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Interfacing old and new technology

Managing the hazards of railway technological interfaces

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Other than rare greenfield constructions, most railways are typically an eclectic mix of old and new technologies, often spanning 50 or even 100 years. During the same period the organisation of a railway can be transformed beyond recognition and this usually adds to the challenges of managing the interfaces. The classic example in Australia is the original railways built in each colony, almost totally independently and without consideration of the other colonies and the modern buzz-word word 'interoperability' definitely was not in the glossary. In Queensland, as late as 1890, there were 11 separate railways with little or no commonality and none 'joined up'. The legacy of this chaotic evolution in Australia could fill several papers such as this one.

I shall examine some interesting and varied examples of technological and other railway interfaces, the hazards associated with them, some actual and some suggested solutions. For example, how DO you build a modern, complex high-speed train such as the Eurostar, full of complex electronic equipment, and then run it on a railway with an antediluvian power system and a signalling system that does not like high frequency harmonics? The task is made harder when the network owner did not have an accurate or complete record of those signalling assets. Eurostar was also interesting from an *organisational* interface point of view, being a tri-national operation involving three countries **not** known for their ability to cooperate on such matters and with widely varying 'cultures'. The first trains driven by French drivers often arrived in London with a nice bottle of red wine in the cab, creating a delicate diplomatic challenge! Interestingly I saw the same thing in the North Sea oil industry 20 years earlier when I was the manager of an offshore installation operated by the French oil company *Total*. The French ex-patriots on the installation insisted on having wine with their evening meal – unfortunately not something that the UK Regulator could tolerate!

The installation of the Train Protection and Warning System (TPWS) on main line approved steam locomotives in the UK is an example of old and new technology working effectively at reducing risk. TPWS has also been installed on four of the regional rail corridors in Victoria, again reducing risk effectively but now its installation in the Melbourne metropolitan area needs to be expedited otherwise that interface becomes an issue, especially with 'driver only' trains. There is an endless list of examples such as these. This paper will focus on a selection, some that have been managed effectively, others that have not, as well as the underlying principles that need to be applied. The aim of the paper is to provide an insight into what needs to be done, the useful tools that are available and the risk based regulatory requirements that need to be met.

Railways these days often have more organisational interfaces than in the past and there are examples where this is actually a barrier to technological improvements that often have safety connotations, because of the difficulty in having all the ‘stakeholders’ agree. This complexity can sometimes stifle innovation, and innovation is always important for rail safety.

Introduction

Interface – *a common boundary or interconnection between systems, equipment, concepts and/or human beings*

In 1998 I moved back to Australia from the UK to take up a position in Melbourne as the first independent transport safety regulator in the State of Victoria. This was at a time when Victoria was about to follow the example of the UK and ‘privatise’ its railways. Not strictly ‘privatise’, more ‘franchise’, rather like McDonalds only less successful! Previously the railways had been ‘self-regulated’ monolithic State organisations, not really answerable to anybody. Obviously this could not continue with the introduction of foreign operators whose main motive was to make a profit.

I was immediately struck by the nature of rail safety risk in this new environment, and the two main components of that risk, as I saw it were ***interfaces*** and ***change management.*** Thirteen years later I think not much has changed in Victoria. The sub-theme of the conference under which this paper sits is ‘Interfacing old and new technology’, which is certainly a part of the overall interface issue. If I could begin with a simple example relevant to Melbourne, the management of railway safety on such busy metropolitan rail systems relies heavily on signalling and the track circuits that register the trains and, along with devices such as mechanical train-stops, ensure separation.

But then along comes the humble track machine (usually belonging to a third party maintainer – another interface), which cannot be guaranteed to operate track circuits, and the sustainment of separation becomes more difficult again relying on a human being, through some kind of block working arrangement – a much less error tolerant system. This is a simple example of an interface that has technical, historical, human and organisational aspects. What are the options? How do we demonstrate that the risks associated with this have been reduced *so far as is reasonably practicable*?

By way of further introduction, here is another Melbourne example of technology that is almost 100 years old still being used today to control one of the busiest parts of the Melbourne metropolitan rail system (300 train movements on average). *Most* of the time it works reasonably well ……..

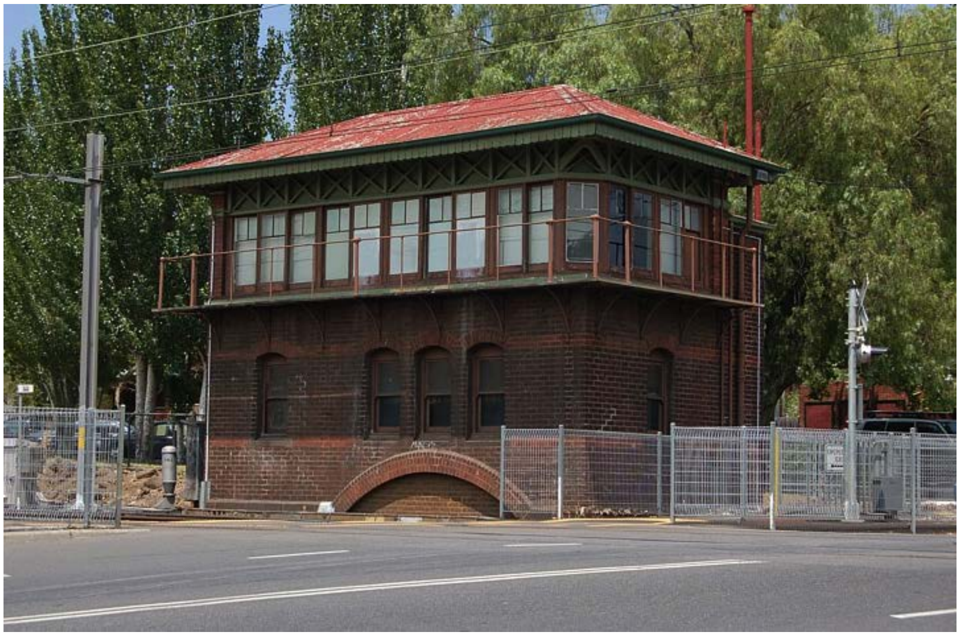

Figure 1 Kensington Signal Box, Melbourne

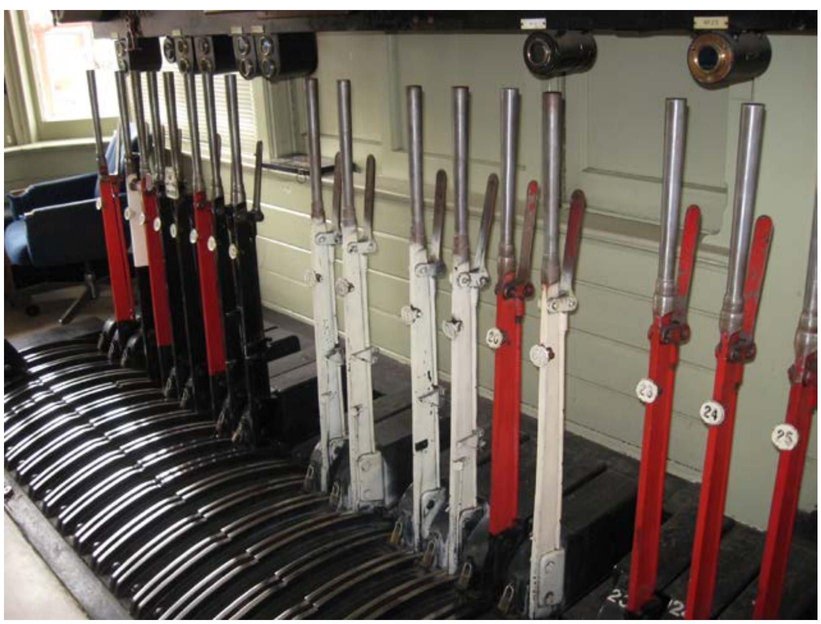

Figure 2 Lever frame of Kensington Signal Box

Kensington Signal Box, circa 1887, with the 19 lever 'cam and tappett' interlocking lever frame that was installed in 1918 and is largely unchanged since then. Some would call this a heritage railway, rather than one of the busiest locations on the Melbourne metropolitan rail network! The implications of this interface of old and (relatively) new technology is very obvious and it has caused significant problems.

Tram Squares

Melbourne is unique in many diverse and positive ways, but one of which to my knowledge that is not so positive is that it is the only city in the world where busy tram lines cross busy main line railways at grade. There are four such locations in the metropolitan area. The operation at each of the four locations is manually controlled from a small 'signal box', including the change over from 1500V DC train overhead traction power to 600V DC tram overhead traction power. Needless to say it is not very error tolerant and over the years there have been numerous incidents of trams being derailed at the protecting catch points and even occasions of the 1500V DC train overhead traction power finding its way into the tram overhead system, with disastrous effects to the electrical systems of trams in the vicinity.

Eurostar

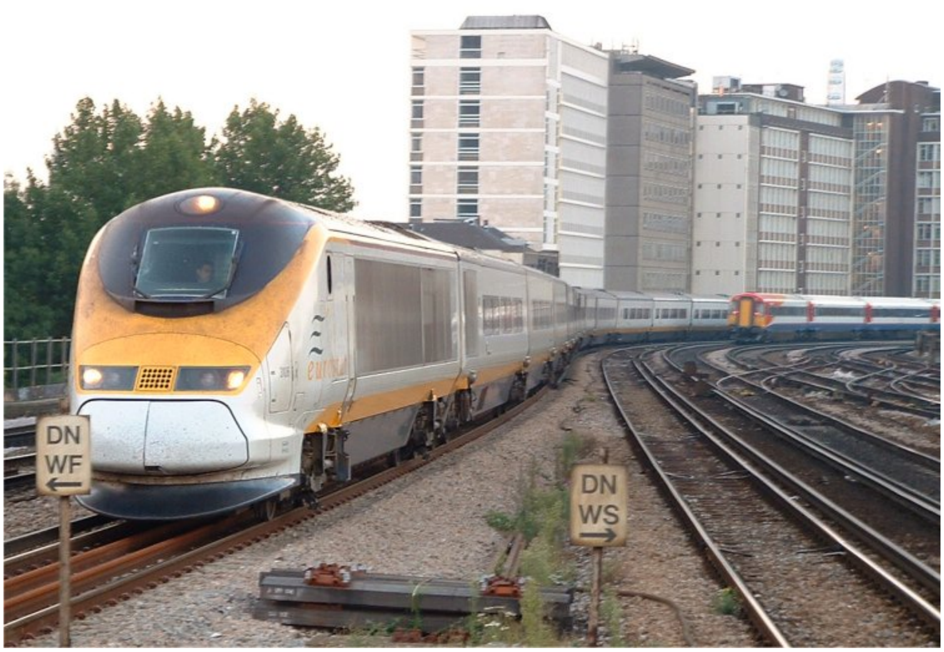

Figure 3 Eurostar departing Waterloo on the old southern third rail system

In my experience the most interesting example of old and new technology was Eurostar. When the Eurostar service was first introduced in 1994 between London, Paris and Brussels it placed a highly complex state of the art electric train on to an antiquated third-rail commuter system that provides a traction power at 750 V DC. The trains had facilities to operate on up to four different traction power systems, the other three using one of two different pantographs for collection of 25 kV AC, 3kV DC or 1.5kV DC. The transition from one system to another required a degree of vigilance from the driver. There were cases of failure to retract the third rail pickup 'shoe' in France and also failure to lower pantographs in England, both resulting in significant infrastructure damage and service delays.

Main line (heritage) steam locomotives

Tornado – Britain's newest main line passenger locomotive!

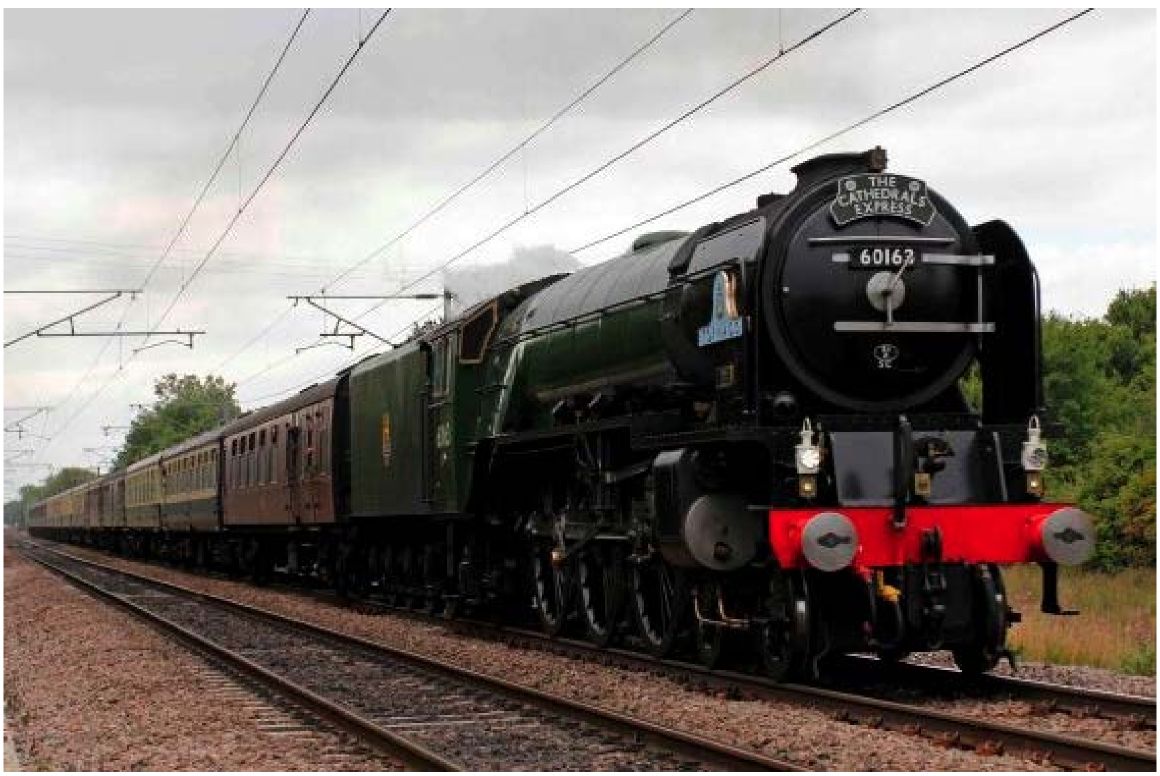

Figure 4 *Tornado,* 'Replica' A1 steam locomotive

For many years I have been associated with the A1 Steam Locomotive Project.

Obviously *Tornado* is NOT a main line heritage steam locomotive, it is not even a true replica of the original A1 steam locomotive, but it does provide a very interesting example of the interface of old and new technology, in many different ways, but let us focus here on the TPWS fitment. TPWS was installed on *Tornado* during the build of the brand new steam locomotive and was thus designed in from the start.

Tornado has TPWS unit Thales Model Number 606108-01 Mod strike 4 that was installed at Darlington in July 2008. The picture shows the TPWS Control Unit and PSU as fitted, under the driver's seat.

All other mainline authorised steam locomotives in UK (the much older real heritage locomotives) are TPWS fitted.

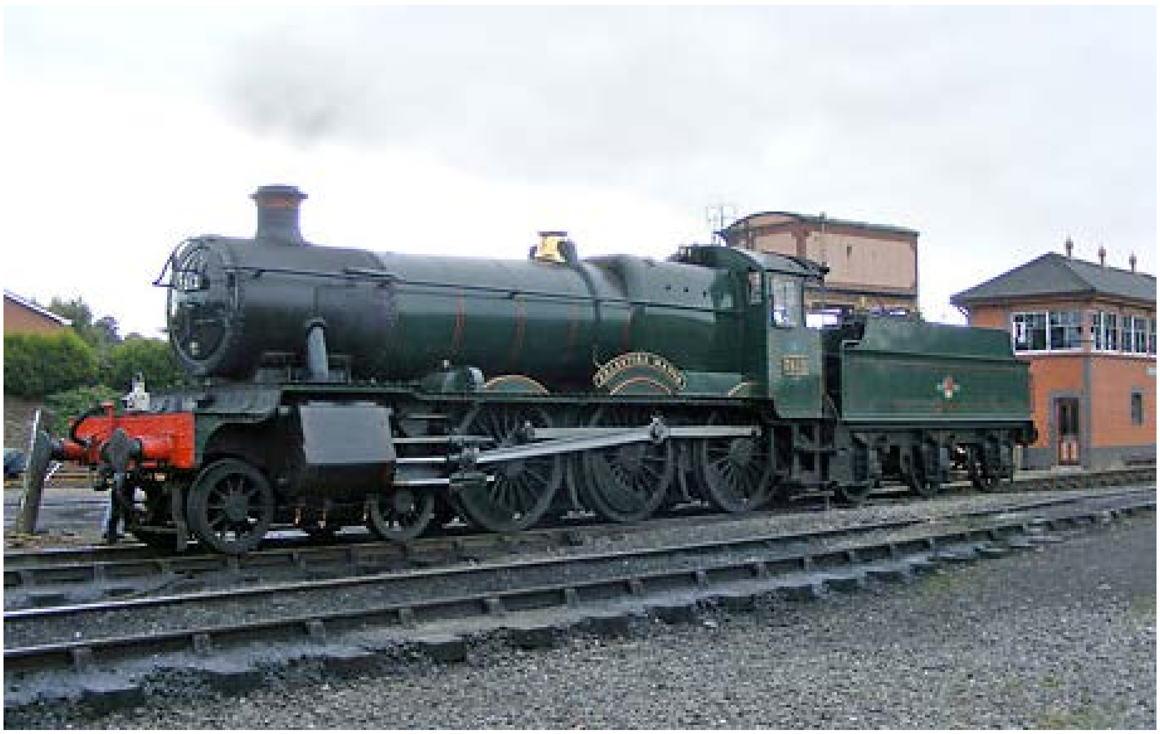

Figure 5 Manor Class '*Erlestoke Manor*', built 1939, TPWS fitted 2008

TPWS in Victoria

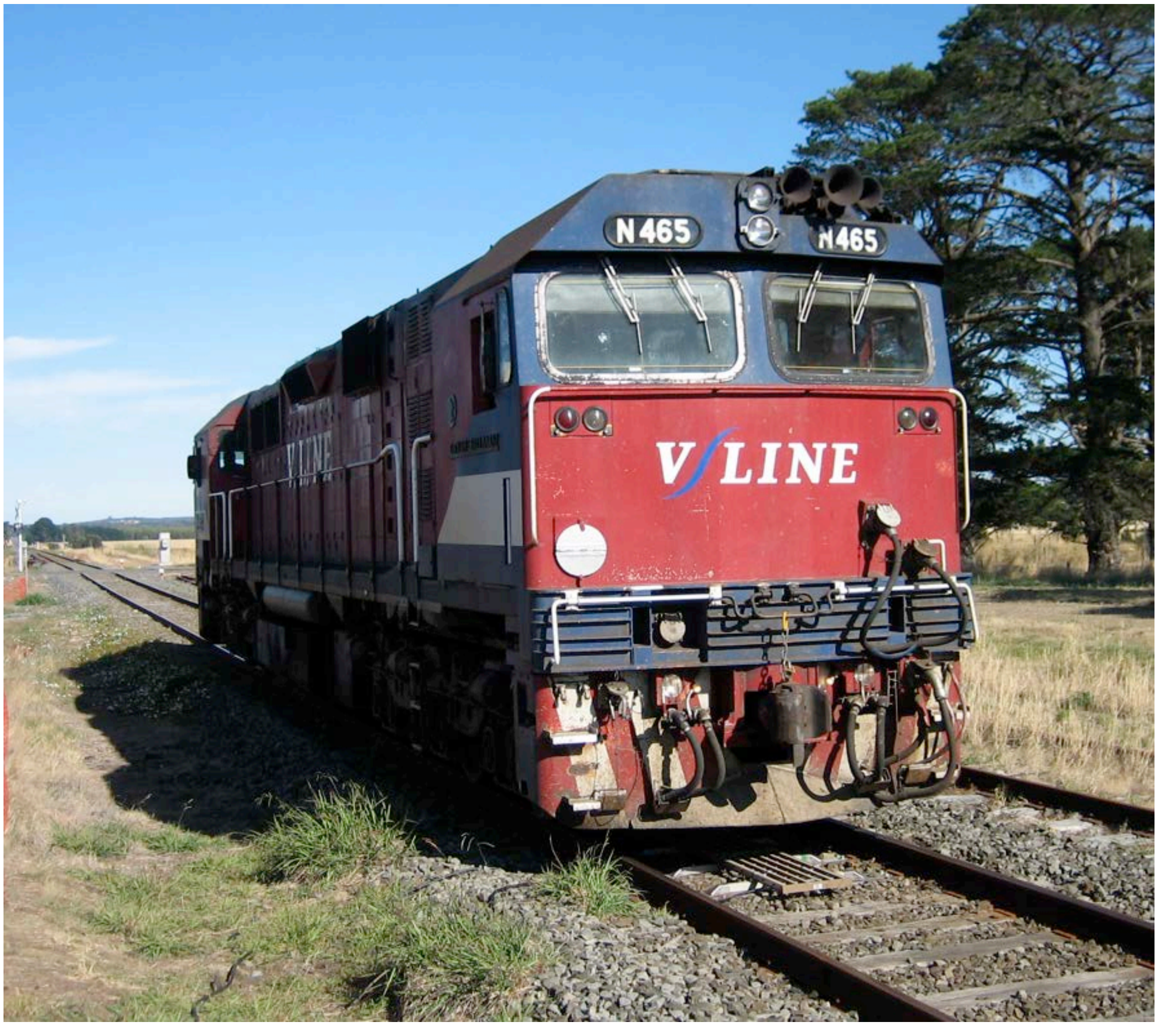

Figure 6 Trials of TPWS in Victoria, Trewalla, 2005

In 2005/6 four regional rail corridors in Victoria were upgraded to 160km/h running. As part of that upgrade a decision was made to install TPWS, identical to the systems used in the UK.

TPWS achieves about 60% of the safety gains of Automatic Train Protection (ATP) for about a tenth of the cost that, from a 'so far as is reasonably practicable' risk reduction viewpoint, is a 'no brainer'. It is now installed on the four main regional rail corridors and all passenger trains that operate these corridors. The plan is to further install TPWS within the metropolitan area of Melbourne at selected high-risk locations such as junctions. Metropolitan electric passenger trains are protected by mechanical train stops but regional diesel powered trains revert to total reliance on the train driver in the metropolitan area.

Conclusions

From the time of the very first passenger fatality on a railway, on the day of the inauguration of the Liverpool and Manchester Railway in 1830, interfaces, both technological and other, have played a vital role in railway safety. From that accident in 1830, and others that followed, possibly the World's first national safety regulator, *Her Majesty's Railway Inspectorate (HMRI),* was set up in 1840. An august body for most of its existence staffed almost entirely by retired senior officers from the British Army. In the early days the main task of HMRI was to ensure that all of the many new railway developments in the UK adhered to some kind of establish engineering practice, thus ensuring the optimum safety for the technology of the day.

Here in Australia we still struggle to establish a national rail safety regulator but it is a little known historical fact that there was already a national rail safety regulator in the past. In the days before Federation in 1901, Australia consisted of six independent 'colonies' still managed largely from the UK. Each of these colonies independently developed railways and HMRI had an overall oversight role of safety on the new railways. Unfortunately this role did not extend to ensuring that when the railways eventually joined up they would have a baseline common approach. So today, for example we have railway signals in Victoria that have a different meaning in New South Wales.

For Australia, much more so than the EU, railway interfaces, both technological and other, will remain a significant threat to railway safety for a long time to come.

Thank you.

Carpe Diem.

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