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THE UNIVERSITY OF NORTH CAROLINA
HIGHWAY SAFETY
RESEARCH CENTER

Testimony to
Subcommittee on Transportation
of the
Appropriations Committee
U.S. House of Representatives

by

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THE NEED FOR A PROTOTYPE MODERN HIGHWAY SAFETY INFORMATION MANAGEMENT SYSTEM

I would like to thank you for this opportunity to appear before you and to provide testimony concerning the need for development of a prototype Modern Highway Safety Information Management System in the State of North Carolina. I would also like to thank you, the members of this Subcommittee and the members of the Appropriations Committee for your continuing interest in, and your support for transportation, and particularly for highway safety research. It is only through your support that state and local agencies, universities and private research centers are able to continue to deal with the increasing traffic demands being placed on our roadway system and to do so in a manner which does not jeopardize the safety of the user.

I am Forrest M. Council, Interim Director of the University of North Carolina Highway Safety Research Center. The Center was established in 1966 to evaluate North Carolina state based highway safety programs, to conduct research on issues of national importance, to train practitioners in the field of highway safety, and to provide public service to local communities using their safety programs. In our 26-year history, we have conducted projects for both FHWA and NHTSA, for various private funding agencies, and for various state agencies within our state through a cooperative relationships with the North Carolina Governor's Highway Safety Program.

I will provide you with my thoughts concerning the need for a improved highway safety information management system. The key points that I will make in the presentation can be summarized as follows:

- that decisions concerning roadway design, maintenance, roadway rehabilitation, and the treatment of hazardous locations are based on short and long-term cost to society, and a major, but often overlooked, cost is that cost associated with death and injury resulting from motor vehicle crashes.

- that the planning required to reduce these motor vehicle crash costs cannot be done without knowledge of how alternative roadway designs affect accidents, or without knowledge of which of the existing roadway locations are the most hazardous.

- that this needed knowledge cannot be developed without good crash and roadway inventory data, and that these data sets are of limited use unless they can be accurately and efficiently linked together. Such linkage requires the precise location of each crash and each section of roadway.

- that accuracy in the locations of accidents requires moving to new technologies such as the use of Global Positioning Systems in conjunction with Geographic Information Systems.

- that even with these new location technologies, the efficient and effective linkage and use of the data requires new database management computer software and programs. In addition, to use the

existing data that has cost millions of dollars to collect in a cost-effective manner will require large scale data conversion efforts.

- that federal dollars are needed to do this work and that North Carolina is the best state to serve as a national model for this effort.

My testimony is based on 20 years of personal experience with traffic records systems for North Carolina and from a number of other states across the nation, and from HSRC's corporate history in developing and using these traffic records systems. Because the research our Center conducts primarily involves the statistical analysis of existing data files, our overall history is aimed toward improvement of the quality of the data that we and other users work with, and toward finding better ways for linking various data bases so that combined data can provide even more useful information. Our staff were key players in the development of the existing NC data system which links accident and roadway information, and I can assure you that we all agree that the system is in great need of overhaul. We and other computer specialists did the best we could do with the available resources at time, but there have not been adequate dollars available to allow either our staff or any of the other state agencies to carry out the needed upgrading and maintenance of the state's data system. In terms of additional expertise, I am currently the director of a research project in which HSRC developed the Federal Highway Administration's Highway Safety Information System -- the five state data base used by FHWA to conduct internal and external analyses related to roadway safety questions that they are interested in. My experience with the data from these other states has provided me with additional knowledge of the needs for such an improved data base system.

The Need for a Highway Safety Information Management System

As noted above, the need for a Modern Highway Safety Information Management System is based on the fact that decisions concerning roadway design, maintenance, and rehabilitation are primarily based on cost. Particularly in these times of budget restriction, engineers and planners are faced with the need to minimize the short-term and long-term costs of their designs to the extent possible, and to assure that the benefits the user derives are greater than or equal to the costs. The major types of costs considered are usually political, environmental, construction, maintenance, and rehabilitation related.

However, although sometimes overlooked, there is an additional major component of the societal cost associated with these roadway programs. This is the cost of motor vehicle crashes, or more specifically, the cost of injuries and deaths which result from these crashes. Indeed the societal economic loss per motor vehicle death (based to a large extent on a number of years of productive life lost) is more than three times the economic loss due to cancer death, and six times the economic loss from each death resulting from cardiovascular disease. Motor vehicle injuries are the leading cause of

injury deaths (30 percent of the total), the second leading cause of hospitalization (22 percent of the total), and result in the largest share of the long-term economic cost related to all injuries in the U.S. Motor vehicle injuries alone are costing our society approximately 49 billion dollars per year in long-term economic costs.[1]

Based on the recent work for the Federal Highway Administration, it is estimated that the societal costs of the average motor vehicle crash on a rural two-lane road is approximately $59,000, that the societal cost of a fatal accident is approximately $1.8 million, and the cost of a serious injury crash is approximately $50,000.[2] While there is no question that it is very difficult to place a value on a human life, particularly if this human life is mine or yours, in a political decision-making process, the engineer or the policy maker is forced to somehow compare the direct program related dollar cost he sees with the dollar savings that might result in terms of motorist's delay or in terms of motorist's injury or death. Thus, the concept of economic losses from accident risks must be faced.

And there is clear evidence that these long-term monetary and emotional costs of motor vehicle crashes can be reduced through well-designed roadway systems. For example, recent research conducted by our staff members at HSRC have shown that the widening of pavement and shoulder on deficient curves can reduce run-off-road accidents by as much as 20-30%.[3] Flattening a roadside sideslope from a 2:1 slope to a 6:1 slope can reduce single vehicle accidents by approximately 30% by providing a more forgiving clearzone.[4] In like fashion, crash cushions protecting hazardous roadside object that cannot be removed virtually eliminate the probability of fatality for occupants of vehicle which run-off or forced off the roadway.[5]

However, the research and engineering community cannot define what a "good design" from a crash risk perspective is without knowing precisely the relationships between various design alternatives (e.g., curves of various degrees of sharpness, lane and shoulders of various widths of types, sideslopes of various angles, etc.) and the related changes in the frequency, rate and severity of motor vehicle crashes.

Just as important from the perspective of traffic engineers in North Carolina and other states are specific problems which result in a high number or rate of crashes at a specific location. In order to treat the problems at these locations, the locations must be identified accurately (based on accident data which is correctly linked to a given location), and there must be detailed accident data available for use in planning the treatments for each site.

To develop this knowledge of the relationships between design and safety and to identify problem locations and analyze them, requires three components.

- a computerized system of data files in which each reportable accident that occurs on any section of roadway on the state system is accurately located.

- a computerized system which contains accurate inventory characteristics for each piece of roadway on the system. That is, for each location on the primary roadway system to be monitored, we need information concerning how wide the road is, how sharp the curve, how wide the shoulders, how many lanes are present, the width of the median, the design of the intersection, etc. In addition, we need to know exactly where the section or intersection in question is located.

- a computer system that can accurately and efficiently link these different data elements from the different key files -- accident files, roadway inventory files, intersection files, pavement files, bridge inventory files, etc.

With respect to the third point, the need for a computer system that can accurately link the different key files, it is noted that the linkage of files has to be based on a consistent and accurate system of locating the data on the roadway system -- "mapping" the accident or the inventory section or the bridge to a location on the existing highway system. The common linkage information used in most states (North Carolina included) has been known as a "county/route/milepost" system. To understand this system, one needs to visualize a stretch of roadway as consisting of a series of "homogeneous sections" -- short sections of roadway in which all of the characteristics of the roadway are basically the same. When a major characteristic changes, then a new section is begun. Each of these short homogeneous roadway sections is defined by a beginning and ending point, and each of these two points is described as being within a certain county, on a certain route, and some number of miles from the beginning of the route (hence, county/route/ milepost). Accidents are located using the same basic system. However, it is noted that not all files that are needed in safety and analysis use this system. For example, bridge inventory files quite often use a different reference system than do accident and roadway inventory files, and pavement files may be totally unique.

The states are now moving to a new type of location system -- Geographic Information System (GIS) -- in which instead of using county/route/milepost to designate the beginning and ending of a section or the location of an accident on the roadway, the latitude and longitude of the point is used. What is important to note here however, is that in order for a GIS system to be useful in terms of safety analysis, all of the old county-route-milepost points for the homogeneous sections of roadways and all of the old county-route-milepost locations for accidents must now be converted to GIS based longitudes and latitudes, a very expensive conversion process. Once this one-shot conversion is done, old data are available for use. The importance of the availability of the old accident data lies in the need for multiple years of data for meaningful analysis due to the low number of crashes that occur at any given location in any given year. The importance of conversion of the old inventory data stems from the very high costs which would be incurred from beginning a new inventory file from scratch. North Carolina and other states have spent millions of dollars over the years in computerizing the accident and inventory data, and to waste this investment would be very poor planning.

The computer software and merging programs necessary to accurately and efficiently carry out the necessary merging of, say, accident data with roadway inventory data, are very complex programs. As noted above, the existing merging systems in North Carolina and in other states were developed manually by computer staff within the states. Computer programming and data storage and retrieval methods of past generations were used in this development. Currently, some states are making use of new computer database management capabilities provided under new software. These new software packages are much more efficient and effective in manipulating data and providing accurate, efficient, and effective output for the engineer, policy maker, and safety analyst.

Problems That Must be Addressed in the Development of the Highway Safety Information Management System

As stated to above, there are three key problems that must be addressed before an effective and efficient highway safety information management system is in place. These are (1) inaccurate accident locations, (2) non-standard location variables on different files, and (3) outdated data management systems.

The first of these major problems is existing inaccuracies in the location of accidents by investigating officers. Under most existing reporting systems, the officer locates a crash site by noting the county, the route, and then providing a distance from a nearby reference point such as an intersection, a bridge, or a city boundary. As can be seen, the mileage part of this estimate is critical to accurately locating the crash. However, in most cases, this is an estimate of mileage, rather than an actual measure of mileage to, say, the nearest hundredth of a mile. If the officer's estimate misses the true location, then the accident would be erroneously "placed" on a different section of roadway which may have different characteristics or at a different intersection from where it actually occurred. This is a particularly troubling problem in our efforts to identify hazardous locations for treatment. If the accident location is not accurate, then truly hazardous locations will remain unidentified because of accidents erroneously mileposted to the wrong location, and some treatment dollars may be erroneously spend on locations which show up as "hazardous" because accidents from other nearby locations are placed there. Based on some past analysis we have done, we know that these are estimates in that it appears that the most "dangerous" place on any roadway in our state and other states is either one-tenth, one-half, or one mile from some point. Clearly, this a move uniform distribution of distances would expected if milages were measured rather than estimated.

The second problem noted above is the use of inconsistent location systems across the different files that need to be merged. As noted earlier, the main location system currently used is some variation of county/route/-milepost system. One problem with such a system is that when a roadway is lengthened or shortened, say through changes in curvature and/or a bypass, then all of the mileposts of all downstream sections must be modified. This is not done on a timely basis in most states, and thus, leads to some accumulation of inaccuracies over time. As noted earlier, in addition to

these inaccuracies, different files within the same state may use different location systems.

The third problem noted is the use of outdated data management (computer software systems). In North Carolina, as well as in other states, there is a tremendous amount of data that must be manipulated by the computer in any safety-related study that is conducted. For example, there are approximately 110,000 sections of the roadway in North Carolina within the 77,000 miles of roadway that the state system covers. Each of these individual sections characterized by 75 inventory characteristics. There are approximately 125 variables collected on each of 175,000 accidents each year. Thus, there are huge sets of data that must be manipulated by the computer each time a run related to safety analysis is conducted. In addition, using the current limited number of files which can be fully merged and linked together, we are missing very valuable information which might be obtained from other files from outside DOT agencies, files such as information on roadside development. This data is available in most GIS-based systems, but is not available to the safety manager unless these GIS systems can be merged and linked accurately with the roadway inventory and accident systems.

However, as noted earlier, the most telling characteristic of the existing North Carolina data management system is that it clearly is far "behind the times" in terms of data management capability. It was a manually developed system and was patched over the years where possible. We, like other states, desperately need to convert to new computer data-based management technology.

The Modern Highway Safety Information Management System as the Answer

We in North Carolina feel that funding of this proposed modern highway safety information management system will provide solutions to the above stated problems. First, the funding will allow us to convert all of our applicable safety-related files to the most recent location technology available -- GIS technology. The use of this system then will allow us to merge accident information with roadway inventory, bridge information, pavement inventory, and other information. And, in turn, it will allow us to access other files not now available to us.

Second, the funding will allow us to improve to a very significant degree the accuracy of accident locations through the use of Global Positioning System (GPS) technology. Through use of receivers in police vehicles at the site of an accident, the officer will be able to obtain and record an accurate longitude and latitude reading for the location. This accurate location of accidents will in turn allow us to link accurately with roadway inventory information, the second key piece of the analysis puzzle. that needs to fit.

Third, the system will allow us to convert what are now outdated computer software systems to newer database management systems. Such conversion will provide the capability of much more efficient and accurate merging of the necessary files, updating of the data in a consistent and

timely manner, and using the data in problem identification and safety research analysis.

Fourth, as an additional benefit to those cited above, upgrading of the overall NC accident records system will also allow us to better pursue a final goal -- the merging of detailed injury data from Trauma Registries, hospital emergency departments, and ambulance call reports with accident data. Currently, our identification of problems and attempts to develop solutions are based on estimates of injury provided by the officer at the scene of the crash. While this data has proven to be enormously useful in safety efforts over the past 20 years, better data on the specifics of injury (e.g., part of body part injured, precise degree of injury severity, etc.) would allow us to determine the effects of severity-reducing treatments such as breakaway sign post, guardrails, and crash cushions with even more precision. In like fashion, this enhanced injury data will provide much better measures of the effectiveness of occupant restraints or other factors related to vehicle design, and will allow us to better study the injuries suffered by the elderly driver and other special subpopulation in vehicle and pedestrian crashes. North Carolina is currently studying the ways in which such trauma and crash data might be merged and the benefits of the combined information. Funding for the Modern Highway Safety Information Management System will hopefully allow us to reach this goal.

North Carolina as the Location for the Model Federally Funded System

North Carolina is the best state for a national demonstration of such a Highway Safety Information Management System due to our history in the traffic records area, the huge amount of roadway under state control, and the interest and expertise of key players.

As noted earlier, North Carolina has a long history of effort and excellence in accident and roadway inventory data collection and computerization and in safety analysis. Unfortunately, our past efforts which have involved large expenditures of funds by the state, no longer leave us with an up-to-date, efficient system. This indeed, makes us very similar to many of the other states in the nation. The difference between us and other states is that our history in traffic records systems development work has provided us with the necessary knowledge of the problems and the "bureaucratic will" to make the necessary improvements.

Second, as noted above, North Carolina has a very large amount of roadway under state control, approximately 77,000 miles, more than most other states. The point here is that, if such a model can be demonstrated to be feasible in our state with our massive system and data files, then it should work in other states.

Finally, the key players in North Carolina are extremely interested in attempting to update our system. We not only have a very active State Highway Patrol who consistently investigates virtually all accidents in rural areas across the state, but also urban police agencies who uses the same accident report form as the Patrol, and who have worked consistently through the years to provide accurate accident information. In addition, various departments

within the Division of Highways are working with the accident and inventory data, are knowledgeable about the problems and needs, and are committed to system improvements. Finally, we at the Highway Safety Research Center continue our very active participation in the development of sound systems in our state, particularly these can be models for other states.

Funding for this system is, in my opinion, a legitimate expenditure of Federal funds since this is a demonstration effort which, if successful, can serve as a model for many more states across the nation. The move to increased emphasis on highway safety in our planning and design is a congressionally mandated responsibility. This management system is needed to succeed in this effort. NC is requesting this Federal initiation funding, and then the state will maintain the system using its own resources. As with most states, without this large one-time expenditure dollars, this system will likely not be upgraded anytime in the near future.

The Difference in this System and the HSIS.

Finally, there appears to be some confusion between this request for the Modern Highway Safety Information Management System and the Highway Safety Information System that HSRC is involved in for the Federal Highway Administration. I note that FHWA's Highway Safety Information System is using the information from accident, roadway inventory, traffic data bases from five states -- Minnesota, Maine, Illinois, Utah, and Michigan. Our staff take raw data from these data bases in each state, prepared them in standard research formats, and merge them for specific analysis questions of interest for FHWA. While the choice of states was based on the accuracy and completeness of the existing data base, the HSIS project does not attempt to enhance the participating states computer systems or data bases, except in the limited cases when HSRC or other HSIS staff find data errors in specific variables, and the information is passed back to the states for their own use. Enhancement of the individual states data base is far beyond the financial scope of the HSIS project. Indeed, enhancing even one state's data base would cost 5-10 times the level of funding under the HSIS project.

On the other hand, the Highway Safety Information Management System project that we're discussing here involves the enhancement of the North Carolina data bases by addressing the inherent problems associated with the data base itself and all phases of the fragmented/highway record system including the analysis and management process. The proposed system begins with improving the collection process and includes revamping the data base and management/retrieval process using new and advanced technology. While the data from the proposed North Carolina system may be used by the Highway Safety Information System project in the future, they are clearly separate entities. Indeed, given the fact that accurate locations of roadway inventory sections and accident events are the key to the accuracy of any highway safety analysis system, if given the choice, FHWA would clearly have gone with states that have GIS/GPS systems in place when developing the current HSIS. Unfortunately, no such states existed when the system was developed.

Summary

In summary, it is clear that North Carolina and other state departments of transportation will always use research-based information from the Federal Highway Administration and other states in the development of safety management strategies. However, the key functions of roadway design, maintenance and upgrading, problem identification, treatment design, and evaluation of effectiveness of safety related projects within each state will remain the primary responsibility of the state. Proper management of such safety issues cannot be successfully carried out without accessible and usable safety information, which in turn, requires coordination of existing data bases and the continual enhancement of the data when technology allows. We feel that the development of the Modern Highway Safety Information Management System will provide North Carolina with the safety information necessary to manage safety decisions. In like fashion, it will serve as a model for the needed state-base systems in other states.

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