Part A

OPENING SESSION

Current Status of Bridge Management System Implementation in the United States

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ABSTRACT

At the Federal Highway Administration, an effort has been initiated to document the status of bridge management in the United States after 10 years of research, development, implementation and promotion. Extensive interviews and meetings are being conducted to document the current practices for each State DOT and the District of Columbia. BMS is intended to provide decision support throughout the transportation planning process and within the project planning, development and implementation stages of bridge programs. Questions therefore sought to document the current, overall system utilized from the point that Federal funds are apportioned to the time that a construction or maintenance project is complete.

The history of BMS development and implementation is provided followed by discussion of the implementation efforts within each State Highway Agency. The transportation planning and programming process within each State is documented. Information collected, BMS application, and plans for bridge management application are discussed as they pertain to strategic planning, STIP/TIP development, and project planning within the bridge inventory. Generalizations are made and potential applications for current BMS alternatives are discussed. Knowledge of this process will highlight the potential applications of BMS in each DOT and will provide a basis for examination of the effectiveness of current systems. In addition, this 'baseline' definition will facilitate continued implementation, research, and development in this area.

HISTORY OF BRIDGE MANAGEMENT AND BMS

In 1967, the Silver Bridge between Point Pleasant, West Virginia, and Gallipolis, Ohio, collapsed during rush hour traffic resulting in the deaths of 46 civilians. Failure of this structure was the result of instantaneous eye-bar fracture. Subsequent Congressional mandates required the Secretary of Transportation to develop and implement the National Bridge Inspection Standards (NBIS) [23CFR §650.300]. This legislation forms the basis for the current state of practice in bridge inspection and bridge management.

The NBIS, implemented by the Federal Highway Administration in the early 1970's, maintains specifications for the inspection and inventory of bridges on public roads. In general, bridges are inspected every two years, though for a small number of bridges, a shorter or longer inspection cycle may be warranted. Inspection information is collected annually through this program and is reported to the Federal government, where it is maintained within the National Bridge Inventory (NBI) database. NBI Information, including condition and appraisal ratings, forms the basis for the prioritization and allocation of federal funding. Fields calculated by the Federal Highway Administration for the purposes of funds disbursement are also maintained within the NBI.

The Federal Highway Administration utilizes the NBI information to isolate projects eligible for federal funds and to allocate such funds to the States. In the initial stages of the program, the focus was to target limited available funds for replacement activity; however, the process was modified over time to incorporate consideration of bridge rehabilitation activity. Funds are disbursed through the Highway Bridge Repair and Replacement Program (HBRRP) [23 CFR §650.400], which utilizes the sufficiency rating to allocate funds, and the Special Bridge Program [23 CFR §650.500], which utilizes a discretionary bridge rating to allocate funds. The sufficiency rating formula considers structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. The rating is calculated utilizing a point deduction system. A bridge in perfect condition would receive a rating of 100. Deficiencies reduce the score received within each of the categories. The resulting rating is determined through the summation of the structural (55%), functional (30%), and essentiality (15%) scores. Special conditions, such as an exceptionally large detour length, may reduce the sufficiency rating further. Bridges with a rating of 50 or less are eligible for replacement funding. A sufficiency rating between 50 and 80 designates eligibility for rehabilitation funds. Each State has flexibility in selecting bridge projects subject to these eligibility constraints. Roughly 20 percent of all bridges (excluding culverts which are treated equivalently for funding purposes) are eligible for replacement funds. In addition, roughly 35 percent of bridges have a sufficiency rating between 50 and 80 and are eligible for rehabilitation funds. The discretionary program, i.e., the Special Bridge Program, considers the sufficiency rating, the total project cost, ADT and ADTT, and the funding disbursed through the HBRRP program.

Utilization of the NBI as the primary data source for the disbursement of funds through HBRRP and the Special Bridge Program has been the basis for bridge management decision making since the early 1970’s. This form of bridge management utilizes aggregated information and thus has limited applicability for analytical decision making. While the formula is convenient for funds allocation, it is not necessarily sufficient for analysis and needs prediction. Several States recognized that a new system would be required to enable more effective bridge program decision making. In the mid to late 1980’s, the increasing differential between funds available and needs became an area of greater concern. A new analytical form of bridge management decision support to facilitate budgeting, policy analysis and project-programming was desired.

Bridge management system (BMS) R&D was thus initiated to respond to this need for a more effective mechanism of decision support. Individual States and the Federal Government began examination into tools and techniques that could be utilized for bridge decision support. The North Carolina State University, under contract from the Federal Highway Administration and the North Carolina DOT, actively pursued research within functional improvement decision support systems, deterioration, and level of service optimization. Research resulted in the development of level of service optimization procedures. Simulation models were examined within the State of

Wisconsin. Bridge management techniques utilizing the Delphi process were examined within Kansas. Several other States (NY, PA, IN, TX, etc.) were active within bridge management system research. Statistical analyses were performed documenting the magnitude and extent of the bridge infrastructure deficiencies.

To document and examine the current practices and tools available for more efficient bridge planning and programming, projects were initiated by the Federal Highway Administration (FHWA) and through the National Cooperative Highway Research Program (NCHRP). The FHWA Demonstration Project 71 [O'Connor, et al.] and NCHRP Project 12-28(2) [Hudson, et al.] reports documented techniques which could be implemented for BMS development and defined the essential components of bridge management systems. These initial research projects provided the basis for further BMS development. The FHWA project continued with the development of the Pontis bridge management system. The NCHRP research continued with the development of the BRIDGIT BMS.

While the Pontis and BRIDGIT development projects were underway, the U.S. Congress passed the Intermodal Surface Transportation Efficiency Act [Public Law 102-240]. This legislation mandated the development and implementation of six intermodal management systems by the Metropolitan Planning Organizations and individual States, including bridge management systems. BMS development efforts were accentuated by the legislative requirements.

Initial developments followed different philosophies. Pontis employed a 'top-down' approach while BRIDGIT followed a 'bottom-up' approach. These philosophies are depicted graphically in Figure 1, which is reproduced based on information disseminated through the National Highway Institute (NHI) bridge management training course.

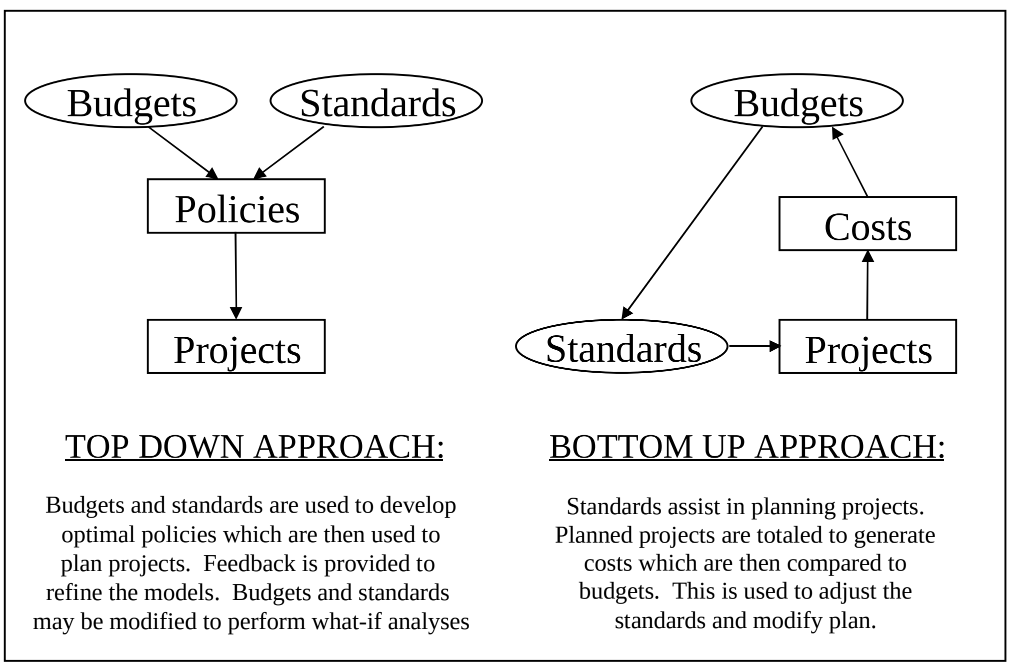

Figure 1: Alternative BMS development philosophies.

Both systems consider preservation and improvement needs over a long-term planning horizon. Preservation models are based on element-level definitions of bridge components with inspection information based on pre-defined condition states. Future conditions based on probabilistic projects are used when formulating present-day programs. Improvement models in each system employ models comparing the actual conditions to the minimum acceptable conditions. Where deficiencies exists, actions are suggested to bring the structure in conformance with desirable standards. Integration in Pontis is performed period-by-period to generate long-term programs. BRIDGIT employs a multi-period integration procedure considering timing of activities to minimize long-term costs. Though specific considerations between the preservation and improvement models differ between Pontis and BRIDGIT and alternative integration approaches are employed, the end-goals of the optimization procedures are equivalent: to maximize the safety and minimize the life-cycle costs.

Both Pontis and BRIDGIT released beta versions of the software in the early 1990's. Since the initial releases, many modifications have been implemented; however, the mathematical optimization procedures have not been significantly modified. Primary changes have incorporated rapidly evolving advances in computer technology.

Pontis has received wide acceptance by State Departments of Transportation. In a survey performed by the Federal Highway Administration and documented within the *12th Annual Report to Congress*, forty-two States had indicated that they intend to implement Pontis. Four States (North Carolina, Alabama, New York, and Pennsylvania) had undertaken and intended to implement their own developments. Florida and Illinois had also contracted State specific BMS developments; however they were undecided as to whether they would implement these systems, Pontis or BRIDGIT. Maine and Indiana were undecided at the time of the survey. Maine has indicated that they would implement either Pontis or BRIDGIT. Indiana has indicated that they will implement either Pontis or their own development. Many Metropolitan Planning Organizations were expected to implement BRIDGIT.

In 1995, the National Highway System Designation Act [Public Law 104-59] officially repealed the legislative requirements for BMS implementation. An informal survey undertaken by the FHWA Bridge Division has indicated, however, that all but three States intend on implementing the systems as indicated above. These three States have indicated that they do not intend to implement bridge management systems and will continue utilizing their existing bridge planning and programming procedures.

CURRENT LICENSING

State-specific developments continue to be used by Alabama, Indiana, New York, North Carolina, and Pennsylvania. Florida and Illinois, initially investigating the development of State-specific systems, have standardized on the use of Pontis. Thus, Pontis and BRIDGIT may be considered as the primary commercially available products. Current licensing of these systems is described.

The current release of Pontis is version 3.4.2 and is distributed as AASHTOWare™. As of May, 1998, there were 45 subscribers to the software, including:

- 38 State DOTs
- The District of Columbia
- Sacramento and L.A. Counties
- The City of Los Angeles
- New Jersey Turnpike Authority
- Hungary and Kuwait

BRIDGIT is currently employed in Maine with several other States examining the system for possible implementation. Recently, a group of 10 States solicited AASHTO to develop BRIDGIT as an official AASHTO Project (CO, KS, LA, ME, OH, OK, VA, WA, WI and WY). A decision has not been made at the time of this writing as to whether the software will be supported by AASHTO. BRIDGIT is also being used in India and is currently being examined by other countries for implementation.

OVERVIEW OF SURVEY

The current implementation licensing status is thus well documented. In an attempt to document the use of the current systems, a nation-wide survey was developed by the Federal Highway Administration. This survey is currently underway and seeks to document the use of the respective systems by State bridge owning agencies. Focus areas include the use of the systems for long-range and strategic planning, STIP/TIP development, and project-level planning activities. The survey established was intended to facilitate discussions. State DOT personnel were interviewed and BMS implementation was discussed in depth. Summaries of the discussions were then developed. To date, approximately 40 surveys have been completed and 26 have been finalized. Results culled from the 26 finalized surveys are presented in this document. Final results documenting the nation-wide implementation status will be available at a later date. Respondents included 24 Pontis States and 2 States employing their own systems.

OVERVIEW OF GENERAL IMPLEMENTATION

General information was first collected with States interviewed to determine which of the parties are responsible for data collection, data management and use of the BMS models. Questions and response summaries are as follows:

- *Who is responsible for maintaining the NBI and the BMS information? Who is the primary user of the system and who is asking for results from the BMS?*

The NBI and BMS information is maintained at the Central/Headquarters level for all of the Departments surveyed. Data maintenance responsibility is somewhat dependent on the organizational structure of the agency. Bridge activities may be consolidated into a single department or dispersed through other functional divisions. Fifteen of the States surveyed maintained NBI and BMS information through the bridge divisions/departments. Six agencies maintained BMS activities within the design department and five agencies operated BMS activity through maintenance or operations divisions. In all cases, bridge personnel are responsible for maintaining the information.

The primary users are bridge engineers or bridge maintenance engineers located in the respective divisions. Typically, there is a single person responsible for BMS activities. This person typically has multiple responsibilities and may only have a short period of time available for BMS activity.

The State-specific systems were used in the generation of the STIP, Division personnel, and by MPOs. Considering the Pontis users, seven States indicated that they were using the system as part of the bridge management process. Four States indicated that the results were used exclusively within the bridge or maintenance section. Three States were using the system to generate results at the request of planners, district personnel, county engineers, MPOs, regional staff, etc. Fifteen of the 24 States indicated that no one has requested results from the system to date. Two of these 15 States indicated that the system was not operational. One State, not included in the 15 mentioned, was unresponsive.

- *Is BMS being employed for all structures or a subset? How many years of BMS information are available (inspection, costs, actions, etc.)?*

Of the 26 States, 13 agencies indicated that BMS inspection and application was being performed for all structures on public roads in excess of 20 feet in total length. Eight agencies indicated that implementation was intended for State-owned bridges only. Other agencies (five States) are either revisiting the question of the extent of BMS application or applying to a subset comprised of both on-system and off-system structures. The number of years available is dependent on the type of information. The number of years of element-level inspection information available is shown graphically in Figure 2.

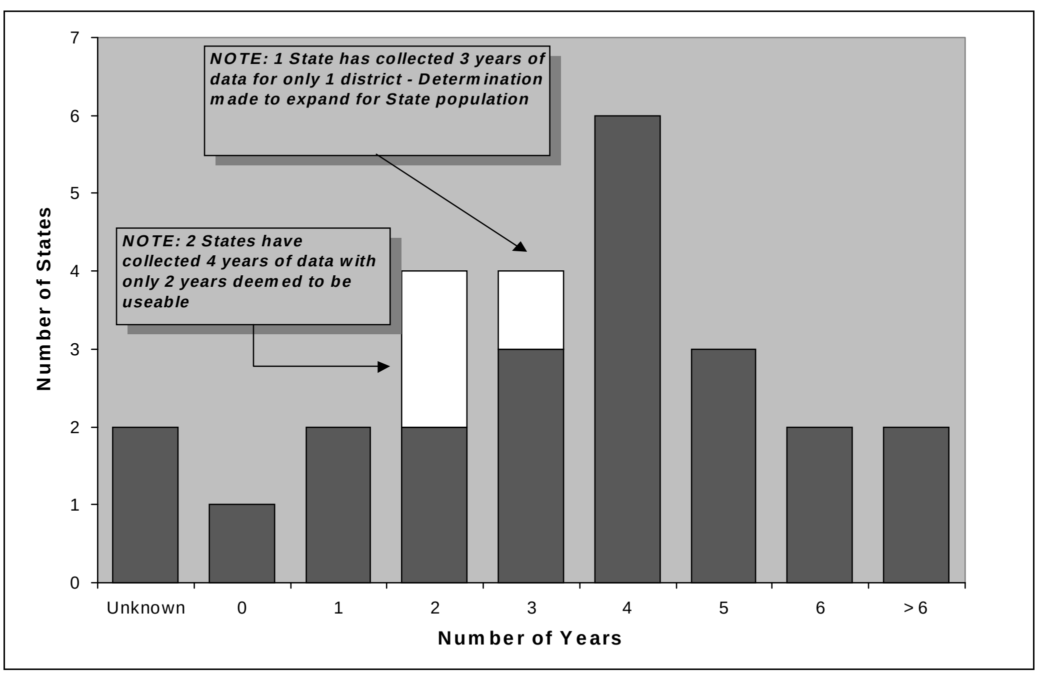

Figure 2: Number of years of element-level inspection data available for the survey states.

With respect to the action and cost models, both agencies with State-specific systems had action and cost information available. It must be noted that these systems, however, operate differently from Pontis and BRIDGIT; therefore, action and cost modeling is performed in a different fashion and takes on a separate meaning. Considering the 24 Pontis States, nine entities indicated that initial model elicitations have not been performed. Eight States specifically indicated that both elicitations were performed and seven States did not provide a clear indication as to whether the models were developed. Twenty of the 24 Pontis States indicated that the cost information available to the agency was not in a format compatible with the Pontis cost models. One State has performed a study analyzing contract bid information to ascertain whether Pontis cost models were representative of local conditions. One State had indicated that 3 years of action effectiveness information had been collected. Another State had developed a maintenance cost estimation system based on a work-crew approach typically used for detailed estimating for construction. This approach may facilitate integration with the Pontis cost models.

- *Have the updating features of the system been utilized? Has a process been established to facilitate this updating?*

Updating of models is distinguished from updating of inspection data. All agencies have a process established to ensure use of current year information in the bridge management decision making process. The two agencies with State-specific systems update cost estimates and inspection information annually. Other information pertinent for optimization/prioritization is updated as necessary. For the 24 Pontis agencies, five States have used the updating procedures at some point during implementation (3 unknown, 16 have not used the capabilities). Of the States who have explored the updating capabilities, three agencies have established procedures to systematically refine the models when data becomes available. Of the States who have not established a process for updating, four indicated that processes to add these capabilities were under development.

USE OF BMS FOR LONG-RANGE AND STRATEGIC PLANNING PURPOSES

Strategic planning involves the establishment of system goals, such as the reduction in deficiency percentages, over a long-term horizon. A more generic model of long-term planning incorporates strategic functions together with the establishment of long-term investment levels, techniques for identification of system-level problems, and development of long-range strategies and actions to accomplish the strategic goals. Bridge management systems, particularly with the network-level functions developed within the systems, may be used to facilitate the long-term decision making process. Questions and response summaries are as follows:

- *Is formalized strategic planning performed? By whom? What goals are developed?*

Fifteen of the 26 agencies surveyed indicated that strategic planning was performed and that the strategic planning process involved a bridge component. In five of these 15 States, the strategic planning process involved transportation commissions and committees involving DOT personnel and other parties. For nine States, the strategic plan was developed within the bridge or maintenance department or by the Chief Engineer.

Four of the States with strategic planning processes did not employ quantitative goals. These States tended to have general priorities, such as a focus on removing load carrying capacity restriction, low conditions, functional deficiencies, etc. Quantitative goals for the remaining 11 States tended to vary from agency to agency. Example goals, each employed by individual States, are as follows:

- Reduce the number of bridges with health index below a minimum level
- Reduce the number of deficiencies by 5% per year
- Have no more than a defined percentage of structure with sufficiency ratings < 50
- Improve a specified number of bridges each year
- Specific goals to reflect legislative proposals

The 11 States without formalized strategic planning followed FHWA goals for reduction of deficiencies. Several of these states had bridge populations that met or exceeded the FHWA goals.

- *What performance measures have been used and what data is required?*

Primary performance measures were the sufficiency ratings and the number of deficiencies:

- 3 States indicated that the sufficiency rating was the only performance measure
- 8 States indicated that the number of deficiencies was the only performance measure
- 8 States indicated that both the sufficiency ratings and deficiencies were used.

For the other States, some of the performance measures were as follows:

- Number of bridges needing work
- The Pontis Health Index
- Structural Deficiencies, Posting and Sufficiency Ratings
- Deficiencies and Load Carrying Capacity
- Bridges in ‘safe’ condition as determined by State formula
- Multiple ratings, including sufficiency ratings and deficiencies, etc.

BRIDGE FUNDING SOURCES

It is generally considered that the primary funding source for bridge preservation, improvement and mitigative activity is the Federal Highway Bridge Rehabilitation and Replacement Program (HBRRP). Other sources of federal funds are available, including the Interstate Maintenance program, the Surface Transportation Program, National

Highway System funds, etc., in addition to State-specific funds. States were surveyed to determine the funding programs used for various types of bridge activity. Questions and responses are summarized as follows:

- *What funding sources are used for various activities (routine maintenance, repair, rehabilitation, improvements, replacements and retrofits)?*

Bridge funding policies varied from agency to agency. Certain generalizations may be made, however. For most States, routine maintenance and light repair were performed using district or regional maintenance crews.

For rehabilitation actions, 15 of the 26 States indicated that HBRRP funds were used for all projects. Two of the remaining States indicated that State-only funds were used. The other 9 States indicated that rehabilitation was performed using a variety of funding sources, including HBRRP, State-funding programs, and other federal programs, including the Interstate Maintenance program, the Surface Transportation Program, etc.

For replacements, HBRRP funds were used exclusively in 18 of the 25 States. For the remaining seven States, replacements were routinely programmed using State-funding programs exclusively.

For improvements, activity may be triggered either by the bridge or by other transportation features. The source of funding was dependent upon the need triggering the project for most States. Twenty-three States indicated that bridge activities were undertaken when triggered by bridge conditions. For 12 of these States, HBRRP funds were exclusively utilized, whereas for the other agencies, the funding source used was case dependent. Where improvements were triggered by other activities, such as corridor widening, 10 States indicated that HBRRP funds were used for the bridge portion of the project. Four States indicated that other federal funding sources would be used in lieu of HBRRP funds. The remaining States indicated that funding sources used were case dependent.

For mitigative actions, the following funding sources were indicated by respondent states:

- 9 agencies indicated use of State funds only
- 5 agencies indicated use of HBRRP funds
- 2 agencies indicated use of Interstate Maintenance funds
- 4 agencies indicated use of multiple funds
- 5 agencies indicated that retrofits are not undertaken independently of other needs

USE OF BMS FOR STIP/TIP DEVELOPMENT PURPOSES

State Transportation Improvement Programs and Transportation Improvement Programs (STIP/TIPS) are employed by State DOTs and Metropolitan Planning Organizations (MPOs) for moderate-range planning and programming in support of the long-term, strategic goals. The process results in documentation of budget-levels and project constraints over a 3 to 7 year period and “are the intermediate step between the long-range plan and ultimate project delivery” [MSIC, p. 29, 1998].

- *Who is responsible for developing the STIP and do they have influence or control over the entire source of funding? Is the STIP project-specific? How are bridge management systems used for STIP development?*

The STIP is developing Planning or Intermodal Programs offices for seven of the 26 States. Bridge Departments (or departments responsible for the BMS) generate the bridge portion of the STIP independently in nine of the 26 States. For two of the States, the bridge portion of the STIP is generated from districts or regions. The remaining States develop the bridge portion of the STIP through Committees with participants from multiple departments. For most agencies, the STIP is a combination of a project-specific document and budget levels which are approved periodically by a Transportation Commission.

The STIP project lists and budget levels are created using engineering judgement and prioritization procedures for all of the States surveyed. Four of the States have indicated that the bridge management system employed was used for STIP development. Three of these agencies used the systems to generate replacement lists and one agency used the system to generate required budget levels for various activities. The remaining States had indicated that BMS results were not used for the STIP development process. Five of these States indicated that they planned to use the results of their system to support this process in the future.

USE OF BMS FOR PROJECT-LEVEL PLANNING AND PROGRAMMING

The project-level planning and programming phase of overall bridge management is comprised of design, construction, maintenance and operation functions. Given annual budget-levels, together with specific project actions identified through the STIP/TIP process, bridge program managers develop annual priority lists and oversee implementation of various required actions.

- *How are project-level programs developed and is BMS used for this purpose?*

For many of the States, the STIP bridge list defines the annual project-level program. Where the programming is performed independently of STIP development, programs were generated using either the sufficiency rating to prioritize structures or State-specific prioritization formulas in conjunction with engineering judgement and inspector recommendations. The four States using BMS for STIP development also use their systems for project programming. Two additional States have indicated that the systems were used for type selection on specific structures. Almost all of the States indicated that they intend to use the systems for project programming in the future.

RESPONSIBILITY FOR PERFORMING ACTIONS

Work plans developed are traditionally undertaken through a variety of internal and contractual mechanisms. Action responsibility is traditionally a function of the organizational structure. States were surveyed to identify departments and divisions responsible for performing actions identified through the project-level programming phase.

- *Who is responsible for performing bridge maintenance, repair, rehabilitation, replacement, improvement and/or mitigation activities?*

For most of the structures examined, the bridge owner was responsible for performing required actions on a structure. However, for some jurisdictions, bridge activities for non-State owned structures would be overseen or, in some cases, performed by State DOT forces. These situations naturally result from cooperative agreements specific to the State and locality under consideration.

There are organizational differences and alternative business practices used in each of the States surveyed. It is beyond the scope of this document to examine each of the structures employed; therefore, a generalized organization, as shown in Figure 3, will be used for discussion purposes.

One respondent indicated that all activity was performed through contracting mechanisms. The remaining States indicated that bridge activities were undertaken either using in-house forces or through contracting mechanisms. The bridge owner is responsible for performing actions, except in cases where States have assumed maintenance responsibility through mutual agreements.

Typically, routine maintenance is performed by in-house crews through the District or Regional offices. Maintenance decision making is the responsibility of District/Regional personnel. Where required actions are beyond the capabilities of the maintenance crews, contracting mechanisms are typically employed. Decision making for more substantial activity is dependent on the action required and the organizational structure of the agency. For all agencies surveyed, there are multiple departments or divisions involved in the decision making process. For instance, repair and emergency actions may be overseen by the maintenance division in coordination with the districts. Rehabilitation and replacements due to conditions may be developed by the bridge design department and overseen by the construction division. Improvements may be the responsibility of roadway divisions with the activity managed by the construction

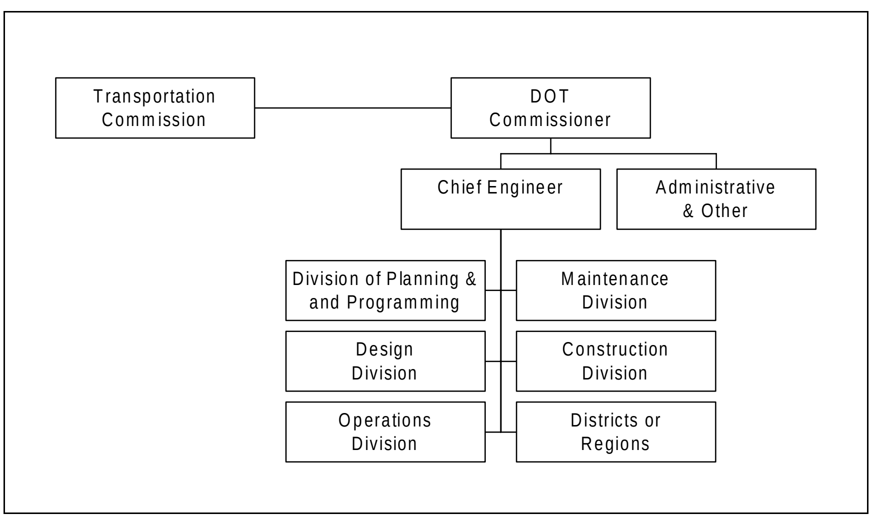

Figure 3: Hypothetical organization for discussion of implementation status.

division. Though summarization of specific departmental action responsibility is beyond the scope of this document, it may be generally concluded that for the agencies surveyed, the decision responsibilities for activities addressed by BMS are dispersed throughout the agency.

ADDITIONAL FEATURES

Additional information was collected through the survey process regarding BMS implementation. Some of the information collected is summarized, by question, as follows:

- *Is there a Maintenance Management System and is it tied to the BMS?*

Fifteen of the States, including the two agencies with State-specific systems, indicated that maintenance management systems were available within the Department. Two (2) States indicated that the information in the MMS was compatible and could be electronically accessed from the BMS. Four of the 15 States with existing systems were examining techniques to enable cost updating within the BMS. Three (3) States indicated that Maintenance Management Systems were under development (one of these States discussed that the development was structured to permit integration with the BMS).

- *Are there pavement, safety, etc. management systems and do they share common data with the BMS?*

Pavement management systems (PMS) were widely available in the States surveyed, as shown in Table 1. Four of the respondent States indicated that the PMS and BMS were able to access information through a common relational structure [3 for safety management systems (SMS) and 1 for congestion management systems (CMS)].

- *Are segmental inspections being performed?*

Segmental definition of the bridge may be performed within the Pontis system. Two of the 24 Pontis States surveyed indicated that segmental capabilities were being utilized. One of these States indicated that the capabilities were applied only to a small number of large structures with varying superstructure configurations. The second State indicated that

Table 1: Availability of Other Management Systems in States Surveyed

System	***Available***	***Under Development***	***Unknown***	***Accessible***
PMS	16	4	6	4
SMS	6	3	6	3
CMS	2	1	6	1

segmental bridge definitions and segmental inspections were performed for all structures with approach spans indicated through the NBI record. Three of the remaining 22 States were evaluating the use of a segmental approach for larger structures in the future.

- *Is there a need for separation of paint and overlay systems from underlying elements?*

With element-level modeling, there are two philosophies with respect to protected elements. The approach taken in the Pontis CoRe element model does not separate underlying elements from protective systems (paint systems, deck overlays, etc.). Pontis States were surveyed to determine whether a need existed for this type of model. Responses were evenly divided:

- 8 States indicated that there was a need for separation
- 8 States indicated that there was not a need for separation
- 8 States were undecided at the time of the survey

One of the States had indicated that a separated element/protective systems approach was currently being used in Pontis. Undecided States were either reconsidering separation at the time of the survey, were unaware of the impacts of separation and needed to study the impacts in more detail, or had mixed opinions on the subject. One of the States responding that there was a need for separation expressed concern that the existing condition state language, without separation, was adversely affecting the sufficiency rating calculation through the NBI translator.

- *Is inspection information collected using electronic data collection techniques?*

This question was intended to determine whether information was collected and maintained in an electronic format using PDAs, laptops, etc. None of the 26 States surveyed had totally initiated a paperless process. Nine States indicated that computer technology was not used in the inspection process. For these States, inspectors did not have access to laptops in the field but could use desktops to generate reports. For the remaining States:

- 13 States indicated that laptops were available to all inspection personnel
- 4 States indicated that laptops were available and efforts were underway to develop an electronic data collection procedure

One State of note had successfully integrated laptops into the inspection data collection procedure several years ago. A second State was actively examining procedures to enable inspectors to utilize the internet for report submittal directly into the inspection database.

- *Is NDE/NDT utilized as a routine part of the inspection process?*

Routine techniques (dye penetrant, magnetic particle, etc.) were utilized by most agencies on a case by case, as-needed basis. One agency indicated advanced NDE/NDT utilization for special situations. A second agency indicated that two specialized teams were available within the agency to perform NDE/NDT with more advanced techniques where needed. Three States indicated that techniques were being employed to assess overhead sign structures in addition to bridges.

- *What additional information is required that is not currently collected or maintained?*

Seven States indicated that no additional information was required for collection. Fifteen States indicated that additional inventory items and NBI-style inspection items were required. Eleven of the States indicated that additional detail is required for special inspection, underwater inspections, and fracture critical inspections. Seven States indicated that more detailed scour information was required. Other specific suggestions of useful additional data are as follows:

- Chloride ion content, salt usage, accident data
- Enhanced information for load rating and routing purposes
- Enhanced corrosion information including material borings (timber, concrete)
- Actual locations of low conditions states in order to track repairs and new damage/deterioration between inspection.
- Alternative units for CoRe elements (substructures in terms of area, alternative condition state definitions)

For the Pontis States, user-defined elements were employed by 13 of the 24 States. Two of the 11 States, which do not utilize user-specified elements, indicated that they would be adding user-elements in the future.

- *How has the implementation effort been impacted by the removal of the mandate?*

With respect to the State-specific systems, one respondent indicated that implementation was not affected by removal of the mandate. The other State indicated that implementation had been slowed primarily due to a lack of urgency. With agencies implementing Pontis, 13 States indicated that the implementation effort was not affected by removal of the mandate. The remaining 11 States indicated that implementation was delayed primarily due to a lack of emphasis from upper-level decision makers, difficulties with resources and manpower, and a lack of urgency. For many of the States (20 of 26), bridge management system activity is a part-time effort. Responsible staff typically are required to devote a substantial amount of time to other activities. In addition, staff turnover, typically through promotion of bridge management engineers, has impeded implementation and progress.

SUMMARY AND CONCLUSIONS

The States surveyed, in general, have collected a number of years of BMS-specific condition information through periodic bridge inspections. The State-specific systems have been employed for several years and are integrated into the business process of the agency to manage bridge replacement activities. A small number of the Pontis States have been actively employing the system to generate results pertinent for bridge management decision making. Most of the other Pontis States surveyed had interest in using the systems to support decision-making within the Bridge or Maintenance Department. As the systems progress and more information becomes available, it is expected that these States will begin to employ the systems within portions of their business practices. The effort summarized in this paper will culminate in a summary of BMS activity nationwide. Results will be disseminated through the FHWA upon completion.

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