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Why focus on speed?

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THIS MODULE provides background information on why speed is a risk factor in road traffic crashes and injury, and the importance of tackling it with a range of different measures. In order to successfully promote, design and implement a speed management programme, it is important to understand the role of speed in road traffic crashes, and the relationship between speed and the severity of those crashes. Such information is important in persuading political leaders, stakeholders and the public to support a speed management programme.

The module is divided into two sections:

1.1 Road traffic crashes and injury involving speed: This section describes the nature of crashes and speed related injury. It demonstrates how unsafe motor vehicle speeds can increase both the risk of a collision and the severity of injury to crash victims. The impact of speed on vulnerable road users, particularly in developing countries, is described. Reasons why people drive at unsafe speeds are discussed.

1.2 What is speed management? This section discusses the definition of speed management – an active approach that requires (or persuades) drivers to adopt speeds that offer mobility without compromising safety. The *Safe-system* approach aims to achieve a road transport system that anticipates and allows for human error, while minimising the risk of death or serious injury. Benefits of speed management are discussed, and the impact of even small reductions in speed on safety is described.

This manual does not suggest that higher speeds cannot be beneficial. Shorter journey times can provide economic benefits and increased mobility. But policy-makers must trade these benefits against the increased costs of death and injury that might occur. This manual presents the road safety case for speed management, and offers practical advice on how to manage speeds in order to deliver road safety benefits.

This manual does not consider speed related noise or air pollution, or energy consumption. Although these issues are important, they are beyond the scope of this manual.

1.1 Road traffic crashes and injury involving speed

1.1.1 Speed, energy transfer and injury

Speed has been identified as a key risk factor in road traffic injuries, influencing both the risk of road traffic crashes and the severity of the injuries that result from them (1, 2, 3). Higher speeds lead to a greater risk of a crash and a greater probability of serious injury if one occurs. This is because, as speed increases, so does the distance travelled during the driver's reaction time and the distance needed to stop. Also, at speed, the effects of drivers' errors are magnified. In a crash, the higher the speed

the greater the amount of mechanical (kinetic) energy that must be absorbed by the impact. Hence, there is more likelihood of serious injury.

According to research (1, 2), harmful injury is the result of 'energy interchange'. During a collision, injury results from the transfer of energy to the human body in amounts and at rates that damage cellular structure, tissues, blood vessels and other bodily structures. This includes kinetic energy, for example when a motor vehicle user's head strikes the windshield during a crash. Of the various forms of energy – kinetic, thermal, chemical, electrical and radiation – kinetic energy transfer is the biggest contributor to injury. It is useful for road traffic injury prevention researchers and practitioners to understand the biomechanics of kinetic energy injuries. This will help them develop measures that will limit the generation, distribution, transfer and effect of this energy during a road traffic collision (2).

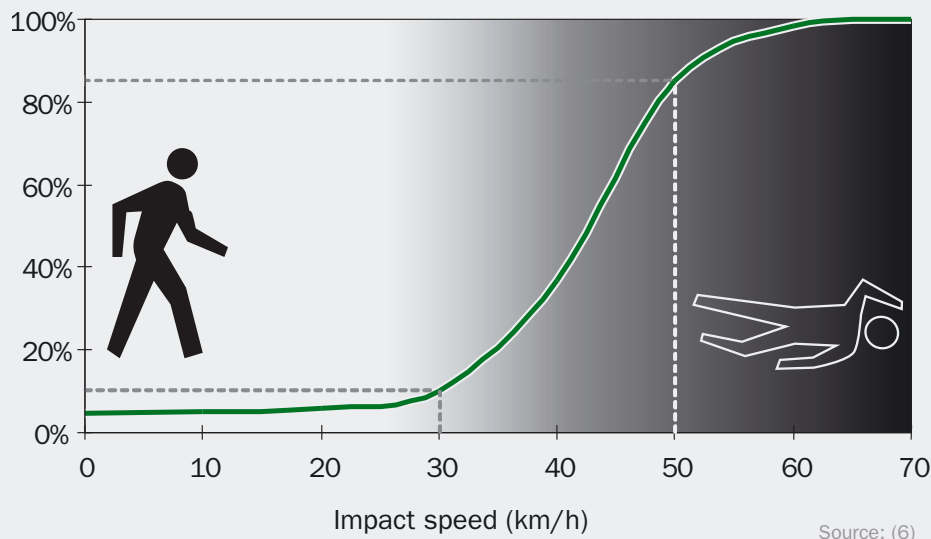
Regardless of whether the kinetic energy is generated by a motor vehicle crash, a gunshot or a fall, the force to which human tissue is subjected on impact is the product of the mass and velocity involved. The kinetic energy to be absorbed equals one half of mass multiplied by the square of velocity – illustrating that the effect of velocity is greatly enhanced as velocity increases. The level of damage to the body will depend on the shape and rigidity of the colliding surface or object, but velocity usually plays the most critical role (4).

In a crash, it is physically impossible for any occupant to securely hold an unrestrained object, such as a child. In a collision of just 50 km/h, the child's weight will effectively increase by 20 times and a 5 kg baby will appear to weigh 100 kg within a split second. Source: (5).



Vulnerable road users such as pedestrians, cyclists, moped riders and motorcyclists have a high risk of severe or fatal injury when motor vehicles collide with them. This is because they are often completely unprotected or, in the case of a motorcyclist, have very limited protection. The probability that a pedestrian will be killed if hit by a motor vehicle increases dramatically with speed. In Figure 1.1 the probability of a fatal injury for a pedestrian colliding with a vehicle is illustrated.

The research indicates that while most vulnerable (unprotected) road users survive if hit by a car travelling 30 km/h, the majority are killed if hit by a car travelling at 50 km/h (6).

Figure 1.1 Probability of fatal injury for a pedestrian colliding with a vehicle

In the majority of serious and fatal crashes, injuries are caused because loads and accelerations – exceeding those that the body can tolerate – are applied by some part of the car (7). The human tolerance to injury by a car will be exceeded if the vehicle is travelling at more than 30 km/h. Pedestrians, as illustrated above, incur a risk of about 80% of being killed at a collision speed of 50 km/h. For car occupants, wearing seat-belts and using well-designed cars generally can provide protection to a maximum of 70 km/h in frontal impacts, and 50 km/h in most side impacts (8). Higher speeds could be tolerated if the interface between the road infrastructure and vehicle were well designed and crash protective – for example, by the provision of crash cushions on sharp ends of roadside barriers. However, most road systems allow much higher speeds without the protective barriers between vehicles and roadside objects.

The unpredictable nature of human behaviour in a complex traffic environment means it is unrealistic to expect that all crashes can be prevented. But if greater attention were given to the tolerance of the human body to injury when designing the transport system, there could be substantial benefits when crashes do occur, meaning they might not lead to serious injury or death. Most traffic systems, however, are not designed on the basis of human tolerance. Separating cars and pedestrians by providing footways is very often not done. Speed limits of 30 km/h in shared-space residential areas are often not implemented. Historically, car and bus fronts have not been designed to provide protection for pedestrians against injury at collision speeds of 30 km/h or more.

1.1.2 How does speed affect road traffic collisions and injury?

Most road safety experts agree that the single most important contributor to road fatalities around the world is poor speed selection, commonly interpreted as the use of inappropriate vehicle speeds, or 'speeding'.



Definition of speeding

It is useful to establish a working definition of 'speeding' for the purposes of police assessment of the role of speed in a crash.

The definition for general application in this manual is drawn from OECD, ECMT (2006) which is: "Speeding encompasses excessive speed (driving above the speed limit) or *inappropriate* speed (driving too fast for the conditions, but within the limits)."

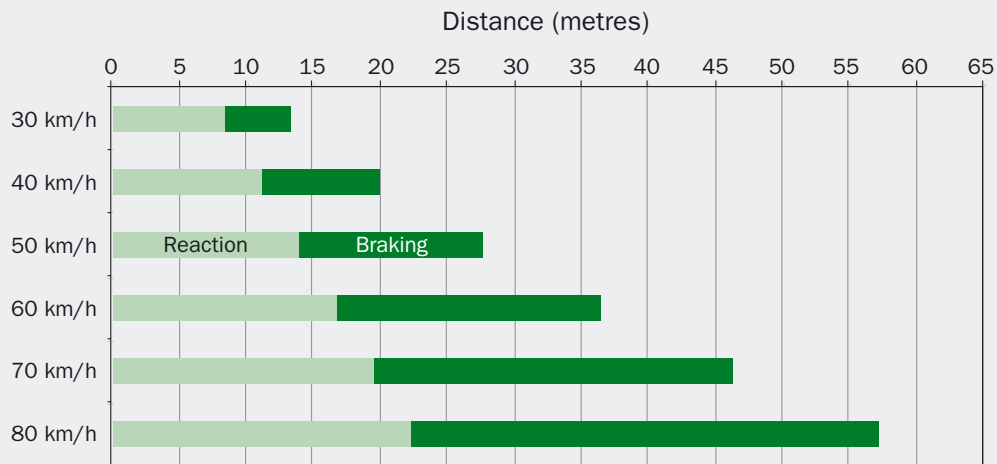
Source: (6)

Higher speeds increase the risk of a crash for a number of reasons. It is more likely that a driver will lose control of the vehicle, fail to anticipate oncoming hazards in good time and also cause other road users to misjudge the speed of the vehicle. It is clear that the distance travelled in a given time – and so the distance travelled as a driver or rider reacts to an unsafe situation on the road ahead – is greater for travel at a higher speed. In addition the stopping distance for a vehicle, after a driver reacts and brakes, will be longer at a greater travel speed.

Studies have shown that reaction time can be a little as one second, but in one trial (9) it was found that most response times were between 1.5 and 4 seconds. The consequences of such factors are illustrated in Figure 1.2.

The figure shows driver reaction distances and braking distances in metres to illustrate what can happen if a child runs out into the road at a point about 13 metres in front of a car. If the car is travelling at 30 km/h it can just stop before hitting the child, but if the speed of the car is 50 km/h, the distance covered in the driver's reaction time (14 metres) is more than the distance to the child. Consequently, the child will be hit by the car travelling at 50 km/h and the chances of it surviving are small.

Excessive and inappropriate speed is the biggest road safety problem in many countries (6). While identifying contributory factors in traffic crashes can be somewhat subjective, there are surveys (10) and studies (11) that suggest that as much as one-third of collisions resulting in a fatality involve an element of excess speed. Speed is an aggravating factor in all crashes.

Figure 1.2 Illustration of the stopping distance in an emergency braking

Source: (6) adapted from the Australian Transport Safety Bureau

CASE STUDY: Speed related crashes, New Zealand

Frith et al (11) attributed 31% of all fatalities and 17% of all serious injuries in New Zealand to speeding in the year 2002, based on police judgements. They further stated that these levels were likely to underestimate the full impact of speed on crashes and crash severity, given that speed contributes to the severity of crash outcomes regardless of the cause.

They indicated that as a broad estimate, if the average speed on New Zealand's rural roads were reduced by just 4 km/h, the total number of road crash deaths would decrease by about 15% and the total number injured by about 8% – meaning that about 45 deaths and 480 reported injuries would be avoided (the difference between the fatal and serious injury proportions reflects the greater impact of any speed reduction on the most severe injuries).

NOTE**Small increases in speed result in large increases in crash risk**

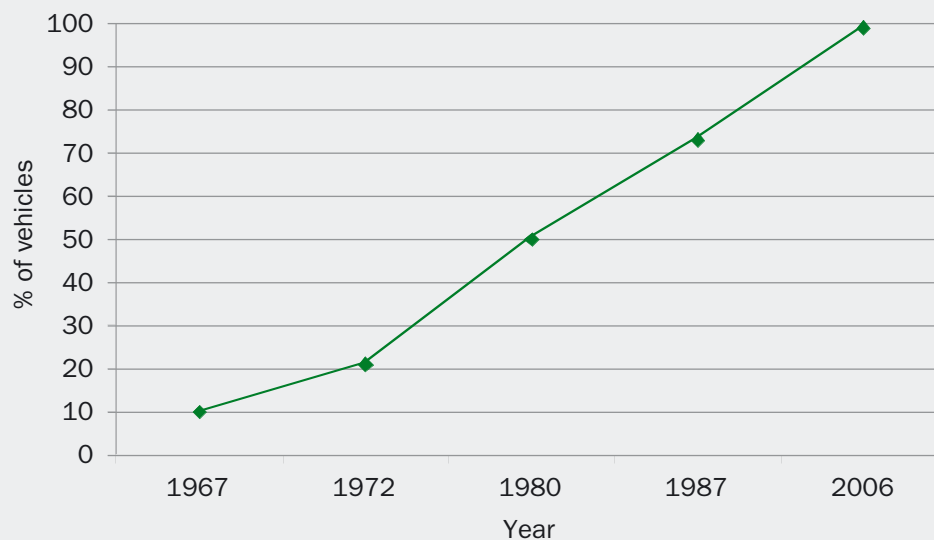
Studies provide direct evidence that speeds just 5 km/h above average in 60 km/h urban areas, and 10 km/h above average in rural areas, are sufficient to double the risk of a casualty crash – roughly equivalent to the increase in risk associated with a blood alcohol concentration of 0.05 g/100 ml (the blood alcohol limit for driving in many countries). The evidence also indicates that 'moderate speeding' (within 10 or 15 km/h of the posted limit), makes a large contribution to serious road crashes – comparable to the contribution of more extreme speeds – because it is so common.

Source: (12, 13)

The problem of speeding has increased over the years since the maximum speed that new cars are capable of is, in many cases, double the existing speed limit in rural areas. Many modern cars now are easily capable of speeding, which was typically not the case when speed limits were first introduced. It is therefore more of a challenge to convince drivers to drive within posted speed limits.

As Figure 1.3 demonstrates, the development of engine technologies over the past 40 years has resulted in most cars having a top speed well in excess of maximum speed limits (6). This presents challenges in managing travel speeds to within limits for both high-level and low-level speeders.

Figure 1.3 Percentage of vehicles sold in France capable of travelling more than 150 km/h



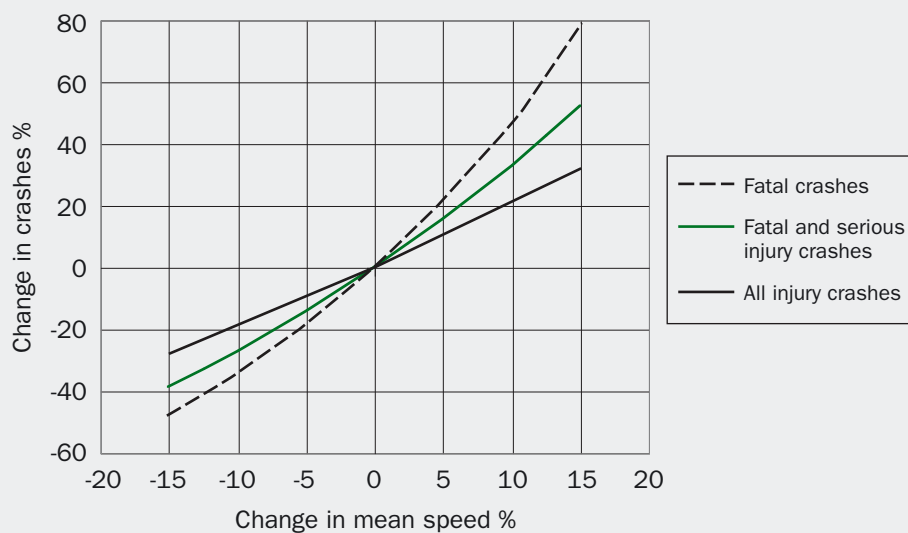
CASE STUDY: Effect of changes in speed limits

A review of the studies on speed limit changes from several countries (South Africa, Belgium, Finland, France, UK, Germany, USA and New Zealand) where a speed limit was reduced or a new limit was introduced found a reduction in road crashes ranging from 8% to 40% (14).

Research in America (15) examined the effect of changes in speed limits on deaths on rural interstate highways. Road crash deaths in the groups of states that raised their speed limits from 65 to 70–75 mph rose by 38% and 35% respectively, relative to fatality levels in the states that did not change their speed limits.

There is a sizeable body of research from around the world (but mainly conducted in higher income countries) that clearly demonstrates the relationship between speed and risk (16, 17, 18). There is a consistent finding from the research that greater speed increases crash, injury, and fatality rates, and that decreasing speed reduces these rates. One example is the *Power model* (19) that estimates the effects of changes in average speed on traffic crash incidence and severity. It suggests that a 5% increase in average speed leads to an approximate 10% increase in crashes involving injury, and a 20% increase in those involving fatalities (Figure 1.4).

Figure 1.4 Illustration of the *Power model* and the relationship between percentage change in speed and the percentage change in crashes



This relationship results both from the laws of physics and the cognitive abilities of the driver/rider to deal with unexpected (but often predictable) circumstances. With higher speeds, the impact speed in a crash increases, as do the forces that the vehicle and occupants must absorb. Higher speeds also mean that road users have a lesser opportunity to take preventive actions.

CASE STUDY: **Raising and lowering the national speed limit, USA**

Between 1987 and 1988, 40 states in the USA raised the speed limit on interstate highways from 55 mph (88 km/h) to 65 mph (104 km/h). This resulted in an increase in average car speeds of about 3 mph (5 km/h). Over the same period there was an increase in deaths on these roads of between 20 and 25%.

Source: (20)

1.1.3 What factors contribute to speeding?

There are many reasons why individual drivers speed. Travelling at higher speeds offers the immediate 'reward' (as a perception, if not in practice) of a shorter journey time. This benefit is reinforced every time a driver undertakes a journey and travels above the speed limit without any adverse consequence. Importantly, while speeding is involved in a very high percentage of serious and fatal road crashes, from an individual driver's point of view, the chance of having a serious crash as a result of exceeding the speed limit is quite low, so the speed-crash threat may be less of a consideration by drivers compared with the speed-penalty threat.

The circumstances of individual trips can influence a driver's choice of speed. For example, if the vehicle is owned by an employer, the driver may be tempted to drive at higher speeds. When an individual is under pressure or feels the need to rush, unsafe speeds may be selected. Sometimes drivers and riders speed just for fun.

Drivers will frequently claim that they were unaware of the speed limit, hence the need for adequate signs, even though ignorance is no defence. Importantly, some researchers believe that people always tend to optimize the level of risk behaviour they engage in, such that they choose to drive faster on 'safer' roads, especially if they perceive little risk of enforcement activity. Others (21) have found that driving fast gives a sense of thrill or achievement.

Most drivers consider themselves above average in terms of skill. A number of surveys conducted in various countries around the world (21) demonstrate that up to 90% of drivers think they are an above average, low-risk driver. For that reason, drivers believe they can travel above the limit and not place themselves at high risk. In any event, many regard the limits as arbitrary and do not fully understand the greater risks associated with even small increases in speed.

Additionally an important factor in many countries is pressure that is applied by fleet managers and employers to be more productive (i.e. drive faster) while public transport operators and the drivers themselves come under pressure to stick to challenging timetables, and even race to pick up passengers and goods.

Increasing motorization

With greater motorization and economic development there is an increasing demand to build roads to a higher standard in order to reduce journey times and congestion. This means higher speeds – but with higher speeds the numbers and severity of accidents will increase for all types of road user unless appropriate action is taken. The *World report on road traffic injury prevention* (22) illustrates these general trends and makes estimates based on them. These show that, while fatalities in high-income countries will fall by 27% over the period 2000–2020, globally there will be an increase of 67%. In south Asia, this increase is predicted to be 144%.



CASE STUDY: Commercial drivers pressured to speed and 'race', Ghana

Comments from taxi/bus drivers were obtained from surveys conducted in 2007 by Ghana's TV Channel 2 and the National Road Safety Commission:

- "We drive at high speeds."
- "There is no enforcement of speeding."
- "Because of the high sales targets, we are under pressure. You can't do anything. You are always thinking of loading."
- "It may take two hours just to get to the (city) barrier so some lose their patience and start speeding."
- "The law at the (bus) station is that if two 'cars' pass you, you have to start again (i.e. lose your place

in the queue), but the owner does not understand this, hence we are always under pressure."*

* At the bus/taxi stations, drivers queue up for passengers in order, departing only when full. The drivers try to keep this order en route. However, if a bus is overtaken on the road by at least two of the buses that were originally behind him, he loses his position and is pushed two places back in the queue at the next bus station. This means further delay before the bus is full and ready to set off again. This results in speeding and racing, because pay is dependent on number of trips and the number of passengers carried.

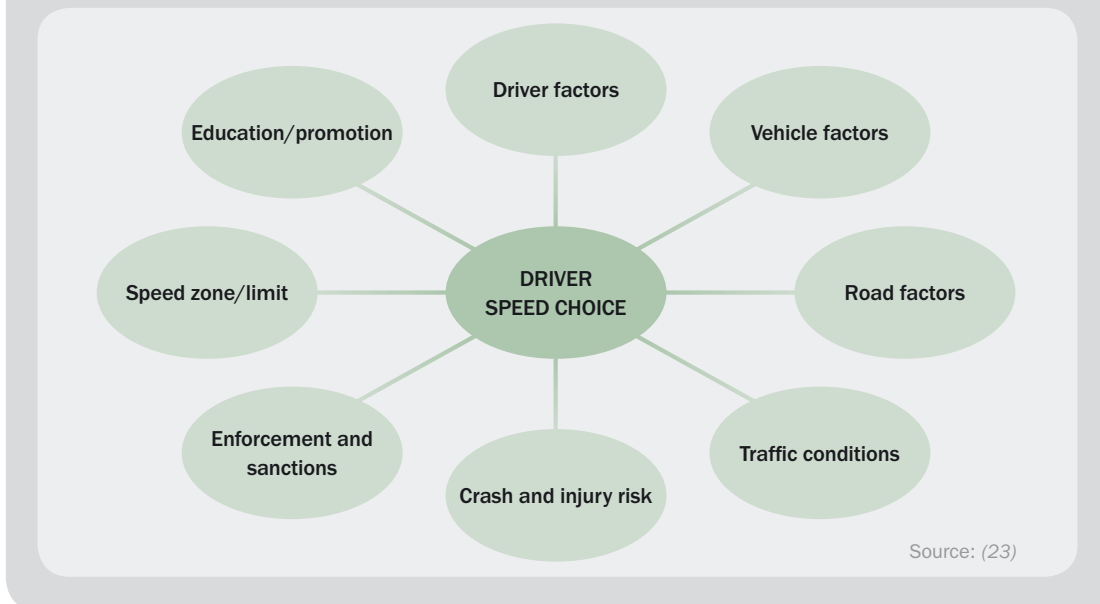
1.2 What is speed management?

Speed management encompasses a range of measures aimed at balancing safety and efficiency of vehicle speeds on a road network (6). It aims to reduce the incidence of driving too fast for the prevailing conditions, and to maximize compliance with speed limits. An appropriate speed, in the context of a *Safe system*, is a speed level that considers traffic safety as the main goal, in the context of mobility and prevailing conditions such as roadside development, the mix of users along the road, the frequency of access to the road (including intersections), the volume and mix of traffic, environmental concerns and the quality of life for residents living along the road.

1.2.1 Aims of speed management

Speed management aims to reduce the number of road traffic crashes and the serious injury and death that can result from them. Speed management needs to employ a range of measures that will include enforcement, engineering and education. The more widespread the measures, particularly enforcement, and the greater the range, severity and implementation of sanctions against speeding, the more compliance will result. To achieve wide public acceptance of enforcement, speed limits need to be appropriate – and recognized as such by the public.

In considering how to influence speed, it is of value to be aware of factors affecting drivers' choice of speed, as illustrated in Figure 1.5.

Figure 1.5 Factors affecting speed choice

Speed limit selection is a critical indicator of the safe speed for that section of road. This imposes a substantial responsibility on the limit-setting authority. In setting appropriate speed limits it is useful to have the following information for the section of road under review:

- speed measurements
- measurements of traffic flow and mix
- traffic crash data
- information from the police on speeding offences
- the design speed and criteria used to build or rehabilitate the road
- land use and property access adjoining the road
- physical characteristics of the road and roadside
- presence of vulnerable road users.

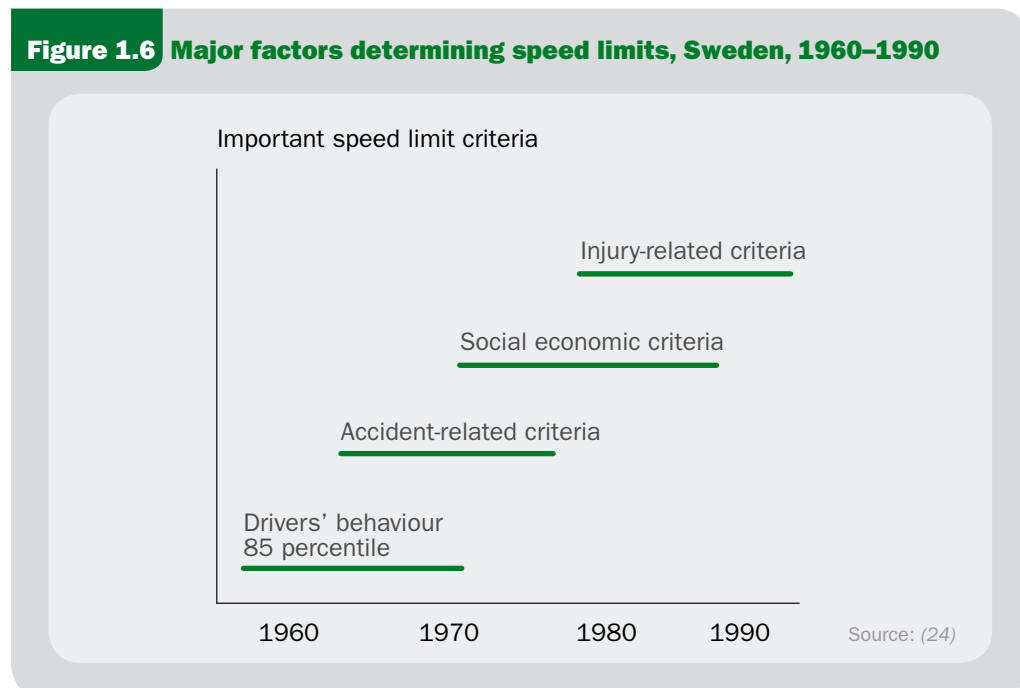
This information will be useful in comparing proposed limits with the current travel speeds (including the speed distribution) and crash rates. The purpose is to identify the scale of the change in travel speed necessary for safe operation, and to identify the measures necessary to achieve this.

Without substantial, and often expensive, traffic calming works, it is necessary to recognize that speed limits without enforcement and enforcement without suitable sanctions usually result in ineffective speed management. Consequently, speed enforcement and sanctions will generally always be needed to ensure compliance with speed limits.

1.2.2 Setting speed limits

Speed limits are widely used to define acceptable speeds. They provide a basic indicator to road users of the maximum speed allowed under the law. In this sense, they can be described as representing a society's judgement, through the legal process, of the balance between the various issues surrounding speed choice. Speed limits have evolved over time as societies have set different priorities for their road system. Figure 1.6 describes this evolution in Sweden.

Figure 1.6 Major factors determining speed limits, Sweden, 1960–1990



In the 1960s limits were set largely to reflect drivers' behaviour and using the 85th percentile speed – in effect saying drivers were making rational choices and only those in the minority 15% would be judged as 'speeding'. As analyses of crash data revealed a growing speed related problem, limits were set that took into account road design factors (sight distance, road curvature and so on). Economic trade-off then was introduced. With cost-benefit analysis of road projects using estimates of the 'value of time' savings to justify investment, there was a natural trend towards faster roads. Finally, with the current philosophy of *Vision zero*, the Swedish parliament has said that avoiding death and injury is an absolute priority, and the speed management system as a whole must be based on this philosophy.

There are no absolute rights and wrongs in selecting limits. It is for a government to determine its priorities, which most likely will change as a society develops. It is undeniable, however, that if a government wishes to reduce the death and injury toll in a country, then the *Safe-system* approach is the way to go. Such a system

cannot be achieved overnight, but by accepting the principles, and applying them as infrastructure, laws and enforcement develop, so the numbers and severity of crashes will be reduced. Section 3.1 discusses good practice regarding setting speed limits in this context.

It should be noted that speed limits on their own will have only modest effects on actual speeds. A study cited in the OECD/ECMT report (6) shows that, in places where speed limits are changed and no other actions such as law enforcement are taken, the change in average speed is only 25% of the change of the speed limit. Other information shows that if speed limits are changed either upwards or downwards by 10 km/h, the change in average speed is only 2–4 km/h. While these changes can improve safety records, it is important to have an effective enforcement strategy when dealing with the issue of speed (16).

1.2.3 Safe systems and the role of speed

In all regions of the world, to prevent road death and disabling injury, a traffic system better adapted to the physical vulnerabilities of its users needs to be created – with the use of more crash-protective vehicles and roadsides. The *Safe-system* approach, as exemplified by *Vision zero* (Sweden), *Sustainable safety* (Netherlands) and *Safe system* (Australia) (25, 26, 27, 28, 12) should set the framework for the long-term management of speeds on a nation's roads. Figure 1.7 illustrates the *Safe system* in conceptual terms.

The aim of a safe system is to achieve a road system that allows for human error without leading to death or serious injury. It recognizes the limits of force that the human body can survive and focuses on systematically addressing various factors involved in specific crash types to reduce the risk of injury. Crashes are always likely to happen, even though there is a continuing focus on prevention. The *Safe-system* approach aims to minimize the severity of injury when a crash occurs and is based on the premise that road users should not die because of system failings.

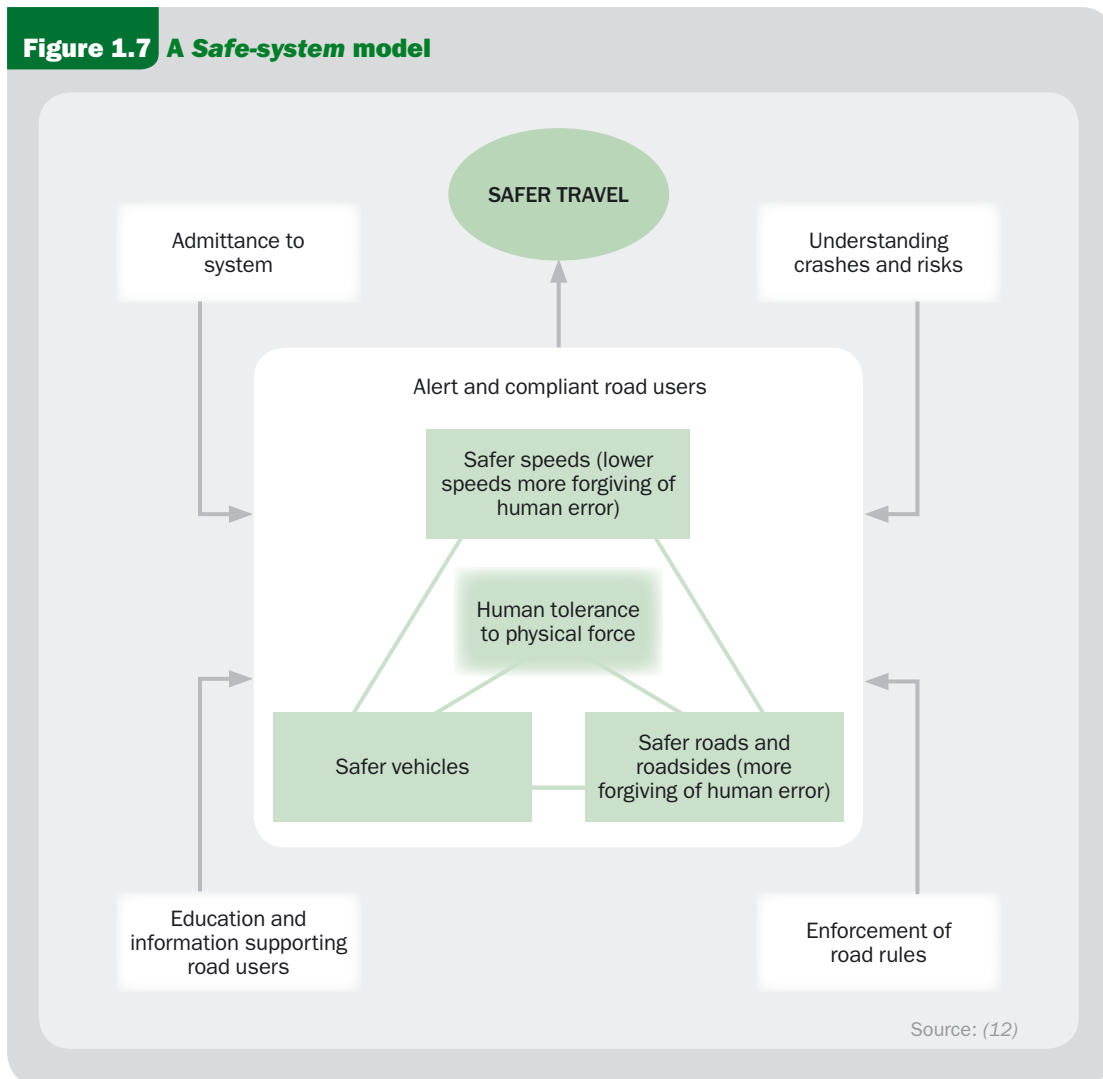
One important cornerstone in the *Safe-system* context is that the care of human life and health is considered to be more important than anything else. This is clearly expressed within *Vision zero* (25, 26) where an ethical approach to road safety is taken. The long-term goal is that no one should be killed or seriously injured in road traffic. The moral basis of *Vision zero* corresponds to the views often already adopted in connection with rail, sea or air travel.

The consequences for speed management of adopting a *Safe-system* approach result in, for example:

- a 30 km/h speed limit being used in built-up areas where there is a mix of vulnerable road users and motor vehicle traffic

- a reduction in the likelihood of fatal side-impact crashes at intersections (it is often preferable to build a roundabout instead of installing traffic lights, and it is advisable to limit approach speeds to less than 50 km/h)
- a reduction in the likelihood of fatal head-on crashes on two-way single carriageway roads (median barriers should be used with high volumes of traffic, or speed limits should be kept below 70 km/h).

Figure 1.7 A Safe-system model



It should be the aim of low and middle-income countries first to stabilize any worsening situation, and second to create road safety policies rooted in 'good practice' as demonstrated by better-performing countries. *Safe-system* thinking can contribute to the immediate needs of low and middle-income countries and, as for all countries, to more rapid, long-term road safety improvement.

The *Safe-system* approach requires system managers to understand crash causes in order to assess crash risk. It is critical that the key risk factors that contribute

significantly to crashes are identified and understood. To assist this aim, accurate crash and injury data collection and analysis systems need to be put in place if they do not already exist.

The key elements in the *Safe system* are:



- **To manage speed**

Carefully targeted, wide-scale infrastructure programmes, vehicle safety improvements and enforcing appropriate speed limits will reduce the likelihood of crashes occurring and/or reduce their severity to survivable levels. For example, it is not feasible to lower speeds on rural roads to 50 km/h (the speed at which a side-impact collision would be survivable) if there are trees or poles adjacent to the roadway. The answer lies in removal of the hazards or installation of protective barriers. Other measures to reduce the likelihood of vehicle-control loss, or vehicles leaving the road, could also be considered, including provision of sealed shoulders and audible edge lining, together with vehicles being equipped with electronic stability control features. On the other hand, speed limits of 30–50 km/h in areas of higher pedestrian crash risk (from vehicles) will substantially reduce pedestrian fatality risks.

These examples assume that road users are complying with road rules. However, the challenges inherent in deterring non-compliant behaviour are substantial, and in lower income countries improvements in training of new drivers and improved enforcement will all need to play a role.

- **Focus on the importance of vehicle safety**

Improving a country's vehicle fleet offers major benefits, and as much as possible should be done to encourage the purchase and supply of safe vehicles. Today, most modern cars protect a seat-belted occupant up to about 70 km/h in a frontal collision (22) and up to about 50 km/h in side impacts. The European Transport Safety Council has estimated that if every car owner upgraded their vehicle overnight to the safest in its class, then fatalities on Europe's roads would drop by 40–50% (29). It is likely that such a development in low and middle-income countries would result in far greater benefits.

Improved pedestrian safety ratings for vehicles and improved object detection technology will also lead to lower severity of crash outcomes. The benefits of intelligent speed adaptation are now available to any country prepared to legislate for its provision in new vehicles, and to develop and maintain the necessary digital

maps of speed limits. This is an important opportunity for major reductions in road trauma, but strong government leadership will be needed to bring it about.

- **Management of road and roadside/network safety**

While ensuring that new roads provide improved levels of safety, the real challenge is how to set and enforce speed limits on the existing road network. If the speeds are too high because of the road standard (high crash-risk) and infrastructure solutions are not cost effective (because of, for example, low volumes/low crash numbers) there will be a need to lower and enforce the existing speed limits. However, the public needs to be made aware of why this is being done and how they will benefit from such changes.



1.2.4 Benefits of speed management

Promoting a successful speed management programme following a *Safe-system* approach clearly has many benefits. The most obvious one is of course the reduction in the number of deaths and injuries resulting from crashes (6, 14).

The safety benefits of lowered travel speeds include:

- greater time to recognize hazards
- reduced distance travelled while reacting to hazards
- reduced stopping distance of the vehicle after braking
- increased ability of other road users to judge vehicle speed and time before collision
- greater opportunity for other road users to avoid a collision
- less likelihood that a driver will lose vehicle control.

Tables 1.1 and 1.2 show the importance of small changes in average speed in producing safety benefits. They show the estimated safety effect of a reduction of speed of 1 km/h and 2 km/h respectively, from different reference levels in percentage savings of different severities of crashes. The tables show that speed reductions have a greater effect for more severe crashes.

Table 1.1 Application of the *Power model* for different reference speeds when the average speed is reduced by 1 km/h

Percentage (%) reduction in crashes for 1 km/h reductions in average speeds

	Reference speed in km/h							
	50	60	70	80	90	100	110	120
All injury crashes	4.0	3.3	2.8	2.5	2.2	2.0	1.8	1.7
Fatal and serious crashes	5.9	4.9	4.2	3.7	3.3	3.0	2.7	2.5
Fatal crashes	7.8	6.5	5.6	4.9	4.4	3.9	3.6	3.3

Table 1.2 Application of the *Power model* for different reference speeds when the average speed is reduced by 2 km/h

Percentage (%) reduction in crashes for 2 km/h reductions in average speeds

	Reference speed in km/h							
	50	60	70	80	90	100	110	120
All injury crashes	7.8	6.6	5.6	4.9	4.4	4.0	3.6	3.0
Fatal and serious crashes	11.5	9.7	8.3	7.3	6.5	5.9	5.4	4.9
Fatal crashes	15.1	12.7	10.9	9.6	8.6	7.8	7.1	6.5

Source: (18)

The tables clearly show the importance of even small reductions in speed. However, achieving such changes in average speed often require great effort. One reason is that drivers' perceptions of a reasonable and acceptable speed tends to increase over time, because of faster cars and better roads. To achieve speed reductions in rural areas, public information activities and enforcement methods need to offset this development through increased effort and stronger sanctions.

CASE STUDY: Reduced speed limit and safety outcomes, New Zealand

During the 1973 fuel crisis, the New Zealand government reduced rural speed limits from 55 mph (88 km/h) to 50 mph (80 km/h), leading to an 8–10 km/h reduction in average rural speeds. The drop in speed led to a significant drop in injuries, as compared with urban roads which were unaffected by the speed limit change (30). On main intercity roads the number of deaths dropped by 37%, serious injuries decreased by 24% and minor injuries decreased by 22%. The corresponding reductions for urban areas were 15%, 9% and 4%.

Many governments have demonstrated a reluctance to enforce limits effectively, as there is considerable public reaction to such measures. A commitment to support enforcement will be essential to achieving safe travel speeds by drivers.



CASE STUDY: **Changes in speed limits and crashes, Australia**

In Australia, the speed limit on Melbourne's rural and outer freeway network was increased from 100 km/h to 110 km/h in 1987 and then changed back to 100 km/h in 1989. Compared to a control area where the speed limit remained the same, the injury crash rate per kilometre travelled increased by 24.6% when the speed limit increased, and decreased by 19.3% when the speed limit decreased (31).

Summary

- The risk of a crash and the likelihood of serious injury as a result of a crash both increase with higher vehicle speeds.
- Reducing speed limits lowers the rate of crashes, serious injuries and fatalities.
- Most unprotected road users survive if hit by a car travelling up to 30 km/h.
- Most unprotected road users are killed if hit by a car travelling 50 km/h.
- Speeding is a major road safety problem in many countries, contributing to at least one-third of all crashes, and is an aggravating factor in almost all crashes.
- Speed limits of 30km/h should be considered for road lengths where there are high pedestrian movements along and across the road, and no adequate pedestrian segregation.
- The *Power model* estimates the percentage change in risk as a result of a percentage change in average speed (the relative speed change). For example, a 5% increase in average speed leads to approximately a 10% increase of all injury accidents, and a 20% increase in fatal accidents.
- The aim of a safe road system is to achieve a road transportation system that allows for human error without it leading to death or serious injury.
- *Safe-system* thinking can contribute to the immediate needs of low and middle-income countries and, for all countries, to more rapid, long-term road safety improvement.
- Speed management is a central part of a *Safe system*. This consists of setting and enforcing appropriate speed limits, but also aims to convince drivers to choose appropriate speeds in the prevailing circumstances through education and publicity; it also advocates the selective use of engineering treatments.
- Without a strong, sustained public commitment to robust enforcement of speeds on the network by government, speed management programmes are unlikely to be effective.

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