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PERCEPTION OF VMS EFFECTIVENESS: A BRITISH AND CANADIAN PERSPECTIVE

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INTRODUCTION

Variable Message Signs are becoming a common sight on the UK Motorway network and have been well established on North American Freeways for several decades, as highway authorities strive to better manage scarce road network resources and provide travellers with up-to-date traffic information and alternative route options. The flexibility of VMS allows them to display varied information on road conditions, safety messages, alternate routes, speed limits, and general travel information. The steady growth in deployment of VMS in the next few years will lead to enhanced use of information to better manage highways and control levels of traffic congestion. The effectiveness of VMS in achieving this goal, however, depends entirely upon driver response to and perception of the information displayed.

Previous research has indicated that VMS information needs to be timely, accurate, easily understandable and also believable for motorists to take any notice of it and act accordingly. This paper will report on findings from several attitudinal questionnaire surveys, conducted in and around London and Manchester in the UK, and Toronto in Canada, to determine VMS effectiveness. The studies focus on driver perception of the effectiveness of different types of information displayed and drivers' preferences for future information provision.

STUDY OBJECTIVES

Drivers in Canada have been exposed to VMS information for a longer period of time than their UK counterparts, since the system has been in operation from the mid 1980's. The reason for conducting a comparative study between UK and Canadian systems was to determine the current perceptions and level of usage of VMS information in both countries, with a view to commenting on the likely take-up of information in the UK as the VMS system becomes further developed over the longer term. This also necessitated the differences and similarities between the two systems to be reported. Changing trends in perception and use of VMS were also to be put into context by referral to evidence from previous VMS system user surveys.

Figure 1: Typical Strategic VMS in the UK (source: The Highways Agency)

PREVIOUS EVIDENCE OF VMS EFFECTIVENESS

Many studies from around the world have been conducted over recent years into the effectiveness of VMS information. Early research (1) indicated that only a very small number of drivers (8%) used VMS to make decisions about whether to change route, when compared to radio traffic reports and personal experience of traffic conditions (2). Research conducted in Washington D.C. (3) on motorist attitudes found that VMS were only moderately influential on motorist behaviours and that there was little influence of demographics on motorist attitudes to VMS. The study also investigated opinions on time-tagging information, to indicate the time when a traffic report is first posted on a VMS, to

help improve accuracy of the information. An overwhelming 87% of motorists supported this idea.

A study conducted in London in the late 1990's (4,5) determined that interpretation of VMS information was good and that it was perceived as being useful (80%). The study also ascertained that there was a general preference for VMS to be used more often, rather than just being left 'blank' (73%). The study concluded that VMS had a limited effect on influencing route choice, but that drivers valued receiving the information, due to being better informed. There was a preference for more up-to-date and relevant information, and for notification of alternate routes.

The Highways Agency (HA) recently published a study (6) that gathered opinions of how satisfied travellers were with various aspects of the UK motorways and trunk roads they had used on their most recent journey. Of a possible score out of ten, where '0' is extremely poor and '10' is extremely good, respondents gave a score of 7.4 and 7.6 to availability and accuracy of VMS, respectively. In the past eight years, there has been an increasing trend in the mean level of satisfaction on motorways for VMS availability and accuracy. The variables have generally followed an increasing trend from approximately 6.3 to 7.6.

Many recent studies have investigated the possibility for wider use of VMS for traffic and non-traffic safety-related messages. A report by the Transport Research Laboratory (7) concluded that safety messages were effective in producing a short-term response in driver behaviour. Long-term studies, however, need to be carried out to investigate whether drivers become de-sensitised by frequent exposure to safety messages. The report also found that the majority of drivers are likely to support the wider use of VMS. Similarly, 81% of respondents found the VMS messages to be either 'very' or 'fairly' useful during the HA's 'THINK! Don't Drive Tired Campaign' (8). The study also revealed that 53% of respondents said that seeing the messages was effective in causing them to consider how tired they were, subsequently, a quarter of them decided to take a break. Overall, 87% of respondents said that they were either 'very likely' or 'likely' to remember the message in the future. These findings on the effectiveness of VMS safety messages are supported by an independent study (9). Research has shown that one of the most effective uses of VMSs is for special events (10). A large majority of motorists will respond to VMS messages when the information directs them to a faster route to the special event, to avoid long delays and congestion (11).

THE UK AND CANADIAN SYSTEMS

VMS in the UK

Variable Message Sign deployment on the UK motorway network has mostly been concentrated around large conurbations, such as London, Birmingham, Leeds and Manchester. There are two main functions of VMS – strategic and tactical.

Strategic VMSs are used on potential diversion routes to another motorway. The signs are located along 'Motorways' and principal 'A' series roads and at motorway interchanges. Their purpose is to display diversionary messages in the event of incidents or accidents (See Figure 1).

Tactical VMSs are used for incident warnings. The purpose of the tactical VMS is to reduce the occurrence of the 'classical' multi-car accident. This is done by displaying messages such as "QUEUE AHEAD" to notify drivers of an upcoming accident to prevent vehicles from hitting the back of queues (See Figure 2).

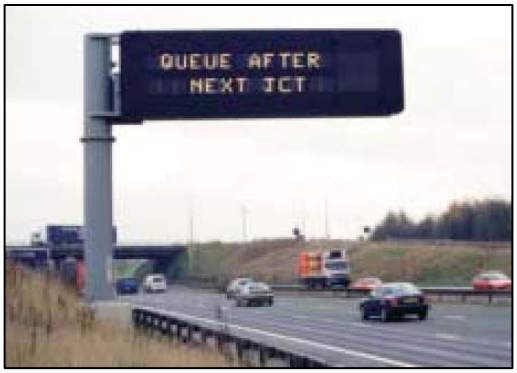

Figure 2: Tactical VMS notifying motorist of queue ahead (source: The Highways Agency)

Under normal flow conditions, the HA policy is to leave the VMSs blank and to only display messages when unusual or abnormal conditions exist (12). There are, however, past occasions where the HA have used VMSs to support events such as the 'THINK! Don't Drive Tired' campaign and the 2002

Firefighters' strike to warn motorists of limited emergency response, and more recently, to remind drivers of the new mobile phone safety regulation.

The Highways Agency is currently conducting an on-road trial of a new generation of VMS known as Motorway Signal Mark 4s (MS4s) along the M4 in Berkshire. Thirty-six signs will be installed between junctions 12 - Theale and 14 - Hungerford, with eighteen signs on each carriageway. The aim is to expand the current range of variable message signs on the national road network with new pictogram MS4s to help reduce accidents and improve journey delays (13).

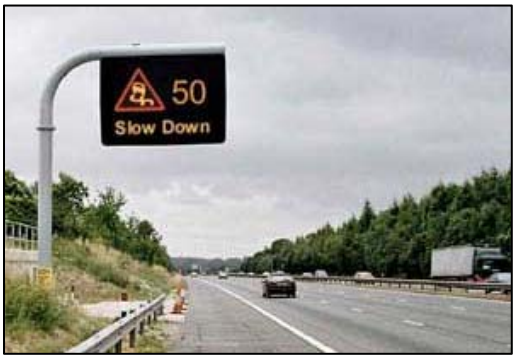

Figure 3: One of 36 MS4 signs on the M4 between J12 and J14 as part of the Highways Agency's On-Road MS4 Trial (source: The Highways Agency)

The cantilever mounted MS4s are for tactical use and will replace existing 2x16 MS3s and central reserve matrices (See Figure 3). They are more versatile than the existing technology and will enable high-resolution twin colour (red and off-white) pictograms and a range of text fonts to be displayed. The MS4 philosophy is based on the adage, "a picture is worth a thousand words". Pictograms of red warning triangles containing off-white images are used to depict incidents, congestion, or hazardous conditions ahead and must conform to traffic sign regulation guidelines (i.e. dimensions, colour, etc.). An independent study has shown that pictogram signs are potentially beneficial for deployment in areas with large numbers of foreign drivers (14), such as ports, and that drivers are able to successfully interpret pictogram information with increased familiarity.

Presently, VMSs are regionally controlled by schemes such as the Manchester Driver Information System (MANDIS), Midlands Driver Information System (MDIS), and various local Police Control Offices (PCOs). In Spring 2004, the Highway Agency's National Traffic Control Centre (NTCC) will become operational. The NTCC, located in Birmingham, will amalgamate all control offices and serve as the nerve centre for England's traffic management operations. As part of the NTCC programme, strategic VMSs are to be installed at all strategic junctions, while tactical VMSs will cover 30% of motorways; bringing the number of VMSs in the country to approximately 1900 signs (12). Such large-scale implementation forms a key objective of the UK Highways Agency to achieve 'informed travellers'.

VMS in Canada

The term 'VMS in Canada' refers specifically to the 'Variable Message Signs' on the Highway 401 COMPASS System within the Greater Toronto Area, Ontario.

Highway 401 is located north of the City of Toronto and is a heavily used urban freeway that passes through Metropolitan Toronto. It has a unique express/collector configuration with a minimum cross-section of 12 lanes. Some sections carry over 350,000 vehicles on an average day. The posted speed limit on all 400 series highways is 100 km/h.

Figure 4: MTO combination VMS on Highway 401, Toronto (source: Ministry of Transportation, Ontario)

A freeway traffic management system has been in operation since the mid 1980's (15). The COMPASS System went into operation in early 1991 and currently spans a distance of approximately 59 km. As of December 2002, there were 33 overhead gantry-mounted LED type variable message signs, 94 colour CCTV cameras, 630 vehicle detection stations and over 3100 vehicle detectors to help manage traffic on Highway 401 (16).

A combination variable message sign is the current standard for freeways set by Ontario's Ministry of Transportation (MTO). The display contains a three-line matrix in between two full matrix graphic display elements at either end of the sign face (See Figure 4). The signs were developed by the MTO in order to be able to display full graphics such as exit arrows and highway identification shields on either end of the sign (17).

The MTO policy is to always display a message on a VMS. During normal operating conditions, such as during the off-peak period, a safety message or a directional message is usually displayed.

VMSs are an integral part of the COMPASS System. They are installed at strategic locations to advise motorists on both the collector and express lanes to divert when arriving at a decision point. VMSs serve two main functions: 1) incident management, and 2) congestion management.

In the event of an incident, the central computer system will alert the operator of a suspected incident and request visual CCTV confirmation. Within seconds of a confirmation, the central computer recommends a specific set of signs and messages based on the location and nature of the incident. The operator must review and approve the response plan before the messages are dispatched to the signs. By supplying motorists with timely, accurate and useful information this may allow them to divert around the problem area or prevent vehicles from hitting the back of queues.

The Variable Message Signs are capable of automatically displaying information related to the level of congestion on the freeway regardless of whether congestion is being caused by an accident or normal rush hour traffic. As often as every 20 seconds, the COMPASS computer calculates average speeds and travel times. The VMSs display average traffic conditions on the express and collector lanes for a pre-defined upcoming section of freeway. The average traffic condition is defined in terms of "MOVING WELL" (75+ km/h), "MOVING SLOWLY" (40 - 75 km/h), and "VERY SLOWLY" (less than 40 km/h). This allows motorists to decide whether to continue on their original route or take an alternate route by transferring onto the express or collector lanes (16).

SURVEY METHODOLOGY

In order to perform a comparison of perceptions between Canadian and UK drivers, a detailed self-completion driver questionnaire was designed for distribution at key locations where drivers would be most exposed to VMS. The Canadian survey was administered at the MTO Agincourt driver-licensing office in Scarborough, Ontario and the UK survey was conducted at the Granada Knutsford motorway services facility on the M6 south of Manchester. The surveys were conducted during early 2002 (18).

The Canadian questionnaire targeted motorists at the eastern section of the Highway 401 corridor, which is host to several variable message signs on east and westbound collector and express traffic lanes. Overall, there were fifteen questions in the survey. The first four questions examined driver demographics through the use of tick boxes or item circling. They asked questions such as gender, age group, number of years fully licensed to drive, and annual mileage. Questions 5 to 7 enquired about driver preferences for traffic information and familiarity with VMSs. Question 5 allowed users to tick more than one information medium, those being: radio, VMS, GPS, mobile, and other. Likert scales were used in Questions 6 and 7 to measure the strength of driver familiarity and exposure to VMS on a scale of 1 to 100. Questions 6 and 7 asked how familiar drivers were with this section of motorway and how frequently they encountered VMS, respectively. A set of variable message signs relating to safety issues and diversion were emphasised in Questions 8 (tick box), 9 (tick box), and 10 (Likert scale). Questions 11 to 15, in Likert format, were intended to analyse driver's perception on the effectiveness of VMS information. These questions asked for judgment on: 'How up-to-date, reliable, and useful is the VMS system?'; 'Would the system be more effective if time stamping of messages were used?'; and, 'Are safety messages effective in achieving a safer driving environment?'

The UK questionnaire was designed for drivers travelling northbound on the M6 towards Manchester. It was similar to the Canadian version, but an additional question was added to investigate the effectiveness of the variable speed limit system. To ensure comparability of results, it was essential that the questions in both surveys were very much similar. The Highways Agency was instrumental in

determining equivalent VMS messages resulting in a comparable questionnaire.

The questionnaire was designed to take approximately 10 minutes to complete. Drivers recruited to take part in the survey appeared to respond well to the questionnaire design, resulting in complete and good quality data. The survey collected data from 52 motorists in Canada and 56 in the UK (19).

INITIAL SUMMARY STATISTICS

The results of the Canadian and UK survey analyses are presented in Table 1. Comparisons of the demographic variables indicate that the UK sample was older and more male dominant (Canada=62%, UK=73%) than the Canadian drivers. Approximately 40 per cent of motorists have had their licenses between 6 to 20 years. There are, however, significant differences when comparing the distribution of the samples at the more extreme ends of years licensed categories. The number of drivers who have been licensed for less than six years is approximately six times greater in the Canadian sample than the UK Sample (Canada=23%, UK=4%). Since the UK sample was older, it is not surprising to find that there are approximately twice as many UK drivers to Canadian drivers who have been fully licensed to drive for more than 20 years. Also, not surprisingly, Canadian motorists drive more annually than their UK counterparts. This could be a result of several factors that are not examined in this study, such as cheaper vehicle operating costs or greater travel distances required between origin and destination, which is typical for North American cities.

The frequency distributions of driver preferences to traffic information in Question 5 were virtually identical in both countries. Both Canadian and UK drivers prefer to receive traffic information while driving from the radio, followed by VMS traffic information, then via in-car navigation/information systems, and lastly by mobile phone.

The results obtained from Question 6 are particularly interesting. Canadian drivers were much more familiar with their sections of motorway than British drivers (Canada: m=72, UK: m=46, where m=mean score).

Several factors may contribute to this difference. The most probable factor is the disparity between the nature and location of the facilities chosen to conduct the survey. The Canadian survey was conducted at the MTO licensing office, which is situated in a neighbourhood a few minutes drive away from Highway 401. This facility is intended to provide MTO services to communities within that region, thus, it is expected that a majority of the motorists surveyed at the MTO facility would be more than "Somewhat Familiar" with their section of motorway presented in the questionnaire.

The UK survey location is distinctly different from the Canadian survey location. Firstly, it is a motorway "rest stop" facility located off a heavily used motorway. The sample would be more heterogeneous than the Canadian sample since the facility serves a diverse group of drivers with different origin and destinations. One could presume that people from nearby communities, who would be more familiar with the section of motorway presented in the questionnaire, would not require the services of the facility on a regular basis. Most of the motorists surveyed, therefore, would be those travelling through Knutsford on long haul journeys.

Secondly, the survey was conducted on Saturday March 16, 2002. As a result of the survey date occurring at the weekend and the nature of the facility, it is possible that there were more drivers on personal weekend trips who would be less familiar with the section of motorway than weekday work commuters presented in the questionnaire. It was also observed that on the day of the survey, there were many football fans taking a rest stop on their journey to a match. These factors may have contributed to the UK drivers being less than "somewhat familiar" with the specified route.

From Question 7, UK drivers indicated that they encountered VMS slightly more than "occasionally" (m=53) whilst Canadian drivers encountered VMS more often (m=73).

Question 8 asked the driver whether they would end the call immediately, decide to end the call when the conversation is finished, or ignore the message if they encountered a VMS sign displaying the message, "DRIVE NOW TALK LATER". The frequency distribution was relatively homogenous for the Canadian sample but more UK drivers indicated that they would end the call immediately upon seeing the safety message.

The results obtained from Question 9, which deals with diversion, illustrates that the

TABLE 1 – Demographics of Sample and Stated Response to VMS

Canadian Questions		UK Questions		Response Choices	Canada			UK		
					N	Frequency (mean for Likert Scales)	%	N	Frequency (mean for Likert Scales)	%
Q1	Gender *(tick box)*:	Q1	Gender *(tick box)*:	Male	52	32	62	56	41	73
				Female		20	39		15	27
Q2	Age group (*please circle one)*:	Q2	Age group (*please circle one)*:	≤20	52	3	6	56	1	2
				21-30		16	31		9	16
				31-40		8	15		9	16
				41-50		12	23		13	23
				51-60		7	14		12	21
				>60		6	12		12	21
Q3	Number of years fully licensed to drive *(please circle one)*:	Q3	Number of years fully licensed to drive *(please circle one)*:	≤5	52	12	23	56	2	4
				6-10		9	17		6	11
				11-15		6	12		8	14
				16-20		8	15		5	9
				>20		17	33		35	63
Q4	What is your annual mileage? *(please circle one)*	Q4	What is your annual mileage? *(please circle one)*	<5000	50	2	4	56	2	4
				5000-10000		9	18		20	36
				10000-15000		20	40		23	41
				>15000		19	38		11	20
Q5	From which medium do you prefer to receive traffic information while driving? *(check all that apply)*	Q5	From which medium do you prefer to receive traffic information while driving? *(check all that apply)*	Radio	52	36	69	56	37	66
				VMS	52	34	65	56	37	66
				In-car navigation/information systems	52	5	10	56	4	7
				Mobile phone	52	3	6	56	2	4
				Other (please specify)	52	0	0	56	0	0
Q6	How familiar are you with the section of motorway between Mississauga and Pickering? *(answer the question by placing an 'X" through the line in the place that best indicates your answer)* [Likert Scale]	Q6	How familiar are you with the sections of the motorway (M6, A556, M56, M60, M62, M602) approaching Manchester from Birmingham? *(Answer the question by placing an 'X' through the line in the place that best indicates your answer)* [Likert Scale]	Not at All Familiar=0 Somewhat Familiar=50 Very Familiar=100	52	m=72		55	m=46	
Q7	How frequently do you encounter electronic Variable Message Signs on the motorway? [Likert Scale]	Q7	How frequently do you encounter electronic Variable Message Signs on the motorway? [Likert Scale]	Never=0 Occasionally=50 Very Often=100	52	m=73		56	m=55	
Q8	What would you do if you were talking on your mobile phone while driving and you saw the following message? *(check one only)* "DRIVE NOW, TALK LATER"	Q8	What would you do if you received a call on your mobile (talking while driving) and you saw the following message? *(check one only)* "DRIVE NOW, TALK LATER"	End the call immediately	51	19	37	50	25	50
				Decide to end the call when you finish the conversation		19	37		11	22
				Ignore the message		13	26		14	28
Q9	Assume that you are driving in the express lane. The traffic is moving quickly and without problems. You are 5 minutes away from Islington Interchange. What would your reaction be if you saw this electronic sign? *(check one only)* "EXPRESS MOVING SLOWLY BEYOND ISLINGTON EXPECT DELAYS"	Q9	Assume that you are driving along the M6 motorway heading toward the Manchester city centre, the traffic is moving quickly and without problems. You are 5 minutes away from J18. What would your reaction be if you saw this electronic sign? *(check one only)* "A556 EAST LONG DELAYS"	Divert at the very next opportunity	52	33	64	56	30	54
				Delay diversion until encountering problems		16	31		14	25
				Ignore the message and continue ahead		3	6		12	21

TABLE 1 – Stated Response to VMS (Continued…)

Canadian Questions		UK Questions		Response Choices	Canada			UK	
					N	Frequency (mean for Likert Scales)	%	N	Frequency (mean for Likert Scales)
Q10	Similar scenario to Q9, assume that you are driving in the express lane. The traffic is moving quickly and without problems. The following sign is posted ahead: *(check one only)* "401 EAST EXPRESS MOVING SLOWLY COLLECTOR MOVING WELL" You divert to the collector lanes as advised. How would you feel if the traffic information provided was not as posted? (i.e. after changing lanes, the collector traffic moves slowly while the express lanes still moves quickly)	Q11	Assume that you are driving along the M6 motorway, intending to use the A556 to drive toward Manchester city centre. The following sign is posted ahead: "A556 DELAYS FOR MANCHESTER USE M62" You avoid the A556 as advised and re-route to the M62. While you are driving along the M62, you suddenly encounter delays. How would you feel if the traffic information provided was not as posted? *(check one only)*	Frustrated Unaffected Other (please specify)	50	34 16 0	68 32 0	56	46 10 0
Q11	How 'up-to-date' is the traffic information on the electronic signs? [Likert Scale]	Q12	How 'up-to-date' is the traffic information on the electronic signs? [Likert Scale]	Not at All 'Up-to-date'=0 Somewhat 'Up-to-date'=50 Very 'Up-to-date'=100	52	m=56		56	m=45
Q12	How reliable is the displayed information? [Likert Scale]	Q13	How reliable is the displayed information? [Likert Scale]	Not at All Reliable=0 Somewhat Reliable=50 Very Reliable=100	52	m=62		55	m=52
Q13	How useful is the displayed information? [Likert Scale]	Q14	How useful is the displayed information? [Likert Scale]	Not at All Useful=0 Somewhat Useful=50 Very Useful=100	52	m=67		55	m=58
Q14	Would the system be more effective if the displayed messages ALSO indicated the time the message was posted? "EXPRESS MOVING SLOWLY COLLECTOR MOVING WELL (POSTED AT 5:30PM)" [Likert Scale]	Q15	Would the system be more effective if the displayed messages ALSO indicated the time the message was posted? "LONG DELAYS AFTER J19 POSTED AT 15:30' [Likert Scale]	Not at All Helpful=0 Somewhat Helpful=50 Very Helpful=100	52	m=82		56	m=85
Q15	How effective are safety slogans in achieving a safer driving environment? Examples of safety slogans on electronic variable message signs: "IF YOU DRINK, DON'T DRIVE!" "ALWAYS WEAR YOUR SEATBELT BUCKLE UP!" "SPEED KILLS, SLOW DOWN!" [Likert Scale]	Q16	If safety slogans were posted on VMS signs, how useful would they be in achieving a safer driving environment? Examples of safety slogans on electronic variable message signs: "IF YOU DRINK DONT DRIVE" "SPEED KILLS SLOW DOWN" "DON'T HOG THE MIDDLE LANE	Not at All Effective=0 Somewhat Effective=50 Very Effective=100	52	m=66		56	m=54
		Q10	Assume you are driving on the motorway at the posted speed limit of 70 mph. What would you do if you were approaching this overhead sign? *(check one only)* [Photo of variable speed limit sign indicating mandatory 60 mph zone]	Immediately slow down to 60 mph Maintain driving at 70 mph but exercise caution Ignore the message				56	28 28 0

majority of motorists in both countries would divert at the very next opportunity if a 'Delay Ahead' message is posted (Canada=64%, UK=54%). Significantly more British drivers, however, indicated that they would ignore the message completely (Canada=6%, UK=21%).

A study of driver emotional reaction to misleading or inaccurate VMS information is examined in Canadian Q10 and UK Q11. British drivers were more frustrated by inaccurate traffic information than Canadian drivers (Canada=68%, UK=75.5%).

Marginal results were found regarding UK motorist attitudes towards perception of VMS information as being up-to-date, reliable, and useful. The UK population perceived VMS information to be less than "somewhat up-to-date" (m=45), only "somewhat reliable" (m=52), and slightly more than "somewhat useful" (m=58). Canadian drivers, on the other hand, were more confident of the VMS system. Messages on the electronic signs are perceived by Canadians to be slightly more than "somewhat up-to-date" (m=56). Reliability is considered more than "somewhat reliable" (m=62) and the usefulness of the displayed information is deemed to be more than "somewhat useful" (m=67).

In both Canada and the UK, drivers indicated a strong preference to having the displayed message time stamped (Canada: m=82, UK: m=85), to give credence to messages.

The last comparable question (Canadian Q15, UK Q16) posed to the driver whether safety slogans such as "IF YOU DRINK DONT DRIVE", and "SPEED KILLS SLOW DOWN" (are/would be) useful in achieving a safer driving environment. In the UK, VMSs are rarely used for this purpose. UK drivers felt that using VMSs to display motorway safety messages would be slightly more than "somewhat effective" (m=54). In contrast, VMSs displaying safety messages are already widely implemented on the COMPASS system. Canadian drivers indicated that the effectiveness was more than "somewhat effective" (m=66). This result may be simply due to Canadian drivers being more exposed to safety campaigning on VMSs.

DETAILED COMPARATIVE ANALYSIS

Correlation Analysis

Several significant correlations were found between the countries of motorist origin (Canada/UK) and the key variables listed below in Table 2, using appropriate Pearson and Spearman's Rho correlation statistics. Correlation coefficients obtained from the analysis tended towards the negative in most cases, indicating a stronger response by Canadian drivers.

TABLE 2 – Correlation strength between Canadian and UK driver variables

		Country
Gender?	Correlation Coefficient	-.125
	Sig. (2-tailed)	.199
	N	108
Age?	Correlation Coefficient	.230
	Sig. (2-tailed)	.017
	N	108
Years Licensed?	Correlation Coefficient	.332
	Sig. (2-tailed)	.000
	N	108
Annual Mileage?	Correlation Coefficient	-.210
	Sig. (2-tailed)	.031
	N	106
How Familiar?	Correlation Coefficient	-.377
	Sig. (2-tailed)	.000
	N	107
Exposure to VMS?	Correlation Coefficient	-.346
	Sig. (2-tailed)	.000
	N	108
What if on mobile?	Correlation Coefficient	-.073
	Sig. (2-tailed)	.465
	N	101
Divert?	Correlation Coefficient	.148
	Sig. (2-tailed)	.127
	N	108
Frustrated?	Correlation Coefficient	-.164
	Sig. (2-tailed)	.093
	N	106
VMS up-to-date?	Correlation Coefficient	-.283
	Sig. (2-tailed)	.003
	N	108
VMS reliable?	Correlation Coefficient	-.261
	Sig. (2-tailed)	.007
	N	107
VMS useful?	Correlation Coefficient	-.227
	Sig. (2-tailed)	.019
	N	107
Time post effective?	Correlation Coefficient	.013
	Sig. (2-tailed)	.893
	N	108
Safety msgs effective?	Correlation Coefficient	-.202
	Sig. (2-tailed)	.036
	N	108

LEGEND

Correlation is significant at the 0.05 level (2-tailed).

Correlation is significant at the 0.01 level (2-tailed).

At the 0.05 significance level (95% confidence), positive correlations confirm that British drivers tended to be older and are licensed for more years than the Canadian drivers. The relationship between 'Country' and 'Annual Mileage' indicated British drivers tend to drive less. VMS usefulness and the effectiveness of safety messages were regarded more highly by Canadian drivers. Highly significant correlations at the 0.01 significance level (99% confidence) were as follows: The relationship between origin of motorists and familiarity and frequency of VMS exposure, showed that Canadian motorists were more familiar with their route and encountered VMS more frequently than British drivers. Canadian drivers also perceive VMS information to be more up-to-date and more reliable.

Inferential Statistics

Inferential statistical tests were conducted to prove causation of the descriptive results above. The results of t-tests on variables of driver perception of VMSs, indicate that the mean scores for Canadian drivers are significantly higher than for British drivers. The variables tested and the results are illustrated in Table 3.

TABLE 3 – t-test results for country of origin

					t-test for Equality of Means		
	Driver Origin	N	Mean	Standard Deviation	T	df	Significance (2-tailed)
Familiarity	Canadian British	52 55	71.7 45.8	32.8 31.5	4.2	105	<0.0001
Exposure to VMS	Canadian British	52 56	73.3 54.9	24.3 25.8	3.8	106	<0.0001
VMS up-to-date	Canadian British	52 56	55.6 45.1	19.7 16.3	3.0	106	0.003
VMS reliable	Canadian British	52 55	62.1 51.7	24.3 13.0	2.7*	105*	0.008*
VMS useful	Canadian British	52 55	66.9 57.6	21.0 18.9	2.4	105	0.019
Safety messages effective	Canadian British	52 56	66.3 53.7	30.4 30.8	2.1	106	0.036

** Variances for the two groups were significantly unequal (F=14.5, p<0.05), thus a t-test for unequal variances was used*

CONCLUSIONS AND RECOMMENDATIONS

Traffic information when used properly can help balance the flow of traffic, maximise roadway capacity usage, reduce motorist travel times, and improve safety on the freeway. The overall results from the recent studies indicate that there are no significant correlations between demographics and motorists' attitudes to VMS. There is still a slight preference by drivers to receive traffic information via in-car radio (67.6%), but VMS is becoming more popular (65.7%). This is likely to increase as exposure to VMS increases and the information starts to take more of an effect on driver behaviour. However the information will need to be kept accurate, reliable and up-to-date for driver acceptance to be maintained.

It has been established that at present Canadian drivers encounter VMS more frequently, and that they perceive VMS to be more up-to-date, more reliable and more useful than do their British counterparts, but it should be noted that the systems have been in operation for a longer period of time in Canada.

Future Sign Deployment Strategy

There is some evidence to suggest that continual exposure to VMS does have a positive impact upon driver perceptions of the quality and usefulness of information and that this will lead to changes in driver behaviour in response to the information. It is recommended therefore that VMS continue to be rolled out across the principal highway networks in both countries and that imaginative use is made of new developments in VMS technologies,

Figure 5: Japanese parking guidance graphical information sign (source: Nagoya Electric Works Co. Ltd.)

enabling both pictograms and congestion graphics (20, 21) to be displayed, to augment the traditional text based VMS systems. Figure

5 above shows a typical Japanese map layout graphical sign with three display colours, indicating the status of available car parks. Technological products currently under development in the USA give full colour displays for VMS, potentially enabling even video presentation of traffic condition information at the roadside.

Future Sign Usage Strategy

The issue of what messages, if any, should be displayed on the VMS when the roadway is operating under normal flow conditions is still under considerable debate. There are two approaches: 1) always displaying a message, and 2) only displaying a message under abnormal conditions. The reason behind always displaying a message on a sign is that the motorist knows that the sign is working. The disadvantage of this approach, however, is that drivers may become desensitised to the VMS messages through overexposure to low priority default messages. Consequently, this may reduce the impact of high priority messages. The practice of leaving the sign blank under normal flow conditions maximises the visibility of the message. The credibility risk of displaying a safety message at a time when incident information should be displayed is also reduced. There are also several drawbacks of such a policy. Drivers may question whether a VMS is working when approaching a VMS that is blank and the public may question the apparent under-utilization of high cost infrastructure. Both approaches to this issue have been applied effectively around the world (17).

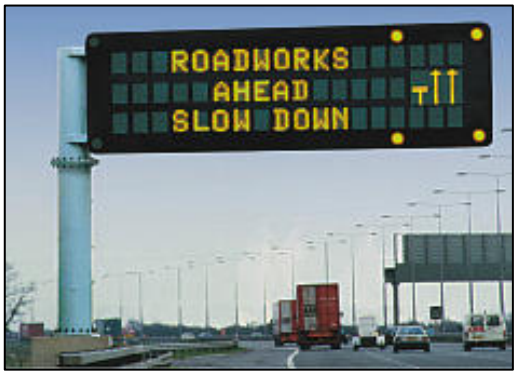

Figure 6: MS3 signs are being rolled out on the UK Motorway Network as part of the National Traffic Control Centre Project (source: The Highways Agency)

Concluding Comments

The key advantage of VMS information is that it is freely available to all motorists and hence is socially inclusive. It is evident that the public consider VMS as a useful and informative system and that there is a strong preference for the signs to be used to display more information and more regularly. In particular the time stamping of messages appears to be a useful and requested feature and would go towards improving message credibility. Overall there seems to be evidence to suggest that as motorist exposure to and familiarity with VMS increases that their appreciation of the information also increases. This is very encouraging for future VMS system deployment and usage and will hopefully aid drivers in making better-informed decisions when travelling on congested major roads in the future.

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