REDUCING RISK ON ROAD AND RAIL

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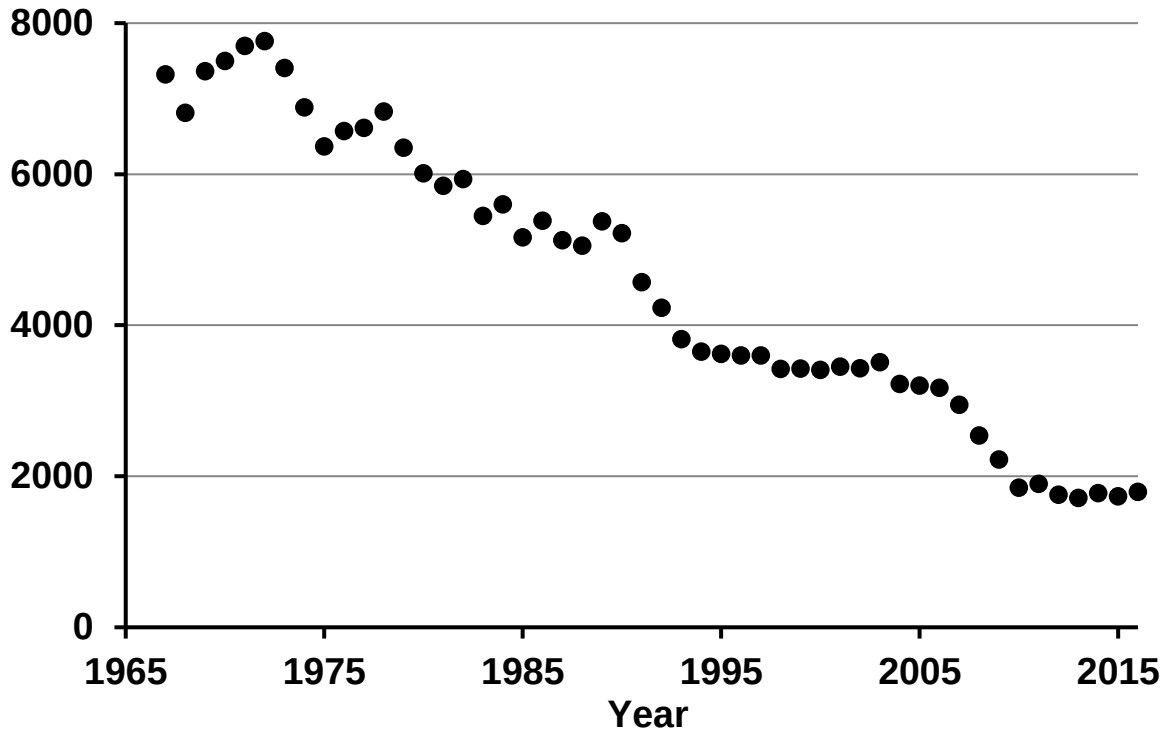
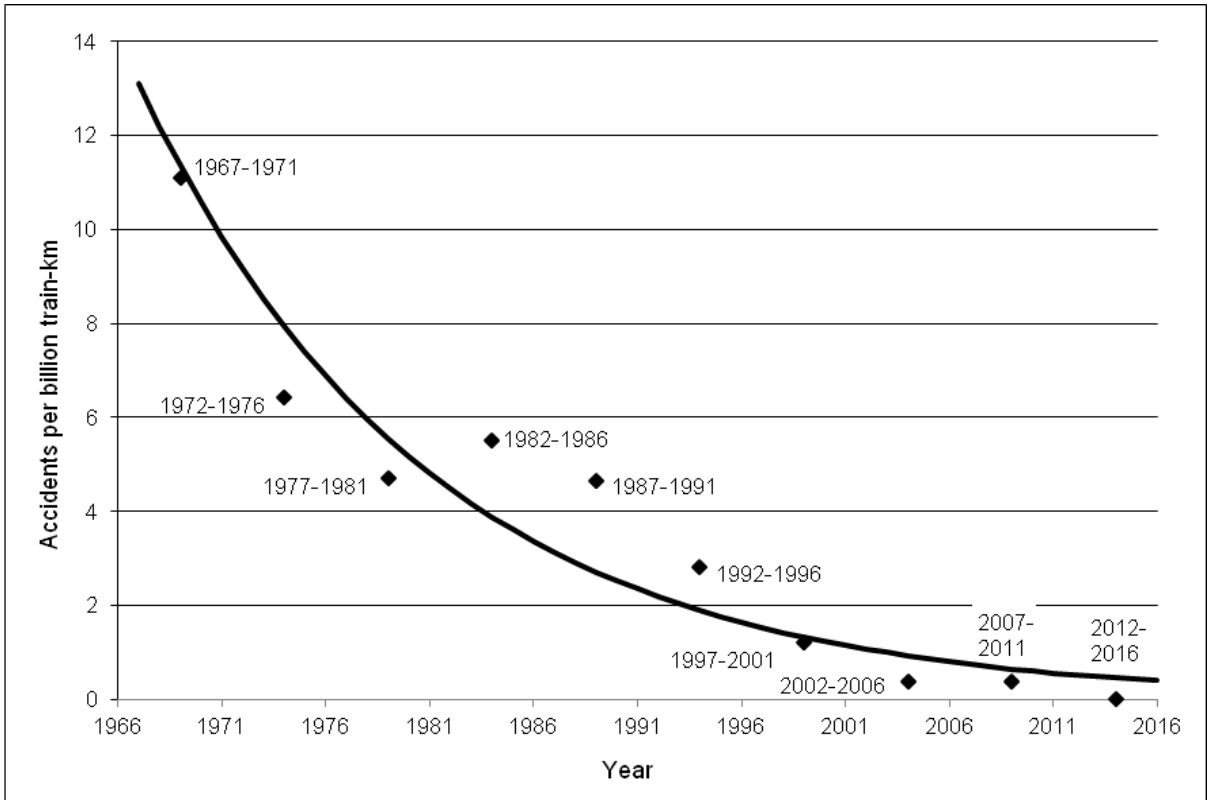
The five decades of UTSG, 1967-2017, have seen substantial reductions in risk of death or injury to users of the roads and railways in Britain.

This chart shows the annual numbers of reported road deaths falling from just under 8000 when UTSG was established to around 1800 since 2010.



This one shows the number of fatal main line train accidents per billion train-km falling from about 12 just after the end of steam traction in the 1960s to around 0.5 in recent years.



(I've credited my colleague Andrew Evans with this chart because it is taken directly from his annual paper on the subject of the particular category of railway accidents known as train accidents – and I shall shortly refer to Reuben Smeed as the founder of UTSG, but otherwise I have decided in the interests of fairness not to mention any names in this short overview.)

UTSG does not claim all the credit for these improvements of course, but we can confidently claim to have contributed to them, and I will try to outline how our contribution has developed and how we are placed to keep helping to address fresh and ongoing challenges in transport safety in the years to come.

When UTSG began in 1967, most of those concerned with road safety were challenged by Reuben Smeed's memorable paper of 1965, estimating in some detail that two-thirds of deaths then occurring on the roads of countries like Britain were preventable by the application of existing knowledge – something that was achieved in aggregate in GB in 2008. A few universities were making substantial contributions to that knowledge in 1967, and their number was set to grow. Growth in academic involvement in rail safety research was also to come, but rather later and in rather different ways.

So I'll begin on the roads. In the late 1960s, use of cars had been increasing rapidly for a decade and a half, and with it the numbers of road deaths and injuries had been rising disturbingly.

At least two universities were providing fundamental understanding of the mechanics and biomechanics of injury in collisions involving road vehicles = injury both to their occupants and to people struck by them.

A notable example from the 1970s is the graph showing how the probability of death for a pedestrian struck by a vehicle increases with the speed of impact, a graph which served the world for 30 years before it was substantially confirmed by more recent studies and statistical method.

In those days, by the way, the numbers of road deaths and injuries were so stark that the focus of road safety research was clearly upon casualty reduction, and the events that gave rise to them, being largely unintended, were simply called accidents. The subtle semantics of today's debates about safety were yet to come.

Growth in the number of universities actively engaged in road safety research was fostered first by constructive relations with the RRL, soon to be TRRL and later TRL Ltd, and subsequently by an intervention by the DfT's predecessor to encourage more behavioural psychologists in universities to contribute to the effort, and by a decade of initiatives by the AA Foundation for Road Safety Research.

One notable example from the 1970s is on-the-spot studies of car collisions, which have continued under various names to this day, usually involving joint working by a university and the RRL successor. These costly but invaluable studies have continued to this day to identify vehicle-related, road environment-related and road user-related factors that contribute to collisions and resulting injury and thus to inform casualty-reducing policies in all three areas. It was thus a British university that led the recent European project DaCoTA in producing a common protocol to enable synergy between expensive studies of this kind across Europe. It is evidence from such studies, combined with that from controlled crash testing and with biomechanical understanding, that has led to the occupant protection built into cars that we all now take for granted, and the steps towards counterpart protection for struck pedestrians and cyclists that a reluctant industry is being gradually persuaded to take.

Another early example of university-TRRL collaboration was the innovative estimation from observations at large numbers of road junctions of empirical statistical relationships between the annual numbers of collisions at the individual junctions, the annual traffic flows and various design features of the junctions. Knowledge of such relationships has enabled numbers of collisions to be reduced at many junctions down the years through minor changes in design either during construction or by adaptation in the course of maintenance or other road works. A recent European review study shows how this statistical technique has broadened its scope and spread round the world in the intervening decades.

By the late 1970s the road safety engineering technique of low-cost treatment to reduce collisions at high-risk sites identified by clusters of recorded collisions had become recognised as highly effective in casualty reduction.

A further important example of collaboration, this time between TRRL and two universities, was to demonstrate how this approach could be extended from addressing clusters of collisions to addressing collisions across whole urban areas of mixed development (other than town centres, for which different approaches were being developed). This extension was achieved through a decade-long full-scale statistically controlled demonstration in five towns

and, helped by counterpart experience across Europe, has led to the established technique known as urban safety management.

In the meantime, estimation of the casualty-reducing effect of treatment of clusters of collisions had been identified, initially by a statistician in Canada early in the 1980s, as being affected by the longstanding statistical phenomenon of regression to the mean. In a timely initiative by one UTSG university, the Canadian expert gave an invited seminar over here and the topic was taken up in this country, first by that university and subsequently by one or two others. Once again, the outcome has been longstanding, but in this case it has been mixed. Widespread understanding of the reality of regression to the mean and its relevance to appraisal in road safety has been accompanied on the one hand by slowness to act on this understanding and on the other by various misapprehensions: in some circles that its effect can be allowed for readily, and in others about the practicalities of applying one of the methods of doing so. Universities are still active in seeking to use modern computing power to allow more effectively for the undoubted phenomenon of regression to the mean.

By the time of the formulation of urban safety management, the context of debate about road safety was broadening in a number of ways – a process to which academics concerned with safety contributed actively. We were, for example, already getting to know colleagues in public health research, anticipating today's recognition of important links between policies for local transport and local public health. Managing road traffic to reduce casualties came to be seen as part of a general managed reduction of intrusiveness of vehicular traffic which, following our German colleagues, we came to call traffic calming. This in turn has more recently come to be seen as part of a still wider concern for the quality of the public realm.

Incidents that used to be called accidents are now usually called collisions (or, unduly melodramatically in my view, crashes) in deference to those who see the word *accident* as implying beyond the scope of prevention.

Again, it has come to be recognised that death and injury are not the only adverse consequences of risk on the roads: people may, for example, feel restricted in where they can safely walk, and thus restricted in important choices in life. Danger reduction thus came to be advocated as a wider objective than casualty reduction – a change of emphasis that has become steadily more apposite as numbers of casualties have been reduced substantially.

Attachment of monetary values to actions to reduce numbers of road collisions or casualties had begun in earnest in the 1960s, but by the 1980s there was increasing concern about the arbitrariness of the component values attached to associated reductions in pain, grief and suffering. This issue was made relevant also to rail safety by the pathbreaking retirement speech of a chief signalling engineer when he recognised that the fact that a safety measure would prevent some accidents should not by itself justify its implementation: instead, the benefits of prevention should be compared with the cost of implementation. This speech led indirectly to a university pilot study of the potential accident-reducing effect of two particular signalling modifications.

Much more important though, is academic work by determined researchers in at least two universities on the estimation of people's willingness to pay for small reductions in risk to large populations that would prevent the deaths of, or injury to, some number of unidentifiable individuals. That work became and has remained highly relevant to the economic appraisal of safety measures on both road and rail. The work had a substantial

influence on the crucial decision by the DfT's predecessor to adopt willingness-to-pay values in the evaluation of road safety measures, with consequent step changes in the values attributed to prevention of collisions and casualties. The values adopted have since evolved only slightly over time, and have been shown to sit comfortably within the broad consensus of valuations adopted in those European countries that have chosen the willingness-to-pay approach. In due course the work of these researchers also helped in a process of reconciliation of values of prevention used in appraisal of safety measures on roads and railways in Britain.

Growth in university research on rail safety has stemmed from several influences: increased public concern stemming from major accidents from the mid-1980s through into the 1990s, steps towards harmonisation and reform of railway operation across Europe, privatisation of railways in Britain, and a consequential opening of the rail industry to greater commercial participation. These combined to lead to a Research Council initiative for funding of rail research in some specific universities and more recently to formation of the Rail Research UK Association, open to all UK universities.

Work beginning in the early 1990s on trends in main-line railway safety in Britain has led to an independent annual statistical assessment alongside the official one, and an internationally respected complementary annual assessment for Europe. That independent assessment for Britain provided helpful reassurance when a leading playwright was given the stage of the National Theatre to help spread gloom and despondency, misplaced as it turned out, that privatisation might have jeopardised rail safety. At that juncture, a government assessment that all was probably well would just have evoked the proverbial Mandy Rice-Davies response. In another long-term study of trends, comparison of numbers of deaths on level crossings with numbers of other deaths on the railways shows deaths at level crossings to have formed a rising proportion of the total, and work on this here in Britain is contributing to a Europe-wide approach to the issue.

Comparison of economic appraisal procedures for implementation of safety measures on rail and road here in Britain has found them to be broadly consistent.

Work on this in the 1990s revealed generally low cost-effectiveness for measures to protect trains from the consequences of signals being passed at danger. This finding helped influence to be exerted against widespread pressure for what would very probably have been ill-advised investment in one particular train protection system on Britain's railways. Support for investment in another system providing greater safety benefits at a comparable cost eventually prevailed.

Alongside research into the economics of rail safety, the formation of the Rail Research UK Association, led our universities to identify many areas of their capabilities as being relevant to railways. Among a range of such capabilities that are relevant to rail safety in particular are many concerned with the health of structures or the stability of slopes, and a wide variety of others ranging from cyber-security through many technical specialisms to human factors in the operation and management of railways. There are already signs of these capabilities finding application to rail safety in practice, but time is needed to tell what pattern of academic involvement in rail safety is emerging.

Returning to the roads, I have already given early and ongoing examples of university research related to the safety of road vehicles and the road environment. Concerning road

users and their behaviour, there was already some psychological research in the early years of UTSG and before that.

But an interdepartmental review of road safety in the early 1980s led the predecessor of the DfT to feel justified in encouraging more behavioural psychologists in our universities to devote themselves to issues in road user behaviour.

The immediate outcome was a gathering by invitation at a country hotel to which one or two key experts from our near neighbours in mainland Europe and a number of professors from our own universities were invited. There followed a productive and much appreciated annual series of residential meetings which has only recently succumbed to the chill wind of austerity.

More substantial outcomes stemming from the readiness of a number of behavioural psychologists to respond to the initiative are exemplified by a nationally adopted technique for training children of preschool and primary school ages to cross the road and otherwise cope with the proximity of motor traffic, at first with but later without the company of responsible older people. Other outcomes, including still ongoing efforts, concern understanding and influencing the attitudes and choices of groups like young and midlife motorcyclists, newly qualified drivers (mainly but not all young), drivers of all ages in relation to choice of speed, use of alcohol and other recreational drugs and of prescribed medicines, and last but not least those who are or perhaps ought to be wondering whether to continue driving.

Complementary to the discipline of behavioural psychology in investigating some aspects of driver behaviour is the technical tool provided by the driving simulator. As a tool this has a much longer history than does UTSG, but in its modern form it was added to UTSG's collective toolbox at the beginning of the 1990s in one of our responses to a Research Council funding initiative. The simulator so established has been progressively enhanced through technical advances and further investment, and continues to enable a steady and influential flow of research, some of it explicitly safety-related.

Another initiative of the mid-1980s with vastly wider consequences was the advent of European Community funding for research – funding accessible to universities in partnership with practitioners and government across national boundaries in all Member States, including up to now the UK. This funding initiative seemed to usher in the era of the acronym as a *sine qua non* of a research project – a device into which as much ingenuity sometimes seemed to be poured as into the research itself.

UTSG members were well to the fore in taking up this funding opportunity by leading or joining consortia to carry out transport research. An early example in the field of road safety was a programme of projects concerned with the safety of vulnerable road users – one project having the acronym VRU-TOO. In this context, a vulnerable road user was one not protected by the body of a vehicle. Another such example in which British universities had a leading influence was known as MASTER and investigated many aspects of the management of speeds of traffic on European roads. These have been followed by a wide-ranging and still ongoing programme of research into e-safety – that is the effects on safety of various applications of information and communications technology used to enhance or adapt vehicles in ways which may assist or distract the driver. The potential benefits of such devices to safety can be enhanced, diminished or even negated by associated changes in the

behaviour of road users, notably drivers – or should we say in the light of upcoming autonomy, adult carers of vehicles?

The emphasis of these programmes, in safety as well as in other characteristics of road traffic, has been shifting strongly towards aspects of use of connected or autonomous vehicles – both technical and behavioural aspects – and implications of the introduction of these vehicles.

During the 1990s came an increasing realisation of how large a proportion of road collisions involve a vehicle being driven in the course of work – not just heavy vehicles with professionally qualified drivers, but also light vans for which specialised driver training is not legally required and numerous cars owned either by the driver's employer or by the driver themself. People can also be killed or injured while cycling or walking in the course of work. This has led to an ongoing programme of promotion of road safety in the course of work, which university research has helped to support – notably in terms of the scope for managements from the highest levels downwards to influence collision-involvement of drivers and vehicles throughout their organisations.

In our research related to transport safety, we have not been content only to advance knowledge, to share this with colleagues in practice and in government, and continually to update and enrich our teaching and training: we have also sought actively to influence policy. Of course this is true of many of our colleagues in UTSG, whatever their aspect of transport research, but it may well be particularly true for those of us concerned with safety, because a larger proportion of our work is liable quite frequently to become the subject of relatively accessible controversy in the media, including the social media, and by no means infrequently so in Parliament – devolved, at Westminster or in Brussels-Strasbourg.

There was scope for involvement of this kind from the early days of UTSG, and indeed before that, but the involvement took more explicit forms with the formation of PACTS (the Parliamentary Advisory Council for Transport Safety) in 1982 and ETSC (the European Transport Safety Council) in 1993. In both cases, academic researchers were involved from the outset and soon became deeply committed. ETSC is modelled on PACTS, which is one of its three founder-members, so the same generic outline description serves for both. They seek to work with the grain of Parliament, Ministers and the government service to support members of Parliament (of any party or none) who choose to concern themselves with transport safety issues – to help them to have access to evidence-based scientific advice about the issues they are addressing. Pursuing this objective naturally opens up opportunities to influence which issues parliamentarians take up, and on what basis in evidence.

The formation and growth in influence of PACTS was contemporaneous with the 1980s Interdepartmental Review of Road Safety and the evolution of the cross-party approach to central government leadership and local government, police and user responsibility in road safety that was expressed in the setting of the 1987 casualty reduction target, and helped Britain to achieve world-leading progress in road casualty reduction until the approach was so sadly abandoned by the Coalition Government soon after the election of 2010 – in favour of localism and a misplaced trust that numbers of casualties would continue to fall regardless.

Without the commitment of academics from the UTSG membership, PACTS would hardly have been able to build up its current respected position and record. And ETSC would have been much less likely to achieve lift-off in its crucial and provisional first two years when

experts with first-hand experience of the kind of role that was envisaged for the fledgling organisation were few, and the UK and PACTS were a unique source.

Topics on which our input has been influential at one or both levels include occupant protection (including that of child occupants), pedestrian protection, treatment of high risk sites, speed management, drink driving, work-related road safety and single-double summer time.

Of course ETSC has built also on immense inputs from Sweden and The Netherlands, and substantial ones from other European countries, but there can be little doubt that the input of UK researchers from UTSG and TRL Ltd and its predecessors has been more than proportionate.

European and global collaboration in road safety management with input from the UK has led to an encapsulation of the state of the art, as it has evolved over recent decades, under the banner *Safe System*. This can be summarised as having 6 essentials, starting with people – that is all of us – as road users:

- Mistakes will continue to lead to road collisions.
- The human body can withstand only limited forces without death or life-changing injury.
- Responsibility for prevention of death and life-changing injury should be shared by system providers, users, and providers of post-collision care.
- Safety management should be aligned with wider societal goals.
- Safety interventions should be shaped to meet long term safety goals.
- Interventions should be managed holistically to reinforce one another

For those working in road safety in Britain who have maintained a broad awareness, Safe System should contain little that is really new. It is consistent with the five pillars of the UN Decade of Action launched in 2011 and with the road safety strategy envisaged for Great Britain from 2010 onwards in the draft strategy *A Safer Way* on which the public were consulted in April 2009, and which had evolved from the bipartisan approach of the preceding 25 years but which was put to one side by the Coalition Government.

The presentation of Safe System in its OECD-ITF handbooks of 2008 and 2016 entitled *Towards Zero* and *Zero road deaths and serious injuries* nevertheless represent a challenging refresher.

Yet this presentation itself needs to be challenged in respect of *Zero*. The word ‘zero’ was brought into the international vocabulary of road safety by the Parliament of Sweden in 1997, when it adopted *Vision Zero,* under which it deemed that no loss of human life or limb is acceptable in return for any benefit of road transport.

Notwithstanding this being at odds both with the ways people live their lives (even with how they use the roads) and with the way governments need to behave in allocating resources among desirable objectives (even among different efforts to reduce avoidable death and injury), Vision Zero has undoubtedly had an inspirational effect in helping to accelerate the reduction in deaths and injury on the roads of higher-income countries since the late 1990s, and probably in helping to kick-start road safety management in middle- and lower-income countries.

As a vision or a marker of ambition it has almost certainly helped us to resist temptation to relax efforts in the light of progress in reducing death and injury on the roads, so long as many are still being killed or injured. But the authors of the 2008 and 2016 handbooks have allowed themselves to assert that zero is more than an inspirational vision – that it is an attainable objective.

Autonomous vehicles notwithstanding, this is to me, as a mathematician turned half statistician, half engineer with a good deal of experience of behaviour in the context of road safety, so incredible as to make it unethical to offer zero deaths as a prospect to decision-makers or the public.

So in suggesting six upcoming challenges facing research in transport safety, I make it

- Challenge 1 to recognise that it is unethical to lead people to expect death and life-changing injury to be eliminated from road transport

- Challenge 2 is to start counting deaths and injuries from falls while walking or cycling without a motor vehicle being involved as transport deaths and injuries to inform the promotion of active travel

- Challenge 3 is to address the risks arising from greatly increased use of powered mobility-assistance scooters (think several thousand per London Borough!)

- Challenge 4 is to aim to achieve creative synthesis between safe access and mobility, active travel for the sake of public health, inclusion of those with reduced mobility, and pleasantness of place, in working together with other professions on enhancing the public realm

- Challenge 5 is to address the risks arising from a gradually evolving mix of road vehicles with differing degrees and kinds of connection and autonomy

- Challenge 6 is to identify and address the forms of risk that will accompany the digital railway.

In relation to these and other challenges, in UTSG we have experience to learn from and to apply, and we are ready to continue to be looked to – but it is down to us to keep on finding and enthusing new talent.