personal autonomy than ever before. We want to take the decisions concerning ourselves on our own...”

In addition to the eagerness to participate in the public debate, the citizens also need to know that their points of view are seriously accounted for the moment decisions are taken. The goal of a citizen-inclusive process is not only about taking a “cliché” about public opinion or giving the public the chance to disseminate fixed points of view. A fruitful participation stems from a process through which citizens can reflect upon and decide strictly on the substantial questions under investigation. Such a process implies thorough discussions on the choices to be made and grants a negotiation space so to find a common ground. One of the relevant aspects in effective communication is also related to a sufficient transmission of information to citizens in order for them to play an active and enlightened part in the process.

Thompson detects a red thread uniting the expectations of the public from regulating authorities, which should:

- speak openly of moral commitments and value judgments;
- give the population the possibility to take action as to their risk exposure;
- speak of risk distribution and advantages, including its distribution over time (generations);
- give account of their actions;

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15 Canada, Standing Senate Committee on Social Affairs, Science and Technology, *Final report on social cohesion*, 1999, Chapter 3.
• recognize that when a risk is under control in a given place, they did nothing but shift it;
• show that the political analysis includes all factors\textsuperscript{17}.

Finally, all parties should listen to the opposite points of view and see the choices that need to be made in the presence of all supporters of the interests at stake. Biases such as “people do not really want to be consulted, they just want their ideas to be accepted” or “if you do not do what they want, they will never recognize the validity of citizens’ participation” are groundless\textsuperscript{18}.

Citizens’ participation seems to be an increasingly widespread practice. However, their participation is often difficult and uncomfortable. Inevitably, some parties may be deceived by the results. Their only consolation is to have been able to take part in a transparent process where all points of view have been listened to and taken into account in a constructive spirit\textsuperscript{19}.

**Recommendation 2 – Creating a trustful atmosphere**

Confidence building is a major goal in risk communication as it poses a challenge to governments and their bodies due to the attitude of the public to perceive them as sources of unreliable information\textsuperscript{20}. When creating a trustful atmosphere, the opposite relation is just as important, because governments may feel that their trust in the public has diminished. Citizens’ participation in the decision making on risk management is such that it can build up trust on both sides. Nevertheless, the public might lose their trust if they feel their opinions are not taken seriously enough or they cannot influence the elaboration of directions. Thus, the search for a balance between a communication able to win trust on one side and protect bodies and agencies on the other side is an endless task calling for an understanding of the public’s expectations.

\textsuperscript{17} M. Thompson, Risk and Rationality: Approaches to the Management of Ignorance About Environmental Health Risks, report on a WHO conference held in Ulm, Germany, 28 to 30 November 1992, on Risk communication: Dealing with the Spectrum of Environmental and Health Risks in Europe, Environmental Risk Assessment Unit, Norwich, University of East Anglia, Research Report No. 11.

\textsuperscript{18} Canada, Ministry of the Solicitor General, notes for a short speech given by the Honorable Andy Scott, Solicitor General of Canada at the Institute on Governance, Aylmer, Québec, 1998.

\textsuperscript{19} R. B. Foster, Enhancing Trust in Institutions that Manage Risk, Foresight and Precaution, Published under the direction of M. P. Cottam, D. W. Harey, R. P. Pape and J. Tait, Rotterdam, Balkema, 2000, n0 1, p. 3-7.

\textsuperscript{20} The facts and figures from Ekos research show that less than one Canadian out of five believes that when their government makes a decision this is done by taking the public interest as the highest priority. More than 80% of them believe real priority is attached to the personal interests of government members, big enterprises, or their friends. The erosion of trust in public institutions was emphasised by major events associated to risk mismanagement. F. L Graves, Collaborative Government: Looking for a Canadian Way?, New Directions, Ottawa, The Public Administration institute of Canada, 1999, N. 6.
Trust consists of a certain number of elements including the feeling of competence, objectiveness, equity, perseverance, and good will. The sources of information on risks, for instance public authorities, must be mindful of the fact that trust plays a crucial role in the acceptance and effectiveness of risk-related messages diffused to the public.

The credibility of the source is a further key factor. Actually, it has been showed that the success of risk-related messages is very closely connected to the credibility of the message source (communicator) or to the “trust” inspired by the latter in the recipient of the message. Thus, partnerships with trustful sources to elaborate and diffuse messages always stand out as an effective and practical means to increase the credibility of risk-related messages.

Openness and transparency are also relevant factors. This means a lot more than simply communicating facts and information. Although it doesn’t allow to achieve the very goal to involve citizens, the mere account of facts might partially bridge the gap between the public’s real perception and a perception suggestive of risks. Risk communication goals must demonstrate a bilateral exchange of information leading to a common approach to discussions on the stakes and to a common influence on risk-based decisions. If the public feels they are manipulated, their trust will drop and they may feel indignant. Renn insists on the fact that the public’s points of view and values must become integral part of the debate: “When value issues are unsolved, technical expertise and skills, as good and deep as they may be, will never help solve the conflicts between social, cultural, and political values”[21].

Building up a trustful relation with the public and nurturing it reveals to be today one of the major tasks of the communicators at the service of the general public[22].

**Recommendation 3 – Being proactive**

Any risk entailing a controversial side and apt to provoke increasing indignation in the public demands an action of proactive communication by the body in charge of managing it. At any moment, external actors (e.g., media, industries or non governmental organisations having a clear acquired interest) can launch the initiative to ensure communication as to such risk. Failure to act proactively may imply a loss of strategic control over risk issues by the body, knowing that the public’s attitude towards the risk will be very difficultly modified ex-post.

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Proactive communication requires a risk issue analysis in order to identify those which are more likely to cause the public’s indignation and to implement a timely communication programme. Risky situations can even be classified based on the fear factors which intensify risk perception and provoke indignation. For instance, the public tends to remember memorable or dreadful events. Their need for information is then higher and that’s when they demand measures to be taken promptly against the related risk.

**Recommendation 4 – Specifying the role of stakeholders and clarifying the decision-making process**

In the past, citizens used to perceive science as an “authority” on information; such a vision has evolved since then. They no longer believe scientific opinions on risks to be necessarily certain. The citizens are increasingly critical (and often cynical) towards science and its capacity to assess risks accurately.

Researches on the matter confirm their vision. The public’s feeling about a “false perception” of risks and the fact that any opinion differing from the experts’ estimates draws on ignorance or stupidity gave way to new approaches recognizing that the public’s reactions towards risk often have a rational basis and that the perspectives proposed by “experts” and “non experts” should shed light on each other, following to a bilateral process\(^{23}\). Consequently, including the points of view both from experts and non experts in the decision making process becomes a milestone in the effective design of risk policies.

To do so, the role of experts in the decision-making process in which the public participates must be clearly stated. Experts must make their technical knowledge available for the solution of problems and expose both clear and blurred factors. Nonetheless, they must be ready to share their role when it comes to choose the best solution to manage the risk\(^{24}\). Frewer (1999) argues that the public is fully able to understand the concept of uncertainty and that they must be provided with clear information on the uncertainties linked with the risk. This way, their sense of trust in the sources of information will be heightened\(^{25}\).

In this purpose, a report published in 1999 by the Canadian government under the title of “Scientific opinions for governmental effectiveness (ASEG)” specified six


principles accompanied with guidelines with a view to easing the effective application of scientific opinions to mitigate the lack of trust by the public in scientific issues\textsuperscript{26}. Principles 4 and 5 are particularly interesting:

- **Principle 4**: scientific advisers and decision makers must inform the public and parties involved of the degree and nature of both scientific uncertainty and risk management methods used to make decisions.
- **Principle 5**: governments must adopt transparent decision-making processes which are open to the parties involved so to show clearly how decisions are made. They must consult both the parties involved within the governments and the population since the beginning and throughout the process to be able to take into account social values in the design stage of risk management policies.

An effective risk management model must fully recognize the existence and validity of risk assessment by experts (empirical assessment) on one side and by the public on the other side (non empirical assessment). The figure below discloses said principle\textsuperscript{27}.

Further studies, however, aroused doubts over non expert assessment. Actually, Hammitt (2000) presented a controversial study concluding that the public’s opinions on risks, composed of various opinions, should not be considered as equally valid when it comes to decision making on risk management. Hammitt distinguishes between cognitive error-based risk assessment by the public (groundless expedients such as intolerance towards the unknown, uncertainty over the scope of risks, over-valuation of low probabilities) and public risk assessment based on a sound moral argument. Hammitt argues on that cognitive error-based risk assessment by the


Social acceptance of risks and their perception

The public should neither have a legitimate role in risk management nor be accepted as a rationale for society-related decisions.\textsuperscript{28}

Similarly, the US National Research Centre (1989) issued a survey on the improvement of risk communication summarizing a key difficulty in relation to the participation of citizens in the debate over risks: “\textit{Openness is something different from power delegation}”. The survey concludes by saying that, if the public is encouraged to participate in the decision-making process, it is the responsibility of the risk manager to set the nature of such participation and the role of their contribution to the investigation of a specific issue as clearly and as soon as possible. External actors to public discussions on the issues must absolutely understand the bounds of their involvement with a view to avoiding any unrealistic expectation as well as a loss of trust vis à vis the institution.\textsuperscript{29}

All in all, clarifying the concept of sharing the decision-making powers with the citizens without sharing the responsibility of decisions is a success factor for the participation of the citizens in the risk management process.

\textbf{Recommendation 5 – Designing a risk communication model suitable for the organisation}

In theory, Renn (1991) argues that the success of a communication model assumes the conciliation of scientific, public and political points of view aiming at reaching the same understanding on complex risks, which results in credible risk management options and policies.

When fundamental public values are at stake, communication goals must point towards a bilateral exchange of information allowing to adopt a common approach and influence any risk-related decisions. The essential underlying principle is that the best way to tackle the value and equity dimensions of risk decision-making is to arrive at a mutual understanding and consensus, said dimensions being the foundations of the trust the public feels in public institutions.

The creation of linkages between the political sphere, scientific (or technical) information, horizontal priorities of the government and the public context (including social-economical aspects) is of the utmost importance. The following scheme discloses the different phases in the design of strategic options and decision-making. The vertical criterion (or challenge) exclusively relies on scientific bases (for risk assessment). The horizontal criterion is based on the public political interface and


creates a horizontal link between the scientific information and political dimension. Finally, the political criterion takes into account the influences and pressure exerted at ministerial and parliamentary level, which are embedded in the decision-making process. The gap between scientific experts and politicians would widen further in the absence of the “horizontal criterion”. And such lack of communication might lead to the inability to manage the risk.

In theory, this kind of risk communication model might generate a risk communication-oriented (and consequently risk management-oriented) decision-making model. In practice, the main determinant of the line to follow in all risk management situations is the “nature of the decision”, as it fixes both the risk communication goal and action strategy.

Remarks on the nature of the decision led to tackle the question of the “debate level”. When combined and integrated to one another, the three main debate levels as described in the works by Renn et Levine (1991) provide us with a starting point for the design of a risk communication strategy. The following table contains the definitions of the three levels, each of which includes its own major goal, direction, and challenges to accept\(^{30}\).

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<thead>
<tr>
<th>Three debate levels</th>
<th>Main goal</th>
<th>Communications -Direction/ needs</th>
<th>Challenge</th>
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<td><strong>LEVEL I</strong> Transmission of technical knowledge (de facto arguments, risk likelihood, potential damage)</td>
<td>TRANSMISSION OF INFORMATION</td>
<td>- Informing the public&lt;br&gt;- In general, unilateral transmission of information&lt;br&gt;- Bilateral communication just to ensure the message has been understood and concerns have been put to rest.</td>
<td>- Message elaboration&lt;br&gt;- Clarity of the message&lt;br&gt;- Effective use of the channels&lt;br&gt;- Urgency/swiftness</td>
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<td>Social marketing&lt;br&gt;Education</td>
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<td>Raising the public’s awareness</td>
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<td><strong>LEVEL II</strong> Debate over the actual, desired capacity of institutions to handle risks</td>
<td>PARTICIPATION OF THE PUBLIC Dialogue with the parties involved and the public</td>
<td>- Defining risk distribution and advantages&lt;br&gt;- Encouraging trust in the risk management body&lt;br&gt;- Setting forth an evidence procedure on task fulfilment and performance satisfaction according to the public’s expectations</td>
<td>- Showing expertise (credibility of the source)&lt;br&gt;- Win/preserve people’s trust</td>
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<td><strong>Level III</strong> Values of the society, cultural-related lifestyles and their influence on risk management</td>
<td>DIALOGUE-BASED COMMUNICATION MODELS RATIONAL DEBATE* Mediation Citizens’ meetings Concertation meetings</td>
<td>- Reaching a consensus over the questions underlying the debate on risks is an essential condition to make decisions.&lt;br&gt;- Risk-related information and dialogue are not enough to find a solution.</td>
<td>- Correct representation of all the parties involved&lt;br&gt;- Spontaneous agreement over the compliance to the rules of rational dialogue (debate)&lt;br&gt;- Addressing the best possible expertise&lt;br&gt;- Clear tasks</td>
</tr>
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* Rational debate: a special form of dialogue where all the parties involved enjoy the same rights and have the same duties to present allegations in order to check the rationale in a context exempt from any social/political control (Renn, 1998).
After setting the debate level, the body in charge of diffusing risk-related information should look into the workings of the communication process, namely into the methodology, tools, channels and products of communication. Obviously, the scope and intensity of the whole participation process for the public, or the “level of debate over risks” depend on the nature of the decision. There is evidence that a single body is not apt to rally the public round on all the questions. For instance, in situations where an intervention is urged, the optimum action plan stands to reason, the question is purely or essentially technical, or as the stake is banal or falls within routine management, it is neither necessary nor suitable to consult the public before acting.

Thus, when risks are well understood, predictable and measurable, communication can be quite simple. Yet, public authorities are more often asked to inform and reassure private citizens against unknowable, unpredictable risks over which no consensus can be achieved among experts. Somebody believes that scientific uncertainty might politicize risks. Such situations would turn the very nature of the commitment between experts, politicians and population into a relation where trust is a determinant.31

**Recommendation 6 – Building organizational capacities connected to risk communication**

Leiss (2001) maintains that most of the institutions lack in the competence needed to handle risk issues, notably in the chapter devoted to risk communication (i.e., to handle any problem arising when the controversy over the best way to handle them rages).

Risk communication, which includes the evaluation of social perceptions, is an extremely complex study field where it is commonly difficult to gain all the information and expertise needed to make communication strategies and public’s needs meet.

It is thus of paramount importance to build competence on risk communication within organisations – actually as important as improving risk knowledge.

**Further recommendations**

1. **Being supported by the top management**

The support of top managers on risk communication is essential as it helps making sure that risk management issues are embedded in the organizational culture rather than being nice theories.

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2. Being aware of the influence exerted by organizational culture on risk communication activities

Organizational culture often favours practices and activities which are opposed to risk communication. For instance, the US Nuclear Regulatory Commission (2004) observed that employees preferred not to communicate any information until the analysis was completed. They wanted to prevent information from becoming public before they were able to provide all certain responses. Risk communication principles encourage the communication of risk-specific uncertainty.

3. Allocating sufficient resources

“The current unbalance between the resources allocated to risk assessment and to risk communication must be corrected, so that society can benefit from the right value of their related investments in the scientific assessment of risks. A good practice to retain would be investing one dollar in risk communication for each dollar invested in risk assessment”\(^{32}\).

4. Active planning

Risk communication activities should be organised as far as possible according to a management system based on a planning-executing-monitoring-learning model.

The development of a risk communication plan shall be ideally based on the participation of the manager in charge of the risk along with a communication expert able to decide the right directions in order to develop a sound communication plan.

5. Establishing clear goals

The success or failure of any risk communication strategy might depend on the setting of clear goals. The goals are destined to vary hugely according to the nature of the risk and may include informing, educating, persuading, negotiating, reassuring and warning. The strategies employed to achieve such goals might encompass an interactive discussion which may be bilateral or just unilateral and prescriptive by nature.

Certain theorists think that the messages intended to convince or set down rules are not appropriate when referred to risk communication. Yet, reality shows that these forms of communication find their own legitimate place in the general model of risk communication. Gutteling and other researchers underline that prescriptive or persuasive communications apt to manipulate or influence behaviours can be

appropriate when citizens are exposed to serious or direct hazards due to their life habits. Moreover, these forms of communication may be desirable when the urgency about a decision doesn’t simply allow to envisage a long process of interactive consultation of the public.

According to Renn (1998), the three main elements in risk communication are informing (modifying what is known), persuading (modifying attitudes/behaviours) and consulting. Risk communication is intended to:

- “ensure that all the recipients of the message are able to understand the sense of the messages they receive;
- persuade the recipients of a message to change their attitudes or behaviours vis à vis a specific cause or risk category;
- create the conditions for a dialogue on risk-related questions so that all the parties involved can participate in an effective, competent, and democratic conflict resolution process”

6. Applying best practices on risk communication

Although the content may change, risk communication techniques are more or less the same as other communication programs, and the knowledge of communication experts is necessary. The following table lists some reference elements.

Some risk communication techniques (summarized by the OECD, 2002).

- Communication to the general public (factual elements):
  - Brochures and handouts
  - TV or Internet presentations
  - Public debates and conferences
  - Exhibitions, fairs, trade fairs, school visits

- Bilateral communication (institutional outcomes):
  - Public meetings
  - Face-to-face meetings
  - TV talk shows
  - Chat sessions and discussion forums on the Internet
  - Free visits, special activities

- Media:
  - Communiqués
  - Press conferences

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• Communication to the actors (common element: discourse on risks)
  – Experts, actors, and public sessions
  – Committee of Experts
  – Consensus conferences
  – Delphi Technique
  – Round tables
  – Mediation
  – Surveys and focus groups
  – Citizens’ Advisory committees
  – Citizens’ Juries

Conclusions

Risk communication is a complex science still in embryo, whose development is strictly connected with the research and fresh knowledge it can lead to. Governments are starting to admit that traditional methods to involve citizens in policy drafting are not always effective. Similarly, institutions at all levels are declaring that a truly interactive and deliberative participation of citizens represents a more effective way to manage risks. This will mean governments will have to adjust their modes of interaction with the public.

The practitioners promptly underline the fact that no form of risk communication shall satisfy all parties. However, theories can be adjusted in a foreseeable way, thereby building an effective communication strategy.

In short, successful risk communication is not about providing information or making a question understood to the actors. Nowadays, a fruitful risk communication stems from a better quality of the debate between public authorities, the public, and said actors.

References

This text is mainly based on the following reference documents:

• Groleau, Annie. Revue de littérature – La communication des risques, Quebec Minister of the Relations with the Citizens and Immigration, 2003, 28 p. – non published.
APPENDIX B: THE RESULTS OF THE SURVEY ON RESEARCH/STUDIES RELATING TO SOCIAL ACCEPTANCE OF RISKS AND THEIR PERCEPTIONS

1. CONTRIBUTIONS FROM GRAHAM VOWELS, UK

1.1. Customer perceptions of personal security – summary of existing research (August 2004/Job number 03021)

Who conducted the research?
TfL Group Customer Research

Objectives
Summarise customers’ perceptions of personal security while travelling in London.

Key findings
• ‘Unsafe’ is not the immediate perception of using public transport in London. But people’s attitudes to and nervousness about their personal security while they are out in London underpin their perceptions of personal security when choosing transport modes.
• Security concerns are primarily about the risk of personal assault. This is heightened when people are travelling alone during the hours of darkness.
• Cars are considered the safest modes of transport in London. Buses are considered safer than the Underground. Four in five Londoners feel safe travelling by bus, three quarters feel safe travelling on the Underground.
• The principle cause of unease on buses is the unruly and anti-social behaviour of other passengers. The wait for the bus and the walk to and from a bus stop, bus station or Underground station are major sources of concern for many, especially when travelling alone at night. Thus, while security concerns about public transport are not always overtly expressed, they are often implied in concerns about unreliable and infrequent services.
• Well-lit streets, stations and bus stops, CCTV cameras and the presence of transport staff help to reassure people travelling at night. Well-maintained environments increase perceptions of security. Countdown displays enable bus users to assess security risks by revealing how long they will have to wait.
• The presence of uniformed police and community service officers increase feelings of security, although the sudden appearance of many police officers has the opposite effect, implying that a crime has been committed.

What is the methodology adopted to collect data in the study?
Information is drawn from 40 existing market research reports (dated between 1996 and 2004) held by TfL Group Customer Research.
1.2. Perceptions of London Streets & the Urban Environment (June 2006/Job number 06027)

Who conducted the research?
TfL Group Customer Research

Objectives
Summarise public perceptions of London’s streets and urban environment.

Key findings
- Four in five Londoners are satisfied with London and their neighbourhood, but at least half regard traffic congestion and fear of crime as major problems. Priorities for improving the London environment are reducing pollution from traffic fumes and dealing with litter.
- Londoners do not know who is responsible for main roads in the capital.
- Almost all know about TfL’s responsibilities for public transport, and around half know about the Congestion Charge and red routes.
- Only a quarter know of its role in managing the streets, such as improving conditions for walking, or managing traffic flow.
- Walking is seen as the safest way of using the streets without being involved in an accident. Satisfaction with the pedestrian environment is often affected by the ‘feel’ of the area - some places are felt to be high crime areas or have the potential for ‘street hassle’, others are felt to be pleasant environments in which pedestrians can relax and not feel anxious. Litter gives the impression of neglect and makes pedestrians feel less secure.
- Regarding improvements to facilities, walkers want better quality pavement surfaces, and more and easier pedestrian crossings. Cyclists are dissatisfied with availability and security of cycle parking. For drivers and motorcyclists, the priorities are better road maintenance and more parking.
- Drivers and motorcyclists say road signage can be inconsistent and unclear. There is too much information on some red route signs, leading to misunderstandings about the rules.
- Most Londoners feel red route regulations are well enforced but favour stricter bus lane enforcement. Most Londoners regard it as a serious offence to breach yellow box, red route or bus lane regulations.

What is the methodology adopted to collect data in the study?
1.3. Teen Road Safety (March 2008/Job number 07206)

Who conducted the research?
TfL Group Customer Research

Objectives
The overarching objective of the research is to provide a year on year assessment of awareness and perceptions of road safety, and communications about road safety, amongst the core teen audience.

This research has also been used to assess the degree to which the extension into “new” media has amplified the teen road safety campaign.

Specifically, the key objectives are:

- to determine levels of awareness of the TRS campaign (any medium);
- to assess understanding and relevance of the campaign;
- to determine levels of awareness of the Debutantes programme and of the TRS embedded message/s;
- to measure any improvements in overall reach indicated by this analysis — i.e. do we have higher awareness than with the traditional-only media plan? (Media Multiplier);
- to determine the degree of any Media Maximiser effect deriving from the medium (i.e. the potential additive communication/message absorption which comes as a result of the environment in which the ad was consumed).

Key findings
- Seven in ten teens claim awareness of road safety messages from either advertising or other information sources; this is highest among non white males. Two fifths of teens claim awareness of road safety advertising; this is highest among non white groups, particularly females.
- Two thirds of teens recognise at least one of the more recent teen road safety campaigns (Shattered Dreams, Don’t Die Before You’ve Lived or Debutantes). Campaign ad awareness is higher among non white teens — who are the group that appear to be least open to the messages.
- Just over one in ten teens are aware of the Debutantes series. Nearly nine tenths of teens who had seen the Debutantes ad thought it was an effective vehicle to deliver the message. The TV/Internet tie in brought a limited extension to the campaign reach.
- More teens than ever take no notice of road safety information, despite awareness that many are killed/seriously injured, suggesting an “it won’t happen to me” mentality. Over half believe it is always/usually up to car drivers to look out for them, indicating a lack responsibility for their own safety.
Almost half of teens can be classified as “high risk” in terms of their approach to crossing the road. These tend to be less receptive to road safety messages. “High risk” teens do not exist as a result of ignorance; most of those that see the messages actively ignore them.

The campaign has greatest impact on “medium risk” teens (1/4 teens classified thus); the ad aware medium risk teens are significantly more likely to advocate the need for road safety information and acknowledge the dangers of crossing a road than the other risk groups.

What is the methodology adopted to collect data in the study?
400 interviews among Londoners aged 11-14 years

1.4. Teen Road Safety Report: Qualitative Research Exploring Triggers and Dynamics Around Teenage Risk Taking on London Roads (October 2008 / Job number 07241)

Who conducted the research?
TfL Group Customer Research

Objectives
To explore the triggers and dynamics around teenage risk taking on the roads, and the implications for marketing.

Key findings
• There is a natural risk seeking impulse amongst teens that has been historically the case, since the birth of ‘teenagers’ as a generation; taking risks is part of the teenage rite of passage.
• Road risk is part of this rite of passage and takes a number of different forms. Behaviours are either conscious (convenience or rebellion risks) or low conscious and either deliver a big buzz of adrenaline or deliver lower levels adrenaline.
• Whilst a minority of risks are unintentional, most teens know how to cross the road safely and are making trade offs in terms of situations in which they can take more risks.
• Teens are bombarded with a host of ‘risk’ messages, and roads are low on the list and the ‘risk’ narrative is therefore hard to apply to road safety.
• Risk is driven by a number of factors:
  – Rewards – personal and immediate benefits,
  – Beliefs – aspects of the teenage mindset,
  – Influences – broader social and environmental conditions that cultivate a risk mentality.
• A number of sample distinctions were identified and explored between area, gender and age.
• Tfl’s current marketing communications achieves high recognition and performs well diagnostically. Some treatments proved more difficult for teenagers to decode.

What is the methodology adopted to collect data in the study?
Qualitative: 4 x observation sessions of teenage road behaviours 8 x ethnography and group discussion sessions. Mix of after school and weekend sessions. Including a mix London Boroughs, 11-14 years, male/female, high to low risk behaviours, deprived and non-deprived areas, BAME and Non-BAME

2. CONTRIBUTIONS FROM JEAN-JACQUES FADEUILLE, FRANCE

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<td><strong>Objectives of studies:</strong></td>
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<td><strong>Methodology of data collection:</strong></td>
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## 1 – GENERAL (continued)

| Moral Author: | A collaboration of IRSN, ADEME, AFSSA, IFEN, INERIS, INRA and INVS, with Cesem opinion |
| Date & number of pages: | (1) February 2007; 22 p. (2) July 2006; 177 p. |
| Who conducted the studies: | AFSSSET (Agence française de sécurité sanitaire de l’environnement et du travail) |
| Objectives of studies: | Final report of research contract entitled “Perplex : Étude comparative de la perception des risques par le public et par les experts” by “Environment and Health of the AFSSSET”. Study on Risk Perception by the Public and the Experts (Perplex) conducted with the assistance of the institute BVA on differences in perception towards risk between the public and environment experts. |
| Findings of the studies: | The purpose of this summary is to present the main results study Perplex |
| Methodology of data collection: | The findings are based on responses from nearly 2000 people interviewed in October 2004. Half a sample representative of the French population. The other half is made up of people working at IRSN, AFSSA, INVS, INERIS and INRA. A questionnaire is used annually by IRSN for its survey on risk perception and safety. |

## 2 – ROADS

| Moral Author: | Sécurité routière |
| Date & number of pages: | August 2008 |
| Who conducted the studies: | Sécurité routière |
| Objectives of studies: | Analyse and criticize a topic from misinformation in two parts: - The perception of risk and its management: what role for the individual and the community? - The road-related risk to the individual |
### 2 – ROADS (continued)

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<tr>
<td>Title:</td>
<td>Travaux dirigés n°18: La perception du risque accidentel chez les jeunes adultes. TD « Perception du risque » – Première ST2S (Tutorial No. 18: The perception of accident risk in young adults)</td>
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<tr>
<td>Moral Author:</td>
<td>M.B. Fontaine</td>
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<tr>
<td>Date &amp; number of pages:</td>
<td>December 2007; 5 p.</td>
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<td>Who conducted the studies:</td>
<td>Chalon-sur-Saône</td>
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#### Objectives of studies:
Identify the difficulties of individual risk perception among young people, especially on the road: 1 - Explain the concept of « risk taking ». Risk-taking is always intentional? Why risk accidental is most often « bad » perceived? This risk is perceived in the same way for boys and girls? Among young and older adults? 2 - Explain the psychological approach of « risk utility ». What are the gains sought by young people taking risks on the road? possible losses? 3 - Define the term « at risk ». In which case, this at-risk dangerous? 4 - How will the results of the survey of young students from Mathias about the perception of risk accidental. Say in the light of all these elements, how to move the actions to prevent road accidents among young

#### Findings of the studies:
To prevent dangerous behaviour of young people on the road, it is necessary to seek first to understand their behaviour, while working on their perceptions of the risks they take, their knowledge on this subject and then imagine them with the means that promote behaviours conducive to health.

#### How the results going to be used:
Promote behaviours conducive to health

#### Methodology of data collection:
Results of the survey of 180 young students from Châlons sur Saône to assess risk perception in the context of an interinstitutional program of prevention of risk-taking on the road of young students.

<table>
<thead>
<tr>
<th>Access</th>
<th>TD18 Perception ind. du risque (MB Fontaine).doc (FR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title:</td>
<td>Sécurité routière et circulation: la responsabilité des différents acteurs. Avis du Conseil économique et social sur le rapport présenté par M. Philippe Da Costa au nom de la section des économies régionales et de l’aménagement du territoire (Road safety and traffic: the responsibility of different actors. Opinion of the Economic and Social Council on the report presented by Mr. Philippe Da Costa on behalf of the regional economies and regional planning)</td>
</tr>
<tr>
<td>Moral Author:</td>
<td>Bureau du Conseil Economique et Social</td>
</tr>
<tr>
<td>Date &amp; number of pages:</td>
<td>June 2007; 248 p.</td>
</tr>
<tr>
<td>Who conducted the studies:</td>
<td>INRETS (The French National Institute for Transport and Safety Research)</td>
</tr>
</tbody>
</table>
While substantial improvements have been recorded - in ten years, the number of deaths on French roads decreased by more than 40%, falling below 5 000 victims - there are still many areas to act as the road becomes socialized space where it would be possible to move safely in respect of everyone, whatever mode of transport used.

The concept of sustainable mobility is emerging to help address the complex problems of travel management. Road safety should be part of this new vision of mobility, more thoughtful, more environmental, or modes of transport are diverse and where the road is shared between the users responsible.

This report represents the automatic control measures that are far more dissuasive than the controls human, more rare, more and more improbable random. It demonstrates that the freedoms of everyone they are not threatened and that lives are more protected.

The road safety is not really a priority. It appears that this policy suffers from difficulties inherent in his character Inter and that many difficulties arise in implementing concrete-control sanction. Local actors agree recognize that the relationship with road users becoming more sensitive. Finally, questions arise about the effectiveness system control sanction.

Recommendations are grouped into several categories have been established to improve the effectiveness of policy enforcement and control and reduce road safety.

Gathering information from data collected and interviews and through the mobilization of many administrations for the production of statistics and qualitative elements.

La sécurité routière en France: bilan de l’année 2007 (Road safety in France: annual report 2007)

ONISR (National Interministerial Observatory of Road Safety)
<table>
<thead>
<tr>
<th>Source, date &amp; number of pages:</th>
<th>Paris: La Documentation française; December 2008; 258 pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who conducted the studies:</td>
<td>ONISR</td>
</tr>
<tr>
<td>Objectives of studies:</td>
<td>Road safety is everyone’s business and, in an international context of sustainable development.</td>
</tr>
<tr>
<td>Findings of the studies:</td>
<td>This report proposes road safety’s results 2007 with figures and elements of reflexion. A comparison is made with the countries of Europe.</td>
</tr>
<tr>
<td>How the results going to be used:</td>
<td>France must achieve the target set by the president of the republic, which is to achieve less than 3000 deaths by 2012</td>
</tr>
<tr>
<td>Methodology of data collection:</td>
<td>To carry out these missions, the ONISR draws on research organizations and research as INRETS, LCPC, SETRA and CERTU. It also makes a contribution of twenty-five observatories Regional, located in the regional directorates of the equipment as well as departmental observatories located in the departmental directorates of the equipment.</td>
</tr>
<tr>
<td>Access</td>
<td><a href="http://lesrapports.ladocumentationfrancaise.fr/cgi-bin/brp/telestats.cgi?brp_ref=094000007&amp;brp_file=0000.pdf">http://lesrapports.ladocumentationfrancaise.fr/cgi-bin/brp/telestats.cgi?brp_ref=094000007&amp;brp_file=0000.pdf</a> (FR)</td>
</tr>
<tr>
<td>Title</td>
<td>Le déploiement du contrôle sanction automatisé en France avec une mise en perspective européenne (The deployment of automated control sanction in France with a European perspective)</td>
</tr>
<tr>
<td>Author</td>
<td>Fabrice Hamelin (INRETS)</td>
</tr>
<tr>
<td>Date &amp; number of pages:</td>
<td>December 2008</td>
</tr>
<tr>
<td>Who conducted the studies:</td>
<td>L’Atelier du CRh : Revue électronique du Centre de Recherches Historiques (Journal of Historical Research Center)</td>
</tr>
<tr>
<td>Objectives of studies:</td>
<td>Since 2003, France implemented a speed cameras system to cover its national road network, that increased surveillance of road users. The deployment of automated enforcement system in France constitutes a major change in road safety-related public action. It is of course a technical revolution with significant juridical and administrative changes. Yet this paper shows that it constitutes also a sort of administrative counter-revolution, which means a re-centralization of state public action in this domain and which grows distance between administrations and users. So it is necessary to study local implementation to understand public and professional acceptance of this new instrument of road</td>
</tr>
<tr>
<td>Findings of the studies:</td>
<td>The CSA is a tool to be well accepted by road users, as indicated by the polls opinion47 and the low number of protest actions.</td>
</tr>
<tr>
<td>Access</td>
<td><a href="http://acrh.revues.org/index713.html">http://acrh.revues.org/index713.html</a> (FR)</td>
</tr>
<tr>
<td>Title</td>
<td>En adoptant tous un comportement responsable sur les routes, on peut sauver 13 vies et éviter 300 blessés par jour (By adopting all responsible behaviour on the roads, you can save 13 lives and prevent 300 injuries a day)</td>
</tr>
<tr>
<td>Moral Author:</td>
<td>DSCR (Security and the Road Traffic Directorate)</td>
</tr>
<tr>
<td>Date &amp; number of pages:</td>
<td>May 2008; 13 pages</td>
</tr>
<tr>
<td>Who conducted the studies:</td>
<td>Ministère de l’Ecologie, de l’Energie, du Développement durable et de l’Aménagement du territoire / Direction de la sécurité et de la circulation routières (DSCR)</td>
</tr>
<tr>
<td>Objectives of studies:</td>
<td>The French’s behaviour driving has changed, but ... If exceptional progress has been made in road safety on the period 2002-2007, more than 4 500 people are killed and over 100 000 are injured on the road each year. This press release informs the French and call them to change their behaviour and their habit.</td>
</tr>
<tr>
<td>Title:</td>
<td>Genres, risques, éducation, socialisation (GEnRES). La psychologie du développement au service de la compréhension de la différence des sexes dans l'accidentologie routière (Kinds, risk, education, socialization (gender). Developmental psychology in the service of understanding of the gender difference in road accident)</td>
</tr>
<tr>
<td>Author:</td>
<td>INRETS, Marie-Axelle Granié</td>
</tr>
<tr>
<td>Date &amp; number of pages:</td>
<td>March 2008; 2 pages</td>
</tr>
<tr>
<td>Who conducted the studies:</td>
<td>INRETS</td>
</tr>
<tr>
<td>Objectives of studies:</td>
<td>GENRES is a partnership project between INRETS and two university laboratories. The objectives are to better understand differences of sex observable in road accidents. Apart from the contributions of this project on the identification of different social influences in the development risk behaviour, the contributions of the project GENRES are also on a better understanding of factors underlying the behaviour of risk-taking.</td>
</tr>
<tr>
<td>Findings of the studies:</td>
<td>The results show the importance of adherence to sex stereotypes as a predictor of risk-taking, from the infancy to adulthood. The behaviour of risk-taking are more numerous when the individual itself strongly in the male stereotypes. Thus, this factor is quite meaningful to cancel the differences when sex is controlled.</td>
</tr>
<tr>
<td>How the results going to be used:</td>
<td>The response in terms of recommendations can be double, even contradictory: bring the family to a less differentiated education-which means to educate parents in their role in education at risk - and establish an institutional education differentiated according to sex - to reduce the differences which have been constructed.</td>
</tr>
<tr>
<td>Methodology of data collection</td>
<td>10 searches were conducted to identify and enable the development of the influence of sexual identity on risk perception on pedestrian populations of children, adolescents and adults.</td>
</tr>
<tr>
<td>Title:</td>
<td>Le risque routier en mission: guide d'évaluation des risques. ED 986 (The risk road mission: guide for risk assessment)</td>
</tr>
<tr>
<td>Moral Author:</td>
<td>INRS (Institut National de Recherche et de Sécurité pour la prévention des accidents du travail et des maladies professionnelles)</td>
</tr>
<tr>
<td>Date &amp; number of pages:</td>
<td>September 2006; 36 pages</td>
</tr>
<tr>
<td>Who conducted the studies:</td>
<td>INRS</td>
</tr>
<tr>
<td>Objectives of studies:</td>
<td>This book help companies to assess the business risk and implement preventive measures risk adjusted road.</td>
</tr>
<tr>
<td>How the results going to be used:</td>
<td>This document includes a series of data sheets in order to help managers develop action plans.</td>
</tr>
<tr>
<td>Title:</td>
<td>Les régimes français et britanniques de régulation du risque routier: la vitesse d’abord (The French and British schemes for the regulation of road risks; speed before anything else)</td>
</tr>
<tr>
<td>Author:</td>
<td>DELORME Robert</td>
</tr>
<tr>
<td>Date &amp; number of pages:</td>
<td>December 2005</td>
</tr>
<tr>
<td>Objectives of studies:</td>
<td>The objective of this project is to characterize the way many and diverse factors, quantitative and qualitative, interact with the action of road safety. The international comparison provides a tool that may reveal aspects that confinement in a country can not detect. It is also a way to show national coherences hardly characterized otherwise. The purpose of research is to characterize the regulatory regimes of the risk related to the road speed (R4V) French and British. Action funded under the PREDIT.</td>
</tr>
<tr>
<td>Findings of the studies:</td>
<td>A first result is to note a significant margin in France in several areas</td>
</tr>
</tbody>
</table>
An evolution to the rise of FPIE (the three factors of progress in France: professionalization, integration, evaluation) asked to act simultaneously on P, I, and E, but by focusing primarily on the effort factor that might lead the other two.

The investigation part of a general hypothesis proposed work as a backbone broadest possible R4. It consists of the representation of organized phenomenon as R4 (content) operating in an environment (context) and evolving (dynamic). Twelve British and French authors of disciplines and diverse expertise (economists, psychologists, statisticians, political scientists, organizational leaders non-governmental occupation of road safety) worked on sectors corresponding.


3. CONTRIBUTIONS FROM TAREK SAYED, CANADA

A risk/cost-based algorithm for the routing of dangerous goods
Who conducted the research Transportation group, Dept of Civil Engineering, UBC, Canada.
Objectives Identify and formulate a set of routing criteria from currently available data to minimize the risk of incidents in the transportation of dangerous goods. He also provided two reports, which I haven’t read yet to summarize.

Development of a Road Safety Risk Index by Paul de Leur and Tarek Sayed, Transportation record 1784, Paper No. 02 2814.


4. CONTRIBUTIONS FROM CONNIE YEW, USA

Traveler Opinion and Perception (TOP) Survey
Who conducted the research FHWA.
Objectives Understand the needs and expectations of users of the nation’s comprehensive transportation systems and the extent to which the existing transportation system meets these needs.
Methodology Telephone.

Risk and safety in the transport sector: A state of the art review of current knowledge
Who conducted the research council of Norway.
Objectives Produce knowledge which can give a better understanding of transport risks and a better basis for risk management within the transport sector.
Main topics Not all the safety measures lead to increased safety.
The transport industry should not copy the oil industry’s way of thinking. Has time run out for the transport sectors cost benefit analyses? Who are role models in traffic? Reliable traffic control require interaction between technology and people. Deregulation increases the demands on supervisory authorities. No one has the single overall responsibility for risk management.

5. CONTRIBUTIONS FROM MARCELO MEDINA SANTIBANEZ, CHILE

*Training course for civil protection*
Who conducted the research National Emergency Office, Ministry of Interior. Objectives Instruction about the best practice related to civil risk perception and protection. Key findings There have been some problems due to training method and promotion. How are the findings going to be used There are 40 people instructed every year, in order to provide trained professionals to related organizations.

6. CONTRIBUTIONS FROM MAARTEN BLOMME, BELGIUM

Introduction of literatures
*Driving and the perception of risk* by G.Hole 2007. *The psychology of driving* by Mahwah.

7. CONTRIBUTIONS FROM JACHEN CAJOS, SWITZERLAND

Swiss research package ABG1 on the *Safety of the road network and its structures* 2005-2009 Research Projects( to be finished in fall 2009).

Contents
1. Methodological basis for comparative risk assessment.
2. Estimation of the network risk.
4. Scenarios of hazard development.
5. Legal aspects of a risk and efficiency based approach.
7. Risk assessment for highway structures.
8. Effectiveness and efficiency of interventions on highway structures.
9. Safety on construction sites of highway structures.

*Risks of major chemical and biological accidents*, Environment Switzerland 2007.
8. CONTRIBUTIONS FROM RAZU ANDREI, ROMANIA

Introduction of COST Action 19 *Proactive Crisis Management of Urban Infrastructure*.
Objectives Define current knowledge gaps and identify possible measures to improve the multidisciplinary research on Urban Infrastructure vulnerability and the handling of crisis situations.

9. CONTRIBUTION FROM JOHAN HANSEN, SWEDEN

Introduction of related URL,
http://ideas.repec.org/a/kap/jrisku/v32y2006i2p151-170.html
http://www.infra.kth.se/tla/projects/vulnerability/index_eng.html