www.itsradar.co.uk
itsradar@fabermaunsell.com
(+44) 0121 262 6066

HIGHWAYS AGENCY

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INTELLIGENCE REPORT

Relevant Topics: *Traffic Management Technology, Pilots, Driver Behaviour, Tolling, Traffic & Travel Information, Technology Solutions, Enforcement, Standards & Policy, Monitoring, Safety*

Subject: **Congestion Targets and the Role of Technology**

Background: The UK Government announced on the 5th July 2005 two new targets for congestion of the UK's road network. These are:

1. By 2007 – 2008 journeys will be made more reliable on the strategic road network; and
2. By 2010 – 2011 the ten largest urban areas will meet the congestion targets laid down in their Local Transport Plans (LTP's) relating to movement on main roads into city centres.

Summary: The amount of congestion on all roads can be manipulated by either increasing the capacity of the road or reducing the level of demand. The following intelligence report profiles various schemes that have been implemented around the world on strategic road networks to achieve these aims. The results of some of the schemes are contained if they have been made public.

Technologies Used: The technologies used in congestion management / alleviation systems include:

- VMS, VSL, ATM, Ramp Metering, & Road User Charging

Applications of these technologies are provided below.

Better Information Provision on Variable Message Signs (VMS)

By improving the quality of information provided on VMS, along with new techniques for displaying the information, will allow congestion to dissipate quicker. A Review of International Good Practice in usage of VMS was carried out by Faber Maunsell as part of the Assessment of VMS Performance project.

From the review the following recommendations were made: -

•Continue procurement and installation of **pictograms** enabled signs with **supporting text** information allowing increased comprehension, especially with respect to languages (as in **Spain**/**Italy**/**France**);

•Continue development of systems to **display journey time information** allowing drivers to make informed decisions about their routings (as in **France**);

•Presentation of **roadworks pre-advice** permitting drivers opportunity to change future travel plans (scheme adopted in **Europe**); and

•Using VMS to **alert drivers to presence of HAR** (Highway Advisory Radio), where trials exist.

Mandatory Variable Speed Limits (VSL)

Mandatory variable speed limits (VSL) aim to improve network conditions for drivers by improving driver behaviour, improving the capacity of the road and reducing flow breakdown. The aims are achieved by lowering the speed but keeping the flow of vehicles moving through an area relatively constant. Constant flows at lower speeds allow greater number of vehicles to be processed in comparison with a road using the national speed limit without enforcement. Following data analysis carried out by a number of consultants on behalf of the Highways Agency it was found that the introduction of controlled motorway between **J10 and J15 on the M25** reduced from seven to five the typical number of shockwaves experienced during the morning peak (HA, 2004)[3].

VSL can also be used to facilitate the operation of High Occupancy Vehicle (HOV) Lanes, as proposed in the section of the **M1** widening scheme between **Junction 7 and Junction 10**. HOV lanes aim to encourage drivers to car share during peak periods. It is envisaged the lanes will be attractive to drivers because the fewer vehicles in HOV lanes enables them to reach their destination faster. It is hoped to have a domino effect, with more people moving to car share reducing the total number of vehicles. HOV lanes have mainly been adopted in **US**. Studies by Comsis (1993)[10] & Pratt (1999)[11] found HOV lanes can **reduce total vehicle trips between 4% and 30%**. A study by Ewing (1993)[11] found if a road was previously particularly congested, HOV facilities separated by barriers can **reduce peak periods trips by up to 30%**. A latter study in **California** found HOV lanes carry on average 2518 passengers per hour during peak hour, substantially more than a congested mixed-flow lane (LAO, 2000)[8].

Active Traffic Management (ATM)

Active Traffic Management (ATM) is pro-active management of traffic by using a number of different technologies in order to make the best use of the existing road space. The concept is that ATM will

provide additional capacity by forcing drivers to make more efficient use of the roads, therefore negating the need for widening of the carriageway.

ATM is being piloted on the **M42** between Junction 3a and Junction 7 in the West Midlands. Along with providing increased information to drivers through the provision of a greater number of VMS the introduction of mandatory variable speed limits and hard-shoulder running are also planned to be introduced over the coming year. In order to facilitate the anticipated benefits in extra capacity a number of enhancements have been made to the section of carriageway. These include the installation of lightweight **full span gantries** which hold various **VMS** (both a line display and lane specific signs), the **digital enforcement technology** and **CCTV** for hard shoulder and incident management. **Loops** for incident detection and congestion management have also been installed along with full motorway lighting and the creation of emergency refuge areas equipped with emergency telephones and **CCTV**.

Ramp Metering

Ramp metering at entry points onto the strategic motorway network can help alleviate further congestion on the carriageway. By restricting the number of vehicles onto the motorway carriageway during peak times it aims to improve the flow of vehicles on the main carriageway. New vehicles are then only introduced when a particular flow threshold has been achieved which means the road can accommodate extra traffic without causing flow breakdown. However, with the introduction of ramp metering a number of issues regarding the congestion created at entrance to slip road have to be considered. It is possible that flow on local roads could be severely affected.

In the United States the **San Diego** Transportation Management Centre, **California** conducted a direct comparison between the same time period on separate days. The results showed that when ramp metering is in operation speed remained constant at around 60mph throughout the morning peak. Constant vehicle flow was also present. When ramp metering was not in operation, speed rapidly fell after 6:30 am, remaining under 30mph for 1¼ hours. Flow was much less consistent, with large variance in the number of vehicles passing through the area (SDTMC, 1999)[7].

Road-User Charging

Road-User charging is the generic term applied to forcing motorists to pay for the use of road space. There are different types of road-user charging that have been introduced around the world in different situations, most of which can be adapted to differing circumstances.

• *Area Licensing*

In these schemes drivers pay for licence to enter the charging area, but following this there is generally no restriction to number of journeys that can be made within congestion area, therefore its ability at reducing congestion is very limited. However, due to its simplicity this type of system is easy to set up & maintain.

Area licensing was introduced in **Singapore** in 1975, creating a **'restricted zone' (RZ)**. Vehicles were only permitted entry if the necessary paper licence was displayed in the windscreen. To enforce the system **staffed barrier control points** surrounded the RZ, recording the details of offending vehicles. Results of the system showed that traffic in the RZ had reduced by 44% initially, but this had fell to a 31% reduction by 1988 (Keong, 2002)[4]. Enforcement of this system was difficult, and as technology developed it facilitated the creation of the current **electronic system** which uses **gantries**, **in-car transmitters** and credited **smartcards**. Every time a car passes underneath a gantry, **short range radio (DSRC)** is used to deduct a charge from smartcard balance. **ANPR cameras** are used to enforce the system by photographing vehicles with no in-car transmitter or insufficient credit. The introduction of the new system reduced traffic volume by further 10% - 15% despite charges for entering zone being slightly lower (Keong, 2002)[4]. This due mainly to the effect of a charge every time a gantry is passed. The new system particularly affected drivers making multiple trips into the CBD as it was estimated that 23% of trips in the CBD during the manual scheme were business people travelling across the CBD to meetings (Keong, 2002)[4].

• *Cordon / Zone Charging*

In these schemes a cordon is created around an area and drivers are charged to enter, such as the scheme in **London**. This system is very versatile, as different charges can be made for different types of vehicle and time of day. However, it can increase congestion along outskirts of cordon as drivers travel round it to avoid paying charge. **ANPR cameras** log vehicle details and compare with a **database**.

After 6 months of operation in London there were 60,000 fewer car movements inside zone, traffic delays decreased by around 30% & drivers spent 25% less time stationary or below 10kmph (Tfl, 2003)[1].

• *Distance Based Charging*

This is the scheme adopted for the majority of toll roads as the driver pays a fee based on the distance travelled along the chargeable road, often using **toll booths**. This system can also be adapted to use with cordon / zone charging by recording the distance the car travelled within the cordon zone.

According to analysis carried out by the HA, from the first 3 months the **M6 toll** regularly carried around 1/5 of all traffic flowing through West Midlands and traffic on the existing M6 carriageway reduced on average by 10% (Dft, 2004)[2]. It was also found that on monitored sections of the M6 parallel to M6 toll traffic levels reduced by between 8% & 13% (HA, 2004)[3].

Another example of this system is the **Melbourne** City Link, a fully **electronic toll road** of 22km. It is a cashless tolling system where a network of **overhead gantries** scan **vehicle e-TAG devices** and **automatically records the tolls**. It has been successful in its aim of reducing traffic in the CBD by linking with the existing road network and guiding traffic around it.

• *Time-based Charging*

In this system, drivers pay a fee for length of time spent using certain roads or within a zone where the charge payable is proportional to time the vehicle is adding to congestion. Benefits from this type of system is that it encourages people to use alternative roads in congested conditions, but could encourage 'rat-running' & faster driving to minimise time spent in charging zone.

A 1996 study carried out in the **US** estimated that the introduction of time-based road user charging (Palmer et al, 1996)[6] meant drivers would take more risks. The effect was found to be highly significant for some measures of risk taking, for example jumping red lights and illegal overtaking. The study also concluded that the effect on risk taking was similar when high prices and even very low prices were compared.

• *Congestion Charging*

This scheme directly charges a driver related to amount of congestion caused by taking a particular journey. There are however disadvantages of this type of system, including the technology needed to determine whether a vehicle is causing congestion (for example **satellites**, **road side sensors**, **in-vehicle equipment**), the definition of 'Congestion', and the system by which drivers are charged.

Cambridgeshire County Council trialled a system using **beacons** on all access and egress routes into the city of **Cambridge** which triggered **in-vehicle technology** connected to the **odometer** (Ison, 1998)[5]. The technology in the system calculated the distance travelled, the congestion caused determined and then debited a **pre-paid smartcard** debited with the charge. Cambridge was seen as ideal location to introduce such a system as its a free-standing city with only 18 access points. The scheme failed to be implemented for a number of reasons, particularly the lack of political support for it as it was seen as a vote looser and the costs involved would have made it prohibitively expensive (Ison, 1998)[5].

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