TRANSPORTATION RESEARCH
CIRCULAR
Number E-C185 April 2014

The Future of TransXML

Workshop Summary

December 11, 2013
Washington, D.C.

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TRANSPORTATION RESEARCH CIRCULAR E-C185

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Workshop Summary

December 11, 2013
The Keck Center of the National Academies
Washington, D.C.

Katherine F. Turnbull
Texas A&M Transportation Institute
Rapporteur

Sponsored by the
National Cooperative Highway Research Program

April 2014

Transportation Research Board
500 Fifth Street, NW
Washington, D.C.
www.TRB.org

TRANSPORTATION RESEARCH CIRCULAR E-C185

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Javy Awan, Production Editor; Jennifer Correro, Proofreader and Layout

Preface

Planning, designing, constructing, and operating transportation systems involve the exchange of large volumes of data. The lack of common data formats to facilitate the exchange of data across different business platforms has been a limiting factor for transportation agencies, vendors, contractors, and other groups. The eXtensible Markup Language (XML) represents a universal structured data transfer methodology that helps facilitate e-business and e-government. XML data structures, or schemas, provide a mechanism to develop and adopt common formats for data exchange.

A National Cooperative Highway Research Program (NCHRP) project completed in 2006 examined the potential of using the XML data structure in transportation and developed TransXML, an open vendor-neutral format for storing, exchanging, and archiving transportation data. Standard public domain schemas for the exchange of transportation data were considered in four business areas: survey and roadway design, transportation construction and materials, highway bridge structures, and transportation safety. The project also outlined a framework for developing, validating, disseminating, and updating current and future schema.

The development and use of TransXML schemas has been limited since the completion of the initial project. No major outreach activities were undertaken after the project. The results of a 2011 survey conducted as part of a second NCHRP project found that many state departments of transportation (DOTs) and other agencies were unaware of TransXML and identified only a few examples of TransXML schemas in use.

The Workshop on the Future of TransXML was held on December 11, 2013, in Washington, D.C. The workshop focused on potential future development and implementation of TransXML. The workshop had six general objectives:

1. Communicate the content of existing TransXML schema and potential future schema;
2. Discuss the benefits and business value of building on TransXML;
3. Gain a better understanding of the activities critical to furthering development, adoption, and maintenance of TransXML;
4. Explore partnership opportunities and alternative approaches;
5. Identify a possible TransXML stewardship framework and process for developing, maintaining, and updating TransXML schema; and
6. Identify potential follow-up activities.

To accomplish these objectives, the 1-day workshop included presentations and working sessions. The workshop attracted 34 participants, including representatives from federal and state transportation agencies, national organizations, universities, and software development and consulting firms.

This document presents the proceedings from the workshop. The proceedings follow the schedule of the workshop. The major topics addressed in the morning general sessions are highlighted. The discussions in the afternoon working sessions are summarized and potential approaches for moving forward are presented.

TRB assembled a planning committee to help organize and develop the workshop program. The planning committee was chaired by Frances Harrison, Spy Pond Partners, LLC. Committee members provided expertise in the development and use of TransXML schema.

Katherine F. Turnbull, from the Texas A&M Transportation Institute (TTI), prepared this report as a factual summary of what occurred at the workshop.

The views expressed in the proceedings are those of the individual workshop participants, as attributed to them, and do not necessarily represent the views of all workshop participants, the workshop planning committee, TRB, or the National Research Council.

ACKNOWLEDGMENTS

A sincere thanks to all who participated in the workshop (see page 30 for the Participants List). Special thanks to the Workshop Planning Committee: Frances Harrison, Spy Pond Partners, LLC, chair; Todd Bergland, Minnesota DOT; George Kopp, Missouri DOT (retired); Edgar Kraus, TTI; Jim McDonnell, American Association of State Highway and Transportation Officials (AASHTO); James Poll, Research and Innovative Technology Administration–Intelligent Transportation Systems Joint Program Office; George Raymond, Oklahoma DOT; and Eric Weaver, Federal Highway Administration (FHWA). Thanks also to TRB staff Tom Palmerlee and Mai Le for their help and hard work in organizing the workshop. Finally, the workshop planning team is grateful to Katherine F. Turnbull for her work in preparing the workshop proceedings.

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Welcome and Introductions

FRANCES HARRISON
Spy Pond Partners, LLC
Moderator

Frances Harrison, chair of the Workshop Planning Committee welcomed participants to the Future of TransXML Workshop, sponsored as part of NCHRP Project 20-94: Development of a Formalized Process for the Adoption, Development, Maintenance, and Enhancement of TransXML Schemas. She described the development and the basic elements of TransXML, and summarized the purpose, objectives, and desired outcomes of the workshop. She recognized and thanked members of the Workshop Planning Committee and TRB staff. Harrison covered the following topics in her presentation.

- TransXML was initially developed as part of NCHRP Project 20-64: XML Schemas for Exchange of Transportation Data (TransXML), conducted from 2004 to 2006. The objective of this project was to develop broadly accepted public domain XML schemas for exchange of transportation data and to develop a framework for development, validation, dissemination, and extension of current and future schemas. The project results are documented in the 2007 *NCHRP Report 576: TransXML: XML Schemas for Exchange of Transportation Data*.
- TransXML is an open, vendor-neutral format for storing, exchanging, and archiving transportation data. It supports the exchange of data across multiple applications and databases, such as geographic information systems (GIS), computer and design (CAD), and construction. TransXML allows for the "loose-coupling" of applications, including exporting and consuming TransXML data. It is self-documenting and human-readable. Harrison indicated that TransXML was only partially built-out as part of the initial project. She further noted that is has not been widely marketed, supported, or adopted.
- Harrison reviewed the purpose of the workshop, which was to discuss options for the potential future development and implementation of TransXML. The workshop objectives include reviewing TransXML as it exists today and identifying potential additions; discussing the business case for expanding and supporting TransXML; reviewing the activities required to develop and adopt new and updated common data exchange formats or schemas; reviewing alternative approaches to schema updating and adoption; identifying minimum and desired elements of a formal process for maintaining and updating TransXML; and identifying potential next steps.
- Harrison described the goals for the workshop. The first was to identify methods for developing a greater awareness and understanding of TransXML applications and benefits of current use, adoption challenges, and different models for consensus building and adoption of standard data exchange formats. A second was to suggest an approach for moving forward, including the potential roles of various agencies and groups.
- Harrison reviewed the workshop format. The morning sessions featured speakers addressing different aspects of TransXML and providing perspectives from state and federal agencies, organizations, and industry groups. The afternoon sessions included facilitated discussions on options for moving forward, alternative processes for developing and adopting schemas, and possible next steps.

Where Have We Been?

TODD BERGLAND
Minnesota Department of Transportation
Moderator

TransXML CONTENT: OVERVIEW OF THE ORIGINAL 2006 TransXML PROJECT

Paul Scarponcini, Bentley Systems, Inc.

Paul Scarponcini provided an overview of the initial NCHRP Project 20-64: XML Schemas for Exchange of Transportation Data (TransXML). He described the focus and intent of the project, the major work activities, the XML schemas developed, and the support schemas. He also presented example applications. Scarponcini covered the following topics in his presentation.

- Scarponcini noted that the intent of the initial project was to develop standard public domain XML schemas for the exchange of transportation data. The project created a framework for the development, validation, dissemination, and extension of current and future schemas. The focus was on four business areas: survey and roadway design, transportation construction and materials, highway bridge structures, and transportation safety.
- Scarponcini reviewed the major work tasks from the initial project. Phase 1 focused on analyzing gaps and opportunities and identifying schemas and sample applications. It also established a framework for using the geography markup language (GML) and conducted a test with GML. Phase 2 identified concepts to be modeled with the unified modeling language (UML). It developed XML schemas, created sample applications, and proposed stewardship options. The results were published in *NCHRP Report 576: TransXML: XML Schemas for Exchange of Transportation Data*, which is available at www.transxml.com.
- The UML was used to create easy-to-read implementation-independent logical models. Class diagrams depict concepts along with their attributes and associations with other concepts. Figure 1 presents the class diagram for the pay item for the payroll schema. It presents the concept, the attributes, possible operations, and associations between different concepts. Scarponcini noted that the UML proved extremely useful in communicating concepts and data details to achieve consensus before encoding. It helped ensure consistency and harmonization between the schemas. Further, it should aid in future modifications, as well as the development of new schemas.
- Scarponcini described GML, which was developed jointly by the Open Geospatial Consortium (OGC) and ISO TC211. It is an XML extension for geospatial applications that is based on the OGC–ISO feature model. GML provides standardized XML coding conventions, full OGC–ISO–SQL harmonized geometry model support, and coordinate reference systems. It also provides linear referencing, TIN support, and compatibility with CityGML, WxS, WaterML, and other OGC standards.

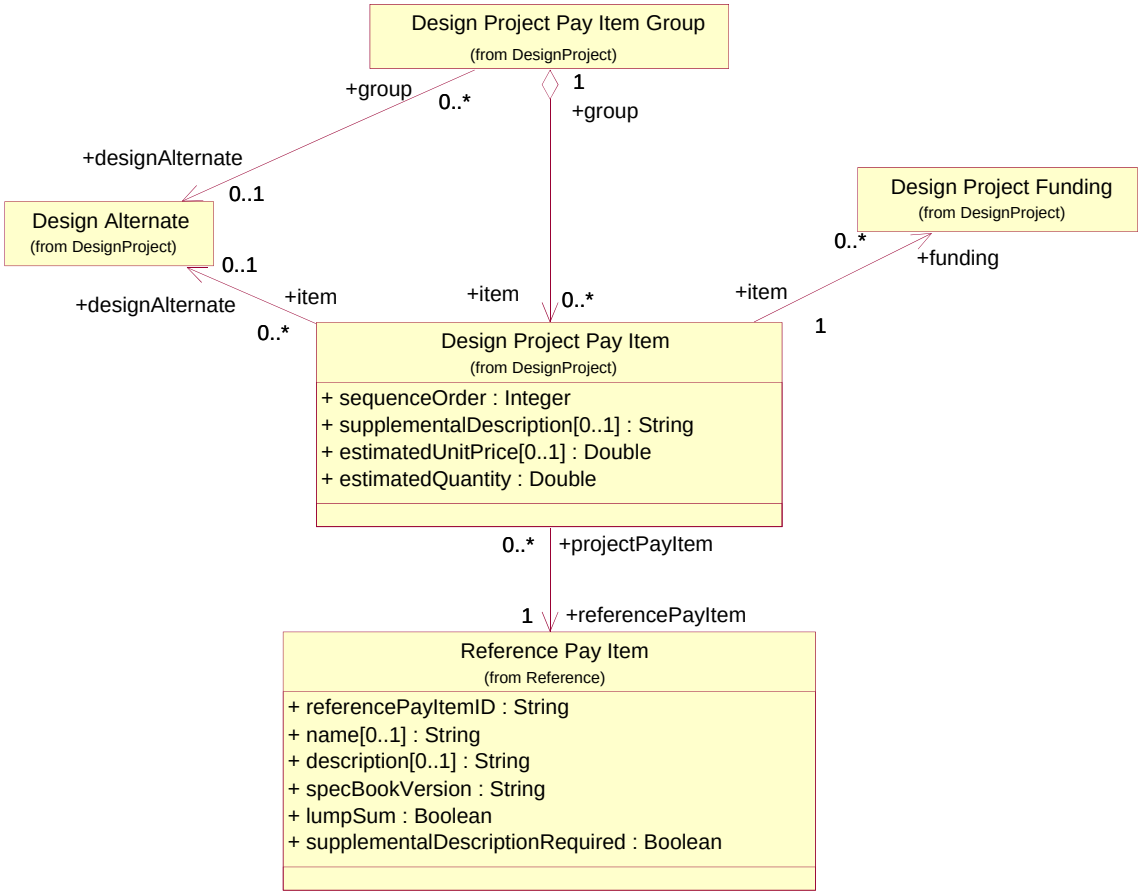

FIGURE 1 Diagram for the pay item for the payroll schema. (Source: Bentley Systems, Inc.)

- Scarponcini noted that there are two types of files in XML: the schema definition file and the XML file. The schema definition file sets the format for exchanging the information. The XML file contains the actual data being exchanged or shared. It follows the XSD format. Scarponcini summarized that there is one document to specify the format and a second document for the actual data exchange.
- Scarponcini reviewed the schemas that were developed by business areas. Three schemas were developed in the survey and roadway design business area. These schemas were geometric roadway design (GRD)–surface model information, design project (DP), and area features (AF). The four schemas within the transportation construction and materials business area were bid package (BP), construction progress (CP), materials sampling and testing (MST), and project construction status (PCS). The one schema developed in the highway bridge structures business area was bridge design and analysis (BDA). NHTSA was also working on a crash data schema at the time. TransXML adopted the NHTSA–JusticeXML crash records XML schema that is based on the Model Minimum Uniform Crash Criteria (MMUCC). The other transportation safety schema was the Highway Information for Safety Analysis (HISA). In

addition, there were three common schemas: linear referencing (LR) using an evolving ISO standard; reference (REF); and a base TransXML core module (TXL).

- Scarponcini described the GRD schema for exchanging roadway design information among design team members. Figure 2 illustrates the data elements included in the geometric design and the user groups. He noted that since LandXML already existed, a conceptual UML model was created and improvements to LandXML were recommended to LandXML.org.
- Support schemas for TransXML included TXL for base concepts, REF for bid items and funding sources, and LR, which uses the recently approved ISO 19148 LR standard.
- Scarponcini noted that the AF schema provides area feature support, as per ISO TC211. Examples of elements included in AF were areas of wetlands, soils, flood plains, hazardous materials, land uses, and right-of-way constraints.
- Scarponcini summarized the DP schema, which includes pay item information from the design process to be passed on to the construction process. Pay items included units of measure, quantities, location, and prices. The DP expands aecXML Infrastructure, adding quantities and cost.
- The BP schema focuses on the proposal bid package preparation for construction contract letting. Scarponcini noted that information in a bid package typically includes location, work type, vendor requirements, milestones, liquidated damages rate, and pay items and quantities. The quantities and materials used and tested can be tracked during construction using the CP and the MST schema. Scarponcini pointed out that TransXML is being used to carry data from design into construction. The PCS schema tracks the construction project status based on information from the construction management system. The project status information can be passed on to different stakeholders.
- Scarponcini noted that the BDA schema enables the transfer of bridge description information across bridge structural analysis packages allowing comparative analyses. Bridge loading rating systems represents one use of the analysis results.

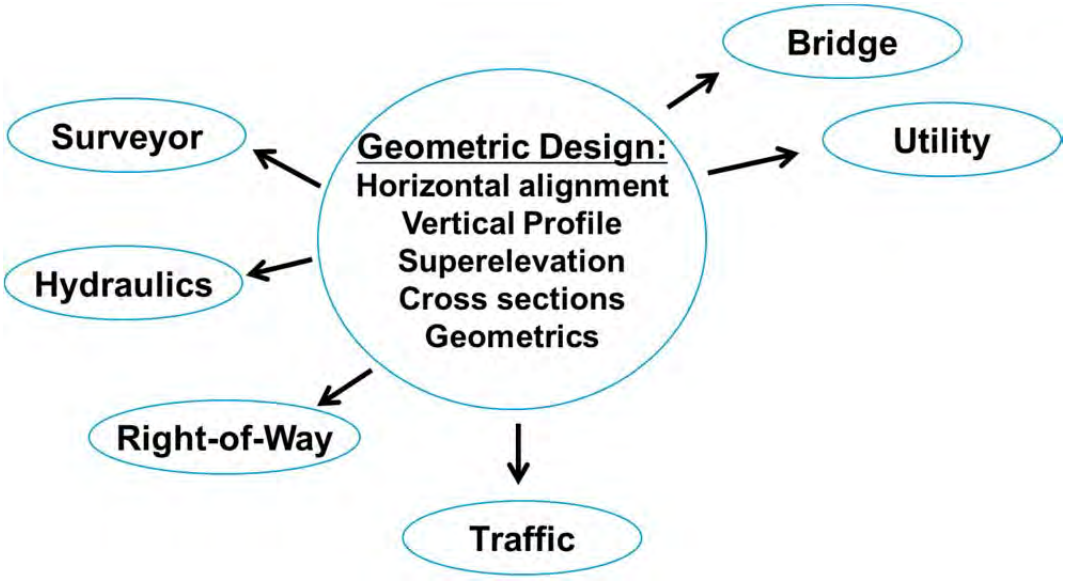

FIGURE 2 GRD schema: geometric design information and user groups. (Source: Bentley Systems, Inc.)

- Scarponcini noted that the MMUCC XML schema was adopted for crash data and put into a GML format. It can be used for transferring highway crash information from police reports to other agencies for processing, archiving, and analysis. The HISA describes safety-related highway inventory items that relate to a specific incident location for integration with crash data to identify high accident locations, to analyze the need for engineering countermeasures, or to evaluate specific countermeasures proposed for a location, based on FHWA's Safety Analyst and TSIMS data dictionaries.
- Scarponcini described some of the applications that were developed and tested to demonstrate the schema. He noted there was at least one application for each schema. Examples of these applications include importing area features from GIS into CAD, retrieving pay items from a master list, selecting items for a project, and adding quantities and costs. Other applications were generating a bid package, generating a web page showing a daily construction progress diary for a project, and producing a web page showing the sampling and testing activity for a material sample. The two crash-related applications were merging two XML data files—one using the NHTSA MMUCC XML schema and the other using a different schema that might be used by a state or municipality—and searching through crash records stored using the NHTSA MMUCC XML schema and linking these to related highway safety information.
- In concluding his comments, Scarponcini acknowledged members of the team conducting the NCHRP project. The team included Bentley Systems, Inc.; Info Tech, Inc.; Michael Baker Jr., Inc.; and Cambridge Systematics, Inc. He also recognized the participation of the NCHRP project team, representatives from AASHTO, FHWA, and the various stakeholders.

TransXML SURVEY AND SCOPING STUDY

Frances Harrison, Spy Pond Partners, LLC

Frances Harrison described the major elements of NCHRP Project 20-07, Task 295, TransXML Survey and Scoping Study. Harrison served as the principal investigator on this 2011 project. She reviewed the study scope, the results of the online survey, and examples of TransXML use. She also discussed opportunities for new data exchange formats and expansion areas, candidate future schemas for TransXML, and barriers to more wide-scale adoption of TransXML. Harrison covered the following topics in her presentation.

- Harrison noted that the initial NCHRP project identified four major business areas for TransXML: survey design, construction materials, bridge, and safety. The project envisioned that TransXML could expand into additional areas, including asset management, maintenance management, project development, and program development. It also identified areas with active standards development already underway. Examples of these areas included operations and intelligent transportation systems (ITS), modeling and simulation, geospatial data, and freight logistics.
- The 2011 study had four major objectives:
  1. Determine the current use and support for TransXML and other standard nonproprietary XML formats for data exchange.
  2. Determine the needs and support for extensions or modifications to existing TransXML schema based on experience to date.

3. Identify priority areas for new common data schema based on the opportunities for reduction in duplicate data entry or enhanced information sharing within and across organizations.
4. Identify suggestions for new industry standard formulas to facilitate data exchange.

- The study began with an online survey in August and September 2011. The survey was distributed via e-mail to the AASHTO Subcommittee on Information Systems and the AASHTO Standing Committee on Planning, attendees of the most recent GIS-T conference, and community members registered on the TransXML website. It was also sent to the TRB Data Section Committee chairs, with a request to distribute to members and friends, and the four Highway Engineering Exchange Program (HEEP) area officers, with a request to distribute to HEEP members. The survey was also distributed to individuals at selected engineering firms and software vendors.
- Harrison reported that 130 complete surveys were received. Responses were received from 38 of the 50 state departments of transportation (DOTs). Other responses came from individuals at metropolitan planning organizations, universities, and consulting and software firms. Individuals responsible for planning, design, construction, operations, safety, and maintenance were all represented in the responses.
- According to Harrison, more than half of the respondents indicated some familiarity with TransXML. One third of the respondents indicated that they had never heard of TransXML, however. Only 15 of the 130 responses indicated that they had evaluated or used TransXML. TransXML–LandXML–GRD was used or evaluated by seven respondents. TransXML–Area Design Features (GIS-to-CAD transfer), was used by three respondents and TransXML–Bridge Design and Analysis was used by two respondents. TransXML–Construction Progress and TransXML–Project Construction Status were used by one respondent each.
- Fifty-eight percent of the respondents reported using either common XML formats or customized formats for their agency. The remaining respondents indicated they were not using XML for data exchange or were not sure what methods were used at their agency.
- Some respondents provided examples of XML usage within their agency or organization. The New York State DOT reported using LandXML adapted with custom elements for automated steel bridge design and detailing functions. In another example, Bentley Systems developed PermitXML based on OS/OW system implementations in 20 states and one Canadian province. The Minnesota DOT reported using PayrollXML for construction contractors submitting standard payroll information into Trns*port.
- To help identify opportunities for gaining efficiencies using common data exchange formats, survey respondents were asked to assign a high, medium, or low rating to different options. Sharing highway or asset inventory information among systems was rated high by 60% of the respondents, followed by bringing highway design data into inventory and asset management software (55%), and sharing traffic data among systems (50%). Sharing highway alignment data across different design software packages was rated high by 45% of respondents, as was sharing crash data among different systems. Sharing utility and right-of-way data among systems was rated high by 44% of respondents.
- The survey also included questions on other opportunities for expansion of TransXML. Respondents suggested the following other businesses areas for TransXML expansion: pavement management (61%); maintenance management (56%); bridge management (51%); and traffic operations–ITS (51%).

- Harrison described pavement deflection data as one possible TransXML expansion area. The data content would include pavement deflection measurements and associated metadata. The data exchanges would be falling weight deflectometer (FWD) equipment to analysis software. The suggested action would be to develop new schema, drawing upon already identified data structures and standards. It would build upon the RN and LR TransXML schemas. She noted that there are multiple producers and consumers of FWD data and that some standards are already in place. The potential development of a XML schema in this area would need to consider the current standards.
- Survey respondents were asked to identify major barriers that limited adoption of common data formats. The lack of awareness of existing formats and how to implement them was noted by 70% of the respondents, followed by too costly to retrofit systems (56%), and common data formats are not compatible with those in use (46%). Other barriers reported by some respondents included incompatibilities across vendor applications; TransXML complexity makes it difficult to justify the investment; resistance to standardization; and lack of resources and stovepipe systems make integration costly.
- Harrison summarized the conclusion from the project. These conclusions included a lack of awareness and understanding of TransXML due to an absence of marketing and outreach and challenges associated with communicating technical concepts. She noted that the survey targeted a broader group than the original project, which could partially explain the lack of awareness. The survey results point to a possible need for additional education about existing schemas. The results also suggest that state DOTs are committed to using XML technology and are interested in expanding TransXML into other areas. Finally, the survey respondents suggested a list of XML and nonXML schema that could be integrated with TransXML.

TransXML STEWARDSHIP

Greta Smith, AASHTO

Greta Smith discussed the need for ongoing support and stewardship of TransXML. She summarized the AASHTO Technical Committee on Electronic Engineering Data (TCEED). She described the initial charge to the TCEED, the interest in TransXML, and the need to identify roles, responsibilities, and resources to promote, maintain, and expand TransXML. Smith covered the following topics in her presentation.

- Smith reviewed the original charge to the TCEED, which was to provide a forum for the development, publication, and maintenance of highway electronic engineering data standards and to provide a nonproprietary exchange of data between and among software applications and data customers. She noted that some schemas were developed as part of the initial TransXML study. She also noted that the 2011 survey canvassed state DOTs on their understanding of TransXML and their need for different types of TransXML schema.
- Smith suggested that the need for TransXML schema has grown since 2004 and has become more urgent. She noted that conveying design plans to construction firms and construction plans to contractors has become more important within the design and construction communities due to increased use of 3-D modeling and machine-guided technology. She further noted that increased communication and information sharing is needed among all the groups responsible for guiding projects through planning, design, construction, and operation.

- Smith suggested that the results of the 2011 survey indicated support among the different stakeholder groups for using available TransXML schema and developing additional schema. She suggested that TransXML schemas could assist with asset management and maintenance and could help close the loop between planning on one end of the spectrum and maintenance on the other end. She further suggested that this need is obvious to most design and construction professionals, as well as personnel in other disciplines.
- According to Smith, marketing and resources are needed to promote TransXML and to develop additional schema. Resources have been lacking since the completion of the initial study. Smith suggested that a comprehensive approach outlining roles, responsibilities, and funding is needed to move forward. She also noted that developing TransXML schema requires technical expertise not typically available at state DOTs. Transportation agencies have the subject matter experts and are the end users of TransXML. She suggested that adding technical measures to TCEED to help interpret how TransXML schema is developed would be beneficial.

Where Are We Going and Why?

EDGAR KRAUS
Texas A&M Transportation Institute
Moderator

STATE DEPARTMENT OF TRANSPORTATION AND AASHTO PERSPECTIVES

Todd Bergland, Minnesota Department of Transportation, and
George Raymond, Oklahoma Department of Transportation

Todd Bergland described the use of TransXML schema by Minnesota DOT. He also discussed issues with the use of PayrollXML and the need for a new schema related to wage decisions. George Raymond discussed the AASHTO TCEED and elements to consider in developing a stewardship model for TransXML. Bergland and Raymond covered the following topics in their presentation.

- Bergland noted that TransXML schemas have been used at Minnesota DOT since 2006. Minnesota DOT uses the aecXML schema, which moves quantities from Bentley's Quantity Manager into AASHTOWare Project. It connects two very disparate systems and allows for seamless integration between the two systems. He noted it is a very efficient system for Minnesota DOT and has been used for many years by the department.
- Bergland suggested that the speakers and comments thus far at the workshop have identified many of the issues and opportunities associated with further promoting and maintaining existing TransXML schema and developing new schema. These issues include funding, stewardship, marketing, and knowledge development. Bergland noted that TransXML is not well known within state DOTs, which is a major limitation. He thought that only a small number of personnel understand and use TransXML.
- Bergland described some of the current challenges with TransXML, using PayrollXML as an example. PayrollXML was identified as one of the initial schemas in the first NCHRP report. PayrollXML was developed by Info Tech. It is the mechanism state agencies use to integrate payrolls from construction contractors into the AASHTOWare Project Civil Rights and Labor product. He noted that PayrollXML is not an adopted standard under the TransXML umbrella; however, it appears to be limiting software vendors from incorporating it into their software. At the same time, general contractors have indicated a need for the software, rather than entering the information into an XML spreadsheet, generating XML, and running it through a valuation process. The ability to generate XML directly from a contractor's payroll application is a preferred approach. Bergland suggested that resolving this issue would be of benefit to state DOTs.
- Bergland noted that a TransXML schema on wage decisions would also be of benefit to state DOTs. He indicated that current wage decisions for every type of worker on a contract have to be imported by state agencies. The information comes initially from the U.S. Department of Labor (DOL) in a format that is not easily readable. Having the information available from the U.S. DOL in a standard TransXML format that could be imported into AASHTOWare would save time and resources for state DOTs. He noted that funding is needed to develop, promote, and maintain this type of TransXML schema.

- Raymond reviewed the formation and the role of the AASHTO TCEED, which was established by the AASHTO Standing Committee on Highways (SCOH) in 2006. He noted that the SCOH resolution establishing the TCEED did not empower the TCEED to develop, adopt, or maintain TransXML schemas. The resolution does indicate that the TCEED will help move TransXML forward, however. Funding from NCHRP has been key to the progress made to date with TransXML. He indicated that further support and direction from the SCOH would be needed to undertake other activities.
- Raymond noted that members of the TCEED do not have the technical experience to validate proposed TransXML schema or to identify potential improvements. A possible approach suggested by Raymond would be to establish a process similar to the AASHTO Subcommittee on Materials. He noted the technical expertise is much more diverse with TransXML and additional resources and outside expertise would be needed beyond any single AASHTO subcommittee.
- Raymond indicated there is no process to adopt existing TransXML schema, let alone develop new schema. No single point of authority or stewardship to accomplish these tasks currently exists. He suggested this workshop could help in identifying approaches, including the needed stewardship and funding. These approaches could be presented to SCOH to move forward. He noted that most contractors and state DOT personnel do not know about TransXML. They just want to be able to seamlessly transfer needed data. He suggested that the first logical step would be to identify the group to be empowered to undertake the needed activities to develop, adopt, and maintain TransXML schema.

FEDERAL HIGHWAY ADMINISTRATION PERSPECTIVE

Eric Weaver, FHWA

Eric Weaver provided one perspective from FHWA. He described his experience being in charge of FWD operations and the database operations for the Long-Term Pavement Performance Program. Weaver covered the following topics in his presentation.

- Weaver noted that when he joined FHWA in 2002, he was on the LTPP team and was in charge of the FWD operations and database operations. According to Weaver, the LTPP has the largest payment performance database in the world, with data coming from nearly 2,500 pavement sections throughout the United States and Canada. Few material field collection and test procedure protocols existed when the LTPP was initiated in the early 1990s as part of the SHRP. Establishing test procedures and protocols was needed to ensure consistency among the four regional contractors collecting pavement data. He noted that it was not possible to wait for vetting through the AASHTO process for all the protocols and procedures deemed necessary by the stakeholders involved. In particular, a calibration protocol had to be established for FHWA to ensure that the data being collected using the FWDs available from the three vendors at the time was consistent, repeatable, and reproducible. Weaver noted that there was a resolution from AASHTO supporting the calibration procedure.
- According to Weaver, the advances in computer operating systems resulted in a need to update the calibration software. A multistate pooled-fund study was established to update the calibration protocol and the software. As part of the update process there was a desire to ensure that the data format that was required by the software was interoperable between FWD equipment vendors through a standard format. Weaver noted that he was unaware of TransXML at the time, so

the existing Pavement Deflection Data Exchange (PDDX) was used and updated to be consistent with the new protocol and software. The equipment vendors needed to offer the PDDX as an alternative format to generate data going into the calibration software. Otherwise, the calibration center operator had to transfer calibration results manually from the calibration center computer to the FWD computer, which takes time and risks the chance of transcription errors.

- Weaver noted that initially there were four regional calibration centers to support the state highway agencies (SHAs). The regional calibration centers used different business models, with some charging a nominal fee for non-SHA FWDs. Personnel at all the calibration centers had to be trained in the use of the new procedures. In addition, the new software and protocol was adopted by additional calibration centers both domestically and internationally. The new calibration system also makes it possible to calibrate a FWD anywhere provided that certain deflection and temperature conditions are adequate.
- Weaver suggested that the work conducted by the FHWA Turner-Fairbanks Highway Research Center (TFHRC) often includes software development; however, the TFHRC role is not well suited for ongoing service support for maintaining and sustaining software. As a result, other organizations were approached to take on the service role of the calibration system and providing training and certifications for the calibration center operators. He noted that the AASHTO Materials Reference Laboratory agreed to take over the service, supporting it with a fee for training and certification. The revenue from the training and certification process is used to maintain and update the software.
- Weaver noted that this example provides a slightly different focus than maintaining and sustaining TransXML, but that the use of the pooled-fund study is relevant. He suggested that the states responding to the TransXML survey and the FHWA may contribute resources to provide a business model for a sustainable solution to developing and maintaining TransXML schemas. He further suggested that any improvement in efficiency through the application of standard data formats benefits the FHWA Federal Aid Program, SHAs, and the construction industry.
- Weaver discussed the Moving Head for Progress in the 21st Century (MAP-21) focus on performance management, including monitoring the performance of the highway system to establish a baseline and to measure improvements in pavements, safety, and other metrics. The ability to aggregate data from all states through the use of common data standards would be of benefit. He noted that automation and technology advances—including 3-D modeling, vehicle-to-vehicle and vehicle-to-infrastructure communication, and roadway electrification—will all need interoperable data formats.

INDUSTRY PERSPECTIVES

Paul Scarponcini, Bentley Systems

Paul Scarponcini provided an industry perspective on the current status of TransXML and options for moving forward. He discussed the four TransXML business areas of asset management, land and property ownership, GRD design, and permits. He also outlined potential outreach activities and collaboration to increase the involvement of AASHTO and state DOTs in standard setting. Scarponcini covered the following topics in his presentation.

- Scarponcini noted that asset management is an important area for state DOTs and other transportation agencies. It provides a significant opportunity for applying TransXML, especially

focusing on the transfer of information from those responsible for design and construction to the actual owner. This information exchange, known as a Civil Building Information Modeling, has proven to be successful in building construction. There are industry standards associated with taking information on components of a building from design and construction and conveying them to the group responsible for owning, operating, and maintaining the building. Existing work in the standards community, such as the Construction Operations Building Information Exchange (COBie) is being extended from buildings to civil and infrastructure projects, COBie For All. Scarponcini suggested this approach would be beneficial for transportation asset management.

- The second business area discussed by Scarponcini was land and property ownership, also called cadaster. This business area is a fundamental responsibility of state DOTs. Right-of-way data might include parcels, appraisals, acquisitions, relocations, and property leases, sales, and relinquishments. Data may be exchanged from state and local cadaster and right-of-way systems to planning and design groups and from design systems into highway inventory systems for use by maintenance and operations staff. There are other standardization efforts underway in this area, including the ISO 19152 Land Administration Domain Model, LandXML and ePlan extension, and a new project by the OGC called InfraGML.
- GRD was the third business area discussed by Scarponcini. Roadway geometric design—including alignments, cross sections, and superelevation—is fundamental to exchanges across life-cycle phases, disciplines, and activities. This business area was not included in the initial TransXML project because LandXML already existed. Scarponcini noted that the current status of LandXML is unclear. Currently, there is no LandXML website. The last update to LandXML was in 2009 and there is no active sponsorship. He noted that this uncertainty is a concern. Knowledge of the alignment of a roadway is fundamental to other activities. Location information, which requires geometry, is critical in transportation. LandXML provided the needed alignment geometry.

  Scarponcini noted two recent efforts to address the uncertainty concerning LandXML.

  – First, the OGC was approached to takeover LandXML. The OGC created Land and Infrastructure Domain and Standards Working Groups to examine LandXML, and to develop recommendations on future directions. The working group noted that while the flexibility of LandXML was beneficial, the flexibility also limited the ability to develop interoperability standards because everything was optional. Problems with the LandXML coding were also identified. Given these issues, the OGC decided to initiate a new project called InfraGML. It would be based on GML, similar to TransXML, and it would use some of the functionality currently supported by LandXML. The OGC approved this approach and the InfraGML project has been initiated.

  – The second recent effort to address the uncertainty associated with LandXML described by Scarponcini was the emergence of Building Smart International (bSI). An infrastructure group, which includes transportation projects, has been formed within bSI with the intent of providing functions similar to those offered for buildings. The same methods of establishing industry foundation classes (IFCs) for transportation infrastructure elements, such as IfcAlignment and IfcBridge, are being used by bSI. Scarponcini noted that OGC and bSI have agreed to work together to define the requirements, which OGC will implement using GML and bSI will implement using IFCs.
- The fourth business area discussed by Scarponcini was permits. PermitXML is currently in use. It provides oversize–overweight permit application information from services and trucking companies to state DOTs. Broader use of a single XML schema across multiple states would simplify the permitting process. For example, large carriers could submit a single application that

could be consumed by multiple state systems. The vendor of PermitXML is open to working with others on a collaborative process to modify the schema.

- Scarponcini noted that no outreach activities promoting the use of TransXML were conducted as part of the initial 2004 NCHRP project. He suggested that the project did do a good job of inreach, including involving key stakeholders and soliciting feedback during the development of the schema. In discussing possible collaborations, Scarponcini noted the major changes and advancements that have occurred in the computer and technology industry since 2004. He also noted that many more groups are now involved in standard setting. These organizations have adopted standards for some XML schema. Scarponcini suggested that an important question is how to work with these standard setting organizations and how to get AASHTO and state DOTs involved in the development of industry standards. TransXML may be of help with these efforts. Scarponcini further suggested that one approach would be to have TransXML serve as an umbrella organization that would help foster development of schema in other areas, working with the standard setting organizations. The standard developing organizations would then support and maintain the schema over time and provide the needed performance tests.

SCHEMA ADOPTION CASE STUDY

Bob DeHoff, Info Tech

Bob DeHoff presented the PayrollXML adoption case study. He described the need for the payroll submission schema, the organizations involved in the development and adoption of the schema, and the key stakeholders within those organizations. DeHoff covered the following points in his presentation.

- DeHoff described the business need for the payroll submission schema. He noted that state DOTs must verify that contractors are paying their personnel the required wages. A paper-based submission process is currently used, with manual verification. The goal of the payroll data submission schema is to automate this payroll verification process, which requires payrolls in electronic rather than paper form.
- Figure 3 illustrates the adoption process for PayrollXML and the key stakeholders. The contractors on the left side of the diagram have the data needed by the state DOTs on the right side. The AASHTOWare Project now has a Civil Rights and Labor module. One of the key feature sets is validating the payroll requirements and accepting data in the XML format. The AASHTOWare Project now supports importing of PayrollXML and automated verification. The PayrollXML schema was developed during the module development. The key now is to get contractors to switch from paper to electronic payroll submission.
- DeHoff suggested that in any data standard initiative there are four communities that ultimately have to be engaged in the process. These communities are the data creators (the contractors in this example), the data consumers (state DOTs in this case), the software system vendors that are the data source, and the software system vendors that are the data destination. He further noted that within those communities there are two stakeholder groups that must be engaged: the decision makers who will authorize the adoption of the new schema and processes and the implementers who will carry out the change and maintain the new system.
- DeHoff described the role of a standard setting organization body in the adoption process. He noted the importance of an easily discoverable home for the standard and associated resources.

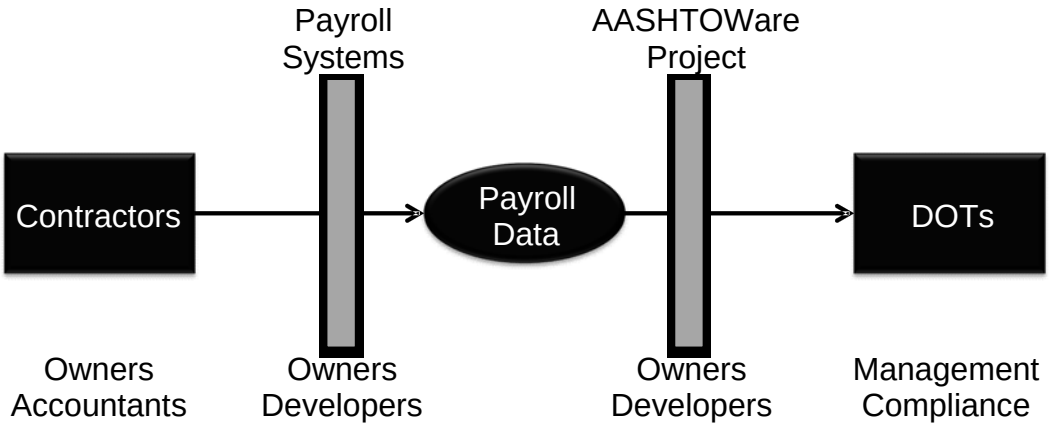

FIGURE 3 Example of PayrollXML adoption process and key stakeholders. (Source: Info Tech, 2013.)

Today, that means people must be able to "Google" it. The standard setting organization also needs to provide the schema development and maintenance methodologies and processes. The development of new schema requires community collaboration, involving the subject matter experts and other groups. Outreach, advocacy, and marketing are also important, as is a persistent ongoing presence.

Identifying Elements of Data Standard Adoption Processes

ERIC WEAVER
Federal Highway Administration
Moderator

AASHTO MATERIALS TEST ADOPTION PROCESS

George Raymond, Oklahoma Department of Transportation

George Raymond discussed the AASHTO Subcommittee on Materials (SOM) and the AASHTO materials test adoption process. He suggested possible options for developing and maintaining TransXML schema based on the AASHTO materials test adoption process. Raymond covered the following topics in his presentation.

- Raymond highlighted a report, which indicated that the first meeting of materials testing engineers was held in Washington, D.C., in 1920. The subjects addressed at that meeting included standard methods for conducting tests of highway materials, test limits to be used in specifications, standard methods of sampling, and standard methods of field testing. He pointed out that it took time to develop these standards and procedures.
- Raymond noted that the AASHTO SOM initiated a process for developing, maintaining, revising, and discontinuing standards and test procedures. He highlighted some of the major topics addressed in the SOM Information and Operations Guide, which was developed in 1994, revised in 2003, and revised again in 2007. The guide includes an overview of the AASHTO committee and subcommittee structure, the SOM purpose and scope, the organization structure, the process for developing and approving AASHTO standards, a style guide for AASHTO standards, and references to the ASTM.
- Raymond suggested that one possible option for developing and maintaining TransXML schema would be to utilize an AASHTO subcommittee in a similar fashion as the SOM, and the materials test adoption process. He noted that another option would be to utilize the national standard setting organizations discussed in earlier presentations.

DIGITAL INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Marc Hoit, North Carolina State University, and Robert Schweinfurth, ASCE Geo Institute

Marc Hoit and Robert Schweinfurth discussed the Digital Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS). They described the development of DIGGS through a pooled-fund study and presented examples of applications. They reviewed the current status of DIGGS and implementation activities. Hoit and Schweinfurth covered the following topics in their presentation:

- Hoit noted that state DOTs commit significant resources to maintain and process large amounts of data. For example, the California Department of Transportation (Caltrans) accumulates approximately 30,000 project files, 2 million documents, and 300 projects a year.

Caltrans has 80 years of data. It is difficult and time consuming to access all this information. He also noted that the Ohio DOT estimates that 20-to-30 person-hours per week are spent on retrieving information.

- Hoit reported that DIGGS was developed through a pooled-fund study with Ohio DOT acting as the lead state. Members of the pooled-fund study included the FHWA, state DOTs, the Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), major software vendors, and other groups. The study was initiated in 2005. He noted it was scheduled as a 3-year project, but it took 7 years to complete due to the time needed for the technical experts to agree on the data definitions and data to be shared. After these decisions were made, developing the schema was less complicated.
- Hoit noted that DIGGS grew out of the work of groups with existing standards. The first standard was the AGS standard in the United Kingdom. The U.K. Highway Agency (HA) mandates that all projects provide data in the AGS format. He described the HA Geotechnical Data Management System (GDMS). An Internet-based GIS stores data on spatial context (mapping and aerial photos), assets, reports, and boreholes. It supports the U.K. AGS data transfer format, including data storage, retrieval summary logs, and summary test sheets.
- The second existing standard described by Hoit was developed by the GeoReseach Group at Caltrans. The system combined boring logs from three different agencies into a virtual data center.
- The third group described by Hoit was the Florida DOT–University of Florida (UF) Pile Standard and the Florida DOT Geotechnical Database. The Bridge Software Institute (BSI) developed three unique pieces of software that can access the database. The software includes FB-Deep, Pile Technician, and database spreadsheets. He presented an example of an in situ spreadsheet. He further noted that the DIGGS database links data acquisition, data review and processing, and software applications.
- Hoit discussed the elements of the current DIGGS standard. These elements included borehole data from point locations and drilling operations, data samples, and site and depth information. He noted that test results can be separated from the samples and locations. Data logs can also be generated.
- Hoit noted that four state DOTs have reported cost savings from using data transfer and access, and plan to move to DIGGS. Ohio DOT reduced borehole drilling by 10% to 20%, resulting in savings of $12 to $24 million a year. Florida DOT reported savings from fewer borings, including $250,000 to $500,000 on one project. The Missouri DOT reported 10% to 15% fewer borings per bridge and $81,000 in savings a year in boring log preparation through the use of electronic data entry in the field. Caltrans reported savings of 20% or $200,000 a year with the implementation of a laboratory data management system.
- Hoit noted that DIGGS uses a computer format that is transferrable, sharable, and archivable. He also described the process used to keep samples separate from test data. This process was developed by the data experts, based on the needs identified by the technical staff.
- Hoit described the current status of DIGGS and future implementation activities, adding that it is GML compliant (international geospatial XML standard). Version 2.0α was available in July 2012. The data tool dictionary schema, and website have all been updated and a “DIGGS to Excel” toll has been developed. He noted that the need for an ongoing sponsor was also investigated. After checking with numerous organizations, Ohio DOT entered into a 2-year contract with the Geotechnial Institute.

- Schweinfurth discussed the goals of the Ohio DOT contact and follow-up activities. He noted the three major goals of the contract are to finalize the DIGGS schema standard from 2.0α to 2.0β and the public release of DIGGS 2.0, to transition ownership to the Geo-Institute, and to develop a long-term business plan and management structure. He also noted a DIGGS advisory board has been formed and that a survey of the DIGGS user community will be conducted. Training materials on the use of DIGGS, including webinars, will be developed. Approximately 15 agencies and groups have been identified to pilot test DIGGS 2.0α, including different state and federal agencies and software and hardware vendors. The final implementation activities noted by Schweinfurth were updating the XML schema and the data dictionary.
- Some of ongoing activities noted by Mr. Schweinfurth included refining the existing DIGGS to Excel tool and the DIGGS to KML tool. Another activity is working with AGS to add AGS 4.3 to DIGGS. Developing an Excel or web form to DIGGS represents still another activity. The final activity discussed by Schweinfurth was developing a validation tool.

agcXML INITIATIVE: INTEROPERABILITY FOR THE CONSTRUCTION INDUSTRY

Fara Francis, Associated General Contractors of America

Fara Francis discussed the agcXML initiative undertaken by the Associated General Contractors (AGC) of America. She provided background information on the AGC and the agcXML project. She described the two phases of agcXML and the model, scope, funding, and end goal of the phase two project. Francis covered the following topics in her presentation.

- Francis described the AGC of America. Founded in 1918, she noted that it is the leading construction industry association in the country. Members include general contractors, specialty contractors, service providers, and other related professionals in the construction industry. The mission and vision of the AGC of America is to promote a better industry for the professionals who build America's future.
- Francis reviewed the first phase of the agcXML project, which was initiated in 2004. The lack of easy data exchange and interoperability on construction projects was a concern for contractors as it was resulting in higher costs. The first phase of agcXML project was funded by the AGC of America. The project focused on developing 10 business transactional schemas such as submittals and change of scope. Francis noted that contractor interest in the project waned during the economic downturn, and the schema were developed only to the concept level.
- According to Francis, a number of factors contributed to renewed interest in the agcXML project. These factors included increased demand from contractors for standards, improvement in the construction economy, and improved and scalable IT infrastructure. Trends in mobile and digital technology were a further contributing factor.
- Francis reviewed the phase two project model. She noted that involving the contractor community throughout the project is a key focus. An advisory board consisting of software vendors, contractors, and AGC staff has been formed to oversee the project. A key role of the advisory board is to identify the improvements needed for existing schema and to suggest new schema for development. Another key role is to promote adoption and use of the schema. There are also working groups for each schema and a technical advisory committee.

- Francis noted that the Burger Consulting Group (BCG) has been engaged as a steward to manage the project. A software architect has also been engaged to develop the schemas. A project management office (PMO) consisting of BCG staff, AGC staff, and other key stakeholders has been implemented. Negotiations are underway with Open Applications Group, Inc. (OAGI), to develop a new schema. There are also ongoing discussions with other organizations and various standards groups.
- The phase two project scope focuses on enhancing the existing schemas, encouraging adoption, obtaining additional funding, and developing new schemas. Francis noted that the RFI schema is currently being finalized and will be demonstrated at the 2014 AGC convention. She suggested that adoption of the XML standards will take time and will involve the coordinated efforts of many groups. She noted that workshops such as this one help with these efforts and encourage communication and collaboration.
- Francis noted that the AGC is funding phase two, along with sponsorship agreements with software vendors. Current sponsors include Coins-Global, Maxwell Systems, Sage, Viewpoint Construction Software, and Blue Book Construction Network.
- In closing, Francis highlighted the end goals of the project. These goals include effectuating change within the construction industry, interoperability within construction software, establishing standards for construction software, and encouraging adoption of the standards. She noted that additional information on agcXML can be found at www.agcxml.org.

NATIONAL INFORMATION EXCHANGE MODEL OVERVIEW

Luke Johnson, National Highway Traffic Safety Administration

Luke Johnson discussed the National Information Exchange Model (NIEM), which uses XML to exchange information. He described the key elements and structure of NIEM, the use of NIEM, the process for establishing domains, and the operation of domains. He summarized the U.S. DOT's efforts to develop a surface transportation domain. He highlighted a scenario focusing on traffic records data and summarized some of the keys to success. Johnson covered the following topics in his presentation.

- NIEM is a community-driven, governmentwide, standards-based approach to exchanging information. Johnson noted that NIEM is already a widely adopted approach used by many agencies. It was initiated by the Department of Homeland Security (DHS) and the Department of Justice (DOJ) with DJXDM, which evolved into NIEM and spread to other areas. NIEM provides a common language at the federal, state, and local levels. The U.S. DOT is currently working to develop a surface transportation domain using NIEM. NIEM is colocated at the DHS, DOJ, and the Department of Health and Human Services (HHS). A program office provides overall technical support. The communities of interest for each domain also provide ongoing support. Data elements can be shared across all domains.
- Johnson noted that NIEM connects communities of people who share a common need to exchange information to advance their mission. NIEM provides a common language with users agreeing on terms, definitions, and formats. This process is independent of the way information is stored in individual agency systems. NIEM also provides a structured approach. It has a repeatable and reusable process for business users to document information exchange requirements in an implementation-ready format.

- Johnson described the structure of NIEM, which includes a core and domains. The NIEM core consists of data elements that are commonly understood across domains. Domains are based on mission areas and include mission-specific data managed through independent stewards. Domains extend the core and govern the data model for any given topic area. He noted that there is a good deal of interoperability and anyone can use the elements in any domain. Future domains are added to NIEM as necessary based on an established need.
- Johnson provided an example of how NIEM works in practice. He noted that a community of interest takes a stewardship role at the domain level. The producers and the users of data work together through the process—from establishing a domain, to managing it, to expanding it. Johnson reiterated the importance of having all the right people involved from both an organizational perspective and from a subject matter expertise perspective. He noted that the participation of personnel with expertise in information technology (IT), data, policy, and programming are all important. He also suggested that it can be difficult to get these diverse groups working together.
- Johnson noted that the NIEM model and process provides a structured approach for groups to work together. NIEM is standards based and is a uniform way to express data models, naming data elements, and structuring information exchange and documentation. For example, two groups that need to exchange information first identify what needs to be exchanged and the data requirements for that exchange. Their data terms may be different, requiring a common vocabulary so they can speak the same language. The two groups can leverage the NIEM data model and development methodology to create the exchange. Additional partner organizations can re-use the developed NIEM exchange, further saving time and resources.
- Johnson explained the process for establishing a domain. The three major steps are identifying business exchanges, engaging stakeholders and building a community of interested parties, and creating and maintaining the domain. Elements associated with identifying business exchanges include aligning to the strategic mission and priorities, determining high-value exchanges that will have substantial reuse, identifying communities of interest, and coordinating with other data stewards. Engaging stakeholders might include identifying scopes, user needs, and early adopters. Other elements might include establishing governance and how to address future changes. Creating domains includes defining the value proposition, identifying sharing partners, and reviewing any existing NIEM exchanges for potential reuse and adaptation. Benefits of NIEM noted by Johnson included wrapping data standards in a common vocabulary and providing a community of interest to maintain data standards.
- Johnson described the two key artifacts of domains. The first is the domain data model, which is a set of data elements and definitions specific to the NIEM mission area that are used to build information exchanges. The second is the information exchange package descriptions (IEPDs), which are a set of valid XML schemas that may include portions of NIEM core schemas, portions of domain schemas, and enterprise-specific or IEPD-specific extension schemas. He noted that the community of interest can organize workshops to manage and update the domain data model. Finally, exchange partners put the data model into action by developing IEPDs.
- Johnson summarized the current activities underway at the U.S. DOT to develop NIEM surface transportation domains. He provides secretariat services for the U.S. DOT Traffic Records Coordinating Committee (TRCC), which is a multimodal group within the department comprised of experts interested in traffic safety data. Mr. Johnson noted that at the state level, traffic records typically include data on crashes, vehicles, drivers, roadways, citation

adjudication, and injury surveillance. Many different groups within state departments of transportation have responsibility for these data, which are used for a variety of different analyses.

- The TRCC hopes to use NIEM to assist with coordination and integration of crash data. For example, crash data and injury surveillance data involves emergency medical services, state and local police, hospitals, trauma centers, and other groups. The NIEM process helps create and enfranchise the diverse groups involved with these large and complex data sets. Johnson noted that the Office of the Secretary's (OTS) Chief Information Officer (CIO) is developing a data governance board for the surface transportation domain. This board will provide stewardship at the U.S. DOT leadership level for the domain. The community of interest will also include the U.S. DOT Safety Council, the TRCC, and other appropriate groups. The process will be coordinated with related activities inside and outside the department.
- Johnson noted that engagement and communication are key to adoption of NIEM schema. He suggested that NIEM is not a specification for data; it is a specification for putting data to work. It provides the framework for bringing stakeholders together to develop standards that can be used by all groups.

Summary of Working Sessions and Approaches for Moving Forward

KATHERINE F. TURNBULL
Texas A&M Transportation Institute
Rapporteur

Three working sessions were conducted in the afternoon, providing participants with the opportunity to discuss approaches and activities to move TransXML forward. The first session, facilitated by Jim McDonnell of AASHTO, focused on possible stewardship models and options for maintaining existing TransXML schema, developing new schema, and providing ongoing education and outreach. The second working session, facilitated by James Pol of the RITA–ITS Joint Programs Office, addressed alternative processes for adopting schema. Participants discussed possible follow-up activities in the third session, which was facilitated by Frances Harrison of Spy Pond Partners, LLC.

This summary, prepared by Katherine Turnbull, the workshop rapporteur, highlights topics discussed by different participants in the three working sessions. Based on the comments by workshop participants, approaches for stewardship of TransXML and processes for developing, maintaining, and updating TransXML schema are presented. Potential funding sources and resources to advance these options are discussed. Possible outreach, marketing, and training activities are also outlined, along with ongoing coordination efforts.

WORKING SESSIONS

The first working session focused on a discussion of different stewardship models for TransXML and options for moving forward. Frances Harrison described three possible options for moving forward and five TransXML stewardship functions. Jim McDonnell facilitated a discussion of possible options and stewardship approaches for maintaining existing TransXML schema and developing new schema. Participants in the second session discussed alternative approaches for developing, updating, and adopting TransXML schema. James Pol described ways the construction materials schemas could be sustained as an example, and facilitated a discussion of possible approaches. In the third working group, Frances Harrison facilitated a discussion of possible follow-up activities from the workshop and steps to move suggested approaches forward. The following topics were covered in the three working sessions.

- Harrison discussed three possible options for the future management and support of TransXML. A first option was to take no action. A second option was a proactive approach, similar to the one mapped out in the original NCHRP project and documented in *NCHRP Report 576: TransXML: XML Schemas for Exchange of Transportation Data*. This broad scale, sustainable stewardship model targeted developing new schema, maintaining and improving existing schema, and conducting extensive outreach activities, educational programs, and pilot projects. An annual budget of $900,000 was estimated in the report for the proactive approach. A third option focused on a minimalist approach. This approach would rely on voluntary efforts, a possible pooled-fund study, potential industry support, or some other method to develop and

update schemas. A process would be established to vet ideas and proposals for new schema, to maintain a web page, and to publish updated schemas. Harrison noted that a variety of alternatives between these three options were also possible.

- Harrison described the five functions and roles for TransXML stewardship outlined in NCHRP Report 576. These functions and roles focused on strategy, technical development, coordination and liaison, advocacy and support, and communication. The strategic functions included establishing a clear vision for interoperability based on the greatest need and value. The technical development function included developing, maintaining, and promoting a family of XML schemas targeted to key areas, and establishing technical standards to ensure compatibility, uniformity, and nonredundancy. The coordination and liaison function included participating in other XML schema and standardization efforts and providing industrywide coordination to ensure coverage across important segments of the transportation industry. The advocacy and support function included promoting the benefits of TransXML, championing and supporting adoption and development through advocacy, and providing technical assistance and limited financial support. The communication function focused on providing a communication mechanism and infrastructure to enable appropriate participation in the schema development process. Harrison noted that these functions involved different skillsets and a wide range of activities, and that the scale for these activities could vary based on available resources and priorities.
- McDonnell suggested that the group begin the stewardship discussion by considering overarching goals for TransXML. Suggested goals included providing a common and easy method to exchange data, system interoperability, and electronic transportation data access. Participants noted that state DOTs are data driven organizations, and that TransXML can assist in implementing the concept of "collect data once, use it many times for different purposes." Some of the overarching goals suggested by participants that would resonate with policy makers and top agency staff included saving money and staff resources, streamlining and enhancing decision making, and reducing risk.
- Participants said that TransXML was needed and that it has the potential for widespread benefits to the transportation community. Participants suggested that TransXML could maximize efficiency, establish interoperability with vendors, provide a doorway to the future, lower the cost of entry into a new process, and enhance the operation of transportation investments. Participants also discussed that the business case for TransXML still needed to be communicated to leadership within state departments of transportation, AASHTO, and other groups to gain support and needed resources.
- Participants discussed different options for future stewardship and management of TransXML. They also thought that the "do nothing" approach was not a desirable option. A majority of participants believed that a sustainable stewardship model was needed in order to realize benefits from TransXML. There was general agreement that AASHTO was the logical stewardship organization and that some type of governing board was needed to oversee TransXML as part of this model. Participants discussed that funding would be critical for AASHTO to consider taking on this TransXML stewardship responsibility.
- Participants discussed different options for the board, including expanding TCEED and establishing a new group. While there was not total agreement on the best approach, participants identified key roles for the board. This group would provide the overall stamp of approval for TransXML schema. The board could be supported by AASHTO technical committees and consultants to provide technical expertise within specific schema business areas.

The board would not develop the actual schema, but would act to help identify needed schema, orchestrate a schema development effort involving participation from software developers, vendors and other stakeholders, develop and use a schema review and adoption process, and approve schema based on the review. Participants again noted that funding would be needed for AASHTO to consider this approach.

- Participants discussed how the board may want to suggest that a schema meets the desired criteria, standard, or need, but not mandate its use. The board could further publish and promote the use of the approved schemas. Participants suggested that additional members with expertise in specialized areas may need to be added to the TCEED and other AASHTO committees to assist with the technical review. Some participants also suggested that consultants would be needed to provide additional technical expertise.
- Participants discussed the importance of communicating and coordinating with other schema development and adoption efforts, including those underway at the U.S. DOT and the AGC. Continuing to explore links to these efforts, including NIEM, DIGGS, and the AGC was suggested as beneficial to all groups.
- Participants suggested that the focus of TransXML should be on schema that addresses key issues and needs of state departments of transportation. Asset management was identified as one topic of importance to state departments of transportation, especially with some of the provisions in MAP-21. Some participants suggested that a dual approach of moving forward with a more comprehensive approach, while at the same time fast tracking development of one-or-two key schemas, would be beneficial. This approach would help to promote the benefits of TransXML to state departments of transportation and other agencies. Pilots focusing on schema for payroll, oversize–overweight permitting, or the FHWA EDC2 3D Modeling Initiative were suggested as possible initial projects.
- Participants discussed the need for outreach and educational activities. It was noted that the results of the survey presented by Harrison in one of the morning sessions illustrates the lack of knowledge about TransXML within many state DOTs and other agencies. It was suggested that developing and implementing a comprehensive marketing, communications, and outreach plan should be part of the overall effort to move TransXML forward.
- Participants discussed the importance of adequate resources, suggesting that efforts cannot proceed without an identified funding source. Participants noted that adequate, stable funding would be needed for AASHTO to consider taking on stewardship of TransXML. A variety of possible funding sources for the ongoing governance, management, and operation of TransXML were identified and discussed by participants. Examples of potential sources included multistate pooled-fund studies, NCHRP, targeted funding in the reauthorization of MAP-21, private-sector groups, and the FHWA–U.S. DOT. Participants suggested that there were major challenges with all of these potential sources. Participants further suggested that developing a funding plan was a key component of the next step in advancing a comprehensive stewardship model. Participants also noted that gaining support of state DOTs and AASHTO leadership was key to moving forward. Coordinating with other efforts and groups, such as NEIM, DIGGS, and the AGC, was also suggested to maximize resources.
- Pol described possible steps to sustain and maintain TransXML schema using the construction materials subject area, including the bid package item, the estimation item, and payment item as an example. Participants discussed the various groups involved in different steps of developing and releasing a bid package, identifying the bid value, bidding on the package, and completing the bid package validation process.

- Participants discussed possible roles for AASHTO and AASHTO committees in developing, implementing, and sustaining TransXML schema. Building on previous comments, participants suggested that the peer review and validation process used by AASHTO committees provides a good model and that these committees could assist with identifying needed schemas in their areas and could assist with the review and validation process of schemas developed by consultants, vendors, and other groups. Given the diversity of topic areas, additional subject matter expertise may be needed on some committees. A pilot implementation effort was suggested by participants to test a possible approach. A link to NIEM, which offers a standard approach to the development of information exchange packages and an existing set of data models within the public safety domain, was also discussed.
- In response to questions from Harrison, participants identified a number of steps that could be taken. As discussed in more detail in the next section, potential follow-up activities included developing a plan for AASHTO stewardship of TransXML and moving forward with an initial pilot test. Suggested elements for the comprehensive plan for AASHTO stewardship included identifying the governing board, the role of TCEED and other AASHTO committees, and developing a process for identifying, developing, and approving TransXML schema. Other possible elements suggested by participants were identifying ongoing funding, developing a marketing and outreach plan, and coordinating with other groups and related activities. Participants noted that securing needed funding was a major challenge and a key activity to gain support from leadership at state DOTs and at AASHTO. Actions related to a possible pilot test involving schema associated with payroll, permits, or EDC2 3D models included identifying key stakeholders, securing funding, and retaining software firms or vendors to develop the schema. Conducting web seminars and meeting with various groups were suggested as next steps to continue the dialog initiated at the workshop.

APPROACHES FOR MOVING FORWARD

Based on the presentations in the morning sessions and the discussions in the afternoon working sessions, the rapporteur, Katherine Turnbull, identified a potential framework for TransXML stewardship and a pathway for advancing TransXML based on this framework. The framework includes overall stewardship by AASHTO and a process for identifying, developing, adopting, and maintaining TransXML schema. As noted in the previous section, making the business case for TransXML and securing adequate funding will be needed for leadership at state DOTs and AASHTO to consider this framework and stewardship model. It is important to note that no commitment from AASHTO on the suggested approach was made at the workshop. The pathway includes identifying potential funding sources and securing needed funding, implementing the stewardship framework, developing and implementing a communications and outreach plan, maintaining ongoing coordination with other related activities, and initiating early action pilots. These major elements of the framework and the pathway are described in this section.

- The TransXML stewardship framework is proposed under the auspices of AASHTO. Figure 4 illustrates the major components of the proposed stewardship framework. Under this approach, AASHTO would establish a TransXML Advisory Board that would provide guidance and oversight to developing, adopting, and maintaining TransXML schema. The Advisory Board would also play key roles in developing and implementing outreach and communication

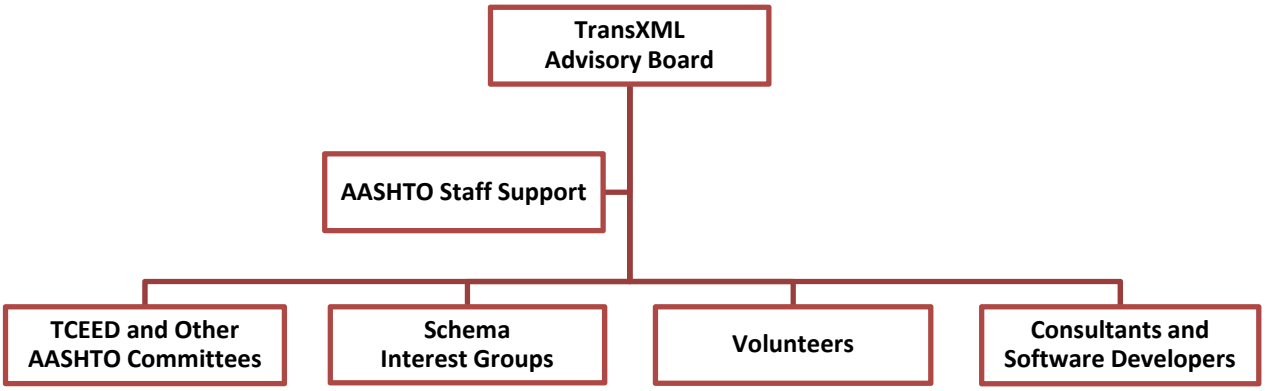

FIGURE 4 Potential TransXML stewardship framework.
(Source: Texas A&M Transportation Institute.)

activities and ensuring coordination and cooperation with other related activities and organizations. It is suggested that the Advisory Board include a mix of key stakeholders from the public and private sectors. Dedicated AASHTO staff would support the Advisory Board. AASHTO personnel would assist with the various board functions and would oversee the work of the AASHTO committees, schema interest groups, volunteers, and consultants. Based on adequate funding, AASHTO staff would also take the lead in developing and implementing communications and outreach plans, ongoing coordination with other related activities, and assisting with the early action pilots. The TCEED and other AASHTO committees would provide the subject matter expertise to help identify needed schema, to review developed schema, and to link to sponsors and stakeholders. Schema interest groups may be formed in the case of schema that cut across multiple AASHTO committees or if there is not a logical AASHTO committee to take the lead. Volunteers from TRB committees, stakeholders, and other groups may assist with various activities associated with the TransXML process. The Advisory Board and AASHTO staff may utilize consultants and software developers to assist with different activities and to undertake the actual development of TransXML schema and related products and services.

- Figure 5 presents a potential process for TransXML schema identification, development, adoption, and marketing. The process begins with the identification of a needed schema by sponsors or other groups. The TransXML Advisory Board would solicit input from stakeholders and other groups on the need for the proposed schema. If the Advisory Board recommends moving forward with developing a schema based on the input received, the appropriate AASHTO committee would be identified or a stakeholder group would be formed if there is not a logical committee. The committee or group would assist with identifying funding and defining the schema requirements. AASHTO would then solicit development of the schema from consultants and software firms. The schema would be reviewed by the various committees, stakeholder groups, consultants, and volunteers. These groups could also identify application tools associated with the schema. Assuming a positive review, the Advisory Board would provide a seal of approval for the schema, which would then be marketed by the vendor and included in the AASHTO suite of schemas. AASHTO would also monitor use, with vendors updating the schema as needed.

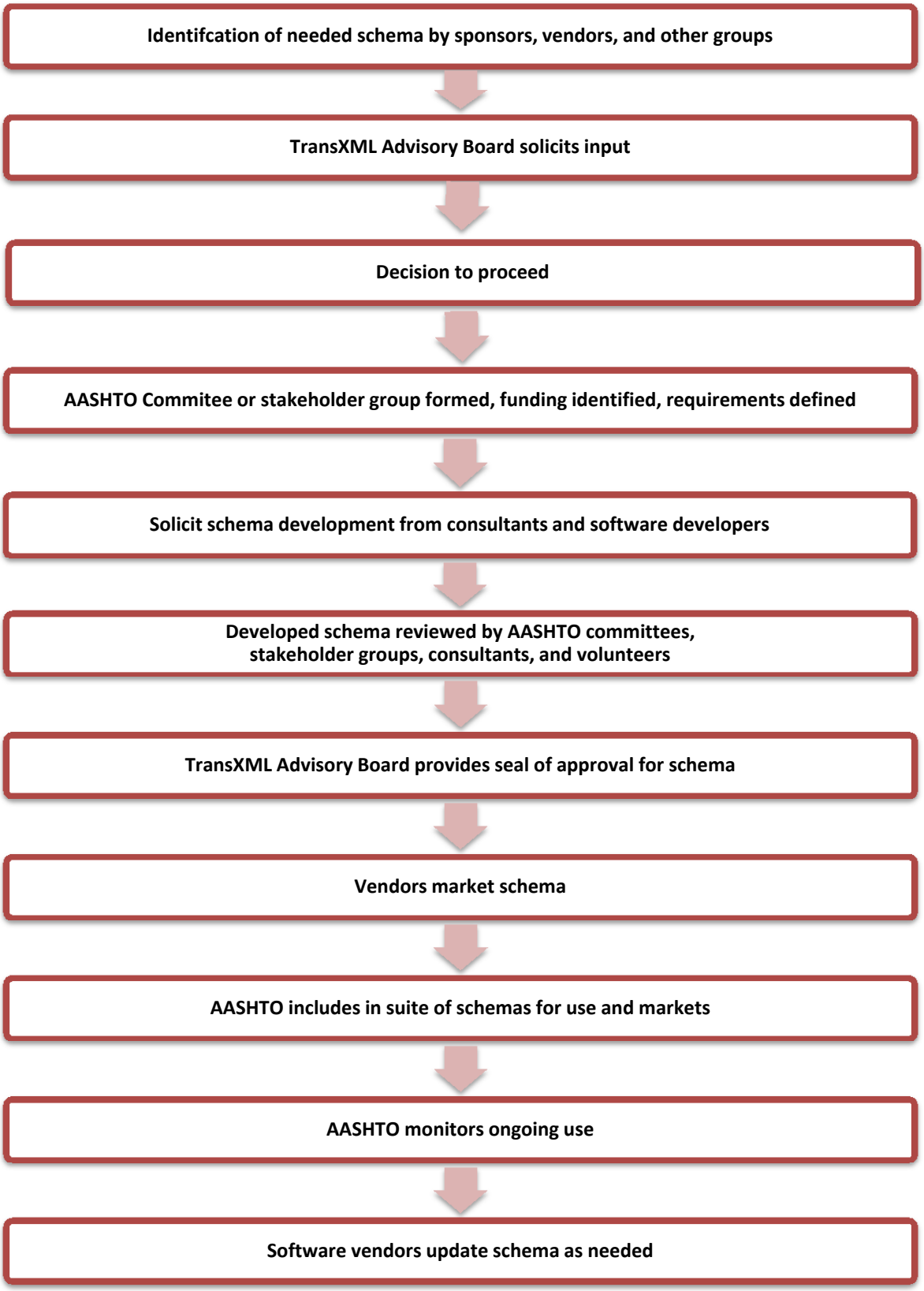

FIGURE 5 Potential TransXML schema development process. (Source: Texas A&M Transportation Institute.)

- Figure 6 presents a potential pathway for implementing the potential TransXML framework. The critical and challenging first step would be to develop and implement a funding plan. Possible funding sources include NCHRP, pooled-fund projects through FHWA or the AASHTO Technical Services Program mechanisms, targeted funding in the next surface transportation reauthorization, coordination with other U.S. DOT activities, and linking with other standards-setting efforts. It is realized that all these funding options have limitations and that finding adequate funding will be a challenge. The previous TCEED-initiated research proposal for the development of a TransXML stewardship model could be reviewed, updated, and resubmitted if appropriate. It is likely that some combination of funding will be needed to advance the TransXML framework. Based on obtaining adequate funding, leadership at state departments of transportation and AASHTO would need to agree to take on TransXML stewardship. If this approval is received, AASHTO would form the TransXML Advisory Board and provide the needed staff resources. The Board and staff would then finalize and implement the schema process described previously, develop and implement a communications and

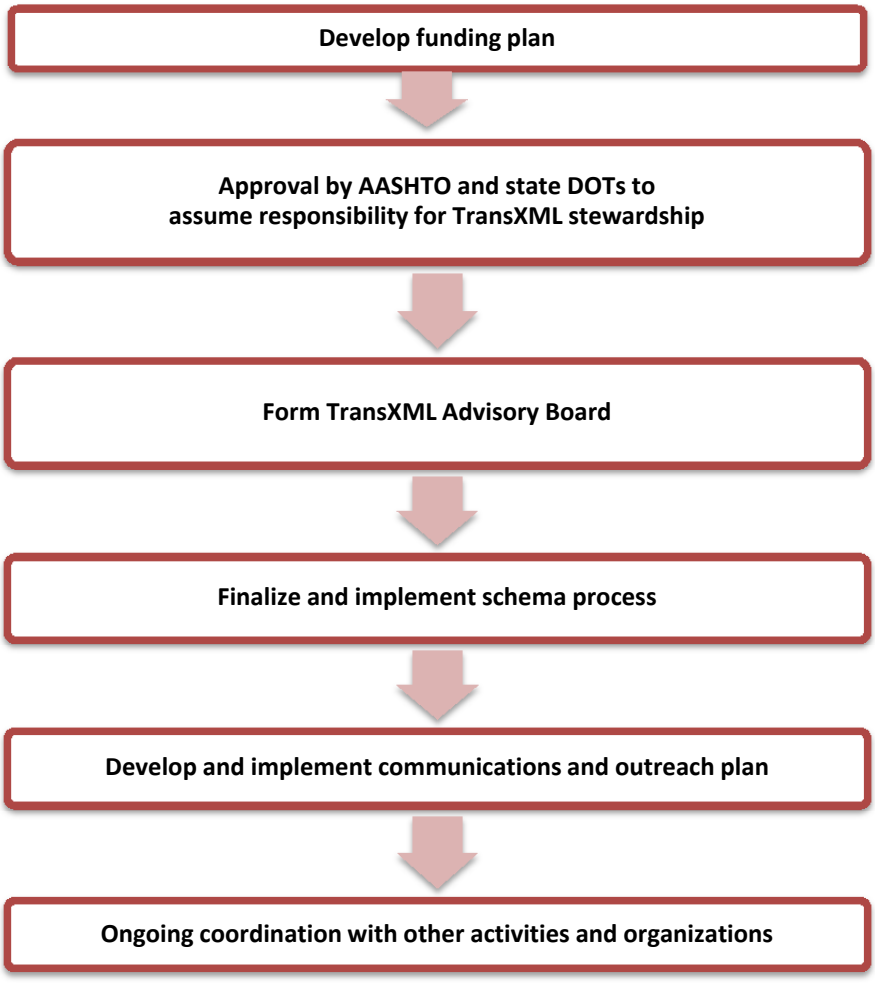

FIGURE 6 Pathway for implementing the potential TransXML framework. (Source: Texas A&M Transportation Institute.)

outreach plan, and provide ongoing coordination with NIEM, DIGGS, the AGC, and other related activities. The communication and outreach plan might include the development of brochures, webpages, videos, and other materials. Providing links to individuals within state departments of transportation using the various schemas represents another possible element.

- Figure 7 illustrates a potential pathway for advancing early action TransXML pilots.

These pilots would focus on an incremental approach to advancing TransXML. The pilots would provide the opportunity to develop a few schemas and get them into widespread use, as a way to build support for the comprehensive stewardship framework and pathway. A first step would be to identify possible pilots. Topics suggested by workshop participants included PayrollXML, PermitXML, and EDC 3D models. Securing funding for the pilots represents a second step. Possible funding sources include the FHWA pooled-fund study program, the AASHTO Technical Services Program, NCHRP, and organization- or vendor-sponsored programs. The

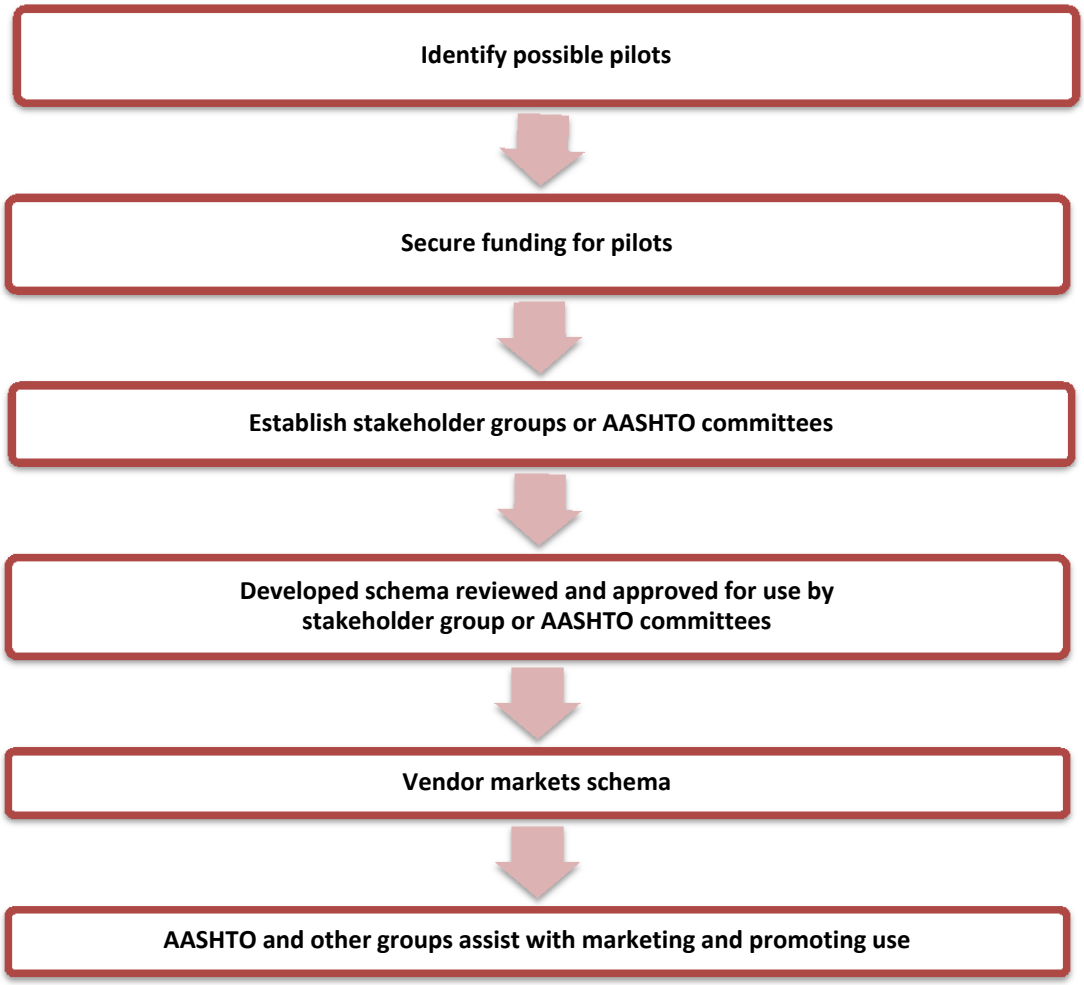

FIGURE 7 Potential early action TransXML pilots pathway. (Source: Texas A&M Transportation Institute.)

developed schema would be reviewed and approved for use by the stakeholder group or AASHTO committee. The vendor would market the schema with support from AASHTO and other groups to promote use. The successful pilots could be used to help build support for the overall TransXML stewardship approach and would allow for the testing and fine tuning of the schema development and approval process.

This proposed TransXML stewardship and pathway for advancing TransXML is presented for further consideration by NCHRP, AASHTO, state DOTs, the U.S. DOT, and other groups. Obtaining the necessary funding would be critical for leadership at state departments of transportation and AASHTO to consider this approach.

Participants List

Tim Armbrechtp
Illinois Department of Transportation

Todd Bergland
Minnesota Department of Transportation

Mike Bousliman
Montana Department of Transportation

Steven Brown
HDR, Inc.

Bryan Cawley
Federal Highway Administration

Paul Degges
Tennessee Department of Transportation

Bob DeHoff
Info Tech

Richard Duval
Federal Highway Administration

Jan Edwards
American Association of State and Highway Transportation Officials

C. Fara Francis
Associated General Contractors of America

Don Grayson
Mississippi Department of Transportation

Matt Hardy
American Association of State and Highway Transportation Officials

Frances Harrison
Spy Pond Partners, LLC

Marc Hoit
North Carolina State University

Luke Johnson
U.S. Department of Transportation

Thomas Johnson
Federal Highway Administration

Edgar Kraus
Texas A&M Transportation Institute

Richard Land
California Department of Transportation

Lisa Loyo
Transportation Research Board

James McDonnell
American Association of State and Highway Transportation Officials

Dan Morgan
U.S. Department of Transportation

James Pol
U.S. Department of Transportation

George Raymond
Oklahoma Department of Transportation

Jeremy Raw
Federal Highway Administration

Gene Roe
Lidar News

Thomas Roff
Federal Highway Administration

Paul Scarponcini
Bentley Systems

Robert Schweinfurth
American Society of Civil Engineers

Greta Smith
American Association of State and Highway Transportation Officials

Nanda Srinivasan
National Highway Cooperative Research Program, Transportation Research Board

Tianjia Tang
Federal Highway Administration

Katherine F. Turnbull
Texas A&M Transportation Institute

Eric Weaver
Federal Highway Administration

David Winter
Federal Highway Administration

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