Highways Agency Managed Motorways Portfolio Foresighting Project

Global Approaches to Managed Motorways and Research Activities

Document Control

Document Title	HA MM FORESIGHTING PROJECT - Global Approaches to Managed Motorways and Research Activities
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Owner	TBC
Distribution	Foresight Project Team
Document Status	Internal issue

Revision History

Version	Date	Description	Author
v0.1	11/01/10	Draft template for population	James Gibson
V0.2	26/01/10	Elements of data population prior to review	James Gibson
V0.3	12/02/10	Further updates inc. international MM	James Gibson/Hetal Patel
V0.4	19/02/10	Document reformat and added information	James Gibson
V0.5	24/02/10	Following QA check and review	James Gibson
V0.6	10/03/10	Minor amendments	James Gibson
V0.7	18/05/10	Minor amendments following meeting discussion and WSP review	James Gibson
V0.7.1	15/06/10	Formatting Update	

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CONTENTS

1 Scope and Methodology

1.1 Context

This report collates and documents the current practice of Managed Motorway implementation by other transport operators combined with known research activities that have been undertaken in both the UK and internationally. This is primarily an information collation and assimilation desk based scanning activity.

This report is presented as a working document and will evolve as more information is collated and entered. Primarily, the report will contain international experiences and recommendations based upon knowledge gained. As information is retrieved from the HA regarding current Managed Motorway research activities from the associated foresighting task, the details will be included and recommendations modified accordingly.

The key deliverables include ascertaining key trends and drivers that may impact upon or affect the strategy for future Managed Motorway rollout on the Highways Agency (HA) network and understand where valuable lessons may be learnt from international best practice. The focus of this report is on the motorway network only and the effects on neighbouring networks (non-motorway) has not been specifically considered. It is however acknowledged that future requirements, such as travel demand management must consider the wider transport network..

1.2 Purpose

The purpose of this report is to address the following questions:

- For this desk scanning exercise, what constitutes a ‘Managed Motorway’?
- Where are they being implemented?
- Who are perceived to be the world leaders?
- What were the drivers for change that brought the schemes to development?
- What are the published key benefits, disbenefits and public perception of the schemes?
- How are transport operators planning for the future?
- Are other operators currently sharing best practice?
- Is there any relevant legislation that is or may affect the current schemes?

1.3 Information Sources

The primary source of information associated with this task will be the internet with numerous visited sites being hyperlinked from this document; other sources include published documents already within the group’s possession. Many operators publish information relating to their systems, research, benefit analysis and planned rollouts. There are numerous conferences held annually including the Intelligent Transport Systems (ITS) world congress which publish synopses and information relating to the presentations. Although this document is not directed purely at the technology aspects, the ITS forum contains a wealth of Managed Motorway information and their international equivalents and is a useful source of information. The data sources include a small number references to non-motorway type roads but only where they could be deployed on motorways.

Additionally, The US Department of Transportation’s Federal Highway Administration conducted a large scale research exercise in 2007, combining site visits and delegations to many relevant departments who manage and implement a form of Managed Motorways (MM). The report can be accessed from the FHW site at; http://international.fhwa.dot.gov/pubs/pl07012/. Current and existing research projects by the HA associated with the M42 pilot, the rollout plans and the first and second tranche of the Managed Motorways Programme (MMP) will be drawn upon.

2 Background: The Managed Motorways Concept

2.1 Definition

2.1.1 Department for Transport's Definition

The Department for Transport (DfT) defines the Managed Motorways concept as, infrastructure for managing motorways of which its implementation is justified by an economic benefit. These economic benefits are derived by weighing up the savings and costs. Savings arise as a result of reduction in congestion, which leads to journey time savings and a reduction in carbon emissions, and costs are produced by accidents which cause delays and injuries. Therefore Managed Motorway infrastructure aims to manage traffic demand by reducing congestion without compromising safety.

The infrastructure for Managed Motorway consists of a 'toolkit' of techniques which are deployed to manage traffic demand. A toolkit of techniques allows network operators to make best use of the infrastructure, hence achieving optimal traffic demand management. There is flexibility in deploying these techniques which gives rise to be clear of the issues to be managed and the outcomes to be delivered to ensure the correct technique is applied in practice.

The DfT views managed motorways as a new and growing initiative in this country and fully promotes and supports it through i policy and guidance (DfT policy and advice on Managed Motorway).

Further DfT guidance and information can be found at;

http://www.dft.gov.uk/pgr/roads/network/policy/mtorsigntrafmanagement/advancemotorsign?page=1

Additionally, the DfT ITS toolkit which covers many aspects of network management including aspects of MM can be found at;

http://www.dft.gov.uk/itstoolkit/its-tool-directory.htm

2.1.2 Highways Agency Definition

The Managed Motorway (MM) concept is a very important initiative to the Highways Agency (HA Managed Motorway Programme (MMP)) which it defines as, technology deployed to control traffic flows on the motorway network to increase journey time reliability and user comfort. The HA's main focus is to extract maximum value out of their existing highway infrastructure by optimising capacity through technology, as widening is simply unsustainable both economically and environmentally. The value of MMP versus traditional approaches such as widening has been a key driver throughout the programme. The HA understands the wider benefits of adopting this concept which will be enhancing levels of service on its motorways, reducing and managing accidents, improving maintenance safety and operation, and reducing adverse impacts on the environment.

The Highways Agency published various implementation guidance on deploying these systems which also includes guidance on health and safety matters. Currently the Highways Agency is looking to improve their efficiency in rolling out effective pilot schemes across designated areas of their motorway network.

An introduction to the HA's rollout of MM is given at;

http://www.highways.gov.uk/knowledge/25754.aspx

2.1.3 Types of Managed Motorway

A number of technologies can be combined to create specific tools of Managed Motorways. A rollout can consist of one or more of the following;

- Hard Shoulder Running (MM-HSR)
- Controlled Motorway (CM) variable mandatory overhead speed limits
- Controlled All-Lane Running (CALR) operational regime, combining CM with permanent use of the hardshoulder
- Basic Controlled Motorway (BCM) as above but utilising verge as well as overhead signage (conceptual stage at HA)
- Ramp Metering (RM)
- Real time and enhanced management from Regional Control Centres (RCC) by improved data collection and information dissemination techniques.

Other elements which can be defined as Managed Motorway from an international perspective may comprise:

- Differential speed limits (enhanced CM)
- Freight segregation and management
- High Occupancy Tolling (HOT) within High Occupancy Vehicle (HOV) lanes
- Access management (a form of enhanced Ramp Metering).

There are several variants of the above types of Managed Motorways.

3 Transport operators with experience in Managed Motorway type systems

3.1 Introduction

There are a large number of operational regimes on inter urban routes throughout the world that constitute a Managed Motorway from the definition given within preceding sections of this document. The report focuses on regions where information is readily available for a desk exercise (existing material and web searches).

The primary focus areas are:

- Mainland Europe
- North America
- Australasia

3.2 Summary

The web based research indicates that the following areas have implemented what is generally understood to be an MM type system;

- England
- Germany (http://i2tern.plan.aau.dk/doks/paper/paper92.pdf)
- Netherlands
- Denmark
- Sweden (http://i2tern.plan.aau.dk/index.php?option=com_content&task=view&id=41&Itemid=56)
- France
- Belgium
- Italy
- Northern Ireland
- Greece
- USA (but more focused on HOV and HOT)
- Japan
- Australia
- New Zealand

Additionally a number of areas are progressing designs based on, or similar to the HA MMP rollout;

- Wales (Variable Mandatory Speed Limit)
- Scotland (Variable Mandatory Speed Limit with infrastructure to allow future hardshoulder running)
- Canada (Queen Elizabeth Highway, Toronto area)

This paper will examine three regions as case study examples. The regions chosen can be perceived as world leaders in Managed Motorway type applications, either by being pioneers or developing newer systems as part of the larger toolkit. A further criteria used to select the three regions is the length of Managed Motorways that is planned, under construction or constructed. The chosen case studies are the Netherlands, Germany and the USA…

3.3 Existing Highways Agency Knowledge

The full Managed Motorway programme was announced in January 2009 by Ruth Kelly MP, Secretary of State for Transport. The announcement included details of a comprehensive feasibility study that aided selection of the areas earmarked for MM and is based upon a number of other reports detailing the success of the M42 Active Traffic Management (ATM) pilot and suggested locations where similar operational regimes would be of benefit. The background research associated with realising the benefits and understanding what would be required in terms of implementation was derived from the M42 ATM pilot. Summary links to research information is given below;

- HA Research Site: M42 Pilot Monitoring 2

  http://www.ha-research.gov.uk/projects/index.php?id=1254

- HA research site: Active Traffic Management Monitoring

  http://www.ha-research.gov.uk/projects/index.php?id=613

- Department for Transport: M42 ATM Summary

  http://www.dft.gov.uk/pgr/roads/tpm/m42activetrafficmanagement/

- Mott Macdonald Market Research: Birmingham Box Active Traffic Management User Perceptions Research

  http://www.marketresearch.mottmac.com/files/page/220436/Highways_Agency_Traffic_Management_User_Perceptions_Research.pdf

- HA Research: Development of Operational Regimes and the Assessment Strategy for the ATM Pilot

  http://www.ha-research.co.uk/projects/index.php?id=483

- HA research HSR60 vs HSR50

  http://www.ha-research.gov.uk/projects/projectdocuments.php?method=download&ID=357

Additionally, a large number of research exercises have been undertaken relating to controlled motorways, mostly prior to the ATM pilot and are key to understanding some of the decisions, technology and operational regimes undertaken as part of the ATM pilot. The research has been undertaken by various consultants. Links to synopsis' or further information is given below;

- HA Research: M25 Controlled Motorway

  http://www.ha-research.co.uk/projects/index.php?id=431

- HA Research: Further Research on the Assessment of Controlled Motorways

  http://www.ha-research.gov.uk/projects/index.php?id=495

- Transport Research Laboratory (TRL) Summary Page

  http://www.trl.co.uk/research_development/intelligent_transport/technology/

- Transport Research Laboratory: Monitoring of the M25 Controlled Motorway 2002-2003

  http://www.ha-research.gov.uk/projects/projectdocuments.php?method=download&ID=353

- ITS World Congress paper, 2006. "A Flexible Approach to Motorway Control" Atkins Transport Systems

  http://atkinstransportsystems.com/downloads/controlled_motorway.pdf

- HA Research: Ramp Metering (30 Sites)

  http://www.ha-research.gov.uk/projects/index.php?id=1259

4 Case Study: Germany

4.1 Introduction and key features

Germany has implemented Managed Motorway type systems since 1996 and there is currently over 200km in operation. The system has been developed and evolved from the existing speed harmonisation systems of the 1970's which are still in operation throughout a large portion of the inter-urban network. This is analogous to the Highways Agency NMCS2 type MIDAS and signalling systems.

The MM toolkit deployed in Germany consists of the following key systems;

- Speed Harmonisation
- Queue Warning
- Temporary shoulder use
- Ramp Metering (Inc control of mainline)
- Truck Restrictions
- Ramp Metering
- Dynamic re-routing
- Truck based distance Tolling.

Temporary shoulder use combined with speed harmonization, as it is known in Germany, was first deployed on the A4 near Cologne, with subsequent installations on the A5 and A3 within the Hessen area. During operation of the hard shoulder, the maximum speed limit is reduced from 120 kph (75mph) to 100kph (62mph).

The Federal Highway Research Institute (BASt) http://www.bast.de/EN/e-Home/e-homepage__node.html?__nnn=true has developed a software tool for assessing the benefits of hardshoulder use.

During the I2Tern (Intelligent Infrastructure for the Trans European n Road Network) conference in Denmark, 2007. Gerd Riegelhuth and Alexander Pilz of the Traffic Centre Hessen provided the following presentation http://i2tern.plan.aau.dk/doks/pp/presentations/Session_3-3/GerdRiegelhuth.pdf which contains a great deal of the background information, summarised in this report.

4.2 Comparison to UK type Managed Motorway

The German systems are very similar from a road network management and user perspective to those in the UK.. The fundamental use of ITS to display lane and speed information is virtually identical. One of the differences is the omission of overhead lane information; the German systems often utilise verge mounted rotating prism Variable Message Signs (VMS) instead.

4.3 Triggers and Drivers for Hessen

Data prior to the global financial crisis (2005) predicted traffic growth of 16% for passenger transport and 58% for freight by 2015. In response to these and other predictions. Germany has a major road building programme in place with 1,730km of new motorway, 2,162km of motorway widening and 717 new bypasses planned to be completed by 2015. There is also a comprehensive five-year plan to extend motorway traffic control over a further 1,200km of motorway, dynamic diversion capability over a further 2,400km and to add an additional 15 regional traffic control centres.

4.4 Overview of current systems

Figure 1: Normal Operation (Hessen Gov)

Figure 2: Hard shoulder running

The original layout of three 3.75m lanes with an inside hard shoulder was converted to four 3.50m lanes. The inside and outside lanes both have a narrow strip for safety purposes

The system is controlled by gantry mounted VMS which are spaced at 800-1000m intervals

There are no Emergency Refuge Areas (ERA).

The variable message signing is both gantry mounted and roadside. When the hard shoulder is not in operation the signs are blank, therefore when there is no symbol displayed above the hard shoulder it is assumed to be closed as a running lane.

The traffic control centre is alerted when flows reach 6,000 vehicles per hour, which tends to be in the peak periods, as this is considered to be the trigger point for activation of hard shoulder running.

However, it is still only operated manually. Staff in the control centre can initiate the system manually at other times as required.

The operation of hard shoulder running is monitored manually using pan-tilt-zoom cameras spaced approximately every 750m. These are programmed to move every few seconds in a pre-determined pattern. Whilst the camera system is capable of detecting incidents on the hard shoulder there is currently no fully automatic incident detection system in place.

4.5 Benefits

There have been no negative impacts on road safety reported and a reduction in congestion has led to a consequential reduction in congestion-related accidents.

One notable statistic is that there appears to be a significant reduction in accidents on the sections of motorway in advance of the hard shoulder running sections. This would appear to be due to the absence of congestion as hard shoulder running has evened flows and reduced slow moving traffic, thereby reducing tail-end shunts.

Hard shoulder running on this section of motorway has increased capacity by 20% (7040 vehicles per hour at 94kmh (59mph) with hard shoulder running compared with 5620 vehicles per hour at 75kmh (47mph) without).

Journey times have improved and traffic flow is particularly improved at the junctions.

Furthermore, public opinion of the scheme has been extremely positive.

5 Case Study: The Netherlands

Part of the system deployed in the Netherlands has many similarities to the HA MM philosophy and comprises of a toolkit of techniques and operational regimes that are implemented as individual components where required.

The components that form Managed Motorways (also known as Managed Lanes) are categorised into the following;

- Hard Shoulder Running (HSR)
- Plus Lanes (similar to HA CALR)
- Interchange merge control (similar to ramp metering)
- Truck Traffic Facilities
- Speed Management

The HSR system shares many of the components of the HA MM rollout and appear almost identical. The main differences being the local signing rules and lead-in information provisionand the inclusion of a green arrow to signify an open lane and verge mounted information signs. The HA signal devices used for MM allow for the green arrow functionality to be implemented if required in the future.

The second element of Dutch MM, known as a ‘plus lane’ comprises of an additional lane within the existing carriageway cross section. This is achieved through a combination of narrower than standard running lanes and hard shoulder combined with increased detection, monitoring and control through technology deployment.

Interchange merge control utilises signals at the merge points of the main highways which is indistinguishable from the Ramp Metering access management strategy utilised on the HA network and throughout the UK.

Truck traffic facilities comprise of a combination of permanent and dynamic regimes that utilise mandatory signage to designate which lanes commercial vehicles can use.

Speed management is analogous to the Controlled Motorway element of HA MM. The most appropriate comparison would be the M25 Controlled Motorway scheme

HSR and Plus Lanes

A number of benefits have been observed since the implementation of HSR in the Netherlands in terms of lane occupancy, accident reduction, and the effect of Emergency Refuge Areas (ERAs) on congestion.

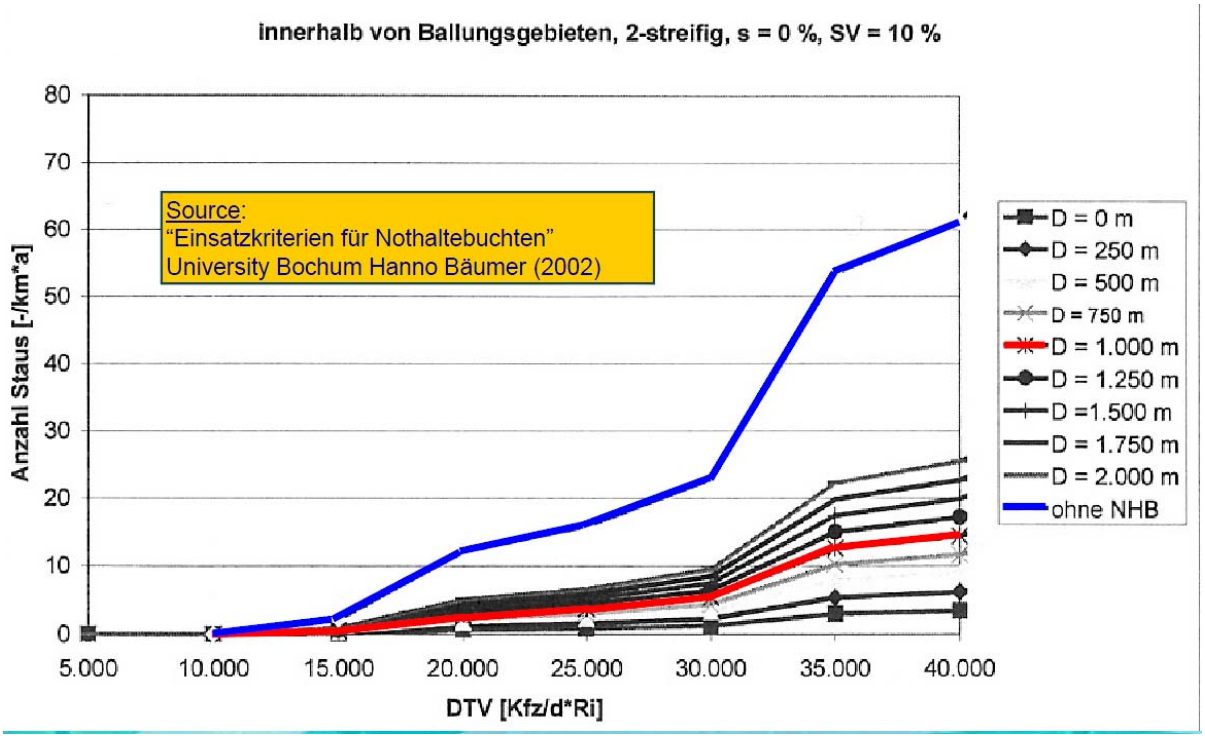


Figure 3: Chart depicting effect and instances of queues dependant on provision of refuge areas (blue – none, black with square pointers – constant)

Additionally, the Ministry has published a number of observations and 'lessons learned' relating the HSR and plus lane operational regimes. These mainly comprise of;

- A Managed Motorway is not a 'normal' motorway and cannot be treated as such , clear and concise information is required at all times
- Authorities should be aware of possible legislation constraints
- Authorities should be aware of the increased workload for traffic operators
- Flexibility in ITS is required
- The desired driver behaviour needs communicating strongly

Interchange Merge Control

Interchange merge control is a tool used on motorway to motorway type interchanges (also as a Ramp Metering addition in the USA) to allow merging traffic free access to the mainline by closing the inner lane of the mainline prior to the merge.

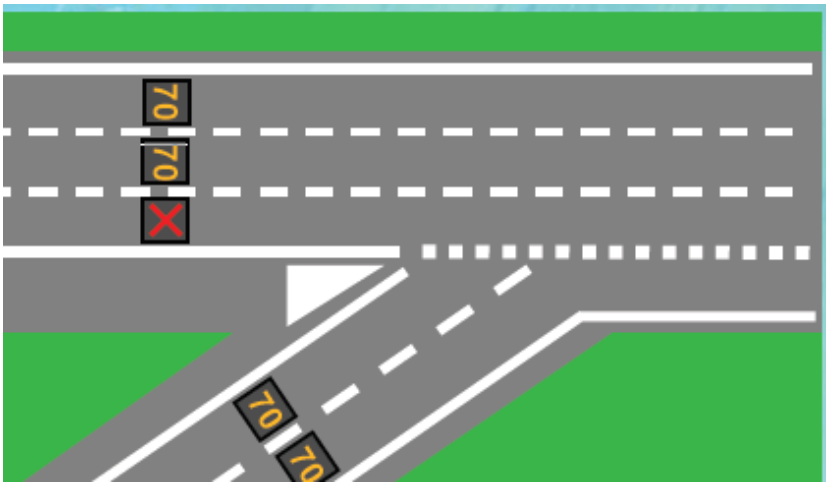
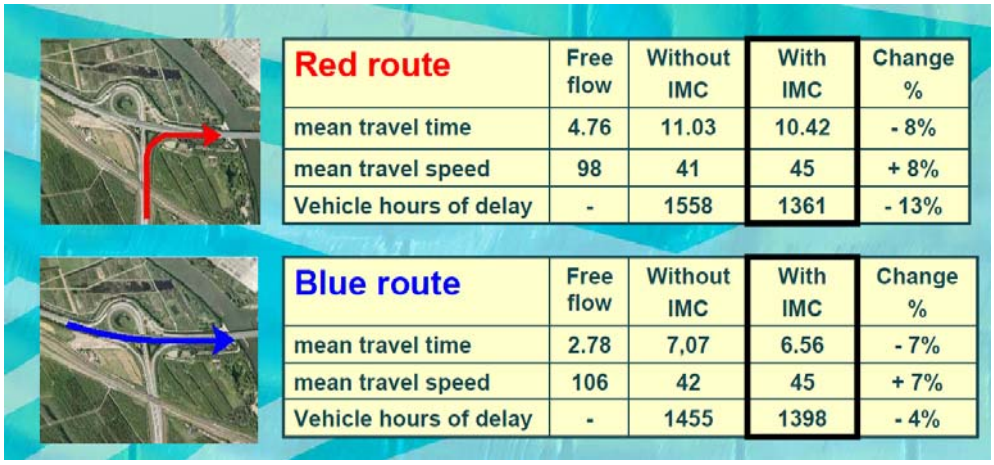


Figure 4: Interchange Merge Control

The trial results below indicate a benefit for both routes.



Red route	Free flow	Without IMC	With IMC	Change %
mean travel time	4.76	11.03	10.42	- 8%
mean travel speed	98	41	45	+ 8%
Vehicle hours of delay	-	1558	1361	- 13%

Blue route	Free flow	Without IMC	With IMC	Change %
mean travel time	2.78	7,07	6.56	- 7%
mean travel speed	106	42	45	+ 7%
Vehicle hours of delay	-	1455	1398	- 4%

Figure 5: Results of Interchange Merge Control pilot

Truck Traffic Facilities.

'Truck Traffic Facilities' consist of various tools to limit the effect of congestion caused by freight vehicles. The primary function is to limit the proportion of freight vehicles in certain lanes through the application of detection algorithms. The automatic system (an algorithm measuring the density of commercial vehicles) is activated approximately 3-4 times per day in the trial area. A marked decrease in congestion has been observed yet the system gained the support of the freight industry by being dynamic and not needlessly constricting the network availability for freight vehicles. Detailed observations have not yet been made widely available.

Figure 6: Truck restrictions

Speed Management

This tool is analogous to the Controlled Motorway concept of the UK, overhead mandatory signals to provide smoother flows and therefore reduce congestion.

Speed Management (Controlled Motorway) on the A13 Rotterdam results;

- Exceptionally high compliance (1% Violation)
- Reduction in NOx and PM10 emissions
- Decreased noise levels
- A 53% decrease of injury accidents with negligible shift to sections outside the control scheme

The vast majority of other Dutch schemes have measured similar results. There is a significant exception on two sections of MM (locations not detailed) where a combination of closely spaced junctions, an upper limit of 80km/h and dynamic speed control have resulted in a significant drop in capacity. A result which should be noted where Managed Motorway implementation is being considered in areas of closely spaced junctions such as urban Motorways.

One major distinction between Rijkswaterstaat Speed Management and Highways Agency Controlled Motorway is the adaptation to also use pollution as a trigger (A13 Rotterdam) rather than congestion only.

Drivers and triggers in the Netherlands

The main drivers highlighted within the national mobility scheme for the continued deployment of the Dutch system are;

- A stronger economy by improving accessibility
- Enabling reliable and predictable door to door accessibility
- Limited extension of infrastructure
- Emphasis on better utilization of road infrastructure (The Emergency Road Widening Act)
- Innovation is a must
- Rapid Elimination of maintenance backlogs
- Road pricing will become a necessity (2012)

6 Case Study: USA

6.1 Background

In the USA, the Motorway Management concept is more commonly known as Active Traffic Management (ATM) or Managed Lanes, which they define as 'the ability to dynamically manage recurrent and non-recurrent congestion based on prevailing traffic conditions.' The focus is on increasing journey time reliability and therefore aims to maximise the effectiveness and efficiency of the transport facility. It is understood that this is achieved by a combination of operational strategies that when fully synchronised, optimise the existing infrastructure and provide measurable benefits to the transportation network and its users.

The USA, the Federal Highway Administration (FHWA) acknowledges this as a significant travel demand management measure and has conducted a significant amount of research on this subject, one such study sponsored by FHWA titled 'Active Traffic Management: The Next Step in Congestion Management, July 2007'. This study scans ATM technologies in four key countries in Europe, and extracts key findings of ATM and how it can be adopted in the USA.

While the USA acknowledges that ATM is not a substitute for large-capacity expansion projects it is, however, a cost effective way in optimising capacity and prolonging the need for physical expansion.

6.2 Component Examples

Speed Harmonisation

Speed harmonisation is present to some extent in the USA. Speed harmonisation is used to slow down traffic that is approaching areas of congestion, collisions or special events. Figure 7 shows an example of a speed harmonisation system in the USA.

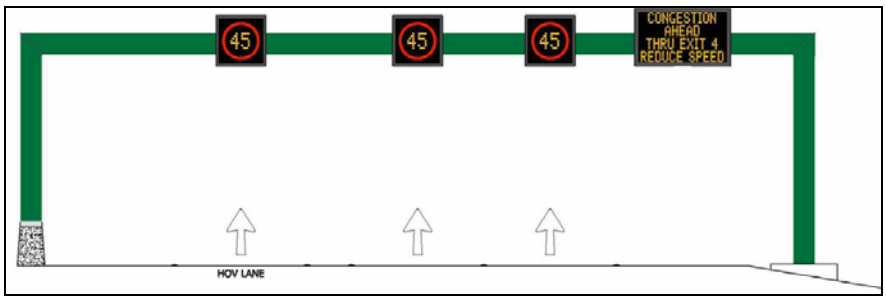


Figure 7: Example Layout of a Speed Harmonisation System
Source: 2008 Northwest Transportation Conference (Active Traffic Efforts in Seattle Area)

Queue Warning

Queue warning systems, warn motorists of downstream queues and direct traffic to alternate lanes to optimise lane usage and capacity, which subsequently increases the throughput.

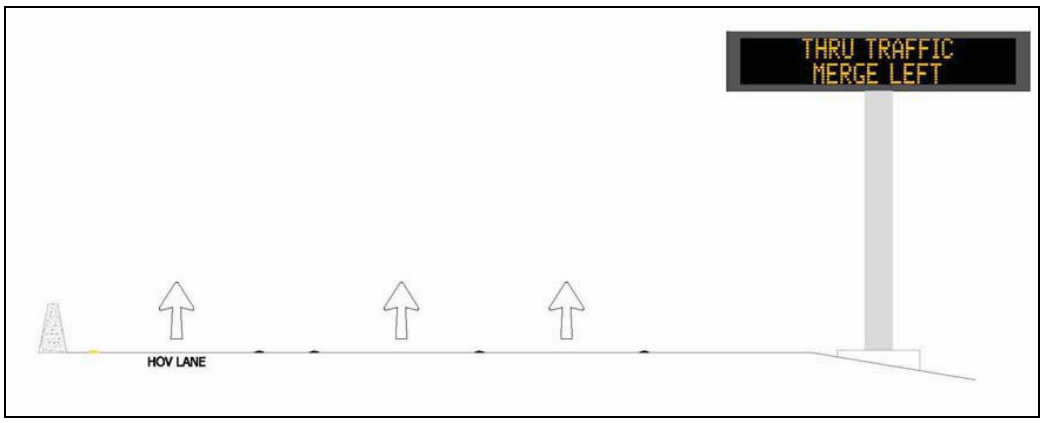


Figure 8: Example Layout of Queue Warning System
Source: 2008 Northwest Transportation Conference (Active Traffic Efforts in Seattle Area)

Junction Control

Junction control systems have a similar function to Queue warning systems as it directs traffic to specific lanes (mainline or ramps) based on varying traffic flows. The system uses dynamic messaging, dynamic pavement markings and lane use control. Detecting traffic flows and having separate lane control is a key part of the system. The system increases throughput and optimises capacity at junctions, however, the key benefit is a reduction in accidents. This is a growing area of interest and further studies are being conducted to investigate driver compliance and increasing its application to other areas.

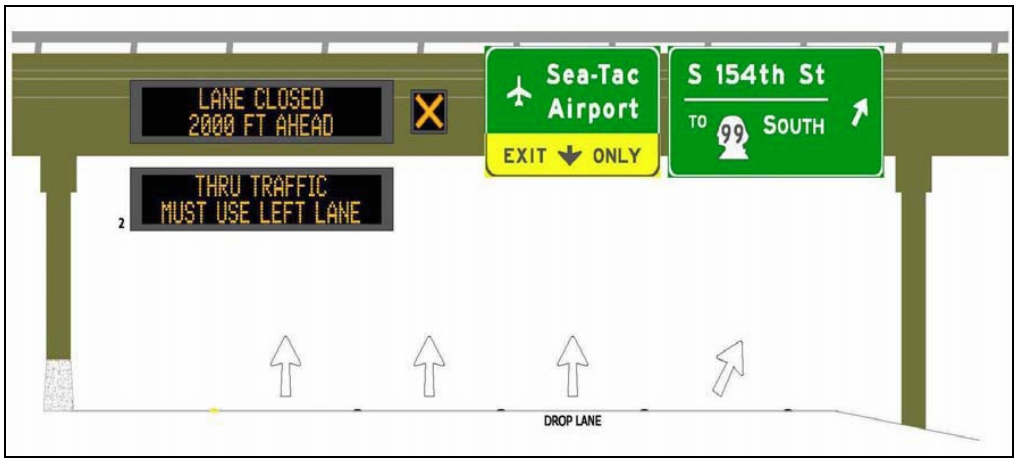


Figure 9: Example Layout of Junction Control System
Source: 2008 Northwest Transportation Conference (Active Traffic Efforts in Seattle Area)

Hard Shoulder Running

Hard shoulder running is conducted for the same reasons as in the UK, that is to keep traffic moving in congested periods or to allow traffic to move around an incident. The benefits are increased capacity, and the challenges are frequent freeway service patrols for quick incident remediation and the shoulder running should extend beyond the roadway bottleneck, not to just before the bottleneck.

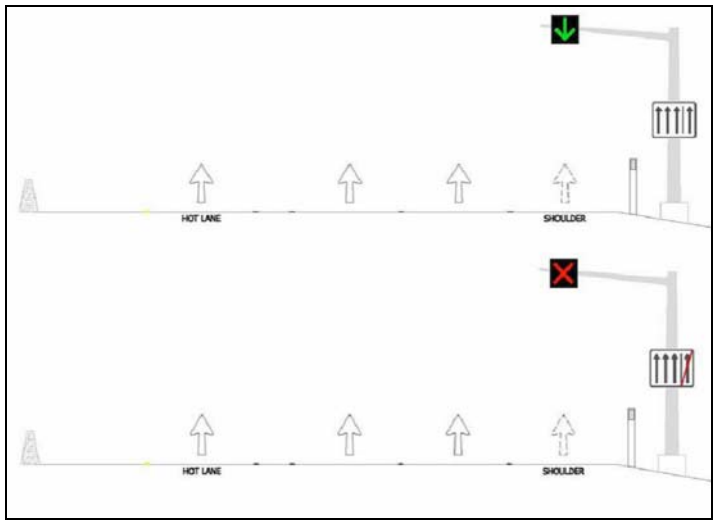


Figure 10: Example Layout of Hard Shoulder Running System

Source: 2008 Northwest Transportation Conference (Active Traffic Efforts in Seattle Area)

HOT Lanes

High Occupancy Toll lanes give drivers the option of driving in the High Occupancy Lanes (HOL) at the cost of a toll fee. HOL are free for vehicles with two or more occupants. An electronic toll that fluctuates with the level of congestion (also known as dynamic tolling) is used to keep the HOT lane free flowing while reducing congestion in the general purpose lanes.

Figure 11: Simulated Photo of I-405's Proposed HOT System

Source: http://www.wsdot.wa.gov/Congestion/technology.htm

In the USA HOT lanes have been implemented on State Route 91 (Orange County) and Interstate 15 (San Diego) in California, Interstate 10 in Texas (Houston), Interstate 25 in Colorado and Interstate 394 in Minnesota (Minneapolis).

Expressway Toll Lanes

Expressway toll lanes operate similarly to HOT, however, are dedicated to vehicles that pay the toll fee only. Express Toll Lanes would offer an escape from congestion with a dynamic toll fee that fluctuates with demand. The system provides users with more choices and helps reduce congestion on other lanes.

Electronic Tolling Systems

Electronic tolling systems allow users to pay a toll fee without stopping at a toll both, this reduces delays and allows dynamic tolling to be enforced, supporting both HOT and Expressway Toll Lane systems.

Travel Time Signs

Travel time signs are used to show travel times across alternative highway routes so motorist can reroute themselves accordingly. This reduces congestion in areas which are heavily congested by directing traffic to alternative routes. In addition it increases user comfort as drivers are warned of delays and expected travel time and hence they are able to respond accordingly.

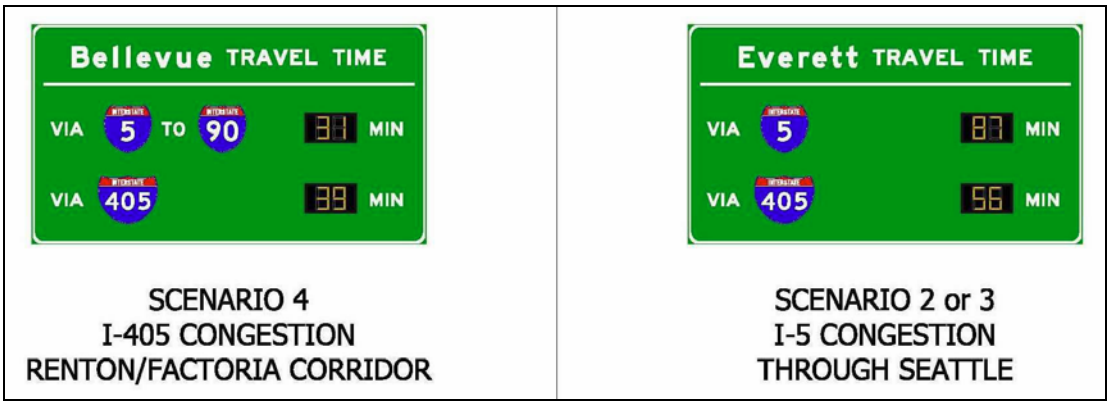


Figure 12: Example Dynamic Travel Time Signage
Source: 2008 Northwest Transportation Conference (Active Traffic Efforts in Seattle Area)

6.3 Status and Research on Managed Motorways in USA

The US Department of Transport, Federal Highway Administration conducted a scanning (see section 5.2.1) study on Active Traffic Management in which it studied certain countries in Europe to better understand the way forward in congestion management for the USA. The study can be accessed here, Active Traffic Management: The Next Step in Congestion Management, July 2007.

The key recommendations from this study were:

- Promote active traffic management to optimize existing infrastructure during recurrent and non recurrent congestion.
- Emphasize customer orientation and focus on trip reliability.
- Integrate active management into infrastructure planning and programming processes.
- Make operations a priority in planning, programming, and funding processes.
- Develop tools to support active management investment decisions.
- Consider public-private partnerships and other innovative financing and delivery strategies.
- Provide consistent messages to roadway users.
- Consider pricing as only one component of a total management package.
- Include managed lanes as part of the overall management of congested facilities.

In terms of ATM strategies, the study classifies key systems and their potential benefits as shown in Table 1.

Active Traffic Management Strategy	Potential Benefits												
	Increased throughput	Increased capacity	Decrease in primary incidents	Decrease in secondary incidents	Decrease in incident severity	More uniform speeds	Decreased headways	More uniform driver behavior	Increased trip reliability	Delay onset of freeway breakdown	Reduction in traffic noise	Reduction in emissions	Reduction in fuel consumption
Speed harmonization	●		●		●	●	●	●	●	●	●	●	●
Temporary shoulder use	●	●							●	●			
Queue warning			●	●	●	●	●	●	●		●	●	●
Dynamic merge control	●	●	●			●		●	●	●	●	●	●
Construction site management	●	●							●		●	●	●
Dynamic truck restrictions	●	●				●		●	●			●	●
Dynamic rerouting and traveler information	●		●	●				●	●			●	●
Dynamic lane markings	●	●							●				
Automated speed enforcement			●		●	●		●	●			●	●

Table 1: Key ATM Systems and their Potential Benefits

6.4 US specific Research Material

- The Federal Highway Administration

http://international.fhwa.dot.gov/

- Managed http://international.fhwa.dot.gov/institute

http://managed-lanes.tamu.edu/

- I-15 Express Lanes, Salt Lake City, Utah

http://www.udot.utah.gov/expresslanes/

- I-15 FasTrak, San Diego, CA

http://fastrak.511sd.com/

- I-25 HOT Lanes, Denver , Colorado

http://www.coloradodot.info/programs/i-25-hov-express-lanes

- Texas DOT (an extensive list on MM type research activities

ftp://ftp.dot.state.tx.us/pub/txdot-info/rti/psr/0-4160-s.pdf

7 Other Deployments

7.1 Worldwide

There are a number of other deployments of MM type systems throughout the world. This list captures the key operators who are implementing MM type systems but with limited or similar deployments to the case studies highlighted in the previous sections;

- Italy: Dynamic use of Hardshoulder 'T3 Project'
- France: Variable Mandatory Speed Limits and limited deployment of hardshoulder use
- Denmark: Variable Mandatory Speed Limits
- Greece: Variable Mandatory Speed Limits
- Sweden: Variable Speed Limits activated by congestion and weather
- Australia: Variable Mandatory Speed Limits Combined with Ramp Metering, tolling and dynamic variable tolling
- New Zealand: Variable Mandatory Speed Limits Combined with Ramp Metering

7.2 Other UK MM

Wales, Scotland and Northern Ireland have installed or are developing comparable systems based on the HA concept (IAN 111 and IAN 112) or the Basic Controlled Motorway (BCM) concept.

Scotland is developing a variable mandatory speed limit section to IAN 111 standard that may allow for future Hard Shoulder Running. This project is an integral part of the Forth Replacement Crossing and expected to be operational by 2017.

The M1 Westlink in Belfast is a motorway that has been constructed as a Controlled Motorway with all of the technology components associated with Controlled Motorways.

In Wales, a section of the M4 between J24 and J28 in South East Wales is currently being upgraded to a BCM type system, incorporating both gantries and verge mounted signalling to deliver a variable mandatory speed limit.

8 Summary of knowledge gained from research exercise

From a review of the available information, it is clear that the Managed Motorways (known by many other terms globally) concept is an established and core tool in many network operators solution to congestion management.

The areas where managed motorways are a key component in inter-urban network management tools are;

- The United Kingdom
- The Netherlands
- Germany
- USA

To a lesser degree (i.e. limited deployments)

- Sweden

- Denmark
- Greece
- Italy
- France
- Australia
- New Zealand

The experiences of Japan can be drawn upon to some degree but the systems they employ cannot generally be categorised as Managed Motorways. The majority of expressways are tolled and owned/operated by private concessionaires. Components that are employed comprise of;

- free flow tolling, both fixed fee and distance based
- Ramp Metering
- Variable speed limits

It should be noted that there may be other components not listed here, a number of the operating company websites are presented in Japanese only which has hindered the process of collating relevant information..

The research presented in this document indicates that the Netherlands and Germany could be considered as world leaders in MM deployment. The USA could also be considered as a world leader but the technologies and tools vary from the standard Managed Motorway definition.

It should be noted that following the planned roll-out of Managed Motorways, the Highways Agency will be responsible for the largest area of dedicated Managed Motorways in the world and will undoubtedly become one of the world leaders.

All known implementations appear to share a common desire in the face of increasing demand on the network to provide a sustainable alternative to road widening..

A key finding from the international implementations of Managed Motorways is that the geographic conditions of the region have significantly increased the viability of Managed Motorways, namely the population density or topography of the areas where implementations exist . This has appeared to provide a significant driver against the further land take associated with widening or new road construction.

9 Summary of common elements/potential for shared knowledge

From the material available on the web and the published information held by the team preparing this paper, it appears there is no common group or organisation that is co-ordinating MM research and sharing knowledge outside of each country. European wide organisations that may be expected to be heavily involved in MM such as ertico www.ertico.com present very little information relating to MM tools. Similarly, Easyway (of which the HA are active members) www.easyway-its.eu do not seem to be taking the mantle of a European co-ordinator or worldwide point of contact for MM in Europe. So far it appears that many operators are learning their own lessons/making their own mistakes and developing their own technologies. It is recommended that benefit could be realised b y benefit in sharing MM knowledge at an international level.

10 Future of Managed Motorways

A number of agencies responsible for the deployment of Managed Motorways generally view the tools as a short to medium term measure in advance of the major road expansion (for example in France and Germany).

The detection systems and information dissemination tools are likely to change considerably in the future as in-vehicle technologies and 'smart phone' applications reduce the requirement for expensive capital and revenue expenditure on roadside infrastructure – Currently tere is no reliable timetable for this transition.

As part of this research exercise, it was found that the operators of the Hong Kong Road network have taken a dissimilar approach to typical MM type systems. It is understood that their own research has indicated a requirement for Hard shoulders in order to minimise safety risks to road users. They are in the process of retrofitting permanent hard shoulders to many of their freeways. This factor and the general approach in Hong Kong should be evaluated further by agencies such as the HA.

11 Recommendations

By evaluating what many of the systems currently being or due to be deployed in the future, specific research areas can be suggested or recommended for inclusion within the HA research and development programmes. Additionally, some of the requirements of Highways Agency IAN 111 may be challenged to provide value and potential savings, possibly enabling further roll-out.

At a strategic level;

- Affirm the HA's leading position in MM by instigating and leading a European or worldwide forum specifically addressing Managed Motorways
- Ascertain what work should be undertaken when the added capacity brought about by MM is attained and exceeded? Should current MM be installing technology with future widening in mind?

From a technical perspective;

- Ascertain Interchange Merge Controls and enhanced Ramp Metering benefits in UK by utilising research from the operators noted previously
- Further investigation of Basic CM type principals to reduce capital cost as Germany use a combination of verge and overhead signage
- Research into the effect of inter-visibility of gantries and whether verge mounted devices can provide the same benefits in some areas. Intervisibility does not appear to be such a factor in other deployed systems
- Dynamic Freight vehicle lane controls in the UK as in Germany and the Netherlands
- High Occupancy Tolling as developed in the USA
- Research to ascertain modifying MM drivers from congestion based to pollution and/or congestion as developed in the Netherlands
- Learn lessons and research into dynamic barriers and video detection (France)
- Automated Hardshoulder opening sequences.