Supplementary written evidence submitted by Mike Mackinnon (RSM0115)

The notes in this document have been developed from those I used for my initial input to TSC. I don't claim to be an expert and am not up to date with all aspects of SM design but have spent 45 years working on all aspects of UK traffic control technology. What I have written about the Smart Motorways scheme, is based on my understanding of the legal issues involved and my opinion of the issues which should be investigated in any review that might be undertaken.

My Background

Trained as telephone Engineer. Technology Degree in Microwave Engineering. I have worked in Traffic Control Technology from 1969 until present

Department of Transport 1969 – 1995: - Type Approval traffic control technology equipment – Optics and Detection Evaluation – UK European Standards Representative (VMS; Traffic Signals & Detection). M25 Holmesdale and Bell Common Special Project.

Involved in development and introduction of nearly all the Departments Technology Standards from 1970 to 1995. The areas that I worked on over this period which may be of interest to the committee, relates to the development of the processes used by the Department to design, approve and implement all the work undertaken in the Motorway Construction programme and its technological development.

Provided technical advice to Departments Road Safety Division

Developed Department HAZOP process for CM Evidence Trail

Went on loan to Munsell's to help design Kuwait inner ring road traffic controls.

Ran motorway maintenance and transmission sections responsible for operational aspects of England's NMCS (The control system for motorway signalling and technology system).

Wrote Department Guide on 'Quarter of a Century of Motorway Communications'

Technical Lead Controlled Motorway. Chaired ACPO Enforcement committee to Type Approve CM scheme.

Represented Department on ICSE (SRS) International Conference on Software Engineering (Safety Related Systems) working on risk assessment of traffic control systems particularly in developing a code of practise to be used on trial schemes.

Developed detector performance standard used in Type Approval which was then taken up as basis of European Standard. Set up the Departments detector test facility at the Fire Service College Moreton in Marsh. This was used with Essex and Surrey Police to carry out some of the tests used for the Home Office Type Approval of the radar speed detection equipment to be used on the Controlled Motorway Pilot Scheme. The high-speed tests were carried out at MIRA and the operational testing on the M25.

MMB/Capita 1999 – 2015. HA Support, including specialist Enforcement work related to the development of the processes needed by the individual projects to build and maintain the Evidential Trail required to secure a prosecution against non-compliance with mandatory signal aspects.

Provided specialist advice to Yorkshire Link DBFO in the provision and evaluation of the traffic monitoring system required under the contract against which they secured their payments.

Set up own consultancy MMTCES in 2012.

Carried out draft work on setting up processes to be used on any technology equipment/system to be used on a UK roads.

Wrote paper for TCS congestion Review 'Out of the Jam' included concept to improve congestion by adding hardshoulder on APR 2/3 Lane Dual Carriageways

Carried out the initial scoping of requirements for hardshoulder monitoring and early evaluation of supplier's equipment.

Responsible for CM MOU between Department Home Office CPS and ACPO

SMART MOTORWAY CONCEPT REVIEW.

The start point of any review of Smart Motorways (SM), should not be with the Technology but by looking at what would be involved in producing a basic safety case for changing a well proven Motorway Design Standard and Operation. This would look at the basis used to determine whether increasing traffic capacity, hence reducing congestion, for minimum monetary cost by

changing the hardshoulder to a running lane, is both cost effective and as ‘safe’ as the current design and operation.

Modifying the hardshoulder to become a traffic lane, is a lot cheaper than modifying a hardshoulder to be a running lane and adding a new hardshoulder.

The question is what safety case should be used to determine what risks would be increased/ created – how could these to be mitigated – how do you assess the risks in monetary terms, can all the risks be fully costed and even if they are, are all the risks acceptable?

*It should have been clearly foreseeable prior to its introduction, that the withdrawal of the hardshoulder (whose purpose in the original design concept was to provide a safe haven along with facilitating emergency services access) would at some point, end up producing a traffic situation where there would be a fatality. Given this, it is a reasonable expectation, the that the first question should be, is this acceptable?

*I suspect the safety case for the original motorways with a hardshoulder was reasonably easy, in that it was foreseeable that there would be incidents with fatalities at some point but it is also foreseeable that a road with no direct conflict ‘points’, and a hardshoulder, even though vehicles were allowed initially to drive at any speed, would be safer than the other road types existing at that time.

*Both subsequently proven to be correct.

I don’t know whether or not Highways England (HE) have produced a safety case for SM and if so whether it was reviewed by the Dtp who I believe are the responsible party (under H & S Legislation) legally responsible for Road Safety in England, a responsibility as I understand it which cannot be delegated.

In creating or reviewing any existing Safety Case there are a number of basic issues that need to be considered.

Up until the HA was formed, the Dtp was effectively directly responsible for all aspects of the conception, design, implementation, operation and maintenance of the English motorway system and would have dealt with all issues. The introduction of elements of business practices impacted on this inherent integrity of the total ‘in-house’ responsibility with some of the unknown and possibly unintended consequences that these changes introduced, i.e., TRL privatisation, changes to L. A’s responsibilities (aspects

taken from their control in some places with additional devolved responsibilities added in others). Examples: -

- What of the relevant Department Standards have been validated against the SM concept?
- What was the original safety case for Hardshoulder?
- What regard has been taken of the Departments 'Four lane gantry signalling Standard, the NMCS design (safety critical issues – signal sequencing – expert review panel and process, maintenance etc):
- The loss of Type Approval under reduction of Red Tape initiative etc.
- What has been the impact of reduced Police input to design and operational issues of running the motorway network.
- How are road users expected to exit a stopped vehicle safely. What is the position if the vehicle is carrying disabled people?

This erosion of direct control has been continued with the changes made to create the Highways Agency and further still HE which has seen the gradual move of technology away from the specialists to a more project rather than design authority approach.

In trying to assess what Highways England might have covered and not covered in terms what factors they considered when developing their Design and Operation concepts for SM there seems to be three main elements that they use support the concept (i) ERA's (ii) Technology (iii) Claimed Improved safety, but there are a number of other issues that do not have appeared to been covered (This view may be that I have only limited access to relevant information.

(iv) Emergency Vehicle access (v) Method of leaving stranded vehicles (vi) Pedestrians in road (vii) Technology issues (vii) Relevance, availability and accuracy of traffic data

My observations (for discussion)

(i) ERA's – There seems to be no National Criteria and in their own right ERA's should have a safety case which should consider how many vehicles do not stop where there is a hardshoulder at a telephone.

How can a vehicle particularly an HGV safely enter and exit an ERA. What happens if there is a vehicle already in the ERA. Where does any support vehicle needed enter/park?

(ii) Technology – There needs to be a separate detailed discussion on use and effectiveness of the ability of any technology to effectively mitigate against an incident which involves any vehicle actually stopped in any running lane. I did touch on some of these issues in my initial paper. I do not believe it is possible to detect a stopped vehicle or a pedestrian (in any lane) and set up in any situation a meaningful means of stopping a following vehicle hitting it -if individual circumstances are favourable the driver (s) of the following vehicle(s) might avoid hitting it by any avoiding action they take which might (or might not be available to them).

(iii) Claimed Improved Safety – I do not believe that it is credible for the SM concept to be able to claim any additional benefits other than those already made for its predecessors apart from the lowering of the monetary cost of providing an additional lane to and existing motorway. It may in fact, other than the costs associated with any accidents it may have actually introduced some disadvantages in non-accident conditions.

(iv) It may be that to properly determine the status of SM as a part of the 'Roads Design Toolbox, that the currently available data is neither detailed nor accurate enough to allow for a truly objective assessment to be made. This is because what in my view is we are looking for a very specific set of data. That is because we are only for looking for incidents which involve vehicles stopping in a running lane and then (i)what percentage result in fatalities (ii) how many near misses have there been (iii) How many vehicles on Standard motorways do not stop at a telephone location?

Amongst other things that might be considered: -

(a) Emergency Vehicle Access – The lack of a continuous clear lane for Emergency Vehicles to get to any incident, decreases some of the major cost benefits used in MIDAS, which is an existing part of the NMCS, and which was in existence long before SM.

(b) Definition of 'safe' for any comparison

(c) Police reaction to original Department Standard for 4 lane motorways with two hardshoulders

(d) Police reaction to Mandatory Signals for Traffic Management

(e) Maintenance difficulties

(f) Road User reaction to signals – role of enforcement
(g) Added issue of where to go if you know you have a problem – originally to your left -now?

Summary

Until the introduction of SM all accidents on a motorway were effectively random and had four main causes – debris – mechanical failure/tyre blow out – driver error – lack of concentration/sleep. The difference is that SM has introduced a category where the cause can be attributable to the lack of a hardshoulder. The core issue is, can a robust safety case be made where the changes being proposed, or any that could be proposed, can provide a viable way to mitigate against the problems.

June 2021

Annex A

Motorway Technology Development

Motorway Technology started in the late 60's with telephones followed by trials of message signs and then central reserve and gantry mounted matrix signals there was also a trial of vehicle detection on the M4 elevated section.

All aspects of the system lay within the Department of Transport TE and TCD Divisions RS Division and TRL all working together with TE leading the design installation commissioning and maintenance of the motorway communications system with HE in HQ and RCU's in the Regions responsible to helping to develop the infrastructure and the Standards via the Chief Highway Engineer. TCD and part of TE were later incorporated into a new Division (TCC) who then became totally responsible for technology aspects of APR's and Motorways. Particularly Type Approval for all technology equipment on APR's – Motorway systems deemed to follow same procedure did not require TA because carried out by in house expert team.

The first communications standard was for telephones be provided at 1-mile intervals and centre reserve signals at two-mile intervals. Next came the provision of gantry mounted signals at Motorway/Motorway interchanges and entry stop signals. The fundamental difference was between carriageway signalling and lane signalling. Any requirements where it was felt other than standard provision was needed required the preparation and submission of a case the CHE. The process was that a cost benefit case was needed where the capital cost was returned within ten years which meant the main cost benefits were always based on improvements in safety.

Apart from some work on developing variable message signs, initial rotating prism signs and then light emitting no new technology was introduced. However, in late 1980's probably the most significant technology to be introduced started trials on the M1 of Motorway Incident Detection and Automatic Signal Setting (MIDAS) which involved having vehicle detection points every 500m. At these points it is possible to measure a number of vehicle parameters like 'speed' 'headway' 'flow' etc. These detection points were then linked to the control system that was used to 'set' the signals and allowed the step function change from operators setting signals based on calls from road users using the motorway telephones.

Whilst possibly not sounding like a significant issue, it was because there were no mobile phones then, so the road user had to decide to report a problem find the next telephone and call in. Unfortunately, they usually didn't know where they were and had to use the number on the telephone an then they had to know in which direction they were headed. This meant that the operators (police in those days - in police control centres) had to set the relevant signals on both carriageways at the same time, the dispatch a car to check exactly where the queue was, deal with the incident whilst having another car despatched whose role was to reverse backwards down the hardshoulder warning approaching traffic to slow down as there was stationary traffic ahead.

AID (later to be known as MIDAS) changed all this not only identifying the motorway but the carriageway and the position down to an accuracy of 500m but also setting the signals automatically downstream of the back of the queue warning the oncoming traffic.

This allowed a safety/cost benefit case to be made based the improved likely of emergency services getting to the scene of an accident within the 'Golden Hour' and converting a possible fatality into a severe injury. The use of the hardshoulder exclusively for emergency use clearly helped in this objective as did the ability for possible reverse access and precisely which ES location was the nearest and hence the best to dispatch.

Fast forward to the next significant development as far as Smart Motorways are concerned. All again during the era where Dtp were still responsible which was an initiative sponsored by RS Division where the output of research by TRL showed that if you could stop a phenomenon called flow break down occurring you could in heavy traffic flow conditions improve 'throughput'. EXPLAIN CONCEPT.

One vehicle slows others around slow at different rates eventually causing all vehicles to stop – road clears – vehicles pull away up to 70 and the meet same again – minor incidents increase but maximum through put maintained for longer. – Achieved by slowing vehicles to slightly slower speed for some distance by using 60/50 mph speed limits

The Departments view was that road users would not in what would look to them like free-flowing traffic slow down to the required 60/50 mph and therefore the matrix signals would have to be made mandatory. This presented

a significant number of technical and procedural changes but once it had been developed into an operational system it was a relatively cheap addition.

So, the M25 Pilot scheme was born.

Key Issues based mainly on original MIDAS savings of automatic signal setting with some improvement in reducing the incidents in flow breakdown. These savings based on operating only in peak flow periods.

Police reluctance to have enforcement of what they regarded as a mainly traffic management not a safety system – in the end lead to development of Traffic Officers.

Cost of enforcement could be controlled by enforcement threshold – not every offender needed.

Signal sequencing – speed enforcement on every speed – anomalies – possible dis benefits.

Hardshoulder still available

Next Managed Motorways

As Controlled Motorways but peak time use of Hardshoulder – mainly for traffic between junctions for local traffic – improvements in lane changing.

Smart Motorways

No hardshoulder – operational all times

Rural and Gantry versions