

Level crossings: How safe can they be?

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Aidan Nelson
Community Safety Partnerships Ltd
PO Box 495, York. YO1 0AX, United Kingdom
aidannelson@comsafetypartners.com

Abstract

Collisions with road vehicles figures large in the risk profile of most railways. However, the casualty rates at level crossings differ significantly jurisdiction by jurisdiction. This paper looks at the opportunities for enhancing the configuration of level crossings and the costs associated with upgrades using examples from around the world to identify opportunities to cost-effectively reduce risk.

In parallel the paper considers the value which can be gained from initiatives to address the inappropriate behaviour of the public (professional drivers, other motorists, cyclists, pedestrians etc.) through a balanced approach to engineered configuration changes, education and enforcement initiatives. The paper concludes with a summary of the challenges to be addressed and suggestions of ways in which they might be resolved without incurring very high costs per fatality avoided.

Context

Level crossing safety issues can be addressed dispassionately using risk analysis techniques to determine priorities for action. However, this counts for very little when the media gets its teeth into an accident, particularly if it readily provides images of great destruction to sit alongside a story of miraculous survival or, more often, death of the road user. All too often railway officials come across as cold and uncaring because their standard line of defence is "the level crossing equipment was functioning correctly at the time of the accident".

While media interest spikes when a fatal accident occurs, the underlying public sensitivity to level crossing issues differs greatly around the developed and developing world. Searching principal languages of the world month after month highlights these differences with Argentina, Australia, Japan, The Netherlands, Spain and the United Kingdom consistently racking up disproportionately large non-accident specific media coverage of issues concerning level crossings. At the other end of the spectrum surprisingly little non-accident specific media interest is shown in China, Russia, the Nordic countries and Eastern Europe.

Generally, media interest in an issue such as level crossing safety is focused on the negatives of accident statistics, near misses, opposition to closure of a level crossing and community action to have a level crossing upgraded. However, there are exceptions to this rule with in

Australia and Spain where upgrade and closure programmes generate significant positive media coverage of actions to reduce risk arising at level crossings. However, elsewhere, the United States for example, where significant numbers of level crossings are being upgraded or eliminated there is nothing like the volume of positive coverage. Where the United States stands out is the coverage given to Operation Lifesaver events and campaigns year-round rather than following a day of action, a particular campaign, day of action or rail safety week.

These significant differences in media coverage may in part relate to the differing efficiency in publicising action to reduce risk at level crossings by rail and or other authorities. However, in reality the end result is that there is different public sensitivity to level crossing safety, congestion, delay issues jurisdiction by jurisdiction. If the public sensitivity is high it can be expected that the political sensitivity will be high too. Single multi-fatality events, particularly if they involve children can change the national consciousness overnight and an increased political will to fund large scale programmes to reduce level crossing risk.

But, it is important to recognise that road accident casualties massively outweigh those arising because of accidents at level crossings. This is important because rationally the national imperative should be to reduce the number of casualties in the most cost-effective manner. As level crossing related fatalities are typically less than 2% of total road accident harm, it is easy to see why it is other factors that lead to level crossing risk having as a high a profile as it does world-wide.

- Road deaths (2006, source ETSC):
 - France 4,709 / 75 per million population
 - Germany 5,091 / 62 per million population
 - United Kingdom 3,300 / 57 per million population
 - Sweden 445 / 49 per million population
 - Netherlands 730 / 45 per million population
- Level crossing deaths (2004-5, source ERA):
 - Sweden 14 / 1.54 per million population
 - Netherlands 18 / 1.11 per million population
 - France 38 / 0.61 per million population
 - Germany 45 / 0.55 per million population
 - United Kingdom 7 / 0.12 per million population
 - 2008 saw 15 deaths on level crossings in Great Britain

Principal of other factors is the higher proportion of rail related fatalities which occur at level crossings and the societal abhorrence of catastrophic train accidents which can arise when a train derails consequent on hitting or being hit by a road vehicle. One such event can be the driver of national action.

A similar change in attitude towards level crossings can be driven from a newly popular commitment to high-speed rail as enunciated by Barack Obama in the United States; or, other economic stimulus programmes like that initiated by the Rudd government in Australia. Likewise train

horn noise associated with level crossings can drive community action as it does in the United States with the growing quest for “quiet zones”. Elsewhere, the driver for action can be delay and congestion which generally drives the most costly schemes and therefore those that are most difficult to justify.

Economic stimulus as a driver

Australia stands out as the country with the greatest focus on level crossing upgrades with the Rudd government committing funds to support each of the states and territories to address their priorities for upgrades. The use of the same risk model across the country enabled each jurisdiction to generate a priority list of crossings developed to essentially the same criteria and therefore focus the available funds where they would most likely deliver the greatest safety benefit.

The focus of the Australian programme is in upgrading passive crossings to an actively protected status and active open crossings to an enhanced protected status. The AU\$150m funding allocated to this programme will see action to enhance the configuration of 290 level crossings, of which 40 projects have already been completed. Although there are clear safety benefits associated with each of these projects, it is important not to lose sight of the fact that the primary driver in the decision to spend this money is economic stimulus.

The unit cost of the enhancements being delivered is relatively low by comparison with European norms and the speed with which the programme is moving ahead is better than achieved elsewhere. However, the real test for Australia is that there is not a hiatus in delivering each state's pre-existing commitment to level crossing elimination and upgrade because of a diversion of resources to delivering the quick spend requirements associated with the Rudd government's nation building funding.

A simple and quick to deliver project contained within the Spanish economic stimulus package has been the large scale commitment to upgrading the road surface over level crossings using a single generic modular system. The simplicity of the project and the ability of a single manufacturer to respond to a major increase in demand have delivered safety benefits quickly even though some of the crossings at which new roadways have been provided will be eliminated by 2012.

In terms of the number of level crossings to be eliminated or upgraded, the US\$8 billion of federal funding to enable future delivery of the United States vision for a high-speed rail network has great potential. However, allocation of funding is only just beginning and there are signs that not all of the proposals for level crossing upgrades and elimination projects will move ahead as quickly as expected.

This is particularly the case where there isn't a community consensus around the high-speed vision and localised opposition to specific infrastructure enhancements. California stands out for two reasons.

Firstly, the state envisages the need to address 800 level crossings on existing rail infrastructure and the growing “not in my back yard” opposition in affluent communities to the South of San Francisco.

At the time of writing, September 2009, it isn't possible to generally consider the cost and time efficiencies of addressing level crossings as an enabler of future higher speed passenger train operation because it is not yet known where funding will be allocated.

National imperatives

The current programme in Spain to eliminate 1,931 level crossings by 2012 at a cost of €1.23 billion is moving ahead rapidly with widespread support from regional and local government as well as a broad acceptance in the community of the benefits to be gained through closure. Any opposition to closure is local and generally capable of being addressed in the scope of an elimination project. For example, there are a number of locations at which a grade separated pedestrian route has been provided at the site of the erstwhile level crossing with the route across the railway for vehicular traffic provided elsewhere either through new construction or consolidation of traffic over a pre-existing bridge or underpass.

The Spanish approach is good at recognising and responding to pedestrian needs as a discrete entity when considering the route to eliminating an individual level crossing. The Spanish approach is also good at looking at the needs of a community in the round when considering level crossings on a corridor through a municipality. While the former can apparently drive in cost because two routes over the railway may be provided. However, by considering level crossings on a corridor basis means that overall fewer more expensive grade separated routes for vehicular traffic will be required. A characteristic of the Spanish approach is the timely engagement with regional and local government which allows most projects to move ahead quickly with strong backing and sometimes additional funding provided to deliver a larger strategic gain for the community by way of a new highway bypass.

A similar approach can be seen in Portugal which has made and continues to make excellent progress in reducing the number of level crossings. In both Spain and Portugal there is generally positive media coverage of the programmes to eliminate level crossings. When an accident does occur, media coverage tends to be well balanced and refer to both the national commitment to eliminate level crossings and local plans to effect their removal. Issues of the timing of an elimination project may draw criticism. However, there is a larger focus on issues of user behaviour than is often the case in jurisdictions where elimination programmes are either unsung or do not exist.

The post-accident knee-jerk commitment to address level crossing risk can lead to a jurisdiction ramping up spend on level crossing upgrade and elimination. For example the Kerang accident in June 2007 led to

the Victoria State Government committing additional funding. Staying with Australia, the recent cluster of fatal accidents at level crossings has led to extra funding being made available to address risk at priority level crossings. In Queensland there is a transparency of the process leading to decisions as to the priorities for upgrade of level crossings as a result of the way in which a Queensland Rail led multi-agency task force is operating.

Although there is worldwide recognition that the best level crossing is one that has been eliminated, in many cases the only affordable route is one of progressive upgrade to first an active open status and in turn to solutions involving the addition of half barriers and in some cases to full barriers. The latter brings with it either the need for obstacle detection by machine or the human eye if the risk of road vehicles or pedestrians being trapped between lowered barriers is to be addressed.

The pursuit of lower cost technical solutions is a global imperative yet there is in reality little international cooperation evident in the pursuit of the nirvana of truly lower cost solutions. Why not, when research published by Britain's Rail Safety and Standards Board identified that costs of delivering the generic automatic half-barrier equipped level crossing varied by a factor of seven across the developed world?

Similarly, why is it that when novel treatments are applied at level crossings there is little formal sharing of the lessons learned and benefits associated with particular treatments? Examples of treatments finding favour in one jurisdiction and not being seen as relevant or cost effective in other jurisdictions abound. For example the widespread use of rumble strips in Victoria sits alongside other states and territories who have similarly committed to the enhancement. What is needed is a sharing of the evaluation that firstly underpins the case for installing rumble strips and more importantly proper evaluation which sets out the costs incurred, benefits realised and other lessons learned.

Elsewhere, there are pockets of commitment to the installation of active advance warning signs around the developed world. However, there is little visibility of any sharing of experiences across jurisdictions. Indeed in the field of traffic calming there is a great deal of knowledge in relation to highways generally yet little in the way of a systematic consideration of what might sensibly be tried on the approach to level crossings. Is this because in many jurisdictions there is still a mindset that level crossings are a railway issue with peripheral requirements spilling over to the highway? This stance is indefensible and there has to be national leadership that ensures that rail, highway and planning authorities are core partners in delivering engineered solutions if level crossings are seen in the wider highway and planning contexts.

Education and enforcement

An example of a national response which doesn't necessarily upgrade a level crossing in the conventional sense is the new found commitment to the use of photo-enforcement in France. This national commitment can

also be seen in relation to raising public awareness of the responsibility they have when faced with a level crossing.

The results of a €0.5m investment in awareness raising across France as the national element of the June 25th, 2009 European Level Crossing Awareness Day have been independently researched. Extensive media coverage was secured in national regional and local media with the result that this and the events lying behind the media coverage resulted in 50% of the population being aware of the initiative.

Some education based programmes to reduce the incidence of harm arising at level crossings have been around sufficiently long for there to be a structured evaluation of the value they bring. For example, Operation Lifesaver in the United States began in Idaho in 1972 and was launched in Canada soon after. What characterises these programmes is the tri-partite engagement of the rail industry, government and communities across the county. Although some funding is provided by government there is also a major commitment of the rail industry to support the programme in kind and funding for particular initiatives. Delivery of the Operation Lifesaver programme locally involves rail and law enforcement staff whose commitment of time is funded by their employer. However, it is the cadre of locally recruited and trained volunteers, including some who work in the rail sector or law enforcement, which makes this programme stand out.

Transport Canada has recently undertaken a quinquennial review of the country's Operation Lifesaver programme to validate that it is delivering value in addressing level crossing and related trespass risk issues. It is understood that the value of the programme has been affirmed and that government funding will continue to be made available. In the United States academic research by Ian Savage at Northwestern University in Illinois¹ has shown that increasing the amount of educational activity will reduce the number of collisions between trains and road vehicles at level crossings.

What is important is that the Operation Lifesaver operates on a long term basis with consistent messaging, albeit methods of delivery evolve over time as is the balance between actions focused on reducing accidents at level crossing and accidents as level crossing deaths continue to reduce relative to trespasser deaths. Operation Lifesaver is spreading as a brand with Mexico, Argentina and Estonia having fully fledged national programmes. Elsewhere it is evident that there is dialogue with Operation Lifesaver and application of the key principle that you have to commit to engineering, education and enforcement in parallel as focusing solely on one strand will not maximise value.

¹ Does Public Education Improve Rail-Highway Crossing Safety? – *Evaluating the relationship between Operation Lifesaver activities and collisions between trains and motor vehicles at public crossings*. Ian Savage, Department of Economics and the Transportation Center, Northwestern University September 2005. Published in *Accident Analysis and Prevention* Volume 38, Number 2 (March 2006), pages 310-316

Elsewhere, there are examples of excellent campaigns to raise awareness of the risks associated with level crossings and to change behaviours so that accidents at level crossings are avoided. If these awareness campaigns on television, radio and on roadside billboards are to have long-term value in reducing harm at level crossings they must be underpinned by face to face education of road users, including pedestrians. School visits can deliver value as can targeted engagement with adult road users. For example, speak to motorists and pedestrians who have been stopped at a level crossing because a train is approaching and you are certain of reaching level crossing users.

A blitz approach at level crossings with a substantive accident or near-miss history or which have otherwise been identified as higher risk can be particularly effective when education of those who stop as they should for level crossings is complemented by enforcement action as a form of education for those who do not use them as they should. However, the effect is local and unless the enforcement activity continues of only transient effect.

Accordingly, the long term commitment of partners is necessary if human-centred enforcement activity is to be effective. However, given the deployment other pressures on traffic police, this is not always assured. Where the senior leadership of traffic police is committed to addressing risk at level crossings there is evidence of a sustained commitment to the issue. For example, in the United States, the Louisiana Highway Patrol is amongst the most pro-active at policing level crossings. It is also possible to see evidence of longer term commitment where there is a national railway police force as in Great Britain.

The cost of human surveillance at level crossings is high and increasingly consideration is being given to the use of photo-enforcement with a particular emphasis on red light running. So far, progress has been limited by the need to develop the legislation to allow for the use of such equipment. Also, integrating the management of photo-enforcement cameras with those used for wider road safety reasons is not always easy. However, although there are still barriers to the effective use of photo-enforcement, these might be overcome sooner if there was a wider sharing of the lessons learned so far and benefits in addressing risk through photo-enforcement at level crossings. At the moment there is too much reliance on intuition as a driver for photo-enforcement and not enough on hard evidence that these schemes really work.

Noise, delay and congestion

Train horn noise can be a driver for upgrading level crossings to compensate for the warning provided by train horns. The United States approach of allowing railways an exemption to sound train horns in other than an emergency when risk has been assessed and appropriate counter measures have been introduced puts the majority of the cost burden on the community who benefits from the creation of a quiet zone. These zones are generally in urban areas and typically involve upgrading of the crossing equipment – sometimes to quad gates, the use

of median strips where half-barriers are retained, wayside horns and closure of crossings in favour of those which are upgraded. This is a good approach because, again, a corridor rather than single crossing perspective is the driver of upgrade and closure decisions. It is also an excellent way of involving local government in finding solutions rather than just moaning about the problem of having a railway running through town.

Level crossings which generate delay and congestion soon become an issue of concern to those directly affected and to those that represent them. However, nothing will be done to address the issue until there is recognition that these are not problems that rail authorities can or should solve independently. Rather there has to be a meeting of minds of the stakeholders who will benefit from solving the problem and those with the funds to permit action.

As we are in Sweden for the 2009 International Railway Safety Conference it is appropriate to recognise the progress that has been made in developing solutions with road and rail authorities working to the same agenda and using the same thought processes in determining actions that are justifiable in terms of the safety and other benefits gained from seeking to address level crossing issues.

The sheer cost of creating a grade separated crossing of the railway in an urban environment can appear prohibitive as can the impact of the new highway arrangements on those who own property and businesses affected by the underpass or flyover necessary to effect grade separation. In so far as funding is concerned it is quite usual for it to take five years or more to secure the necessary budget at national, regional and local levels. Part of the difficulty in justifying the expenditure is the way in which delay avoided is valued.

The greatest progress in securing grade separated solutions where either the level crossing issues are subsumed in a wider highways scheme; for example, the construction of a new bypass and changes to local traffic distribution networks and / or there is a national or regional budget for a programme to eliminate level crossings. As explained earlier, Spain is an example of the national imperative to reduce the number of level crossings is sufficiently funded to allow for many grade separated solutions. However, in Spain there is also a willingness to bring in additional regional and local funding to allow a broader highways solution to be implemented.

In conclusion

The cost of upgrading and eliminating level crossings is generally seen as too high yet there are those who consistently deliver projects at a fraction of similar schemes in other jurisdictions. Where progress is made quickly it is because there is a national and funded programme backed by political will to effect change.

However, engineered solutions alone will not address risk arising at level crossings as an equal emphasis on education of users and the taking of enforcement action against those who abuse level crossings is necessary.

The issue for is on the one hand to work to develop strategic partnerships which recognise that level crossings are not solely a railway issue. On the other, there needs to be a worldwide and structured sharing of good practice and lessons learned in the quest to eliminate level crossings and where this is not justifiable to better manage the safety risk and other impacts of level crossings. Europe is well placed to generate a sharing through the European Level Crossing Forum and European projects such as SELCAT. Canada and the United States work well together and are open to wider collaboration. However, now is the time to go further in collaborating to address the various issues posed by level crossings.

After all, you can spend a lifetime arguing about detailed differences in current practice and lose sight of the fact that level crossings are generic worldwide with the same problems to be solved. For example, everyone is faced with the issue of the flangeway gap and compatibility of level crossings with mobility scooters and cycles yet no one has a solution. Surely, this is a project where collaboration rather than individual action is the way ahead.

Aidan Nelson
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