

TRANSPORTATION IN THE NEW MILLENNIUM - A LOOK FORWARD

The State of Practice of Safety Management Systems

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Introduction

This paper examines the State of Practice of Safety Management Systems (SMS) with respect to their management and systems implications for the nation's Transportation System in the New Millennium. The SMS, as envisioned in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), was intended to be integrated with the planning and implementation of other transportation management systems to assure program efficiency and effectiveness. The ISTEA was to set the stage for a new era in transportation management. Environmental considerations alone introduced a new set of managers in the policy and implementation phases. The requirement for long range development plans for states and metropolitan areas and the requirement for transportation management systems changed the planning and decision structure, also introducing new players in the decision making process. The ISTEA established a systematic base for managing the transportation infrastructure. This is illustrated in the interrelationship of the transportation management systems mandated by the Act and the need to coordinate and integrate all transportation improvement programs of the past into a cohesive unified effort.

Federal transportation legislation, over the last several decades, has progressively enhanced the planning approach and introduced the systemic underpinning that encouraged integrated planning and implementation of highway initiatives. This progression was more fully established by provisions in ISTEA that required the States to adopt a systematic management approach to highway planning, design, and construction as it affects, Pavements, Bridges, Safety, Congestion, Transit Facilities, and Intermodal Transportation Facilities and Equipment. While the recently passed Transportation Equity Act for the twenty-first Century (TEA-21) allows the continuation of this program approach and, importantly, the necessary funding, the concern is the lost opportunity potential of the management system approach.

To place this discussion in context we must recognize that the SMS, as well as the five other management systems referenced in ISTEA, are subsystems of the transportation system. A basic tenet of systems theory is that any system is inevitably embedded within a higher level system. Therefore, to fully optimize the objectives of a system we must understand its relationship to, and impact on, the higher level system. That is, the SMS to the transportation system. The transportation system, likewise, is embedded in the socio-economic system, which, in turn, is embedded in the political-administrative system. This discussion can become so tangential to the extent that we lose ourselves in its complexity. Therefore we will confine the discussion to the relationship of the SMS to the transportation system. A brief discussion of transportation and SMS in the United States is therefore in order.

The Transportation System

One of the nation's most treasured assets is its surface transportation system, and in particular the highway system. Highway networks have played a major role in moving people and goods since the beginning of recorded history. The advent of the motor vehicle in the early twentieth century accelerated the development of these networks to the current vast transportation systems required by today's modern societies.

In the United States, several important Federal-aid highway acts were instrumental in the development of modern highway transportation systems. Probably the most significant of these being the Federal-Aid Highway Act of 1956 which initiated the largest peacetime public works program in history.¹ Additionally, the Act created a Highway Trust Fund to assure adequate finances to carry out the Act's provisions. The trust fund continues today to be the financial foundation for major transportation initiatives in the United States. Additionally, many states enacted highway trust funds at the state level following the federal lead, thereby creating a financial base at the state level to maintain the highway infrastructure.

¹ Highway Pavements, Volume 1, National Highway Institute, Sept. 1992

The highway transportation system is comprised of complex components of interactive subsystems that are highly interdependent. This suggests that concerns for administration of any of the subsystems, at any level of government, would require some appreciation of the scope and purpose of the transportation system in whole. Understanding the importance of transportation to the nation's economic well being is paramount to our discussion and raises the concern for sustainable development of this system to move people and goods cost-effectively. The demands on the system are growing while, according to recent studies funding appears to be static.

In a 1997 study by the Transportation Research Board, the TRB Executive Committee listed several critical issues in transportation which were prompted by their concerns in "...the debate over the focus, funding, and priorities of the next reauthorization legislation for federal transportation programs." ² The major critical issues outlined in the report are:

- ◆ Mobility and Accessibility
- ◆ Sustainable Development
- ◆ Safety and Security
- ◆ Technology Innovation
- ◆ Institutional Roles

The TRB Executive Committee recognized the highly developed, complex system of roads, public transit systems, railroads, airports, ports & waterways that woven together provide the modern lifestyle Americans now rely upon. They noted in the study that over 12.4 billion tons of freight moves through the transportation system annually at a cost to shippers exceeding \$440 billion. Together, spending for personal and commercial transportation represents about 11 percent of the total U.S. economy. The transportation system serves as the lifeblood of the U.S economy.³

The post-World War II era brought Americans unprecedented prosperity and mobility. Automobiles became a central feature of American culture, reflecting several decades of rising per capita incomes, the suburbanization of cities, and the construction of the interstate highway system. This is dramatically reflected in the most basic transportation statistics. The number of motor vehicles registered in the United States increased from 31 million in 1945 to over 207 million in 1997. The actual miles of motor vehicle travel are even more dramatic. In 1945 Americans traveled 250 billion vehicle miles and by 1997 this increased to over 2.5 trillion vehicle miles.⁴ The automobile became a status symbol as well as a private transport vehicle. Americans love their cars. We are paying a price for this love affair.

The Safety Management System

One of the six management systems, required by ISTEA, was the Safety Management System. This management process was to unify the way government officials, at all levels, manage highway safety programs. Prior to ISTEA, states were required by the Highway Safety Acts of 1966, to develop a Highway Safety Plan that was intended to be a systematic approach to highway safety problem resolution. The United States, in this regard, has experiences with safety management systems for over 33 years that were, for the most part, highly successful. The Highway Safety acts of 1966 were the impetus for the safety initiatives that reduced the highway death toll from in excess of five deaths per one hundred million vehicle miles of travel to less than two today. These acts required an organized planning approach to the administration of federal highway safety grants by State safety officials.

From a highway safety perspective the transportation system is studied through its major components:

- ◆ the roadway and its environment,
- ◆ the operator, and
- ◆ the vehicle.

These components can be further subcategorized into design features, operational features, behavior, etc. Adding to the complexity, each component is to some degree interactive and adaptive. The most adaptive of these is the operator.

² The reauthorization in question is now TEA-21, the Transportation Equity Act for the Twenty-first century.

³ TR NEWS, Number 193, November-December 1997

⁴ From Auto Safety - Assessing America's Performance by John D. Graham. The number of registered vehicles and miles of travel have been updated.

It is from this perspective that we can better understand the role of highway safety as a measure of quality of the product - transportation. While the U.S. transportation system is considered the safest road system in the industrialized world, traffic fatalities have been increasing over the last several years with the latest numbers totaling over 42, 000 deaths annually. The societal costs are estimated at over \$150 billion. Most transportation officials consider these "byproduct" statistics unacceptable.

The TRB study, as well as most efforts in highway safety today, cites safety concerns that are developed through some form of brainstorming technique based in consensus. These efforts are useful in addressing pressing safety problems of the time. The issues developed through these techniques warrant the attention of transportation officials and, in particular, the highway safety community. But in too many cases the studies address these issues without the implicit connection to the industries major product – transportation. This is accompanied by a lack of recognition of the interdependence of each of the proposed initiatives raised by the consensus processes used. The systems approach called for in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is partially satisfied.

Consequently, while transportation managers and planners struggle to optimize the benefits to the transportation system by integrating improvements among the subsystem components, they can only be partially successful, at best. The optimization of the investment of limited human and financial resources to the transportation system in whole is rarely if ever achieved. The futile struggle is perhaps most evident when you examine the State of Practice of Safety Management Systems (SMS).

The State of Practice of Safety Management Systems (SMS)

Over half of the States took advantage of training programs offered through the National Highway Institute in Safety Management Systems and Best Practices. This was an attempt by the States to comply with the ISTEA requirements and build on the practices already existing in their agencies. Those States that reacted to the ISTEA requirements early on and began implementing Safety Management Systems have in place a more integrated approach to highway safety management than they had previously.

Opposition by several States to what they perceived as a burdensome and costly data systems requirement, led to congressional action. This resulted in the passage of the National Highway System (NHS) Designation Act in 1995 removed the mandatory requirement for the management systems. The gains made in the years following the passage of ISTEA in implementing the management systems were curbed. What evolved is a philosophy that prevailed among transportation chief executives who were most instrumental in removing the mandatory requirements of the management systems. They did not want to be held responsible for results that required actions outside their sphere of control. As mentioned earlier, the state transportation officials cited, in their argument against the mandatory provisions, the burden of implementing costly data systems. Yet most of the information systems that support transportation management existed to some degree in most states then, and have been enhanced since.

The irony is that today most transportation chief executives are implementing performance management systems that are more burdensome on the most critical of governmental resources, the human resource, and still require information systems to collect data and track performance. This is not an argument against these initiatives (I personally support them), but rather, a suggestion that the reasons for their opposition was more politically inspired due to the atmosphere in most of the country at the time against unfunded mandates.

Today, an honest assessment of the "practice" of Safety Management is more realistically one of status quo. I don't mean this to be a broad-brush indictment of safety practices across the country. But, in too many cases, traffic engineers "practice" their trade and apply and refine the tools that are traditional within their discipline and only occasionally will be involved with safety partners from other transportation disciplines. This is also true of the other transportation safety disciplines, such as traffic law enforcement, driver safety, vehicle safety, or injury prevention.

Recent federal legislative action indicates a trend toward a diminishing role for federal agencies in programs that must be implemented at the state and local levels. The U.S. Department of Transportation's involvement in state and local transportation programming is more in a supporting role and as an agent to disseminate information. A transfer of management and control also accompanies the devolution of funding of transportation programs to the state and local levels of government.

However, this is not unintended or undesirable. There are indications today, in management literature⁵, that management at the state and local levels of government have progressed significantly. They cite numerous governmental agencies applying Total Quality Management and Baldrige assessment criteria to their management performance structures. A consumer-oriented approach to providing goods and services is now prominent in private and public enterprises.

The critical issue today, for the states and local agencies is to be more aware of the quality of the products and services they provide and to whom they are provided. Strategic planning has been used to augment the traditional planning process in many cases, with strategic management as the administrative implementation mechanism. Transportation managers are more aware of their customers and the customer demands than ever before. This awareness is evolving from a better appreciation of their business (transportation) and all its implications.

A Look Forward

Many transportation officials look to Intelligent Transportation Systems (ITS) as the future mechanisms for appreciable gains in highway safety. The term Intelligent Transportation Systems refers to the integrated electronics, communications, and hardware and software elements that can support ITS services and products. According to the U.S. Secretary of Transportation, the ITS was intended to "...save time and lives and improve the quality of life for Americans everywhere."⁶ While ITS has much potential for improvements in safety, the major program initiatives address congestion and the concomitant problems relating to congestion. ITS was intended to enhance another major quality measure of the transportation system – mobility. It should have an impact on highway safety, but only in concert with improvements to mobility.

Safety and mobility are not mutually exclusive. They are measures of quality and value for the transportation system. Improving the quality of the highway transportation system through investments in ITS will produce safety benefits. But maintaining the balance between safety and mobility will be a challenging equation to transportation managers. Discerning where enhancing one compromises the other is a difficult task. Ultimately the highway user (customer) must decide the level of risk he/she is willing to accept as it relates to mobility. Many of these issues will be resolved in the "marketplace." This was true with many of the provisions of the 1966 Highway Safety Acts and is evident today with regard to the acceptance by the motoring public on the use of occupant protection devices and alcohol safety programs.

We must understand these political, cultural, and technical issues and how the "marketplace" reacts to them. The safety strategies cannot be dealt with effectively in an isolated fashion. Efforts in the past have suffered from the flaw of addressing these issues independently. Quantum gains in safety will not be realized until highway safety practitioners from all disciplines understand their interdependence, and form an alliance that shares their talents and information to collectively develop countermeasures that address the driver, vehicle, and road to improve highway safety.

Safety Management Systems as they were envisioned in ISTEA and continued in TEA-21 are the framework for partnerships to accomplish the safety gains that the public (customer) expects. At the 1998 TRB meeting a Task Force of the Safety Management Committee developed a suggested framework of a Safety Management System. This framework was to serve as a foundation for safety officials to assess the viability of their safety management process. The concept was developed on the premises that:

- first, a SMS is a complex adaptive system,
- second, two ingredients are necessary to prosper - prediction and feedback, and
- third, to manage the SMS we must build models that allow us to anticipate its performance.

The following process was agreed upon as a tool to help jurisdictions set up a SMS and to measure progress toward successful implementation:

- ◆ **Partnerships:** An accepted characteristic of a Safety Management System is that several stakeholders in the highway safety community work together in the development, implementation, and administration of a Highway Safety Program for their jurisdiction. The partnership can be extended or limited based on the jurisdictions political, organizational, and management climate.

⁵ Public Administration Review (PAR) and Public Manager are among the publications noted.

⁶ Intelligent Transportation Systems Infrastructure Initiative, U.S. Department of Transportation, October 1, 1997.

Partnering suggests that the many safety programming efforts currently existing in a jurisdiction can be coordinated to optimize resources and program results. Several factors may prompt this type of networking. Among these is the safety planning activities that occur at the state and local levels of government that are seeded by federal funds. The state agencies that administer these funds should form a core partnership. The programs in question are the Highway Safety Plan (HSP), the Highway Safety Improvement Program (HSIP), and the Motor Carrier Safety Assistance Program (MCSAP). One requisite of the partnership is a strong commitment from each partner to support the initiatives developed by the partnership and to provide resources to execute and administer the highway safety program. The immediate benefit realized will be in eliminating redundant and overlapping activities.

- ◆ **Common Vision and Mission:** A major task of the safety stakeholders committee is to develop a common mission statement from which the program goals will emanate. The mission statement should be developed based in the jurisdiction's statutory requirements to provide a safe highway environment. Goals are the vehicles that take a program from the mission statement to action plans that eventually will achieve the envisioned mission. The stakeholder partners should set the goals.
- ◆ **Decision-Making Process:** A structured decision-making process will be the mechanism to develop strategies (action plans) to achieve the goals. The strategies should be developed based on appropriate highway safety information. One decision-making model we have used successfully in developing program initiatives is Quality Functional Deployment (QFD). Originating in Japan in the early 1970's, QFD is a set of planning and communication routines that focuses and coordinates skills first to design, then to production, and then to market goods that customers want to purchase and will continue to purchase. Relating this concept to highway safety would mean, for example, that the motoring public accepts legislative initiatives with a high level of compliance.
- ◆ **Performance-based Action Plan:** The formal decision-making process is the foundation and the building blocks to the strategic action plans. The action plans, in turn, provide the basis for developing the highway safety program budget for a jurisdiction. The action plans should be performance-based. The decision-making method used should provide the necessary information to measure performance.
- ◆ **Progress Reporting System:** A progress reporting system should be developed to monitor progress as well as provide the link to the above steps for feedback and/or modification. The progress reporting system should include a tracking mechanism to measure status of the strategies selected and implemented. A regularly scheduled stakeholder committee meeting should review the progress of the strategies to determine whether they are achieving the stated goals. The progress reporting system should provide enough information for the stakeholders to make decisions to modify, delete, or adjust strategies as warranted.

The Management of Safety programs by federal and state governments have been in existence, I suppose, since the first safety program was incorporated into their organizational mission, most probably at the local level within police activities. As a matter of law, the regulations that accompanied the Highway Safety acts of 1966 specifically require and lay out a process of administration for those programs that are eligible for federal funding. However, on close examination we find that each of these programs, while being characterized as systematic problem solving methods, were independent of each, and in too many cases became fragmented in their application at the state and local levels of government. Limited transportation resources will require coordinated planning and programming for all transportation modes.

The challenge today is to strategically manage the transportation system, with all its components, that are so essential to the nation's social and economic well being. We often talk about the dynamic nature of the transportation industry. Yet, to improve our "business" we employ standard methods based on past practice. These methods will result in incremental improvements at best. The federal government embarked on a management initiative dubbed "reinventing government" several years ago, with much fanfare and projected promise. However, so far it has not achieved the breakthrough performance gains projected. Breakthrough, discontinuous performance gains are the only way to equal or exceed the rate of change going on in the world around us.

The methodology required to achieve this will be through reengineering principles based in a strategic agenda. This methodology involves reengineering techniques used to transform the way we do business to directly impact the services and products we provide in line with the customer’s concept of what the product or service should provide. If we are to keep apace of the changes generated through an improved economy, increases in mobility, the demand for more efficient transport of goods and services, then we must be bold in our pursuit to transform the transportation business, and safety management particularly, to meet these challenges. We must understand those critical factors most instrumental for success.

Critical Success Factors

In any enterprise there are those who believe every activity deserves a high degree of attention and a commitment to provide resources to perform these activities at a high level of quality and efficiency. Each manager of these activities is charged with assuring this level of performance. Change is dealt with incrementally to achieve continuous improvements in areas the enterprise is currently engaged. However, when change is not continuous a method is needed that will focus on those activities or products that are critical to the success of the enterprise. The QFD method described earlier is effective in defining the critical issues to be addressed in the rapidly changing transportation industry.

The following figure is a high-level conceptual process map of a Safety Management System. Reengineering requires a careful examination of the steps within each program process to determine which add value to the service or product. The management of safety programs demands no less an effort if we intend the management to be systemic and provide the breakthrough performance we desire. Each of the symbols shown in blue (or shaded) represents management processes at a lower level of activity. Note the interconnectivity of the major safety program areas.

SAFETY MANAGEMENT SYSTEM PROCESS MAP

