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Development and Evaluation of a National Data-Management System for Highway Tort Claims

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ABSTRACT

This report presents the findings of a project conducted to investigate the feasibility of an automated national data-management system for collecting and disseminating highway tort claims information. Data items from the American Association of State Highway and Transportation Officials (AASHTO) Survey on the Status of Sovereign Immunity in the States were selected for the basis of design and construction of the core data elements within the model system. Five pilot states were selected to provide a representative sample of tort claims processing systems in use on a national level.

The findings suggest that a national tort data-management system could be technically feasible if the following conditions can be met: (1) appropriate time, state personnel involvement, and access permission to perform a full data audit and assessment on states' internal information systems; (2) changes to the state systems to include data items not being recorded, a standard identification code for tracking case information throughout departments and agencies, and internal initiatives to improve the data entry process within their own systems; (3) begin with a dynamic data standard designed to become more unified and common through an evolutionary process; (4) utilize a single contract agency to perform the data audit and information system assessment and to design and develop the national data-management system; and (5) commitments of financial resources by participating state departments of transportation.

SUMMARY OF FINDINGS

The purpose of this project was to assess the feasibility of a national data-management system for information on highway tort claims and lawsuits filed against state departments of transportation. A principal objective of the feasibility methodology was to develop a model data-management system that would offer state departments of transportation a secure method for collecting and manipulating highway tort claims[1] information and related statistics, a method of data processing that does not cause an undue burden on state employees, and a method of reporting or displaying current information about highway tort claims in a statistical platform. The model system was not to create and use a fixed, uniform data standard to which all states would report; most states expressing a willingness to participate in a national system indicated that their willingness was predicated on not having to significantly modify internal systems or enter data and information multiple times. Thus, requirements for the model data-management system included: compatibility with multiple software and hardware platforms used by the states, capability of processing dissimilar data items supplied by the states, ability to accommodate multiple formats of exported data, and cost-effectiveness of implementation and maintenance on a national level.

The work scope called for three basic areas of development: the selection of a specific set of data items from the AASHTO Survey on the Status of Sovereign Immunity in the States (AASHTO, 1992) to be used in creating the core data elements for the model system; the on-site survey and assessment process of tort claims information systems in five states participating in the model system development; and the construction of a model data-management system that provides state personnel with a mechanism to enter and retrieve the desired information.

Selection of the data elements to serve as the foundation of the model data-management system began with a series of on-site state interviews and mailed questionnaires covering the original AASHTO survey questions. The data content selected for this project is representative

1 Unless otherwise specified, for the remainder of the report, the term "claims" will be used to include both pre-litigation tort actions and torts in litigation.

of the needs of legal and risk-management departments expressed in the interviews and responses to the questionnaire.

The states' internal data varied greatly in terminology (reference and label), type, amount of data, consistency of data entry, and timeliness that information was being entered into the system. Although the establishment of a fixed, uniform data standard was not an objective of this project, the creation of a uniform standard reporting coding for tort claims information can begin with the pool of data items obtained during this project to form a dynamic data pool that can become more unified and fixed over time. However, a more in-depth analysis of the states' data and investigation into the usage of terminology is required.

The intent of the five state on-site visits was to review and assess tort claim and risk management-related information systems for content and data structures, data export and transfer capabilities, and degree and means of data sharing between departments and agencies. The planned outcomes from these reviews were the identification of relevant data fields, data definitions, and the technical means by which data could be exported and transferred to the model system.

These outcomes were completely met in some states but only partially achieved in others. The principal constraint in the latter was that state personnel could not precisely define the content of data fields. In one case, proprietary software was being used and state personnel did not have sufficient knowledge to access the data field definitions. In another state, accessing the data field definitions required a third-party contractor that controls the state's data. Unfortunately, the contractor's fees were prohibitively expensive. As a consequence, the research team, assisted by state personnel, attempted to select the desired data by field label rather than by field definition. Subsequent analysis of the exported data records indicated that data field labels vary from state to state. Furthermore, all states have some degree of unpopulated data fields and in some cases the lack of data in the field is extensive. For these reasons, the data exported from the state systems did not directly support the output requirements. In addition, it became apparent that the 3 days given to conduct each site survey proved to be insufficient to fully identify and verify the data sources and content within each state's system.

The ability to construct a fully automated data input and retrieval process was restricted by department policies that prohibited a direct network connection. These policies are intended to protect the states' computer systems from accidental introduction of potentially damaging foreign programs as well as unauthorized intrusion into the systems' secure segments. Therefore, the data export process developed for the model system by necessity uses less automated removable media or FTP transfer, which require slightly more time and effort on the part of states' technical staff. A web-based interface was created for entering aggregate data directly from departmental staff on a yearly basis. This interface was created to offer a means of entering information that could not be calculated directly from the data retrieved from a state's information systems, and also to offer states that still use paper-based information systems a means of using the model system. The web-based interface will require an encrypted data transfer mechanism known as VPN (Virtual Private Network), which is readily available and easily implemented. However, the cost of implementing this level of security was beyond the project budget. The data entry forms were secured from non-authorized access through the use of a user account and associated password to gain access to the website.

The model system was constructed with "off-the-shelf" products that offer scalability, maximum hardware utilization, and ease of management by a minimal compliment of staff. The following three readily available products were used in this project. The Microsoft Visual Foxpro relational database program provided efficiency, versatility, speed (Rushmore Engine), and scalability. The Macromedia Cold Fusion 4.5 Server and Studio package provided a web application development platform that is scalable, compatible with other web platforms, integrated with a majority of database programs, and offering a development and administration environment that requires less technical and human resources than the Microsoft platform. The Dell Power Edge 2400 is a mid-range computer-server that provided adequate upgrade capability in both processor and memory and enough hard drive space to serve the potential needs of this project with the possibility of transitioning to a national implementation of the data-management system. The operating system was upgraded to a Microsoft Windows 2000 Server for its increased stability, enhanced security features, and potential for integrating a Virtual Private Network connection through encrypted transmission.

The system required a component for entering aggregate data and component(s) for searching and displaying the stored tort claims information in a format similar to that of the AASHTO Survey on the Status of Sovereign Immunity in the States (AASHTO, 1992). A simple and familiar interface was created to enable state personnel to enter aggregate information into the system and pull information on tort claims and other related topics. The original construct called for a somewhat more versatile interface that permitted users to perform more complex searches and create dynamic reports; however, redesign of the data tables to overcome the technical issues encountered with the software program has limited this level of functionality in the model system. The project research team attempted to create the same functionality through the web application software, but development became program intensive, and again time and cost became an issue. The research team had to settle on the basic reporting formats similar to those found in the AASHTO report.

Phase II: Construction of the Model Data-Management System for Highway Tort Claims has concluded with the completion of these primary objectives: a method of collecting highway tort claims and related information, a method of data retrieval that does not cause excessive burden to departmental staff, and a method of reporting on the collected information. The secondary objectives of creating an "automated" data retrieval process, a uniform standard coding structure, a fully capable search component, a mechanism for creating presentation-quality reports, and the highway deficiency component were not realized in this project. The feasibility of implementing a national data-management system depends on the ability to optimize the primary objectives and overcome the obstacles encountered with pursuing the secondary objectives. Administrative concerns, departmental policy restrictions, and technical implementation issues further hinder the ability to overcome the secondary objectives. The individual state's administrative and policy issues are the most restrictive and require motivation and commitment from the state departments of transportation to be resolved. The technical issues are not difficult to resolve, but the necessary time and financial resources from state DOTs must be available to effectively implement such a system. It would be important to have a number of state DOTs participate in a system not only for the financing of the system, but also to have data from enough states to make the system useful.

CHAPTER ONE
INTRODUCTION AND IMPLEMENTATION APPROACH

BACKGROUND

Prior to the 1960s, the doctrine of sovereign immunity precluded governmental liability for damages in most states unless the government consented, generally through statute, to suit. Between the mid-1960s and late 1970s, numerous legal challenges to the doctrine eroded its liability protection in many states. During and after this period, states experienced a dramatic increase in state tort claim and lawsuit activity, particularly from injuries associated with highway-related incidents. By 1991, AASHTO estimated that annual state payments made in settlements or judgments for highway tort-related incidents were between $135 million and $345 million. The range on such estimates was necessarily broad, for there was not a reporting system for highway tort claims to which all or even a large majority of states regularly responded.

During the 1980s risk management programs were implemented by departments of general administration in many states to combat the rising cost of tort liability. These programs assumed administrative responsibility for tort claims and created electronic databases to assist in their management. These database systems served the needs of the overall state claims administration but lacked the components and versatility to assist either DOT risk management and legal divisions or Offices of Attorney General in meeting their departmental needs. In response, some DOT and Attorney General offices created internal database systems to assist in their risk reduction efforts. This trend resulted in numerous segregated and disjointed pools of tort claims and risk management information that was neither congruent nor consistent within the states, nor between the states.

An initiative in the mid-1970s by the AASHTO Administrative Subcommittee on Legal Affairs resulted in the Survey on the Status of Sovereign Immunity in the States (AASHTO, 1992). The first survey was conducted in 1977 and requested approximately 80 data elements that focused on sovereign immunity status, legislative policy, claims and lawsuit statistics, and insurance liability policy. By 1992, the survey grew to more than 400 data elements, but on many elements the response rates was sporadic, in some cases below 50% of the states. In addition, the validity and reliability of the information being

returned in the late 1980s was highly suspect due to terminology differences and internal inconsistencies. Declining survey responses and an increasing need for information that would provide a national perspective on tort claims in relation to eroding sovereign immunity sparked interest in research to explore the feasibility of a national tort data-management system. NCHRP sponsored Project 11-7 for this purpose; this report presents the findings and recommendations of that research.

PHASE I: INTERIM REPORT REVIEW

The Interim Report (Gittings, 1999) from Phase I provided an overview of the computer technologies and tort claims information systems for the legal and risk management departments of 40 states. A policy needs assessment determined the most critical tort and risk-management information for public policy making and highlighted many administrative concerns and technical obstacles to implementing a model data-management system.

The Interim Report revealed a wide variety of computer hardware, desktop and network operating systems, and database software being used to manage and store tort claim and related information. A small number of states reported the use of paper-based systems to manage their information. A majority of the systems are intradepartmental and have no link to systems in other departments for information sharing. The systems are primarily used for claim/lawsuit administration, monitoring trends, and evaluating program or legislative initiatives. Another less-utilized application of the information included a means to determine premiums based on loss history, analysis for funding to risk-transfer mechanisms, and the generation of management reports. Overall, state employees rated the systems above average for accuracy and timeliness and below average for accessibility.

The administrative concerns for pooling tort claims information into a national data-management system focused primarily on security and risk exposure. The cost and effort to participate in the project were given as secondary concerns. The technical concerns focused primarily on the diversity of computer hardware and database software, network and data security, and the ability to export data in a format compatible to the model system.

The data content of the systems varied greatly from state to state and between departments within the states. The differences in data content between the states and internal departments were most significant for variations in definition and terminology used to classify data items.

In Phase I, a select list of questions derived from the AASHTO Survey on the Status of Sovereign Immunity in the States (AASHTO, 1992) was used to determine what highway tort-related information states would find useful from other states, and how much of this information they would be willing to share with other states through a data-management system. This survey produced 34 data items, similar to those in the 1992 AASHTO survey, that were ranked by interest by the respondents. Tables 1.1 and 1.2 provide a breakdown of the results for this survey.

The data items from this list fell within these nine basic data categories:

- Risk management training and legal defense training material;
- Contractor indemnification information;
- Risk management office organization;
- Types of alleged highway deficiencies;
- Claim and lawsuit statistics;
- Resources for claims administration and lawsuit defense;
- Liability insurance information;
- Sovereign immunity-related information; and
- Claim/lawsuit procedures.

Of the nine categories, risk management training and "legal defense" training received the highest ranking. The following items received special interest by the survey respondents:

- Expert witness information (e.g., name, expertise, prior testimony);
- Citations for precedent-setting case law;
- Existence of training programs for tort liability/risk management, specifics on training programs, and any materials used for these trainings; and
- List of state contacts for tort liability/risk management training.

Table 1.1: Responses Regarding the Priority of Each Category of Information From Other States

Item Description	Average Response	No. of Responses[1]	Percent Indicating High, Very High or Moderate Priority
1. **Sovereign Immunity**			
a. Sovereign immunity statutes	2.94	36	55.56%
b. Type of limitations on immunity	3.42	36	86.11%
2. **Claims/Lawsuit Procedures**			
a. Types of tribunals available for deciding claims	2.72	36	58.33%
b. Whether jury trials are allowed	2.44	36	52.78%
c. Details on venue restrictions	2.36	36	44.44%
d. Funding resources for settlement payments	2.94	36	66.67%
3. **Claim and Lawsuit Statistics**			
a. Number of claims filed annually	3.50	36	91.67%
b. Dollar value of claims filed annually	3.42	36	77.78%
c. Number of claims pending (open)	3.22	36	80.56%
d. Dollar value of claims pending (open)	3.17	36	77.78%
e. Number of claims disposed	3.42	36	86.11%
f. Dollar value of claims disposed	3.50	36	86.11%
g. Separate statistics on lawsuits disposed by settlement from lawsuits disposed by judgment	3.56	36	91.67%
4. **Types of Alleged Highway Deficiencies**			
a. Major highway deficiencies by number of claims	3.66	35	94.29%
b. Major highway deficiencies by dollar value	3.68	34	94.12%
c. Major highway deficiencies by severity of injuries associated with each deficiency	3.65	34	91.18%

[1]Does not include those who indicated that they were uncertain about a given item.

Table 1.1: Responses Regarding the Priority of Each Category of Information From Other States (Continued)

Item Description	Average Response	No. of Responses[1]	Percent Indicating High, Very High or Moderate Priority
5. **Resources for Claims Administration and Lawsuit Defense**			
a. Annual expenditures on claims/lawsuit defense	3.60	35	94.29%
b. Annual defense expenditures by cost category	3.47	34	85.29%
c. Number of attorneys	3.14	36	80.56%
d. Number of attorneys by type	3.14	36	80.56%
e. Details of cost, experience, etc., by attorney type	3.40	35	85.71%
6. **Contractor Indemnification**			
a. Details of third party tort liability	3.75	36	91.67%
7. **Risk Management Office and Liability Insurance**			
a. Whether states have a formal risk management office	3.69	35	88.57%
b. Details about formal risk management offices	3.80	35	94.29%
c. Whether states carry liability insurance for highway claims	3.28	36	80.56%
d. Details on liability insurance coverage	3.24	34	82.35%
e. Whether self-insured state carries fully funded reserves	3.20	35	77.14%
8. **Training in Risk Management and Tort Liability**			
a. Whether states have training for tort liability	3.86	35	100.00%
b. Details on tort liability programs	4.00	35	100.00%
c. List of materials used for tort liability training	4.03	35	100.00%
d. Points of contact for tort liability	3.94	35	100.00%
9. **Miscellaneous**			
a. Information on expert witnesses	4.06	35	97.14%
b. Citations for precedent setting case law	4.00	34	100.00%
c. Average Time for disposition of lawsuit	3.06	35	80.00%

[1]Does not include those who indicated that they were uncertain about a given item.

Table 1.2: Priority of Each Category of Information From Other States in Order of Highest Average Response

Item Description	Average Response	No. of Responses[1]	Percent Indicating High, Very High or Moderate Priority
Information on expert witnesses	4.06	35	97.14%
List of materials used for tort liability training	4.03	35	100.00%
Citations for precedent setting case law	4.00	34	100.00%
Details on tort liability programs	4.00	35	100.00%
Points of contact for tort liability	3.94	35	100.00%
Whether states have training for tort liability	3.86	35	100.00%
Details about formal risk management offices	3.80	35	94.29%
Major highway deficiencies by dollar value	3.68	34	94.12%
Major highway deficiencies by number of claims	3.66	35	94.29%
Major highway deficiencies by severity of injuries associated with each deficiency	3.65	34	91.18%
Annual expenditures on claims/lawsuit defense	3.60	35	94.29%
Separate statistics on lawsuits disposed by settlement from lawsuits disposed by judgment	3.56	36	91.67%
Dollar value of claims disposed	3.50	36	86.11%
Number of claims filed annually	3.50	36	91.67%
Annual defense expenditures by cost category	3.47	34	85.29%
Dollar value of claims filed annually	3.42	36	77.78%
Number of claims disposed	3.42	36	86.11%

[1]Does not include those who indicated that they were uncertain about a given item.

Table 1.2: Priority of Each Category of Information From Other States in Order of Highest Average Response (Continued)

Item Description	Average Response	No. of Responses	Percent Indicating High, Very High or Moderate Priority
Type of limitations on immunity	3.42	36	86.11%
Details of cost, experience, etc., by attorney type	3.40	35	85.71%
Whether states carry liability insurance for highway claims	3.28	36	80.56%
Details on liability insurance coverage	3.24	34	82.35%
Number of claims pending (open)	3.22	36	80.56%
Whether self-insured state carries fully funded reserves	3.20	35	77.14%
Dollar value of claims pending (open)	3.17	36	77.78%
Number of attorneys	3.14	36	80.56%
Number of attorneys by type	3.14	36	80.56%
Average time for disposition of lawsuit	3.06	35	80.00%
Funding resources for settlement payments	2.94	36	66.67%
Sovereign immunity statutes	2.94	36	55.56%
Types of tribunals available for deciding claims	2.72	36	58.33%
Whether jury trials are allowed	2.44	36	52.78%
Details on venue restrictions	2.36	36	44.44%

The data categories revealed 106 separate data items or, more specifically, information "bits." These information bits were selected as the individual data elements for the model system. The data elements are grouped into 11 categories of information that legal and risk management departments might find valuable. Appendix A presents the core data elements as formatted to create the web-based entry forms for this project.

PHASE II: PROBLEM STATEMENT, RESEARCH OBJECTIVES, AND WORK SCOPE

Without a means to collect and report tort claims and lawsuit statistics and information from each of the states, a national picture of highway tort liability cannot be assembled. Thus, the purpose of this NCHRP research project was to assess the feasibility of a national data-management system for highway tort claims and lawsuits. The feasibility assessment was based upon evaluation and recommendations for the following issues:

- The willingness and ability of states to participate in the national system;
- Potential benefits to users and others;
- Potential obstacles to state participation in a national data-management system;
- Requirements for ongoing operation, maintenance, and enhancement of a national system; and
- Potential costs imposed on the states.

The central component of the feasibility methodology was the development of a model data-management system that would provide useful content, quick data retrieval, intuitive navigation, and a user-friendly reporting mechanism. The development of such a system is dependent on good design. The overall design of this database application had to accommodate three important functions: data collection and normalization, processing, and presentation. A good design can be achieved if the following is known: (1) the performance and storage capacity of hardware and software, (2) database performance objectives, (3) the content and format of desired output, and (4) the content and format of input. The development team acquired equipment of sufficient capacity and utilized the network infrastructure at Penn State to complete the hardware requirement. The Microsoft Studio Suite

development software was used to generate the databases. This software was later supplemented with web development software from Allaire/Macromedia when the developer experienced difficulty generating web components with the Microsoft product. The initial output schema (and master list of data content) was derived from interview and survey responses received from 40 states. Making contact with state resources and extracting the necessary data would achieve the acquisition of input data, the final component required to begin the database system design.

On-Site Survey Process

The Interim Report proposed a six-state sample group for pilot testing the model system; however, budgetary constraints restricted this to a five-state sample. The Phase I research indicated that technology levels varied from a traditional paper-based system to a highly sophisticated, fully automated, computer network system that collected, tracked, and shared tort claims information between multiple departments. The technology levels provided one criterion for dividing the states into sample groups. To further define the groupings, data access scenarios were constructed that would reflect potential problems associated with connecting the model system with the states' computer systems to create a seamless and automated process for data retrieval. Geographical location and level of tort activity and experience were also used to help define the sample groups. Thus, the candidates for the pilot study were reviewed and selected on the basis of four criteria:

- Accessibility – based on the scenarios outlined in Appendix B that describe the five access methods;
- Technology level – based on the level of computerization and method of data collection that each state is using to track and store its tort data;
- Geographical location – the intent is to provide a broad representation of geographical locations; and
- Level of tort activity and experience – the intent is to provide a broad range of tort activity and experience.

Within each sample grouping, a preferred state was identified along with a first alternative should the preferred state be unable or unwilling to participate in the project. The preferred and first alternative states and access scenarios are presented in Appendix B.

The on-site interviews were conducted with state representatives of legal, risk management, engineering, and highway agencies to identify appropriate resources and facilitate data acquisition. The states' Attorney General offices were contacted to request and discuss participation in the project with a follow-up letter that described the project goals, concerns, and the type of information to be collected. The on-site visits were scheduled with the states that agreed to participate in the project, and a follow-up document was sent that outlined each state's responsibility, visit agenda, and a list of personnel to assist the team (see Appendix C). The on-site survey required 3 days to complete and all attempts were made to accommodate the schedules of those being interviewed. The initial meeting provided a detailed presentation of the project goals, objectives, concerns, obstacles, and needs to all departments involved in the survey. Representatives from legal and risk management agencies supporting state departments of transportation were asked to participate in on-site interviews with the research team concerning the existence, maintenance, and content of pertinent electronic files. The technical professionals and functional managers for the department were also in attendance. All three groups made every effort to be helpful.

Data Environment

The total data content for the model system was planned to originate from two sources: aggregate totals compiled by state personnel and entered into the system via the web-based entry forms, and the data retrieved from the individual states' databases. The state data records were planned for export directly from the individual state systems and sent to the model system in a native, or universal text-based file format. The analysis process needed to address two questions: "Do the state's internal information systems contain the necessary data to produce the desired aggregate totals without the need for significant human calculation?" and if not, "Can a limited amount of calculations be programmed into the system that would convert the raw data into the desired aggregate totals?"

The data environment identified 106 data elements, excluding highway and injury characteristics, as the target content of the database. The 106 data elements were captured in a 52-question survey targeting 67 policy characteristics and 39 legal and claim-related statistics. Interviews with functional and technical managers identified the requisite state data files to be retrieved. The

development team anticipated differences in the content and format of data from state to state. The research team collected record layouts of the database structures and data samples from each state. The developer then matched state data elements to those of the core data list. The data transfer process was accomplished through Internet transmission or a record download mailed to the research team on a portable (removable) storage medium such as floppy diskette or zip drive. A translation program was written to convert the data to a compatible format. Data normalization techniques were applied to accident files, legal files, and risk management files. The data were collected, normalized, sorted, and then transferred to a central repository. A single batch program processed the data and generated all of the reports for access from the web site. A user-friendly search-and-query language (SQL) component provided a highly flexible and versatile search component. An extensive glossary that defines and qualifies data elements for the user community would be difficult to construct, since the model system contains more than 400 searchable elements.

The diversity of references and labels used to code and track tort claims information in each state will pose a major obstacle to this project, especially with the absence of a national uniform standard for comparison. The core data elements provide a viable structure for the model system to sort and organize the state's internal information for import into the model system. The model system's data structure and design were formulated with hope of using the base data pool from the states to calculate the output required to fill the core data elements.

The Interim Report noted a high interest in having alleged highway deficiencies for tort claims within the data-management system. The recording of alleged causal factors could be a valuable resource for directing legal defense, risk management training, and maintenance and operations programs to proactively address conditions associated with highway tort liability. Phase I revealed that some states include alleged highway deficiencies in recording highway tort claims information; however, the level of detail and terminology used to document this information was varied and sporadic. The ability to create a highway deficiency database that provides a comprehensive overview of the conditions and detailed circumstances alleged as causal factors is dependent on a standard profile for identification. A uniform causation coding system was developed based upon causal information currently being collected by the states and the Standardized Cause of Loss Codes developed in the Public Risk Database Project (PRDP). The proposed coding system uses four classifications that

identify the highway system type, the organizational function responsible for creation or maintenance of the system type, the component that contained the problem, and the specific activity within the component that caused the damage. The data retrieved from the state systems were reviewed for pertinent causal code references.

Model System Environment

A typical web application environment provides for the interconnectivity of the client-side environment (a computer, web browser, and web pages) and the server-side environment (central database software, web application software, and computer server) linked via the World Wide Web. The client-server environment is a widely known architecture for providing resource management and application processing over a local area network of client (desktop) and server computers. The planned model tort data-management environment is in principle the same architecture, but uses the World Wide Web to connect the user to the data-management system for the purpose of entering and viewing information.

The client-side environment for the planned model system employs a web-based interface that provides any user with Internet access the ability to interact with the data-management system through an SQL-based interface from a remote desktop computer. The client does not need a significant amount of processing power, since the server handles the back-end data processing. The model system's server environment differs from this scheme in that the web application has preprogrammed search tools and does not currently offer an SQL-based search function. The one requirement for the user is that by design Microsoft's Internet Explorer browser must be used to perform the secure logon process that is controlled through the operating system on the server. The logon access control is the most basic form of web security and does not manage internal data security by state or segment. The ability to encrypt data transmission exists through the secure sockets layer connection but requires a third-party encryption key process to be absolutely effective.

The model system structure will provide more automated search functions and rely less on an SQL function. The SQL function permits a more granular search capability but requires much more knowledge and action by the user. Since clients of varied technological "know how" will use the model

system, pre-programmed search functions made more sense, even if limited. Figure 1.1 demonstrates the process of a user (client) initiating a session with a data-management system for the purpose of data submission or retrieval.

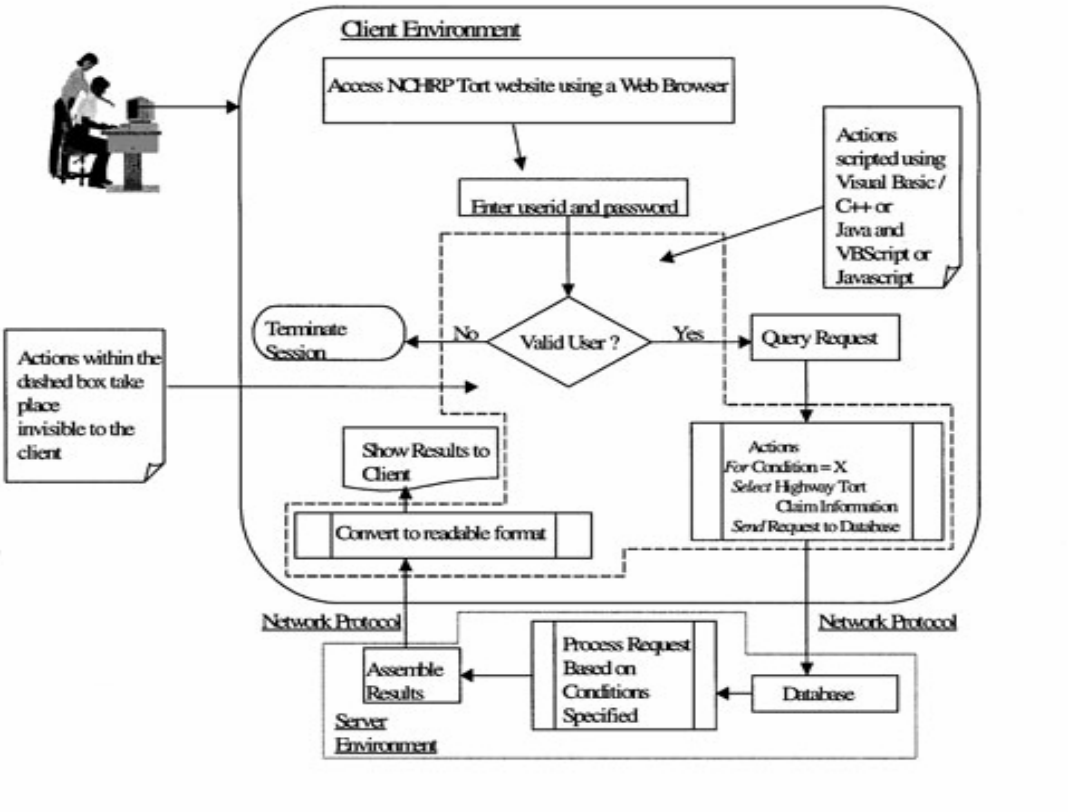

Figure 1.1 Scheme of Client Environment for Web-based Interface

The server-side environment consists of a Dell Power Edge 2400 computer server running the Windows 2000 server operating system, Cold Fusion Web Development Platform, and the Microsoft Visual Studio Suite. The data-management server was originally set up with the Windows NT4 operating system, but was upgraded to Windows 2000 for improved administrative and security functions (e.g., increased stability, "plug & play" capability for adding and removing hardware, encryption of data within the server). The Allaire Cold Fusion Server and Studio provides a web application development environment that can be more readily managed with a minimum of less experienced personnel. The Microsoft Visual Studio Suite, which contains a relational database (Visual Foxpro 6.0) and other development and programming tools, had been represented as a complete development package for simple creation and deployment of database-driven web applications.

Ultimately, the Microsoft suite required more expertise than anticipated, and was available for use as a sole development environment. Visual Foxpro, Microsoft's mid-range relational database, did prove to be an effective environment for database development and offers the scalability of an enterprise-level database without the cost. The potential transition to a national implementation made Foxpro a viable choice for its growth potential.

The server environment or "back-end" to the model system is the central database environment that consists of the database program, data tables, and functional programming and the web application server software that is integrated with services of the operating system. The database environment is the workhorse of the whole process and processes information input and output in a standard relational environment. Figure 1.2 demonstrates the structure and process of a client retrieving information from a relational database using a horizontal table structure that is linked by key fields.

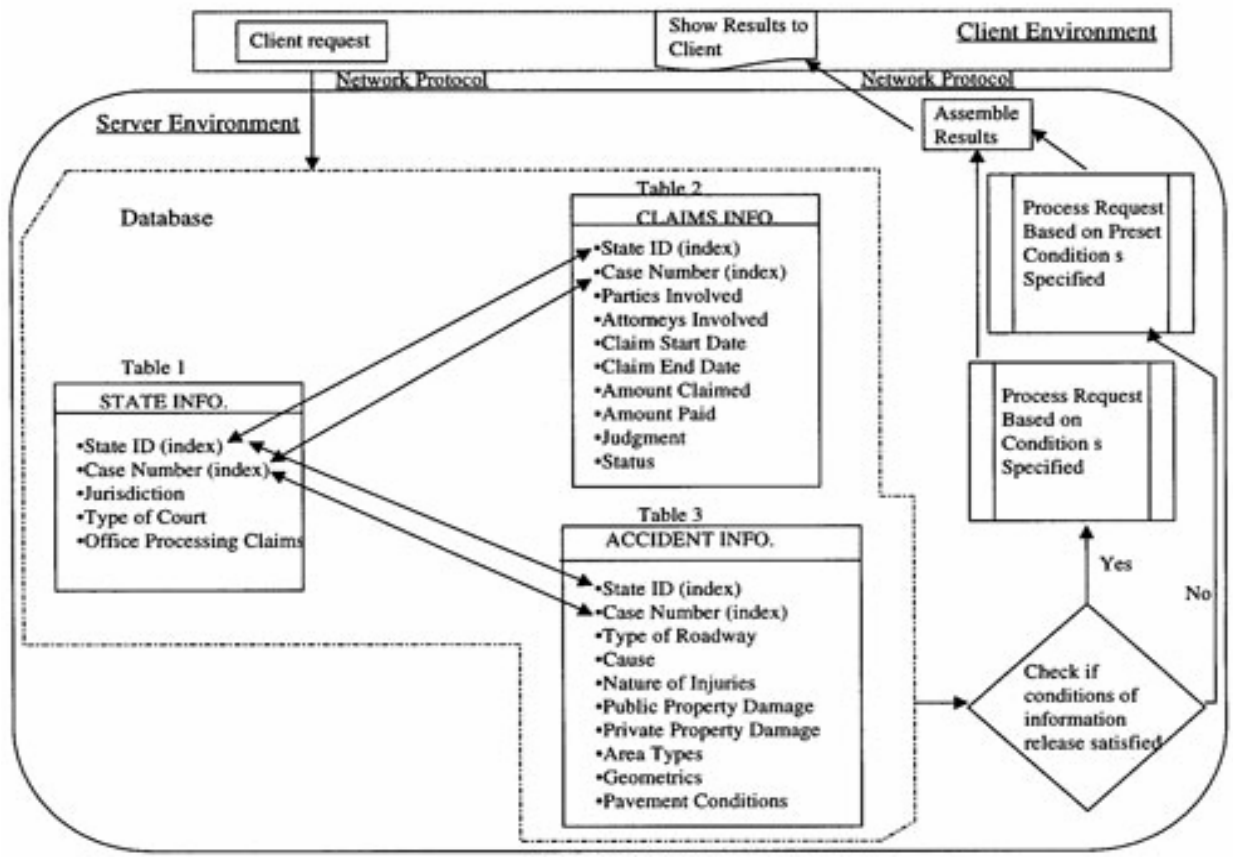

Figure 1.2 Scheme of Server Environment for Data Processing

The user interface can be understood as all components within the site that require or offer a level of user input to obtain a result. The components that comprise the user interface include entry forms, reporting functions, index search functions, and a discussion forum. The user interfaces had to be designed with a varied user community and simplicity in mind. Additionally, the very nature of a national pilot project dictated that the interfaces be familiar to the user community to demonstrate the value of the system. This was accomplished by using the 1992 AASHTO report designs as a model for creating the report layouts and the AASHTO survey as a model for the data entry forms. The report categories followed the nine data categories identified (e.g., sovereign immunity status, claims and lawsuit statistics) and the data entry forms were laid out according to organizational structures (e.g., legal, risk management, and insurance/liability).

In addition to the data entry and reporting functions, strong interest in expert witness information and a standard tracking mechanism for alleged highway deficiency information required the construction of separate data-management components. The data of greatest interest in relation to expert witnesses was the information from depositions and/or court testimony. A preliminary investigation determined the availability and recording media for these data and the needs for converting paper-based documents to a computer-based search mechanism. The "key word" indexing search component was ideal for this function. The indexing technology can handle nearly all word processing formats, text file formats, portable document file (PDF) format, spreadsheet formats, and presentation formats. Once the document is indexed, the user can search content by title, name, state, date, and case identification number. Since the program looks at characters and not definition or context, the user must make sure to use correct spelling. Through the use of "operators," such as "and," "or," and a comma "(,)" a user can narrow a search to target very specific information. The down side of this component is the time and cost in labor to scan and convert paper documents to one of the many digital formats.