Is a strong safety culture taking root in our highway agencies?

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Introduction

The purpose of this paper is to present an exploratory investigation into the relationship between safety legislation for transportation planning and the nature of the safety culture that has developed in highway agencies. An effective and efficient transportation system has long been a national priority, and safety is a major goal of the transportation system, but has a strong safety culture taken root in our highway agencies? This paper investigates the major transportation and safety related legislation of the last fifteen years and considers the effects of legislation on the safety culture of highway agencies, especially State Departments of Transportation (DOTs).

During the last 15 years, legislation has moved purposefully towards making safety a central, explicit, comprehensive, and integrated part of transportation planning. Safety management systems have advanced. Data and analytical tools have been improved and refined, and the effects of countermeasures have become better understood. The recently enacted Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU) builds on previous legislation in giving specific and increasing recognition to safety issues.

Major highway agencies such as DOTs, metropolitan planning organizations (MPOs), transit agencies, and local governments are usually large, well-established organizations where change may not come naturally. How do agencies vary in their commitment to safety? Has safety become a more explicit and fully integrated part of all aspects of transportation planning?

Safety legislation can lay out requirements for highway agencies to bring about the implementation of the legislation and can support those requirements with the carrot of project funding and the stick of penalties, but the legislation's ultimate success or failure in reducing fatalities and injuries is likely to be affected by the ability of individual agencies to implement the legislation effectively and to sustain it by means of a strong safety culture. Such a culture would accept and adopt the legislation in the full spirit intended and would succeed in entrenching safety as its central and permanent focus for decision making.

Understanding the relationship between legislation and safety culture

A preliminary literature review reveals very limited information on the relationship between legislation and safety culture. The gap in our knowledge may be attributed partly to the difficulties associated with considering the complex and abstract issues involved in discussing "safety culture," but suggests that we need to start right at the beginning with our investigations.

The goal of understanding the relationship between safety legislation and the safety culture within DOTs will require analysis of a large number of issues:

- Definition of safety culture for highway agencies.
- Measurement of the safety culture of highway agencies.
  - appropriate methods for quantifying safety culture
  - data required for quantifying safety culture
  - criteria that define and quantify a strong/weak safety culture
  - specific measures or attributes of safety culture that are strong predictors of success in reducing fatalities and injuries
- Developments in safety legislation.
  - how highway agencies have responded to past legislation, for example, to safety management systems (lessons learned), including case studies
  - how highway agencies are responding to current legislation (lessons learned), including case studies, and how agencies are monitoring the effects of SAFETEA-LU in reducing fatalities and injuries in relation to the type of safety culture found within State DOTs
  - how other (non-legislative) developments have affected the safety culture of highway agencies
- The nature of the safety culture currently found in highway agencies.
  - major issues that are affecting the way safety culture is evolving
  - ways in which some agencies have created and maintained a successful safety culture
- Lessons learned about highway agencies' ability to change their safety culture, including case studies.

The task of finding answers to the issues listed faces specific challenges including: the need to define institutional safety culture, the lack of past research, the lack of past measurements of safety culture and its relationship with legislation, the difficulties involved in making culture a concrete, quantifiable issue, and the need to ensure that the approach is productive and makes a constructive contribution to improving highway safety.

Objectives of this paper

The issues listed above are numerous and ambitious. This paper briefly discusses just three of the issues listed:

- Definition of safety culture for highway agencies.
- Measurement of the safety culture of highway agencies.
- Developments in safety legislation (1991 to 2005).

The paper then discusses examples of the safety culture of highway agencies in Sweden, England, and the United States (national and state levels).

A definition of safety culture for highway agencies

We must start by asking what we mean by institutional safety culture and the safety culture of a DOT. If we were describing the safety culture of the general public, we might point to the public's widespread acceptance of safety measures such as seat belts and zero tolerance for impaired drivers. A positive indication of how the public's safety culture has changed is the surprise that one experiences in 2007 realizing that in the early 1980s, fewer than 20 per cent of drivers used seat belts. A negative indication of how the public's safety culture has changed is today's need to be concerned about aggressive drivers.

At the simplest level, the safety culture of an organization is "the way we do things around here." Historically, industries that are complex and high-risk (such as aviation, nuclear power, mining, chemical processing, and manufacturing) have given the most consideration to safety culture. These industries emphasize the importance of establishing a successful safety culture that thinks about safety constantly, recognizes that an explicit safety approach will prevent accidents, and makes a persistent effort to seek improvements.

The International Atomic Energy Commission Agency (IAEA) definition of safety culture is one of the simplest:

> *Safety culture is that assembly of individual and organizational characteristics and attitudes that ensures that safety is regarded as an overriding priority and that safety issues receive the attention warranted by their significance. (IAEA 1991)*

Measurement of the safety culture of highway agencies

In assessing the safety culture of DOTs, we want to establish where the culture stands on a continuum from strong to weak and where the culture can be improved and strengthened. There are no standardized or "off the shelf" tools for measuring the position of an organization's safety

culture, but surveys and questionnaires have been widely used to assess safety culture within various industries (nuclear power, chemical, construction, manufacturing, etc). Qualitative methods, including focus group discussions and case studies, can also be used.

Several attributes of safety culture may be measured, including:

- Individual and group values, perceptions, attitudes, and behavior regarding safety.
- The commitment of upper-level management to identifying safety as a core value, acting as a "safety champion," providing resources and visible support to safety programs, and maintaining support when resources are scarce or when difficulties arise.
- A clear mission and vision statement with commonly understood and agreed goals.
- The nature and quality of the relationship with other agencies working on safety.
- The organization's safety management system.
- The quality of data and reporting systems (the organization should be a "reporting culture").
- The quality of training programs.
- The level of competency of the organization's safety programs.
- The involvement of all employees.
- The encouragement of new ideas.
- The organization's willingness and ability to learn proactively and to adapt as necessary to change.
- Accountability.

The safety criteria listed above are often discussed in relation to safety management systems. They are clearly tabulated as appraisal criteria in the National Cooperative Highway Research Program's report on Integrated Safety Management Process (Bahar et al. 2003).

In the late 1990s, Zogby, Knipling and Werner noted that the United States has had experience with safety management systems since 1966 (Zogby, Knipling, and Werner undated). An SMS "can be improved through better management," but needs management that goes beyond updating previous work. "Management must consider major events and changes occurring outside of the organization and/or jurisdiction" and must be "action oriented, with a strong emphasis on practical results." Zogby recommends that the leaders of management set the mission statement (because it is the leaders who allocate resources), and he stresses the importance of the mission statement being communicated through every level of the organization (Zogby undated).

No widespread formal studies of the safety culture of DOTs have been found. Informal attempts have been made to assess the safety culture of DOTs by examining the organizational chart (to see, for example, how many designations are specifically for safety) and also by examining the web site and other material produced by the DOT. It may be assumed that a highly open and transparent DOT (with, for example, clearly named contacts and ready access to their phone numbers and email addresses) is likely to have a strong safety culture and "nothing to hide."

Development in safety legislation—1991 to 2005

Legislating for safety has been a long-term and ongoing process. Since 1991, there have been three major Acts: the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), the 1998 Transportation Equity Act for the 21st Century (TEA-21), and the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU.) They are briefly described below.

Intermodal Surface Transportation Efficiency Act (ISTEA) 1991

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 moved the historical focus of highway and transit programs away from construction, capacity, and congestion. The Act changed the emphasis towards mobility and access, system performance, and consideration for the environment and quality of life. Under these three headings, ISTEA required statewide transportation plans to consider 23 planning factors (and metropolitan plans to consider 16 planning factors).

The Act did not specifically mention safety as part of the planning process but mandated six comprehensive management systems including a Safety Management System (SMS) as a pre-requisite for funding. The SMS was part of the strategy to improve the management, operations, and safety of the highway system through improved data analysis and collection, through improved coordination, cooperation, and communication among agencies, and through the development of collaborative strategic plans (Depue 2003).

The emphasis of the ISTEA SMS was on bringing together all the agencies involved in safety and coordinating with other systems and activities (Zogby undated). A 1994 Federal Highway Administration (FHWA) tour to investigate highway safety management practices in Japan, Australia, and New Zealand noted the emphasis these countries put on networking and consensus building among government, industry and citizen groups seeking to improve safety.

Several States embraced the development of an SMS and the associated opportunity to obtain funding while several others struggled with the links between the SMS and federal funding. The SMS (and most of the other mandated management systems) became optional in 1995 under the National Highway System Designation Act.

Transportation Equity Act for the 21st Century (TEA-21) 1998

In 1998, the Transportation Equity Act for the 21st Century (TEA-21) called for comprehensive safety consciousness. The Act required state DOTs (and MPOs) to "increase the safety and security of the transportation system for motorized and non-motorized users." This was the first time that safety became an explicit part of transportation plans. "Prior to TEA-21, safety was sometimes a prominent factor in project development and design, but this legislation calls for

safety consciousness in a more comprehensive, system-wide, multimodal context" (FHWA 2001a). The Act did not, however, separate safety from security and did not require specific reports on how safety was addressed. Under TEA-21, an SMS remained optional.

In 2003, Depue reported on the adoption and implementation of SMSs (Depue 2003). She noted that 26 states had an active SMS approach in 2001 and four states had no SMS process. She concluded that "the opportunity to put the SMS process into practice is being lost in the United States."

Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU) 2005

The Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU) became law in 2005. SAFETEA-LU has a strong focus on integrated, comprehensive safety planning and makes greatly increased funding available. The Act establishes the Highway Safety Improvement Program (HSIP) as a core program and nearly doubles the funds available for infrastructure safety and comprehensive, strategic highway safety planning. The purpose of the HSIP is to reduce fatal and serious/life changing crashes. The program includes planning, implementation, and evaluation of safety programs and projects.

Strategic Highway Safety Plans (SHSP) are a new requirement (under the HSIP) and must be fully linked and integrated with the transportation planning process and associated plans. (From July 1, 2007, all newly adopted statewide and metropolitan transportation plans must be consistent with SAFETEA-LU planning provisions.)

An SHSP is a data-driven, four- to five-year comprehensive safety plan that provides a comprehensive framework, statewide coordination, and specific goals and objectives for reducing highway fatalities and serious injuries on all public roads. The SHSP is a cooperative process that includes input from public and private safety stakeholders.

SAFETEA-LU gives certain safety issues (work zones, older drivers, and pedestrians, including children walking to school) special emphasis in the Act. Security is handled separately. Flexibility is an important part of SAFETEA-LU's approach, allowing states to examine their own circumstances and to concentrate on their most critical safety needs.

The FHWA's view is that "starting the development of an SHSP should not be an overwhelming or arduous task" (FHWA 2006). The American Association of State Highway and Transportation Officials' (AASHTO) "Self-Assessment Tool" (AASHTO 2004) could be used to as one approach to initiate the process and to assess whether a state's current safety efforts are strong or in need of development.

Many of the SAFETEA-LU provisions entail (or may lead to) cultural shifts in the agencies working with the legislation. In the long run, successful achievement of the goals of the legislation will depend on the ability of the appropriate agencies to respond and change. The FHWA and AASHTO have recently completed a SAFETEA-LU workshop during which state officials raised a specific example of an area of concern: collaborating with resource agencies in the area of strategic planning. The workshop found that, "Some states have had difficulty

engaging resource agencies during planning stages. This may be due in part to their lack of familiarity with the planning process, inadequate staff capacity, disagreement about the level of detail necessary, reluctance to waive project-level reviews, or a history of conflict or distrust among agencies. Culturally, some agencies view themselves as "regulatory" rather than "planning" organizations. Moving to a more strategic planning approach often takes considerable time" (Cambridge Systematics 2006).

Additional challenges facing the implementation of SAFETEA-LU include the need for high quality data for improved analysis and the need for committed leaders able to guide the development of SHSPs, promote shared goals, and work effectively with other agencies: "SHSPs need champions that effectively break down stovepipes" (Cambridge Systematics 2006).

Examples of the safety culture of highway agencies

As mentioned earlier, there is very limited information on the safety culture of highway agencies and how that safety culture is related to legislation. This section of the paper first examines two approaches in Europe (Sweden and England) and then examines information from the United States.

The example of Sweden demonstrates the safety culture effects of national-level legislation in which safety is a long-term commitment and a complete priority. The example from England demonstrates the effects of a national initiative that encouraged local authorities to improve safety through a project that both improved short-term safety and created a foundation for a culture change through increased staff motivation and an emphasis on institutional linkages.

Sweden

In1997, the Swedish Parliament passed an Act stating that Sweden's long-term road safety goals were zero fatalities and zero serious injuries. This goal is known as Vision Zero. Vision Zero gives a very clear message to highway agencies that almost every feasible countermeasure designed to reduce the number of fatalities and serious injuries must be implemented. Under Vision Zero, cost-benefit analysis and the most cost-effective solution are not the issue: safety is paramount, and cost and mobility take second place.

It is assumed that drivers make errors and that it is the responsibility of Swedish highway agencies to anticipate the errors and to adapt the road system to bring about the desired goal of zero fatalities and zero serious injuries. This approach demands the long-term commitment of highway agencies, strong leadership, and a strong safety culture that can sustain the processes to achieve the long-term goal.

England

The Gloucester Safer City project provides an example of how the adoption of a new approach and a change in safety culture can improve safety at the small-city level (Department for Transport 2002). The project was part of the British government's 1996 "Safe Town Initiative."

Gloucester is an English city of 100,000 inhabitants. The project's target was a 33% reduction in road casualties by 2002. The approach was based on: a concentrated team effort; taking a systematic city-wide view; implementing proven safety measures; and conducting customized consultations with the residents of each area affected. In particular, highway authorities, district councils and the public worked closely together under a management structure set up especially for the project. Deaths and serious injuries decreased by 38% (the exact time period is not clear).

The report lists four lessons, all of which involved cultural change:

- The enthusiasm of the city's officials and elected members was essential, especially when other agencies were involved in the project. "Enthusiastic staff can help to keep other agencies committed."
- The systematic application of a formally adopted and published urban "safety management strategy" was a great help in guiding the project's progress.
- The team placed priority on good consultation including (although time-consuming) clear feedback to the public.
- The management structure was effective and essential to the success of the project. It succeeded in bringing about close co-operation between county authorities and city authorities.

United States

National level

The FHWA and AASHTO's goal is to reduce highway fatalities by a fifth by 2008 (AASHTO 2005). A fatality rate of 1.0 per 100 million-vehicle-miles-traveled would reduce the number of fatalities to about 30,000 per year.

This approach illustrates a difference in the safety cultures of the United States and a country like Sweden. Whereas the United States accepts a certain number of fatalities and injuries on highways and mandates a desired percentage decrease in death and destruction, Sweden's stated goal is that no one should die on a Swedish road. Sweden's safety culture is based on the principle that drivers make mistakes and it is unethical for authorities to fail to take whatever measures are necessary to reduce crashes. In the United States, "primary responsibility for safe driving rests with the driver. The Federal government provides standards and regulation for the design and construction of both vehicles and roadways, but it is up to the driver to ultimately avoid errors such as running off the road" (FHWA 2005).

State level

State fatality rates in 2003 varied from less than 1.0 fatality per 100 million-vehicle-miles-traveled in Vermont, Massachusetts, Connecticut, and New Hampshire to more than 2.0 fatalities per 100 million-vehicle-miles-traveled in South Carolina, Idaho, Arizona, Arkansas, Louisiana, Mississippi, South Dakota, and Montana. The safety culture of the highway agencies of these states is only one of many factors behind the range in fatality rates, but it is one worth exploring, especially for the role that a strengthened safety culture could play in reducing the fatality rate in the states with the greatest challenges.

The FHWA's review of Highway Safety Improvement Programs (HSIP) in six states noted nine elements common to states with the most effective safety program. These elements are quoted (in italics) below (FHWA 2001b):

- *The establishment of safety as a major goal of the agency and the commitment of the highest officials*. For example, states with effective programs enjoyed the active support of the state governor.
- *A good multidisciplinary safety-management process with a strong component for roadway safety*. States that had continued their SMS after 1995 when having an SMS became optional, were described as "highly effective" with a clear focus on safety and a culture in which different disciplines can work well together.
- *Emphasis on safety in all projects*. States with a good SMS found TEA-21's requirement that safety must be fully incorporated into state and metropolitan transportation planning straightforward.
- *A designated safety division or a safety engineer/coordinator within the state DOT*. A focal point leads to an effective safety program.
- *A designated safety section or safety engineer/coordinator in each regional office of the state DOT*. Similarly, a focal point leads to an effective safety program at the regional level.
- *Community-based traffic safety programs*. The participation of local government and the community level in the safety program will include minor collectors and local streets where many crashes occur.
- *Efforts to assist localities*. Local agencies usually lack safety staff and expertise.
- *Use of current technologies*.
- *A Traffic Records Coordinating Committee*: a multi-agency team to oversee and advance the data-related issues.

Conclusions

Transportation legislation has made safety an increasingly important focus for transportation planning activities in the past 15 years. Consideration of safety has become increasingly explicit. Legislation has encouraged or insisted on giving safety priority through better data, better analysis, better reporting systems, and the adoption of a structured comprehensive approach, such as a safety management system with a clear mission and vision statement. Challenges have included

using project funding as a carrot, encouraging different agencies to work together, defining responsibilities and accountability, and walking the line between offering the flexibility required for differing circumstances and missing opportunities when some agencies do not take up the approach advocated.

Safety legislation naturally deals with the relatively "hard" aspects of transportation planning. To maximize the benefits of legislation, we need to consider the impact of legislation on agencies' "soft" culture aspects. The "soft" aspects include: (1) individual and group values regarding safety, (2) making safety the major goal of the agency, (3) how ambitious the targets for crash reduction should be, (4) the commitment of leadership, (5) the nature and quality of the relationships with other agencies involved in safety including different levels of government (including support for local government's safety efforts), (6) political agendas, (7) the focus of state research organizations, (8) and informing and consulting the public. Then there are other intangible, but important, issues like the agency's energy and enthusiasm, or action and commitment, and the agency's ability to sustain the safety effort beyond the present champions and participants.

Legislation cannot succeed unless it is embraced by the relevant agencies and unless agencies are willing and able to change where necessary. We do not know whether a strong safety culture is taking roots in our highway agencies. The area is little explored. It should, however, be possible to fill the gap. It should be possible to improve our understanding of the nature of the safety culture within DOTs and other public agencies, and to improve our understanding of the relationship between safety legislation and institutional safety culture. To build a world-class safety culture, we need to start by understanding where we are today. Such an understanding will help to promote change in the safety culture of the organizations in the front line of working towards a safer transportation system with fewer fatalities and fewer serious injuries.

Next steps

It is important to understand why some highway agencies become overall success stories, why others have problems creating a safety culture, and how agencies can move from a weak safety culture to a strong one. It is important to understand how the development of an intrinsically strong safety culture may be encouraged by safety legislation and may lead to a reduction in crashes.

A detailed study of the safety culture of highway agencies, such as state DOTs, would help us to understand safety culture and the role of safety culture in helping to make safety legislation a success. This study could be closely tied to the recent SAFETEA-LU legislation. The objectives listed in this paper provide a starting point for the investigation. One approach might be to work closely with states, such as Iowa, Arizona, New Jersey, Kentucky, and Minnesota, known to have made special commitments to safety in their planning. A follow-up and initial approach might be to design a questionnaire and to conduct focus groups as a basis for providing insights from across the country.

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Biographical statements

Geni Bahar, P. Eng., has over twenty-seven years of experience as a civil engineer specializing in the area of traffic and road safety engineering Geni has led multidisciplinary teams in projects where her safety engineering research experience has allowed her to bring safety explicitly to the practitioners' world.

In recent years, Geni served as Principal Investigator for a high profile research project for the Transportation Research Board National Academy: NCHRP 17-18 "Integrated Management Process to Reduce Highway Injuries and Fatalities Statewide". The outcome of this project provide the framework and tools for the implementation of integrated and comprehensive safety programs to support the AASHTO Strategic Safety Plan for the nation, and to apply the AASHTO Guides (Series 500: Tools for Life); as well to develop State Strategic Highway Safety Plans, as defined by the SAFETEA-LU.

Other recent projects, for which Geni has served as Principal Investigator are NCHRP 5-17 "Safety Evaluation of Permanent Raised Pavement Markers" (Report 518), and NCHRP 17-28 "Pavement Marking Materials and Markers: Safety Impact and Cost-Effectiveness (Wed Document 92). She is currently serving as Principal Investigator to NCHRP 17-27 "Prepare Parts I and II of the Highway Safety Manual," and TCRP A-30 "Improving Pedestrian and Motorist Safety Along LRT Alignments" and Co-principal Investigator for the multi-year initiative of the Federal Highway Administration for the research and functional specification development for the *Safety Analyst* software tools.

Currently, Geni is a member of TRB Committee for Operational Effects of Geometrics, a member of the TRB Task Force for the Highways Safety Manual, a member of TRB Committee for Safety, Data, Evaluation and Analysis, a member of ITE International Traffic Safety Council, a member of the Transportation Association of Canada's Standing Committees for Road Safety, and Geometric Design Standard.

Nesta Morris was educated in England where she graduated with a MSc (Econ) in Urban and Regional Planning from the London School of Economics (London University). She has over twenty-five years of research and consulting experience in urban planning and transportation studies. Her international experience includes England, Swaziland, South Africa, New Zealand and Canada.

In Canada, she participated in the creation of a framework designed to assess the impact of civil engineering measures on accident rates and road safety in Ontario. This led to her involvement in the research for the first edition of the Highway Safety Manual for the National Cooperative Highway Research Program. She has always been interested in multidisciplinary work and new approaches and has had the opportunity to work on a wide range of subjects and projects. Briefly, these include:

- Public transportation planning in a recently deregulated environment (New Zealand).
- Issues facing local authorities undergoing major changes; the incorporation of a new area into an existing regional transportation authority; community participation; guidelines for professionals adapting to new approaches (South Africa).

- Innovative studies of the methodological issues involved in cross-cultural surveys (South Africa).
- Implications of urban population expansion for transportation planning infrastructure requirements (South Africa).
- Management of the field work for the Swaziland Census Preparation Project (a project conducted for the United Nations to test the feasibility of conducting an accurate census in a developing country in Africa) (Swaziland).