TxDOT Statewide TSMO ITS Standards and Specifications

February 2021
Version 1.1

Prepared By

DOCUMENT CONTROL		
Date	Version	Description
1-15-21	1.0	Traffic Safety Division Review (Prepared by Maldonado-Burkett and AECOM)
2-09-21	1.1	Formatting revisions.

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List of Acronyms

Acronym	Definition
CAD	Computer Aided Design
CCTV	Closed-Circuit Television Camera
COTS	Commercial Off The Shelf
DOT	Department of Transportation
DMS	Dynamic Message Sign
FHWA	Federal Highway Administration
ITS	Intelligent Transportation Systems
MTD	Materials and Test Division
RDC	Regional Distribution Center
RTI	Research and Technology Implementation
RWIS	Road Weather Information Systems
TRF	TxDOT Traffic Safety Division
TSMO	Transportation Systems Management & Operations
TxDOT	Texas Department of Transportation

Executive Summary

The TxDOT Traffic Safety Division (TRF) is evaluating the statewide construction standards and specifications for Intelligent Transportation Systems (ITS) equipment. This evaluation is being conducted along with a standard statewide data platform or standards and specifications for sharing data to help with multi-agency interoperability and to improve efficiency. This is a strategic initiative under the TXDOT Statewide Transportation Systems Management & Operations (TSMO) Strategic Plan. With new types of detectors, communication, and emerging technologies becoming available, a vetting process needs to be developed. The current device acceptance process should be re-evaluated regularly based on agency needs, industry standardization, and device types.

What are ITS Standards and Specifications?

TxDOT has established standards and specifications for the construction and maintenance of highways, streets, and bridges. Local government projects with state/federal funds, or projects located on the state highway system, must comply with the latest TxDOT Standard Specifications, Special Specifications and Special Provisions or request TxDOT written approval of alternate, equivalent specifications. They are defined as:

- Specifications. Directives or requirements issued or made pertaining to the method and manner of performing the work or to quantities and qualities of materials furnished under the Contract.
- Special Provisions. Additions or revisions to these standard specifications or special specifications.
- Special Specifications. Supplemental specifications applicable to the Contract not covered by these standard specifications.

TxDOT provides computer aided drawing (CAD) standard plan files that may be used as follows:

Statewide Standard Files

TxDOT divisions maintain statewide electronic master files. The responsible division is identified in the plan title block, and good quality printed versions of the file may be used statewide in plan sets without being signed and sealed by a licensed engineer.

District Standard Files

TxDOT districts maintain district electronic master files, which are modified from statewide standard files for that district or developed by that district. The responsible district is identified in the plan title block, and good quality printed versions of the file may be used within the responsible district without being signed and sealed by a licensed engineer.

Modified Standard Files

A modified standard file is specific to a particular job. Any modifications to a statewide or district standard file, however minor, must be documented briefly and dated in the revision block of the sheet, and the designation "(MOD)" must be appended to the standard plan name inside the title block. Each modified standard file must be signed and sealed by a licensed engineer.

What is an ITS Material Producer?

TxDOT approves products and materials from various manufacturers and producers. Each may contain the following information:

- Products
- Materials
- Producers
- Manufacturers
- Producer Codes

As an example, traffic signals are pre-qualified for use with the Department's Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges and are associated with Department Material Specifications referenced in Standard Specification Items 680, 681, 682, 685, and 690, which pertain to the installation of highway traffic signals.

What is a Prequalified Product?

These are individual ITS devices approved for purchase that follow TxDOT Special Specifications.

Evaluation Program

The product evaluation program evaluates submissions that can benefit TxDOT efforts associated with traffic control, materials, construction and/or maintenance of highways, streets, bridges and related infrastructure, for use by TxDOT districts or TxDOT contractors. TxDOT does not participate in product development. Eligible products must be non-hazardous and commercially available for purchase.

Recommendations

The resultant recommendations from evaluating the statewide construction standards and specifications for ITS equipment are summarized in Table 1 and are further detailed in Section 7.

Table 1: Summary of Recommendations

Recommendations
Standards and Specifications need to be expanded to include key ITS technologies and devices.
Key ITS devices should be added to the TxDOT's Material Producer List and Prequalified Products List.
The Material Producer List should include manufacturers whose products are prequalified and commonly purchased by TxDOT Districts.
Designate a budget for the RTI division to purchase products for the sole purpose of testing and conducting pilot tests of desired products throughout the Districts.
The districts should provide a list of vendors and products they prefer to the TxDOT RTI Division for evaluation and testing. This process should occur once every year or other year.
Districts need to develop a list of inventory items to be stocked at the Regional Distribution Center (RDC) supply warehouses.

1.0 Introduction

TxDOT's TRF Division is evaluating the statewide construction standards and specifications for ITS equipment and systems. It includes standard statewide data platform or standards and specifications for sharing data to help with multi-agency interoperability and to improve efficiency. This evaluation is a strategic initiative under the TxDOT Statewide TSMO Strategic Plan. The evaluation includes the following:

1. Identify additional ITS Statewide Standards and Specifications needed.
2. Make recommendations on key ITS devices to be included or modified on TxDOT's Material Producers List.
3. Evaluate and make recommendations regarding procurement procedures.
4. Develop strategies for the management of statewide procurements and blanket purchase orders.
5. Develop strategies to maintain approved vendor product lists to facilitate purchasing ITS components on construction projects.

The goal of this effort is to streamline the procurement of ITS devices on construction projects throughout the State.

1.1 TSMO Overview

The goal of the TSMO Strategic Plan is to increase safety, reduce congestion, and improve transportation reliability statewide by identifying cost-effective potential improvements in how the State operates and maintains the transportation system. This requires integrating planning and design with construction, operations, and maintenance to manage the transportation network holistically and optimize the existing and future infrastructure. With new types of detectors, communication, and emerging technologies becoming available, a vetting process needs to be developed. The current device acceptance process should be re-evaluated regularly based on agency needs, industry standardization, and type of device. TSMO focuses on optimizing system performance by developing and operating an integrated transportation system that provides reliable and accessible mobility.

1.2 Stakeholder Workshop and Individual Meetings

TxDOT's TRF Division is leading the evaluation with participation by representatives from TxDOT Districts. A TSMO ITS Standards and Specifications Workshop was held on August 14, 2020. Table 2 identifies the stakeholders who participated in the kick-off meeting. The purpose of this workshop was to:

1. Identify goals for ITS Standards and Specifications.
2. Generate consensus on suggestions and recommendations for ITS Standards and Specifications to include all key ITS devices.
3. Generate consensus on suggestions and recommendations for ITS Prequalified Products List and Materials Producer List.
4. Discuss common procurement challenges faced by each district.

The following topics were discussed during the workshop:

- Workshop Objectives
- TSMO Overview
- Project Overview
- Why do we need ITS Standards and Specifications?
- TxDOT's Current Status on ITS Standards and Specifications
- TxDOT's Approval Process

Table 2: Initial Stakeholder Meeting Participants

Partner Agency	Attendees
TxDOT Project Manager	Barbara Russell
TxDOT TSMO Champions and Coordinators	Joe Hunt, Mike Walsh, Camille Marek, Chris Pruitt, John Gianotti, Craig Kneifel, Will McLane, Gabriel Garcia, Jesus S. Leal, Darius Samuels, Tommy Henderson, Chad Windham, Seth Franks, Terry Harris, Jeremy Dearing, Rafael Guzman, Valerie Taylor, Ugonna Ughanze, Michael Awa, Kimberley Clarida, America Garza, Darwin Lankford, Jeff Miles, Doug Finnigan, Zheng Tan, Rebecca Wells, Christina Trowler, Blair Johnson, & Steven DuShane.
AECOM	Victor De la Garza, Joe Hutchinson & Bob Edelstein
Maldonado-Burkett	Scot Love & Jonathan Gaynor

In addition, some follow up one-on-one meetings were conducted to allow districts to discuss operational challenges.

1.3 ITS Standards and Specification Goals

On August 21, 2017, TxDOT issued the initial "Statewide TSMO Strategic Plan" which adopted the following TSMO vision and mission statement as presented below. The initial TxDOT "Statewide TSMO Strategic Plan" was updated during May 2020. The link to the Statewide TSMO Strategic Plan may be found on the TSMO Webpage: http://www.txdot.gov/inside-txdot/division/traffic/tsmo.html

The TxDOT Statewide TSMO Strategic Plan's vision and mission are:

Statewide TSMO Vision:

Improve safety and mobility for all modes of transportation by integrating planning, design, operations, and maintenance activities and acknowledging all opportunities for innovation.

Statewide TSMO Mission:

Through innovation, collaboration, and performance-based decision making, transportation facilities are developed, constructed, maintained, and operated cost-effectively, with the end user in mind.

To achieve this vision and mission, TxDOT established the following objectives:

- **Safety** – Reduce crashes and fatalities through continuous improvement of traffic management systems and procedures.
- **Reliability** – Optimize travel times on transportation systems in critical corridors to ensure travelers are reaching their destination in the amount of time they expected for their journey.
- **Efficiency** – Implement projects that optimize existing transportation system capacity and alleviate congestion.
- **Customer Service** – Provide timely and accurate travel information to customers so they can make informed mobility decisions.
- **Collaboration** – Proactively manage and operate an integrated transportation system through multijurisdictional coordination, and cooperation between various transportation disciplines and partner agencies.
- **Integration** – Prioritize TSMO as a core objective in the agency's planning, design, construction, operations and maintenance activities.

The goals for TxDOT ITS Standards and Specifications are based on these objectives and the "needs" for having them to maintain high reliability throughout the infrastructure life cycle. Based on these "needs" the goals are defined as the following:

- Allow for competition in the marketplace so that TxDOT is not dependent on a single vendor.
- Provide guidelines and improve efficiency in procurement and construction.
- Increase asset uptime reliability and decrease cost on maintenance.
- Improve interoperability of data sharing among multiple agencies.
- Optimize performance and integration of devices and systems.
- Allow resource sharing among districts during times of emergencies.
- Facilitate knowledge sharing across the State.

2.0 ITS Specifications

2.1 Current Status

ITS Specifications are written requirements for ITS devices and communications. There are several ITS specifications that address the needs of individual districts. What is lacking is Statewide ITS specifications that could help the districts that have less experience with ITS in general. Standard specifications apply statewide. Special specifications apply to a single district while special provisions apply to individual projects. TxDOT ITS standard specifications include:

- Conduit,
- Ground Boxes,
- Highway Traffic Signals,
- Temporary Traffic Signals,
- Vehicle and Pedestrian Signal Heads,
- Roadside Flashing Beacon Assemblies,
- Traffic Signal Pole Assemblies,
- Pedestal Pole Assemblies, and
- Pedestrian Detectors and Vehicle Loop Detectors.

Missing from the ITS Standard Specifications are:

- Full-color Matrix Dynamic Message Signs (DMS),
- Bluetooth Detection,
- Lidar Detection,
- Weather Stations,
- Low Water Crossing System, and
- Wrong Way Driver Detection System.

2.2 Evaluation and Approval Process

When a TxDOT District needs an ITS device, a specification must exist or be written before the district can procure said device. TxDOT Districts write specifications as needed. The Research and Technology Implementation (RTI) Division writes new and/or improved specifications for Statewide use by TxDOT. The Materials and Test Division (MTD) maintains TxDOT's specifications and retires outdated specifications.

2.3 Recommendations

Specifications are used in low cost bidding. Without a specification, procurement can only be conducted at the State level. A team of subject matter experts should collaborate to write standard specifications for the devices on the missing list in Section 2.1. standard specifications need to be expanded to include all key ITS devices.

3.0 ITS Standards

3.1 Current Status

ITS standards, commonly referred to by TxDOT, are installation detail plan sheets that depict the installation of ITS devices and structures. ITS standards are included in a set of Plan Sheets Specifications and Estimates. The Traffic Safety Division develops and maintains TxDOT ITS standards. Those Standards include:

- ITS Poles,
- ITS Cabinets,
- ITS Solar Power Systems,
- ITS Conduit,
- Typical ITS Device Site Layout,
- ITS Ground Boxes,
- ITS Fiber Optic Cable, and
- Work Zone ITS - Temporary Queue Detection System.

Missing from the ITS standards are:

- 4-inch Conduit,
- Tracer Wire Stub-Up,
- Back-to-back Dynamic Message Signs (DMS) installation,
- Weather Stations or Road Weather Information Systems (RWIS),
- Low Water Crossing System, and
- Wrong Way Driver Detection System.

3.2 Evaluation and Approval Process

Districts prepare their own standards. District standards are managed by individual districts, while Statewide standards are managed by various TxDOT divisions. Statewide standards are selected from the districts and sometimes modified to fit additional districts. Those modifications and statewide standards are developed by TRF.

3.3 Recommendations

Standards are used in project design. As the districts have varying levels of expertise in ITS, new standards are needed and should be designed. A team of Subject Matter Experts in ITS should collaborate to prepare standards from the missing list in Section 3.1

4.0 ITS Material Producer List

4.1 Current Status

The Material Producer List identifies approved manufacturers to purchase from. The Material Producer List is not very extensive. This causes delays in the process for districts when they procure ITS devices, as they are subjected to the TxDOT Evaluation Process. TxDOT's Material Producer List (2020) includes:

- ITS Pole Fabrication Plants,
- Junction Boxes, Manholes, and Inlets Fabrication Plants, and
- Traffic Signals, Vehicle Signal Heads, 12" LED Traffic Signal Lamp Unit, Pedestrian Signal Heads, Pedestrian LED Countdown Signal Modules, Accessible Pedestrian Signals, Solar Power Flasher Controller Assembly, Signal Controller Assembly, and Battery Back-Up System for Signal Cabinets.

Missing from the Material Producer List are:

- none

4.2 Evaluation and Approval Process

The TxDOT Material Producer List is a list of lists. Each list within the TxDOT Material Producer List is itself a list of manufacturers who are certified to meet TxDOT specification compliance for a particular specification or specifications. These lists are maintained by various TxDOT divisions. For example, the lists entitled "Intelligent Transportation System Pole Fabrication Plants," "Junction Boxes, Manholes, and Inlets Fabrication Plants (Multi-Project)," "Roadway Illumination Pole and Luminaire Arm Fabrication Plants," and "Traffic Signal Pole Assembly Fabrication Plants" are maintained by the TxDOT Materials and Test Division (MTD) while the lists entitled "Traffic Signals" and "Roadway Illumination and Electrical Supplies" are maintained by the TxDOT TRF Division. Manufacturers whose products are prequalified may be included on a relevant list by contacting the appropriate division.

4.3 Recommendations

The list needs to be expanded to include additional or commonly used ITS device manufacturers. Once these manufacturers' devices are tested and approved, then they may be added to the Material Producer List.

5.0 ITS Prequalified Product List

5.1 Current Status

The Prequalified Products List is a list of approved products. TxDOT screens products for use by districts, which, when approved, are included on this list. TxDOT's Prequalified Products List (2020) includes:

- Traffic Signal Cabinets,
- Flashers and Cabinets,
- Digital Loop Vehicle Detector Units,
- Video Imaging Vehicle Detection System,
- Wireless Video Imaging Vehicle Detection Systems,
- Thermal Traffic Cameras,
- Networked School-Zone Flasher Systems,
- Radar Vehicle Detection Systems,
- Wireless Magnetometer Vehicle Detection Systems, and
- Uninterruptible Power Supply (UPS) System for Signal Cabinets.

Missing from the Prequalified Products List are:

- Bluetooth Detection,
- Over-height Detection,
- Low Water Crossing System,
- LIDAR Vehicle Detection System,
- Portable Queue Detection System,
- Road Weather Information System, and
- Wrong Way Driver Detection System.

5.2 Evaluation and Approval Process

The TxDOT Research and Technology Implementation (RTI) Division evaluates products to be included in the Prequalified Products List. Prequalified products have been tested and are prequalified for use by TxDOT. This is done to verify products are beneficial to TxDOT before spending public funds.

The process begins with TxDOT Form 1684 - RTI Product Evaluation Request, which is submitted electronically. This form is then reviewed and compared to any applicable Item code, specification, special specification, or Department Material Specification within TxDOT. If a match is found, a Product Evaluation number is created. Representatives from various TxDOT Divisions and Districts form a Product Evaluation Committee that decides what division might be interested in the product. Then the Product Evaluation Committee determines whether there is interest in TxDOT district offices. If there is no interest, a 'no interest' letter is sent to the product submitter and this is the end of the process. If interest is found, the vendor will be asked to provide to TxDOT a

free sample for testing. (This tends to upset vendors, so they try to convince districts to not follow the TxDOT evaluation process.) Once TxDOT is provided a free sample, the RTI Division will decide whether to review the product themselves, test the product in a laboratory, or test the product in a district project. The product is then deemed favorable or unfavorable after testing. Favorable products are added to the Prequalified Products List. Products that lack interest may be resubmitted after a year. Products deemed unfavorable may be resubmitted after six months.

When asked if the TxDOT Product Evaluation Program process could be improved or changed, TSMO Champions and Coordinators at the initial workshop responded that the program and process is acceptable but needs to be applied to ITS. Specifically, responses include the following:

- It is difficult to get the latest stocked items at the RDC warehouse.
- It is difficult to get the equipment or the products we prefer. Just because something is on the MPL, does not necessarily mean it's a high-quality product.
- When having a product demonstrated, purchasing considers it an after the fact Purchase Order.
- It takes too long to get the procurement completed and seems like the process changes each time.
- Out for bid vs "chain buying".
- Delay in getting materials in a timely manner.
- It is difficult to purchase test equipment.

5.3 Recommendations

The length of time it takes to procure ITS equipment was identified as the highest priority problem needing to be resolved. Districts need to provide a list of what they want stocked at the RDC Supply Warehouses. TxDOT prefers to buy in bulk to get better pricing. If districts can obtain what they need from the four RDC Supply Warehouses, then the procurement process will be much quicker. Each district should provide TRF a list of vendors and products they would like to have tested. This process should occur at the most every other year.

6.0 Procurement and Inventory Process

Purchasing inventory is conducted at the State level through blanket purchase orders and at the district level through district specifications to the lowest bidder. If a specification for a device needed is not available, a new specification or a provision to a specification must be written before the item can be bid.

According to TxDOT's Research Manual (2018), a product evaluation committee consisting of representatives from various TxDOT divisions and districts reviews and evaluates products for TxDOT's use. First, interest in the product itself is evaluated. Second, if interest is found, the vendor of the product will be asked to render to TxDOT, without charge, a sample product for testing. Third, if the vendor provides a free sample, the product can be laboratory tested or tested within a district project. Fourth, the product will either receive a favorable or unfavorable determination unless further testing is required. If a product fails the testing, six months must pass before it may be reevaluated.

This process works and is in line with what other states follow; however, items should be identified and go through this approval process before they are needed. During the workshop stakeholders expressed several concerns:

- The amount of time it takes to procure ITS equipment.
- The latest devices are not stocked at the Regional Distribution Center (RDC) Supply Warehouses; therefore, products must go through the evaluation process before being purchased.

The RDC Supply warehouses supply TxDOT Districts with equipment needed for projects and maintenance. There are four of these RDC Supply Warehouses:

- 3500 Jackson Ave., Bldg. 10, Austin, TX 78731,
- 2400 N. E. Loop 317, Athens, TX 75751,
- 709 S Broadway, Post, TX 79356, and
- 2024 Hwy 46 N, Seguin, TX 78155-2206.

The districts need to develop a list of inventory items that should be stocked at each warehouse. If the districts can obtain what they need from these centers, then the procurement process will be much faster. Recommendations include:

- Identify the specific brands and products of ITS equipment that each district prefers.
- Stock the RDC Supply Warehouses with this ITS equipment.
- Identify the vendors who are attempting to bypass the TxDOT Evaluation Process and educate these vendors about the process.
- Encourage vendors to showcase their best products at technical conferences.
- Expand the Material Producer List to cover more manufacturers such as Skyline, Wavetronix, Bluetoad and Daktronics.
- Audit the actual amount of time it takes to order ITS devices.

7.0 Recommendations

Based on the workshops, one-on-one follow-up meetings, and evaluations conducted in this report, the following recommendations are suggested regarding TxDOT ITS Standards and Specifications.

- Develop a special working group of Subject Matter Experts to expand the current ITS standard Specifications to address the items included in the missing list in Section 2.1 and standards from the missing list in Section 3.1 Standards and specifications should be expanded to cover all commonly used ITS devices.
- To streamline the procurement process throughout Texas, key ITS devices must be on TxDOT's Material Producer List and Prequalified Products List.
- The Material Producer List needs to be expanded to include commonly used ITS device manufacturers of DMS, Bluetooth, and Radar detection.
- Designate a budget for the RTI division to purchase products for the sole purpose of testing. Conduct pilot tests of desired products throughout the districts.
- The districts should provide a list of vendors and products they prefer to the TxDOT RTI Division for evaluation and testing. This process should occur at most every other year.
- The districts need to develop a list of inventory items that should be stocked at the RDC Supply warehouses. If the districts can obtain what they need from these four centers, then the procurement process will be much faster. Recommendations include:
    - Identify the specific brands and products of ITS equipment that each district prefers.
    - Stock the RDC Supply Warehouses with this ITS equipment.
    - Identify the vendors who are attempting to bypass the TxDOT Evaluation Process and educate these vendors about the process.
    - Encourage vendors to showcase their best products at technical conferences.
    - Expand the Material Producer List to cover more manufacturers.
    - Audit the actual amount of time it takes to order ITS devices.

References

TxDOT Statewide TSMO Strategic Plan - August 1, 2019

TXDOT Statewide TSMO Strategic Plan on TSMO Webpage:
http://www.txdot.gov/inside-txdot/division/traffic/tsmo.html

TxDOT Material Producer List:
https://www.txdot.gov/inside-txdot/division/materials-and-tests/producer-list.html

TxDOT Specification List:
http://www.dot.state.tx.us/business/specifications.htm and https://www.txdot.gov/inside-txdot/division/materials-and-tests/txdot-specifications.html

TxDOT Standards List:
http://www.dot.state.tx.us/insdtdot/orgchart/cmd/cserve/standard/toc.htm
TxDOT Prequalified Products List:
http://www.dot.state.tx.us/gsd/purchasing/supps.htm#prelists

TxDOT Form 1684 - RTI Product Evaluation Request:
https://www.txdot.gov/inside-txdot/forms-publications/forms/research.html

TxDOT Research Manual (2018) Chapter 10: Product Evaluation Program:
http://onlinemanuals.txdot.gov/txdotmanuals/rtt/product_evaluation_program.htm