SUCCESSFULLY DELIVERING COMPLEX ITS PROJECTS USING AGILE METHODOLOGIES

ITS-NY 30th Annual Meeting and Technology Exhibition – A Connected World
Jun 14-16, 2023

Oliver Hoehne, ESEP, PMP, CSM
Technical Fellow, Systems Engineering
WSP USA
AGENDA

❖ BACKGROUND
❖ TRADITIONAL SYSTEMS ENGINEERING CHALLENGES
❖ AGILE METHODOLOGY
❖ APPLICATION TO ALLROADS PROJECT
❖ ACHIEVED OUTCOMES, SUMMARY & CONCLUSION
❖ Q&A
Project focuses on following initiatives:
1. Improve Border Crossing Performance and Travel Time
2. Improve Commercial Vehicle Operations and Safety
3. Expand Regional Smart Mobility
4. Improve Incident Management
5. Provide for Operational Integration within NFTA and with Regional Smart Mobility
7. Provide Enhanced Real-Time Information for Travelers
8. Enhance Data Collection, Fusion, Distribution and Archiving
Traditional Systems Engineering Challenges

Systems Engineering Standards for Intelligent Transportation Systems

Regional Architecture(s) > Feasibility Study / Concept Exploration > Concept of Operations > System Validation Plan (System Acceptance)

System Verification Plan (System Acceptance) > Subsystem Verification Plan (Subsystem Acceptance) > High-Level Design

Detailed Design > Unit / Device Test Plan > Unit / Device Testing

Software / Hardware Development Field Installation

Implementation

Operations and Maintenance > System Validation > Changes and Upgrades > Retirement / Replacement

Continues to follow Waterfall Principles

VEE Model

Time Line

Development Processes
Traditional Systems Engineering Challenges

Waterfall Challenges

Potential Challenges:
- System not Meeting Requirements
- System not Meeting Expectations
- Late Discovery of Requirements
- Changed Needs/Requirements
- System Not (Reliably) Working

Potential Results:
- System not Usable as Implemented
- Project out of Time/Funds
- Contractor Unwilling to Make Changes
- Neither Client nor Contractor Happy
- Potential Litigation

Timeline: .. 2 .. 5+ Years
Agile Methodologies
Manifesto for Agile Software Development (https://agilemanifesto.org/)

❖ 4 Key Values:
– Individuals and interactions over processes and tools
– Working software over comprehensive documentation
– Customer collaboration over contract negotiation
– Responding to change over following a plan

❖ 12 Key Principles (Excerpt):
– The highest priority is to satisfy the customer through early and continuous delivery of valuable software
– Welcome changing requirements, even late in development
– The most efficient and effective method of conveying information is face-to-face
– Working software is the primary measure of progress
– At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.
Executive Summary:
... to find innovative ways to better manage the development and deployment of Intelligent Transportation Systems (ITS) and Connected Vehicle (CV) projects ...
APPLICATION TO ALLROADS PROJECT
TRADITIONAL SYSTEMS ENGINEERING, COMBINED WITH AGILE SOFTWARE DEVELOPMENT

KEY PARTIES:

- **CLIENT:** NIAGARA INTERNATIONAL TRANSPORTATION TECHNOLOGY COALITION (NITTEC)
- **DESIGN CONSULTANT (WSP):** PRELIMINARY ENGINEERING
- **DESIGN BUILDER:** FINAL DESIGN, IMPLEMENTATION & TESTING, TRAINING
- “CONSTRUCTION” OVERSIGHT: WSP

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- **16±1 SPRINTS (3 WEEKS EACH)**
- 4 FACTORY ACC. TEST EVERY 3 MONTHS
- 2 SYSTEM INTEGRATION TEST EVERY 6 MONTHS
- 2 SYSTEM ACCEPTANCE TESTS (2 THEMES)
APPLICATION TO ALLROADS PROJECT – PRELIM. ENGINEERING
ConOps, System Requirements, Conceptual Design

3.1 Module / Subsystem Decomposition

Each module will be described in the context of the overall ATCMTD System in the following subsections.

3.1.1 Graphical User Interface(s)

The graphical user interface (GUI) is a human-computer interface (i.e., a way for users (humans) to interact with computers) that uses windows, icons and menus and which can be manipulated by a mouse (and often to a limited extent by a keyboard as well).

The GUI will allow users to view and perhaps third-party applications and displays, data sources and graphical front ends of the data and performance.
## Application to AllRoads Project – Final Design

### Development of User Stories, Acceptance Criteria, Sprint Backlog Planning

<table>
<thead>
<tr>
<th>Functional Area</th>
<th>Requirement #</th>
<th>Requirement Description</th>
<th>User Story</th>
<th>V&amp;V</th>
<th>Acceptance Criteria</th>
<th>Sprint</th>
<th>Sprint_End</th>
</tr>
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<tbody>
<tr>
<td>3.1.1 Border Crossing</td>
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<td>4.5</td>
<td>5</td>
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<tr>
<td>3.1.1 Border Crossing</td>
<td>[BC-Syr-0040]</td>
<td>The ATCMTD system shall allow border crossing operators to measure travel time reliability to assess the efficiency of their operations. Context: Border crossing travel time reliability measurement is used by regional transportation planners (UN 7.1.3).</td>
<td>As a NITTEC user, I would like to be able to store and see historical travel times within the ATCMTD system.</td>
<td>Demo</td>
<td>The border wait time module that shows the border crossing times in the INET™ system.</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.1.1 Border Crossing</td>
<td>[BC-Syr-0050]</td>
<td>The ATCMTD system shall allow border crossing operators to measure travel time reliability and delay/travel time separately between truck traffic versus passenger vehicle. Context: NITTEC currently receives BluFax information that contains delay data for passengers and trucks, but NITTEC currently only reports the delay for passenger vehicles (UN 7.1.4).</td>
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<td>The ATCMTD system shall allow border crossing operators to measure travel time reliability and delay/travel time) for truck traffic specific to trucks (UN 7.1.4).</td>
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<td>[BC-Syr-0070]</td>
<td>The ATCMTD system shall allow border crossing operators to measure travel time reliability and delay/travel time) for passenger vehicle traffic specific to passenger vehicle operators (motorists) (UN 7.1.4).</td>
<td>1. As a NITTEC user, I would like to be able to share truck delay info via a REST API in the Data Mart so that others can receive that delay info. 2. As a NITTEC user, I would like to be able to notify the stakeholders (trucking associations) via email when truck delays reach a certain</td>
<td>Demo</td>
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</tbody>
</table>
5.1.4 Use Cases and Sequence Diagrams

The following section details the use cases and sequence of data and the systems. These are meant to serve as a guideline for all users of the system. It will assist in utilizing the data.

5.1.4.1 Border Crossing Use Case Description

The following illustrates the primary use cases of the Border Crossing Project. Various actors and actions are listed below.

**NOTE:** Any time there is a user group where the name contains “NTTEC” as the first level of that agency. For example: NTTEC user could be NTTEC Supervisor.

**Border Wait Time Use Cases**

- **Use Case Name:** Border Wait Time
- **Primary Actor:** NTTEC Supervisor
- **Stakeholder(s):** NTTEC, Supervisor, PMA User, NTP, User, NYSTA, User
- **Description:** The use case is centered around viewing and managing messages to inform motorists about delays at the border crossings. The control of these messages can be either manual through the ATCM/DC or automatically generated by the DSS within ATCM/DC.
- **Pre-Condition:** A NTTEC Administrator or Supervisor account has the proper view and control permissions to manage Travel Time and BWTM modules.

**Typical Workflow:**

1. Administrator logs into the INET™ ATCM/DC interface.
2. The Administrator navigates to the Travel Time inventory, selects the Travel Time Sign, and selects a new Sign to be used for border messaging.
3. The Administrator selects the message used for the sign as well as assigning time segments to the message.
   - Travel Time Segments will be correspond to each of the borders.
4. The Administrator saves the travel time and the sign will start posting on the next schedule.
5. The Administrator can deactivate the border messaging by removing the sign from the signing page.

- **Use Case Name:** Activate Border Crossing DMS
- **Primary Actor:** NTTEC User
- **Stakeholder(s):** NTTEC, Supervisor, PMA User, NTP, User, NYSTA User
- **Description:** This use case covers the usage of DMS messages to notify the public of international border crossing delays and travel times.

**Border Wait Time DMS Messaging Sequence Diagram**

- **Use Case Name:** Activate Border Crossing DMS
- **Primary Actor:** NTTEC User
- **Stakeholder(s):** NTTEC, Supervisor, PMA User, NTP, User, NYSTA User
- **Description:** The following use case covers the usage of DMS messages to notify the public of international border crossing delays and travel times.

**Sequence Diagrams (Interactions)**

- **Use Case Name:** Activate Border Crossing DMS
- **Primary Actor:** NTTEC User
- **Stakeholder(s):** NTTEC, Supervisor, PMA User, NTP, User, NYSTA User
- **Description:** This use case covers the usage of DMS messages to notify the public of international border crossing delays and travel times.
### Application to AllRoads Project – Implementation

**Sprint Reviews, Use Case Walk-Through, Followed by SW Demonstration**

#### Completed Issues

<table>
<thead>
<tr>
<th>Key</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTTEC-247</td>
<td>Sprint C - Project Documentation; FAT, RTM, JPA, and Confluence</td>
</tr>
<tr>
<td>NTTEC-248</td>
<td>FAT Procedure creation</td>
</tr>
<tr>
<td>NTTEC-349</td>
<td>Close Gears for NTTEC</td>
</tr>
<tr>
<td>NTTEC-341</td>
<td>Update WMS graphs to reflect weather conditions</td>
</tr>
<tr>
<td>NTTEC-339</td>
<td>Add zoom and location based response to the build for NTTEC</td>
</tr>
<tr>
<td>NTTEC-336</td>
<td>Add segment geometries in 3D to support map layer</td>
</tr>
<tr>
<td>NTTEC-337</td>
<td>Create RT Road Condition Product and Meter</td>
</tr>
<tr>
<td>NTTEC-338</td>
<td>Create LTD 3D production service template</td>
</tr>
<tr>
<td>NTTEC-340</td>
<td>Create LTQ 3D producer service template</td>
</tr>
<tr>
<td>NTTEC-341</td>
<td>Define message format for LB event messages &amp; document in an ICD to deliver in the future</td>
</tr>
<tr>
<td>NTTEC-342</td>
<td>Create IB CAD event layer in IPI in the Data Mart</td>
</tr>
<tr>
<td>NTTEC-345</td>
<td>Update data high to use update or insert</td>
</tr>
</tbody>
</table>
| NTTEC-350 | Integrate TransCor Data Fusion Engine into NET |}

#### View VDS Data

- Use Case: View NFTA Transit Routes on Map
  - Requirement: NFTA-26-00002 The ATCMTD data must allow transit operators to inform travel plans in such a way as to allow real-time views to make alternate travel plans, make an alert for a schedule deviation (Unit 7.4).
  - Primary Actor: NFTA User / NFTA User
  - Description: This use case demonstrates the ability to view accurate NFTA transit routes on the map.
  - User Stories:
    - As a NFTA user, I would like to be able to receive accurate, real-time data and alerts related to transit services.
  - Acceptance Criteria:
    - All data must be retrieved accurately and displayed on the map.
    - The map must be able to show real-time transit routes.

- Use Case: View NFTA Transit Routes
  - Requirement: NFTA-26-00002 The ATCMTD system shall integrate third-party travel time data sources to improve user experience.
  - Primary Actor: NFTA User
  - Description: This use case demonstrates the ability to view accurate NFTA transit routes on the map.
  - User Stories:
    - As a NFTA user, I would like to be able to receive accurate, real-time data and alerts related to transit services.
  - Acceptance Criteria:
    - All data must be retrieved accurately and displayed on the map.
    - The map must be able to show real-time transit routes.

#### Use Case Details

- **Use Case:** View Waze Events in the ATCMTD System
  - Requirement: NFTA-26-00002 The ATCMTD system shall integrate third-party travel time data sources to improve user experience.
  - Primary Actor: NFTA User
  - Description: This use case demonstrates the ability to view accurate NFTA transit routes on the map.
  - User Stories:
    - As a NFTA user, I would like to be able to receive accurate, real-time data and alerts related to transit services.
  - Acceptance Criteria:
    - All data must be retrieved accurately and displayed on the map.
    - The map must be able to show real-time transit routes.

- **Workflow:**
  - Overview: A dashboard that displays system messages.
# APPLICATION to ALLROADS Project – System Testing

## Factory Acceptance Test #01

### Table of Contents

1. Introduction
2. Factory Acceptance Test Cases
3. Operational Functionality Test Cases
   - System Reliability, Availability, and Maintainability (RAM)
   - Test Case RAM01 – App Server Failure
   - Border Crossing
   - Test Case BC01 – Configure Border Crossing Wait Time
   - Test Case BC03 – View Border Crossing Travel Times
   - Test Case BC04 – Create Border Crossing Open Lane Request
   - Test Case BC05 – Create Border Crossing Ban/Restriction, Weekly
   - Test Case BC06 – Share Border Crossing Event Data via API
   - Test Case BC07 – Share Border Crossing Delays via API
   - Test Case BC08 – Share Border Crossing DMS Messages via API
   - Test Case BC09 – View Border Crossing Dashboards

### Test Case BC03 – View Border Crossing Travel Times

**Purpose:** The use case demonstrates the ability of the ATCMFD system to display information related to travel times and delay data.

**Requirements:**
- ATCMFD system shall allow border crossing operators to view travel times and delay data for passenger vehicles and trucks.

**Test Steps:**
- On the List window, select the TT icon on the switcher bar.
- Observe the list of Border Crossing Travel Times and the following data:
  - Section ID
  - Route Description
  - Section Name
  - Start & End Description
  - Status
  - Travel Time
  - Average Speed
  - Flow
  - Data Source

**Expected Result:**
- Verify that the ATCMFD system displays a list of travel times for cars and trucks.
APPLICATION TO ALLROADS PROJECT – OVERSIGHT
REQUIREMENTS BASED REVIEWS USING MODEL-BASED SYSTEMS ENGINEERING (MBSE)

3 SPECIFIC REQUIREMENTS

3.1 FUNCTIONAL REQUIREMENTS

This section describes the ATCMTD Functional Requirements of the ATCMTD Operational Scenarios as described in the following ATCMTD Operational Scenarios. Associated with this section are:

- Business Requirements
- Stakeholder Requirements
- Key Performance Indicators
- System Context Diagram
- System Requirements
- Sub-Requirements

Each operational scenario is further broken down into specific requirements, including:

- Geographical Scope
- Business Requirements
- Stakeholder Requirements
- Key Performance Indicators
- System Context Diagram
- System Requirements
- Sub-Requirements

3.1.1 Border Crossing

The ATCMTD system shall allow bridge and border crossing operators to share border crossing delay information via a web-based portal on the ATCMTD website to travelers via route allowing to make route choices for border crossings (UN 7.1.1).

3.1.2 Border Crossing

The ATCMTD system shall allow border crossing operators to assist travelers in making route choices for border crossings (UN 7.1.2).

3.1.3 Border Crossing

The ATCMTD system shall allow bridge and border crossing operators to assess the quality of the predictions of delay provided to the traveling public, by verifying predicted delays versus historical records of predicted delays (UN 7.1.3).

3.1.4 Border Crossing

The ATCMTD system shall allow bridge and border crossing operators to measure travel time reliability and delay/travel time separately between border crossing operators and passengers (UN 7.1.4).

3.1.5 Border Crossing

The ATCMTD system shall allow bridge and border crossing operators to measure travel time reliability and delay/travel time separately between border crossing operators and passengers (UN 7.1.5).

3.1.6 System Requirements

[BC-SyR-0010]: Border Crossing Requirements

[BC-SyR-0020]: The ATCMTD system shall allow the region to balance the load of traffic across border crossings to maintain/improve travel times for travelers and maintain efficiency of operations at border crossings (UN 7.1.1).

[BC-SyR-0030]: The ATCMTD system shall allow travelers to access the quality of the predictions of delay provided to the traveling public, by verifying predicted delays versus historical records of predicted delays (UN 7.1.2).

[BC-SyR-0040]: The ATCMTD system shall allow bridge and border crossing operators to measure travel time reliability and delay/travel time separately between bridge and border crossing operators and passengers (UN 7.1.3).

[BC-SyR-0050]: The ATCMTD system shall allow bridge and border crossing operators to measure travel time reliability and delay/travel time separately between bridge and border crossing operators and passengers (UN 7.1.4).

[BC-SyR-0060]: The ATCMTD system shall allow bridge and border crossing operators to measure travel time reliability and delay/travel time for truck traffic specific to truckers (UN 7.1.4).

[BC-SyR-0070]: The ATCMTD system shall allow bridge and border crossing operators to measure travel time reliability and delay/travel time for passenger vehicle traffic specific to passenger vehicle operators (motorists) (UN 7.1.4).

[BC-SyR-0080]: The ATCMTD system shall allow border crossing operators to share truck delays with transportation operators, including but not limited to, regional border crossing operators and freeway/tollway operators (UN 7.1.5).

[BC-SyR-0090]: The ATCMTD system shall allow border crossing operators to notify travelers via the ATCMTD website to travelers about route choices (UN 7.1.6).

[BC-SyR-0100]: The ATCMTD system shall allow border crossing operators to notify travelers via the ATCMTD website to travelers about route choices (UN 7.1.6).
## Application to AllRoads Project – Oversight

### Establish Traceability: Owners, User Needs, Sys-Req., User Stories, Acceptance

<table>
<thead>
<tr>
<th>Owner (ConOps)</th>
<th>User Need (ConOps)</th>
<th>Name</th>
<th>Text</th>
<th>User Stories (RTM)</th>
<th>Acceptance Criteria (RTM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NITTEC</td>
<td>UN 7.1.1</td>
<td>SRD-1.1.1.6 System Requirements</td>
<td>The ATCMTD system shall allow border crossing operators to share border crossing delay information via dynamic message signs and the NFBC, PBA, and NITTEC websites to travelers en-route allowing to make route choices for border crossings (UN 7.1.1).</td>
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<td>As a NITTEC user, I would like to be able to store and see historical travel times within the ATCMTD system.</td>
<td>Border crossing/travel time modules that store and measure border crossing travel times.</td>
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<tr>
<td>NITTEC</td>
<td>UN 7.1.3</td>
<td>SRD-1.1.6.3 (BC-Syr-0010): Share border crossing performance</td>
<td>The ATCMTD system shall allow border crossing operators to share border crossing delay information via dynamic message signs and the NFBC, PBA, and NITTEC websites to travelers en-route allowing to make route choices for border crossings (UN 7.1.1).</td>
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<td>NITTEC</td>
<td>UN 7.1.4</td>
<td>SRD-1.1.6.3 (BC-Syr-0004): Historical border crossing travel time reliability</td>
<td>The ATCMTD system shall allow border crossing operators to measure travel time reliability and delay/travel time separately between truck traffic versus passenger vehicles. Context: NITTEC currently receives BIFAR information that contains delay data for passenger vehicles and trucks, but NITTEC currently only reports the delay for passenger vehicles (UN 7.1.4).</td>
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<td>NITTEC</td>
<td>UN 7.1.4</td>
<td>SRD-1.1.6.3 (BC-Syr-0005): Measure (separate) travel time reliability and delay</td>
<td>The ATCMTD system shall allow border crossing operators to measure travel time reliability and delay/travel time separately between truck traffic versus passenger vehicle. Context: NITTEC currently receives BIFAR information that contains delay data for passenger vehicles and trucks, but NITTEC currently only reports the delay for passenger vehicles (UN 7.1.4).</td>
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### Concept of Operations (ConOps)

- **SRD-1.1.6 System Requirements**
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### System Requirements Document (SRD)

#### 3.1.1.6 System Requirements

- **BC-Syr-0001**: The ATCMTD system shall allow border crossing operators to share border crossing delay information via dynamic message signs and the NFBC, PBA, and NITTEC websites to travelers en-route allowing to make route choices for border crossings (UN 7.1.1).
- **BC-Syr-0001**: The ATCMTD system shall allow the region to balance the load of traffic across border crossings to maximize travel time of travel to the traveled and minimize effective contribution to border crossing congestion (UN 7.1.1).
- **BC-Syr-0001**: The ATCMTD system shall allow border crossing operators to store and measure historical border crossing travel time reliability to assess the efficiency of their operations. Context: Border crossing travel time reliability measurement is used by regional transportation planners (UN 7.1.3).
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APPLICATION TO ALLROADS PROJECT – OVERSIGHT

CAPTURING SPRINTS IN SYSTEM MODEL

Implementation across all Functional Areas
APPLICATION TO ALLROADS PROJECT - OVERSIGHT
CAPTURING & TRACING DETAILED DESIGN IN SYSTEM MODEL
APPLICATION TO ALLROADS PROJECT – OVERSIGHT

USE CASE REVIEW AGAINST SYSTEM REQUIREMENTS

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<tr>
<th>Name</th>
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<tr>
<td>SRD-1.1.1 Border Crossing</td>
<td>The ATCMTD system shall measure the shifts in spatial and temporal extent of congestion at various border crossings during specific periods where one or more border crossings experiences a delay as part of the key performance measures (GR 1.9.1).</td>
<td>S03-02. View Border Wait Times, S05-16. View Border Crossing Dashboard – Campuses &amp; Sites, DDD 5.1.4.3 View Border Wait Times, DDD 5.1.4.6 View Border Crossing KPIs / Data Sharing</td>
</tr>
<tr>
<td>SRD-1.1.1.5 Key Performance Indicators</td>
<td>The ATCMTD system shall measure and report the following border crossing key performance indicators (KPI) (CO 5.1): • Border crossing delay • Border crossing travel time • Usage level balance of the three crossings open to the public</td>
<td>S03-02. View Border Wait Times, S03-03. View and Store Historical Border Crossing Data, S03-04. View Border Crossing KPIs / Data Sharing, DDD 5.1.4.3 View Border Wait Times, DDD 5.1.4.6 View Border Crossing KPIs / Data Sharing</td>
</tr>
<tr>
<td>SRD-1.1.6 System Requirements</td>
<td>The ATCMTD system shall allow border crossing operators to share border crossing delay information via dynamic message signs and the NFBC, PBA, and NITTEC websites to travelers en-route allowing allow to make route choices for border crossings (UN 7.1.1).</td>
<td>S04-05. Receive DMS Messages from Crossings, DDD 5.1.4.4 Activate Border Crossing DMS</td>
</tr>
<tr>
<td>SRD-1.1.6.1 Share border crossing performance</td>
<td>The ATCMTD system shall allow border crossing operators to store and measure historical border crossing travel time reliability to assess the efficiency of their operations. Context: Border crossing travel time reliability measurement is used by regional transportation planners (UN 7.1.3).</td>
<td>S03-03. View and Store Historical Border Crossing Data, DDD 5.1.4.3 View Border Wait Times, DDD 5.1.4.6 View Border Crossing KPIs / Data Sharing</td>
</tr>
<tr>
<td>SRD-1.1.6.2 Historical border crossing travel time reliability</td>
<td>The ATCMTD system shall allow border crossing operators to measure travel time reliability and delay/travel time separately between truck traffic versus passenger vehicle. Context: NITTEC currently receives Blufax information that contains delay data for passenger vehicles and trucks, but NITTEC currently only reports the delay for passenger vehicles (UN 7.1.4).</td>
<td>S02-01. View Border Wait Times, S03-03. View and Store Historical Border Crossing Data, DDD 5.1.4.3 View Border Wait Times, DDD 5.1.4.6 View Border Crossing KPIs / Data Sharing</td>
</tr>
<tr>
<td>SRD-1.1.6.3</td>
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<tr>
<td>SRD-1.1.6.1</td>
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<td>SRD-1.1.6.2</td>
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<tr>
<td>SRD-1.1.6.3</td>
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</table>
APPLICATION TO ALLROADS PROJECT – OVERSIGHT

USE CASE REVIEW AGAINST SYSTEM REQUIREMENTS

- The ATCMTD system shall measure the shifts in spatial and temporal extent of congestion at various border crossings during specific periods where one or more border crossings experiences a delay as part of the key performance measures (KPI) (5.1.9).
- The ATCMTD system shall measure and report the following border crossing key performance indicators (KPI) (5.1.9):
  - Border crossing delay
  - Border crossing travel time
  - Usage level balance of the three crossings open to the public

- The ATCMTD system shall allow border crossing operators to share border crossing delay via dynamic message signs and the NITTEC website to travelers en-route allowing to make route choices for border crossings (5.1.9).
- The ATCMTD system shall allow border crossing operators to store and measure historical border crossing travel time reliability to assess the efficiency of their operations. Context: Border crossing travel time reliability measurement is used by regional transportation planners (5.1.9).
- The ATCMTD system shall allow border crossing operators to measure travel time reliability and delay/travel time separately between truck traffic versus passenger vehicle. Context: NITTEC currently receives Biufax information that contains delay data for passenger vehicles, but NITTEC currently only reports the delay for passenger vehicles (5.1.9).
APPLICATION TO ALLROADS PROJECT – OVERSIGHT

CAPTURING & TRACING TEST CASES IN SYSTEM MODEL

Test Cases

BC03 – View Border Crossing Travel Times

Nine (9) Requirements for this Test Case

- SRD-1.1.6.1 [BC-SyR-0010]: Share border crossing performance
- SRD-1.1.6.2 [BC-SyR-0040]: Historical border crossing travel time reliability
- SRD-1.1.6.3 [BC-SyR-0050]: Measure (separate) travel time reliability and delay
- SRD-1.1.6.4 [BC-SyR-0060]: Truck travel time reliability
- SRD-1.1.6.5 [BC-SyR-0070]: Passenger vehicle travel time reliability
- SRD-1.1.6.6 [BC-SyR-0110]: Dynamic message sign content
- SRD-1.1.6.14 [BC-SyR-0180]: Traffic conditions for access routes into/away from the border
- SRD-1.1.6.17 [BC-SyR-0220]: Long distance travel times
- SRD-1.1.6.23 [BC-SyR-0320]: 3rd party travel time data storage
# Application to AllRoads Project – Oversight

## System Test Review against System Requirements

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<tr>
<th>Name</th>
<th>Text</th>
<th>User Stories (RTM)</th>
<th>Acceptance Criteria (RTM)</th>
<th>Verified By</th>
<th>Test Cases (FAT #01)</th>
<th>Review Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRD-1.1.1 System Requirements</td>
<td>The ATCMTD system shall allow border crossing operators to share border crossing delay information with the NHTSA, PBA, and NITTEC websites to travelers en-route allowing to make route choices for border crossings (UN 7.1.1). As a NITTEC user, I would like to be able to receive travel time DMS messages from the Crossroads system to assess and report conditions received from the DMS.</td>
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<td>SRD-1.1.1.6</td>
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<tr>
<td>[BC-Syr-0010]: Share border crossing performance</td>
<td><strong>Dynamic message signs</strong> and the NHTSA, PBA, and NITTEC websites to travelers en-route allowing to make route choices for border crossings (UN 7.1.1).</td>
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<td>WSP: Compliant</td>
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<tr>
<td>SRD-1.1.1.6</td>
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<tr>
<td>[BC-Syr-0040]: Historical border crossing travel time reliability</td>
<td>The ATCMTD system shall allow border crossing operators to store and measure historical border crossing travel time reliability to assess the efficiency of their operations. Context: Border crossing travel time reliability measurement is used by regional transportation planners (UN 7.1.3). As a NITTEC user, I would like to be able to store and border crossing/travel time modules that</td>
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<tr>
<td>[BC-Syr-0050]: Measure (separate) travel time reliability</td>
<td>The ATCMTD system shall allow border crossing operators to measure travel time reliability and delay/travel time separately between truck traffic versus passenger vehicle. Context: NITTEC currently receives Blufax information that contains delay data for passenger vehicles and trucks. NITTEC currently only reports the delay for</td>
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</table>

## Test Steps

<table>
<thead>
<tr>
<th>Test Case ID</th>
<th>Test Name</th>
<th>Test Steps</th>
<th>Expected Result</th>
<th>Pass/Fail/CAUTION</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC03_03</td>
<td>View Border Crossing Travel Time on DMS</td>
<td>1. On the DMS list window, select a DMS list that displays a current message on the sign. 2. Observe the following: a. Last poll time b. Status c. District d. Travel time message e. Close the DMS window.</td>
<td>Verify that: a. The DMS opens in a new detailed viewer. b. The last poll time is recent.</td>
<td></td>
<td>The travel time delay for cars and trucks displays.</td>
</tr>
</tbody>
</table>

WSP: Compliant.
ACHIEVED OUTCOMES, SUMMARY & CONCLUSION

❖ BACKGROUND:
  – Mar 2022: Project Start (Design-Build)
  – May 2022: System Design Start (Detailed Design Doc., Requirements Workshops)
  – Oct 2022: Implementation Start (Sprints)
  – Feb 2023: 5 Sprints Completed, 1 FAT Executed, 100+ Req. Demonstrated
  – May 2023: 10 Sprints Completed, 2 FAT & 1 SIT Executed, 235+ Req. Demonstrated
  – Apr 2024: Project End (Final Test)

❖ AGILE METHODOLOGY, COMBINED WITH STRONG OVERSIGHT:
  – Has been delivering early and continuously working software
  – Working software is used as primary measure of progress
  – Has allowed prioritizing requirements and changes to requirements interpretations
  – Traceability and requirements based review ensure compliance to contract

❖ CONCLUSION:
  – Agile Methodology Highly Recommended for Complex ITS Projects
Thank you!

Contact details

Oliver Hoehne, ESEP, PMP, CSM
Technical Fellow, Systems Engineering
New Jersey, USA

+1-862-371-7314
oliver.hoehne@wsp.com

wsp.com