APPENDIX A:

Issues in the Regulation of Commercial Electronic Variable Message Signage (CEVMS): Excerpts from the Federal Highway Administration Report

Safety and Environmental Design Considerations in the Use of Commercial Electronic Variable-Message Signage

(FHWA/RD-80-051)

Application of Highway Investment Costs to CEVMS

Editor's Note: The following passages appear on page 68 of the FHWA Report.

The trouble is that self-restraint in marketing CEVMS is likely to prove every bit as difficult as in marketing other types of electronic signs. . . .

The risk to the public highway investment from outdoor advertising therefore is, as it always has been, in the lack of market incentives or industry self-regulation to prevent excessive and poorly designed or constructed signing, and in the risks that accompany sign maintenance activities. . . . And this is what continues to be the risk that must be faced in any authorization for increased use of CEVMS, either in the present authority for on-premise usage, or in any possible proposal for extended used at off-premise location in the future.

Generally local planning and land-use controls have not been equal to dealing with the pressures to develop land in the major urban and suburban corridors. Strip commercial development, often with lavish use of on-premise signs, is common in these corridors. The growing use of CEVMS, as discussed in this section, may do little to improve this overall situation.

APPLICATION OF CURRENT TECHNICAL KNOWLEDGE TO DEVELOPMENT OF STANDARDS

Editor's note: The following passages are a continuous excerpt from pages 68 to 84 of the FHWA Report.

When consideration is given to the development of standards governing roadside display of commercial electronic variable-message signing, it is suggested that standards should address at least those aspects of signing that are listed below. In this list no attempt has been made to indicate priorities or rankings of importance that these aspects should have in any set of standards. Nor does the discussion of these aspects indicate all of the situations in which they are interrelated. These are matters that will enter into the design of standards in accordance with policy decisions regarding scope, purpose, and other factors.

A. **Longitudinal Location**. This refers to the location of signs along the highway in their relation to the major geometric design features of the highway. Such features include intersections, interchange entry and exit points, channelization features, traffic control devices (including official route markings and directional signing), highway structures (bridges, viaducts, overpasses), and design features which require a high level of attention to the driving task (sharp curves, lane drops, "weaving" areas, areas of reduced sight distance).

B. **Spacing and Density**. This refers to the number of signs that are located within a specified linear distance in roadside areas in their relation to highway traffic safety and effective delivery of informational messages to motorists on the adjacent highway.

C. **Lateral Location**. This refers to the distance that signs are set back from the highway, measured in distance from the edge of the main traveled way. Lateral location standards may also consider the angle of a sign on which the messages are displayed relative to the line of sight of motorists on the adjacent highway.

D. **Interaction with Traffic Signs**. This refers to both the location and design of signs as these factors may affect the operational effectiveness of official traffic control devices.

E. **Duration of Message On-Time**. This refers to the length of time that the full text of a message is visible to view on a variable-message sign panel.

F. **Duration of Message Off-Time**. This refers to the length of time that the message panel of a variable-message sign displays no part of any message.

G. **Duration of Message Change Interval**. This refers to the length of time between display of the full text of one message and the display of the full text of the next message in a series of messages programmed for a variable-message sign. It includes, but can be longer than the message "off" time, and might be equivalent to a visual "dissolve" in which one image fades from view while another appears. Thus, some visual portions of two sequential messages might be displayed simultaneously.

H. **Total Length of Information Cycle**. This refers to the length of time required to display all elements of a pre-programmed sequential message or a message series. Pre-programming may be in the form of a manually activated remote control device.

I. **Rate of Intensity or Contrast Change**. This refers to variable-message signs in which the illumination or contrast does not change instantaneously, but increases to a maximum level and then decreases to a minimum in the course of changing messages. The rate of this change is the interval of time between the moment of maximum illumination intensity or contrast for the message that follows it.

J. **Flashing Signs and Lights**. This refers to a cycle of intermittent illumination in which the phases are arranged so that the changes in illumination or contrast appear to be displayed in sudden bursts of light. The flashing character of a sign is determined by reference to the interval of time between its maximum and minimum illumination in the cycle of change for the messages displayed. Flashing signs may include those that present repetitive displays of the same message or a series of different messages displayed on sequence.

K. **Brightness and Contrast.** This refers to the degree of intensity and contrast between a sign's message and its background, and is a factor affecting the legibility of sign messages. Optimum correlation of intensity and contrast maximizes legibility. Poorly correlated intensity and contrast may reduce legibility either by too little illumination and contrast or excessive brilliance (glare).

L. **Animation and Message Flow.** This refers to the sequential display of the elements of a message so as to give the appearance of their movement on or across the message panel of a sign.

M. **Size of Sign and Lettering.** This refers to the size of the cabinet and message panel of a variable-message sign, and the size of letters, numbers of other elements of messages displayed thereon. Size of lettering includes spacing any number of characters or lines, but does not include any style of characters.

N. **Primacy of Information.** This refers to the priority accorded to the various types of messages displayed in roadside areas. Priorities are determined by correlation of motorist information needs, motorist-driving tasks, and other information stimuli present in the roadside environment.

O. **Maintenance Requirements.** This refers to the services that must be performed to maintain an electronic variable-message sign in optimum operational condition. It includes routine servicing and repair of mechanical, electrical, or electronic parts, but does not include major replacement or reconstruction of portions of the sign.

In developing standards for the foregoing design, structural, and operational aspects of electronic variable-message signing, the summary presented in Table 4 indicates the general relationship of these aspects to the public interests involved. Each of these 15 aspects of electronic variable-message signing is discussed in greater detail below.

TABLE 4. IMPACTS OF CEVMS ON TRAFFIC SAFETY AND VISUAL ENVIRONMENT

Design, structural, or operational aspect	Operationally Unique to EVM Signs	Impact on traffic safety	Impact on visual environment
A. Longitudinal density	No	High	Medium
B. Spacing and density	No	High	High
C. Lateral location	No	High	High
D. Interaction with traffic signs	No.	High	Medium
E. Duration of message on-time	Yes	High	Medium
F. Duration of message off-time	Yes	Low	Low
G. Duration of message change interval	Yes	High	High
H. Total length of information cycle	Yes	High	Medium
I. Rate of intensity or contrast change	Yes	High	Medium
J. Flashing signs and lights	No	High	High
K. Brightness and contrast	Yes	High	Medium
L. Animation and message flow	Yes	High	High
M. Size of sign and lettering	No	High	High
N. Primacy of information	No	High	Low
O. Maintenance requirements	Yes	Medium	High

A. **Longitudinal Location**. A critical safety consideration in selecting the longitudinal location of CEVMS is the preservation of motorist sight distance in the vicinity of intersections or other highway features and in traffic situations demanding specific attention to driving tasks. A second consideration, relating both to safety and effectiveness of communication, concerns the impact of commercial signing in roadside areas upon the time-sharing capability of motorists when they must deal with the concurrent display of commercial advertising messages, traffic information and control messages, and directional information.

Empirical evidence from accident studies indicates that the presence of advertising signs is, in some circumstances, associated with traffic accident locations. Also, the bulk of the experimental and accident study evidence indicates that, notwithstanding a substantial capability for time sharing in reading and comprehending a series of messages, conditions can arise where this capability is overloaded. Elimination of messages having a low priority for safe micro performance of driving tasks (commercial advertising) facilitates concentration on messages with high operational priority (traffic control signing, route guidance, directional signing).

Because of the novelty and attention-commanding characteristics of conspicuous, high-contrast signs, a conservative criterion for estimating sight distance requirements should be employed when locating such signs. . . .

B. **Spacing and Density.** Notwithstanding the recognized ability of motorists to selectively filter out messages or other sensory stimuli that are extraneous to their immediate driving tasks and related directional information needs, human factors research indicates that the capability for processing information is finite, and under some circumstances may become overloaded. In such instances the result is distraction or failure to comprehend certain messages, and increased difficulty in maintaining information processing priorities according to the driving task needs. Spacing and the risk of overloading the driver's information processing capability, and the principle of "spreading" has been recommended in order to better relate the location of roadside signs to the information needs of driving tasks.

Evaluations of the impact of CEVMS on motorists' information processing capability under varying conditions also must take into account the exceptional readability, size, and variability in mounting heights of CEVM signs. It would appear to be possible to arrange two or more of these signs in such a manner that all would be visible and readable by a motorist simultaneously, where conventional signs or standardized billboards arranged in the same manner would not.

Applied to the matter of locating on-premise CEVMS in rural and other roadside areas where land development is not intense, the problem is subject to the same considerations that govern longitudinal location. In areas of roadside strip commercial development, or in other areas of concentrated development such as shopping malls with storefronts facing and visible from an adjacent highway, space for "spreading" is not generally available. CEVMS technology and design options, however, offer opportunities for accommodating several advertisers by sequential displays on a single sign panel. Sign manufacturers have cited this capability in connection with the possibility of reducing the density of separate signs in roadside areas having high commercial development, and it would seem to be appropriate for use in standards for CEVMS in areas where other forms of on-premise signing are or may be utilized.

C. **Lateral Location**. Considerations of traffic safety make it necessary to prevent the placement of physical obstructions or fixtures that may constitute collision hazards immediately adjacent to the main traveled way of a highway. These areas, called "clear zones," typically extend to 30 feet (9.14 m) for conventional highways. Normally it is to be expected that the location of electronic variable-message signs will not involve conflict with established clear zones, since in practice all will be located outside of the right-of-way. Instances may occur in the densely developed urban environments, however, where recommended clear zones may extend beyond the right-of-way line. In such cases the need to reduce potential collision hazards indicates that standards for lateral location of on-premise electronic variable-message signs should apply the clear zone principle.

In addition to reducing the risk of roadside collision hazards, standards for lateral location should reduce the time that the drivers' attention is diverted from road and traffic conditions. Generally this suggests that signs should be located and angled so as

to reduce the need for a driver to turn his head to read them as he approaches and passes them.

Lateral location of CEVMS must give priority to maintaining clear zones that may be necessary for the existing terrain and highway geometric design. Selection of lateral locations beyond these clear zones should relate sight distance to the total length of a sign's information cycle, permitting the viewer to see the entire cycle by a series of glances. Necessary sight distance for lateral locations should not be provided by trimming, destroying, or removing trees or shrubbery from the right-of-way.

D. **Interaction with Traffic Signs**. Safety considerations require that traffic control devices and official directional signing have priority in the competition for motorists' attention while driving. One occurs where the design of commercial advertising signs in roadside areas makes it difficult to quickly identify and select out official signs from others near them.

These situations were recognized in the Regional Standards for regulating outdoor advertising signs adjacent to the Interstate System, promulgated in 1960 under the Bonus law (23 FR 8793, Nov. 13, 1958, as amended). The pertinent excerpts from these standards are as follows:

> Section 20.8(a) No sign may be permitted which attempts or appears to attempt to direct the movement of traffic or which interferes with, imitates, or resembles any official traffic sign, signal, or device.
>
> Section 20.8(b) No sign may be permitted which prevents the driver of a vehicle from having a clear and unobstructed view of official signs and approaching or merging traffic.

These general provisions, applicable to both on-premise and off-premise outdoor advertising signs, are as necessary in the regulation of CEVMS as for conventional advertising signs. In determining when the design of advertising signs is similar to official signs, authoritative standards and specifications are furnished by the *Manual of Uniform Traffic Control Devices*. Determination of when the view of an official sign is obstructed or interfered with is an engineering judgment based on the circumstances of each situation.

E. **Duration of Message On-Time.** The length of time that the full text of a message is visible to view is directly related to the ease with which a motorist can comprehend it without interfering with his driving task. The longer a message is displayed, the more opportunity a motorist has to choose the moment when he can best divert his attention from driving to read a roadside commercial sign.

Selection of a reasonable minimum standard for the duration of message "on-time" should be correlated with the length of the message or message element. Experience of state highway agencies using electronic variable-message signs for road and weather information on Interstate System highways indicates that comprehension of a message displayed on a panel of three lines having a maximum of 20 characters per line is best when the on-time is 15 seconds. In contrast, the customary practice of signing which merely displays time and temperature is to have shorter on-times of 3 to 4 seconds.

F. **Duration of Message Off-Time**. The interval of time between sequential displays of messages or message elements directly affects the ease with which a motorist-viewer can comprehend a series of messages or message elements. As this interval of "off-time" is lengthened, the difficulty of maintaining the continuity of attention and comprehension is increased. In prescribing an operational standard, an interval should be selected which provides optimum conditions for comprehension without creating time-sharing demands that jeopardize the priority of attention to driving tasks.

G. **Duration of Message Change Interval**. This issue is closely related to several others discussed in this chapter, including: rate of intensity or contrast change (which is incorporated herein); flashing signs and lights; and animation and message flow. It should be the intent of any regulations to bar those uses of CEVMS that may distract or overload the driver, while not prohibiting the changing of messages on such signs at reasonable intervals.

For purposes of this discussion, the "message change interval" is that portion of the complete information cycle commencing when message "one" falls below the threshold of legibility and ending when message "two" in a sequence first reaches the threshold of legibility.

Present technology makes it possible for a displayed message to be removed from the sign face and a new message displayed in its place (with a blank period of predetermined length between the two) in such a brief overall time that the entire operation is barely perceptible by the human observer, particularly a driver in a moving vehicle. On the other hand, the same technology can be employed so that the time taken to present or remove a message can be extended. This can be achieved in several ways. For example, a multiword message can be "written on" or "erased from" the display face one character or word at a time rather than all at once. Second, on a sign capable of displaying message movement or animation, the first message can be moving across the sign while a new message is also moving in to take its place. Third, the illumination and/or contrast of the message can be varied so that one message appears to fade or dissolve into the subsequent one.

Control of the message change interval should be regulated to ensure that this interval is not obtrusive regardless of the technique utilized to effect the change. In other words, if the message change is accomplished by a change in illumination intensity, this change must be accomplished in the shortest possible time permitted by the system hardware and software, with the further restriction that no discrete messages will ever overlap on the display, nor would one message ever appear to gradually fade or dissolve into the next. Likewise, regulations should ensure that no message would appear to be written on or erased from the display piecemeal, i.e., less than the entire message at once. If such a partial image-change technique is required by a particular control system technology, a maximum time limit should be set for the complete message change such that the passing motorist is unable to read (and is not "compelled" to try to read) the message during the change. It is suggested that the figure commonly used as a measure of average glance duration, 0.3 second, be used here as a maximum permissible message change time limit. . . .

H. **Total Length of Information Cycle**. The goal being sought in the regulation of the information cycle length is that of allowing the passing motorist to comfortably read the entire message without an excessive added burden to his information processing workload; and of minimizing the sense of anticipation felt by the motorist while waiting to see what the next display will be, which could compel the driver to fix his attention on the variable message sign at the expense of his other tasks.

Information cycle length can be a function of the type of sign used and the nature of the information being transmitted, as well as the actual amount of material to be communicated. At one extreme is the unchanging, fixed message sign. In this case there is no information cycle per se, so the driver may read the sign when it is most convenient for him, provided his transit time is long enough for the text length. The simplest sign that may be regarded as having a measurable information cycle is that of the two-message alternating display. The most common form of this is the time and temperature sign. . . .

Clearly, this type of sign can have its information cycle length extended by the addition of a third message (e.g. the name of the business providing the sign), or by increasing the complexity of the present message (perhaps by displaying temperature in both degrees Fahrenheit and centigrade). Adding to the message complexity requires a longer time commitment by the driver to read and interpret the sign. Adding an additional message not only increases this time commitment, but increases the compelling characteristic of the sign as well. This situation is exacerbated with the type of sign in which several sequential displays are required to form one thought. Here, the motorist's compulsion to attend to the sign is greatly increased due to the psychological difficulty of leaving a task when it is incomplete. (This phenomenon is well documented in the psychological literature and is known as the Zeigarnik effect.) The famous "Burma Shave" signs were early examples of the commercially successful use of this concept. . . .

A different problem arises in the case of a sign where many independent messages are displayed sequentially. This might commonly occur in a regional shopping center, where the management erects an electronic, variable message sign and grants each member business "equal time." . . . When many merchants are involved, it is impossible to display every message in the short time that the sign is readable to the passing motorist. In order to minimize the compelling nature of the display caused by the driver's desire to read every message, and to prevent the motorist from committing potentially unsafe driving acts (drastic speed reduction, lane change, etc.) in a (possibly) futile attempt to do so, it becomes necessary to extend the total information cycle by con-

straining the message change interval at the low end. Specifically, it should be required that each message be held on display long enough for the sign to appear to be unchanging to any given motorist. While there is a high likelihood that a message change will occur within a particular motorist's field of view, the compelling qualities of the display will be minimized due to the long message "on-time" coupled with the fact that any one motorist will see at most one such message during a particular trip.

A worst-case condition occurs with a running message sign, in which the display is capable of continuous movement, and cannot be said to have a finite length. . . . As discussed in section K of this chapter, it is recommended that such signs be prohibited in those areas controlled under the Highway Beautification Act, as amended.

It should be noted that certain types of signs might possess information cycles even though their actual messages do not change. . . . The preprogrammed changes of color, pattern, and sequence of their lamps, however, effectively create information cycles. In the case of the Uniroyal sign, this information cycle lasts four hours. Clearly, any signs that have an information cycle but do not change messages should not be permitted on the roadside.

In summary, signs that are capable of displaying motion or animation, and signs that display information cycles without changing the texts of their messages, should be prohibited under the Highway Beautification Act amendments. Those signs on which many independent messages are displayed sequentially should maintain a minimum "on-time" for each message calculated to be such that a motorist traveling the affected road at the 85th percentile speed would be able to read not more than one complete or two partial messages in the time required to approach and pass the sign. In no case, however, should this on-time be less than four seconds. Since the average glance duration is generally accepted to be 0.3 second, a display time per message of four seconds would require less than 10 percent of the driver's available visual search time. A shorter display time could be too demanding when there are more competing needs for the motorist's attention.

In the case of signs on which a complete message requires several sequential partial presentations the situation is more complex, but formulae can readily be derived to compute acceptable ranges of total information cycle lengths for different highway/traffic/signing conditions. For any chosen vehicle speed, sign size, and distance from the road, a total information cycle time (taking into account message "on," "off," and "change" time) could be derived from knowledge of the number of display changes required, and the number of words and lines per display. Since the display details will obviously change over time, the regulation should be based upon a hypothetical worst case, and should incorporate such stipulations into its text. Any formula to be developed for this type of sign would have as its criterion the capability for a motorist, driving at the 85th percentile speed, to read the sign's entire message (within certain limits) without any undue increase in his processing workload. This goal would have to be met no matter where in the display cycle the motorist was first able to read the sign.

It is believed that, if the driver is given sufficient time to read the complete message, and can be reassured that he has, in fact, seen the entire display, he will be less compelled to continue looking at the sign with a possible adverse impact on his driving performance. By extension, when the series of sequential messages is too long for a passing motorist to read, the potential compulsion should be minimized by greatly extending the display change cycle as discussed above. And, in those cases where the display changes without a change of message, or where a message has the capability of continuous motion, the compulsion should be avoided by banning the signs from the roadside.

I. **Rate of Intensity or Contrast Change**. Refer to **Duration of Message Change Interval**.

J. **Flashing Signs and Lights**. The critical parameters for a sign or light to be designated as flashing concern the relative durations of the "on" and "off" phases of the signal, the pattern of these phases, the rise and decay time required for the signal to achieve maximum and minimum intensity, respectively, and the relative brightness of the "on" and "off" signal phases. In fact, a sign or lamp need not be completely extinguished between "on" phases to be designated as flashing. A perceptible change of brightness between the "on" and "off" phases is sufficient. The issues of signal brightness and contrast will be dealt with in another section. For the purpose of defining the operational use of the term "flashing" it does not matter whether the sign displays the

same message repeatedly or if the message changes periodically or with each cycle. The main factor of concern is the attention-getting nature of the signal, as governed by its flashing characteristic, which, intentionally or not, can capture and hold the motorist's attention even before he can read the message.

. . .

The objective of any regulation governing flashing signs or lights for roadside commercial use should be to minimize the likelihood of potentially hazardous attention-getting or distracting properties, while permitting signs which present messages which can change over time. The safety goal is to permit the messages to be changed in an unobtrusive manner, so as to avoid introducing a novel or distracting visual element into the driver's perceptible environment.

To this end it is suggested that any commercial sign visible from the highway be specifically prohibited from flashing (as defined below) if it displays a message of unchanging text. The illumination of or within such a sign should be regulated to permit a maximum of two "on" and "off" phases within any 24-hour period, unless such illumination is controlled by a device that senses the outdoor, ambient illumination in the immediate vicinity of the sign. Such signs should be permitted to cycle on and off as the ambient illumination under natural conditions changes about a level as yet undefined. These two proposals may seem somewhat arbitrary, but they have been based upon analysis that considered daylight versus night conditions; weather; periods of rush-hour traffic; and business operating hours.

For all roadside commercial signs subject to regulation which present messages whose text changes over time, the safety goal of unobtrusive message changes can be met by optimizing two parameters: a) maximization of the length of the signal "on-time" as a percentage of the total cycle; and b) minimization of the flash rate or number of periods per unit time in which the signal is on. For example, a signal that is "on" 50 percent of the time (a 50 percent duty cycle) and has a flash rate of 10 cycles per minute would yield a display that is on for 3 seconds, off for 3 seconds, etc. Obviously, the goal of a near steady-state (non-flashing) signal can be achieved by maximizing the duty cycle to nearly 100 percent and minimizing the flash rate, possibly to a value of 3 per minute or less. A sign displaying a message requiring sequential displays, however, needs a flash rate high enough for the entire sequence to be read by the passing motorist without demanding an undue degree of the driver's attentional capacity. The duty cycle issue can be resolved easily (the "off-time" figure required to be as brief as the actual time required to replace one message with another by the system hardware and software in conjunction with minimum performance standards), but an acceptable flash rate must be based upon research through which the tradeoff between the motorist's ability to read the entire message and a flash-rate low enough to avoid excessive attentional attraction can be optimized empirically. The resolution of this issue will also have to take into account the maximum message length (total informational cycle) that the motorist is expected to read, and his compulsion to read the entire text.

An initial approach to this problem might proceed as follows. Assume that the goal is that the "average motorist" (one traveling at the 85th percentile speed, perhaps) be able to read a sign's complete message during a fixed percentage (perhaps 30 percent) of the time it will take him to travel from the point at which the sign's message is first legible until he passes it. Then the flash rate would be determined to be that subdivision of the total information cycle length that allows the entire message to be seen once in that time period. For further discussion of this issue refer to **H. Total Length of the Informational Cycle.**

K. **Brightness and Contrast**. Like the issue of letter and sign size discussed in a later section, the major parameters affecting sign legibility due to brightness and contrast are well documented in the human factors literature. . . . Under daytime conditions it is usually irrelevant to talk about a sign that is too bright or contains too much contrast. At night, however, this is not the case. Here, the range of brightness acceptable for sign legibility depends largely on ambient lighting conditions. Brightly lit urban areas, the glare of oncoming headlights, or competition from nearby illuminated signs can all interfere with the driver's ability to read the message on a particular sign. Worse, a commercial sign of brightness and/or contrast that is too high for the particular circumstances of its placement can lead to the driver's inability to read nearby official signs or can temporarily destroy his night vision (of importance for hazard detecting and seeing roadway delineation) under otherwise low illumination nighttime conditions. Thus, it is crucial that upper limits on

sign brightness and contrast be established for CEVMS in nighttime use. The advertiser should not be restricted on the low end of brightness or contrast under the reasonable assumption that he will take care to design a sign that meets at least the standards of good human factors practice for ease and comfort of reading.

. . .

Lighting engineers and designers speak of two phenomena which may be caused by excessive illumination, and which are closely related. These are disability glare (the more severe), and discomfort glare. The former often results in a reduction in contrast of the visual stimulus. . . ., and may adversely affect the driver's ability to read a sign; the latter, as its name implies, makes the sign reading task less pleasant, and may affect the effort which the driver will make to read a sign. Glare sources, some of which were mentioned above, will additionally impair seeing at night since they can change the eye's pupil size and its degree of dark adaptation. Obviously, a bright illuminated sign, or simply a sign of high luminance, may affect sign reading comfort or ability not only of its own message, but those of nearby signs and road markings as well. When it is remembered that a brightly lit advertising sign could act as a glare source, conceivably affecting the driver's ease of reading official signs and markings, it becomes clear why regulations establishing upper limits on CEVMS nighttime luminance must be set so as to avoid possible discomfort glare. Such limits are not easily defined, and should be subject to empirical validation.

L. **Animation and Message Flow.** The one characteristic of a sign or light bank, which has perhaps the greatest potential for motorist distraction as well as a dominant impact on the aesthetic environment, is motion or the illusion of motion of lights or other display features. Signs possessing such capabilities have been variously referred to as animated, chasing, scintillating, or traveling, among others. The unifying feature among them is the appearance of movement, either of lights themselves, or of letters, numbers, characters, or graphics that are often comprised of many individual light bulbs. The electronic, remote control of the displayed image which is a hallmark of the type of signs addressed in this report, coupled with the programmable features of the state-of-the-art display technology being discussed, permit such signs to offer animation and message flow quite readily. Such signs can be visually captivating, and their traditional use on movie theatres, the Las Vegas and Times Square commercial strips, and, increasingly, on major sports stadium scoreboards emphasizes this point. Clearly, however, they have no place on or alongside our Nation's highways, where their very advantages can cause a serious problem of distraction of attention from the driver's task. It is recommended that signs that convey an appearance of movement or animation in any form should not be permitted in those areas controlled by the Highway Beautification Act, as amended.

Specifically excluded from this section, and addressed in other sections of this chapter, are signs in which the message may be changed, electronically or mechanically, by the appearance of complete substitution or replacement of one display by another, but in which the appearance of movement during message display, or of messages appearing to move across the display face, is not present. The distinction being made is that of a changeable message display, in which a message being presented is visually removed and then replaced with another, versus and animated, moving, or dissolving display in which part or all of a message displayed on the sign appears to move during the time it is intended to be read.

M. **Size of Sign and Lettering**. It is not the function of this report to prescribe to the advertising industry the optimum human factors display characteristics for their products. Yet, with regard to choice of character size, spacing, and typeface used on CEVMS visible from the highway, the goals of the highway safety specialist are closely aligned with those of the advertiser. The reason for this is straightforward. In order for the advertiser's message to be conveyed to the motorist quickly, clearly, and unambiguously, the display should be designed with full understanding if the constraints imposed by vehicle speed and vibration, diverse lighting and weather conditions, and the need for driver time-sharing among simultaneous, competing tasks. As the readability of a particular display is degraded, the likelihood of the message is being completely and accurately read and understood diminishes. This is because the motorist will require more of his already limited time to read the sign because he begins to read it later than he otherwise would, or because he chooses to ignore it rather than struggle to read it.

Accordingly, commercial sign display characteristics relating to sign size and to character size, spacing, and typeface should be chosen with the guidance of one of the many excellent human factors design guidelines available for this purpose—with careful attention paid to environmental constraints under which signs will often have to be read.

Of course, it is entirely possible to erect a sign of a size and with characters so large that readability is no problem. On the other hand, such a sign would be likely to create potential for motorist distraction, and would probably be judged as more deleterious to the aesthetic environment as well. Thus, where existing regulations do not apply it will be necessary to develop guidelines for maximum limitations on sign and character size for commercial electronic variable message signs.

N. **Primacy of Information**. Traffic safety and human factors research indicate that priorities must be maintained in providing information to motorists while they are driving. In regulating display of information in roadside areas, primacy must be given to messages that relate directly to driving tasks and coping with traffic situations. This principle has been referred to earlier in the recommended regulation of longitudinal location of CEVMS in order to reduce the risk of driver distraction in the vicinity of interchanges, intersections, and other major driving decision points, and in the recommended location of such signs so as to avoid interference with the easy identification and recognition of traffic control devices.

Application of the principle of primacy to the problem of assuring the necessary functional balance of information displayed in roadside areas involves regulating the message content of signage. Traditionally, on-premise signage has been used for a wide variety of purposes, including identification of a business site, advertising goods or services for sale, entertaining viewers or providing public service information, and giving directions into and about the business site.

Electronic variable-message signs are capable of all of these uses. The necessity for primacy of information responsive to motorist's information and direction-finding needs suggests that their use should concentrate on messages that identify business sites, give directions into the site and its facilities (parking and loading areas, internal circulation pattern), goods or services available, and other information necessary to use the site (e.g., hours of operation).

The principle of primacy of information is recognized in the Highway Beautification Act's provisions for assuring that adequate directional signing and travel information are available to motorists. It is also applied in Federal Regulations regarding priorities for removal of nonconforming signs, and in standards that prohibit in certain locations the display of information not related to motorist needs or traffic operations. But while relevant legislation and court decisions appear to be broad enough to permit promulgation of standards requiring CEVMS to give primacy to certain types of information, the problem of enforcing such standards is formidable. The ease with which CEVMS information displays can be changed, in some cases almost instantaneously, means that compliance with primacy standards must rely almost entirely on the self-restraint of individual sign owners and operators. While a sign operator's record of responsibility in this matter might be considered a relevant factor in determining fitness for a license to display a CEVMS, the day-to-day detection and correction of failures to observe information primacy principles is clearly a difficult administrative aspect of this matter.

O. **Maintenance Requirements**. Since the communication function of CEVMS requires that mechanical, electrical, and electronic elements be maintained in proper operating condition, it is essential that standards for such signage include a requirement that they shall be maintained in good repair at all times.

Where light bulbs comprising part of a message display are not working, they can present an unintelligible pattern that frustrates the viewer's expectations and holds his attention for longer than normal recognition and comprehension time. For motorist viewers this may be a particular safety hazard under certain traffic conditions. Similar risks may result where the message display panel uses mechanical devices or is controlled by electronic means and these elements malfunction.

The CEVMS cabinet should receive regular maintenance, and repair or replacement when needed, since this housing may affect both the operational and aesthetic aspects of the sign. Cabinets that are not weather proof obviously increase the risk that mechanical, electrical, and electronic elements of the sign will be exposed to damage or deterioration. Also, when the exterior appearance of a cabinet is allowed to deteriorate it

becomes an unattractive feature of the roadside environment, reflecting an unfavorable impression of both the sign site and its advertiser.

Standards may reasonably require that signs shall be kept in good operating condition and external appearance, and such standards are not invalid due to vagueness merely because they fail to specify the particular maintenance or repair measures that must be taken by sign owners. Moreover, such standards may also reasonably provide that failure to keep signs in good operating condition or external appearance will be a basis for forfeiture of permission for operation of such a sign.

NEEDED RESEARCH

A series of three research studies is recommended in order to obtain definitive answers to those safety and environmental questions raised in the body of the report, which, after prolonged debate in the research literature, still are not settled. The three questions, which correspond to the three research studies to be described below, can be broadly summarized as follows:

1. Is there a demonstrable relationship between the presence of roadside commercial advertising signs in general and CEVMS in particular, and driver distraction, information processing ability, or workload?
2. If the answer to question 1 is yes, can those features and other characteristics of signs . . . which are thought to contribute to this established relationship can be empirically identified, and can the critical parameters of each contributing feature be specified?
3. Through empirical testing, can a relationship be demonstrated between roadside commercial advertising signs, and specifically CEVMS, and the aesthetic impact of the roadside environment upon highway travelers and adjacent property users?