MDT Traveler Information Reporting System Product Evaluation

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1. EXECUTIVE SUMMARY

Road reporting systems are the backbone of many traveler information dissemination techniques including 511 traveler information phone numbers and traveler information websites; therefore, these systems must be efficient and easy to use.

Currently, the Montana Department of Transportation (MDT) uses two separate road reporting systems: a summer reporting system and a winter reporting system. This situation creates several challenges for MDT personnel, including having certain periods of the year when staff members may need to use both reporting systems at one time, as well as the limitations of the systems themselves due to insufficient functionality and automation.

To remedy these challenges, MDT partnered with the Western Transportation Institute (WTI) at Montana State University Bozeman to research the options for obtaining a new road reporting system that can accomplish all of MDT's needs. Phase One of this project was a requirements analysis that included the determination of stakeholder needs and formalization of the requirements for a new reporting system.

This report documents Phase Two, which includes the identification of off-the-shelf reporting system vendors that currently exist, a review of their reporting systems, and a comparison of these systems to MDT's requirements for a new reporting system from Phase One.

MDT has six options for how to proceed with its road condition reporting system including:

- Do nothing: In this scenario, MDT continues using the current road condition reporting systems as they are, with no modifications.

- Build Custom System: In this scenario, a software company creates a road condition reporting system to exactly match the requirements.

- Modify Existing System(s): In this scenario, MDT modifies the existing road condition reporting system(s) to meet the requirements for a new system.

- Purchase CARS: In this scenario, MDT purchases the CARS off-the-shelf system created by Castle Rock Consultants and has it updated to fully meet MDT's requirements.

- Acquire HCRS: In this scenario, MDT gains access to the HCRS software from NDOR or ADOT and hires Oz Engineering (or another suitable company) to adjust the system to meet MDT's requirements.

- Purchase IRIS: In this scenario, MDT purchases the IRIS off-the-shelf system created by Meridian Environmental Technology, Inc. and has it adapted to fully meet MDT's requirements.

Throughout the rest of the report, only four of the six options are specifically evaluated relative to each requirement: the three vendor systems and the existing MDT system. It is assumed that the "modify existing system" and "build custom system" options would meet all MDT requirements.

Researchers compared the four systems to each of the specific requirements to determine if the system fully meets requirements, partially meets requirements, does not meet requirements, or if it is unknown/unclear. To evaluate the three vendor systems, researchers consulted user manuals, web sites, and a test system.

To better understand how the four systems compared to each other overall, their ability to meet the requirements (fully, partially, not at all, or it was unclear) were tallied. These results are shown in Table ES- 1 with the numbers in the boxes representing the number of requirements that fit in each category.

Table ES- 1: Tallied Results for Systems' Ability to Meet Requirements

	CARS	HCRS	IRIS	Existing System
Fully Meets Requirements (x)	23	13	13	25
Partially Meets Requirements (p)	22	32	24	26
Unknown (u)	24	24	32	5
Does Not Meet Requirements (-)				13

These results indicate that if the requirements were used as written, the options to modify the existing system and the custom build approach would fully meet the requirements. However, it may be more difficult and time consuming to modify the existing system or create a custom built system, than it would be to modify one of the vendor systems. Of the four systems that would require modifications, the existing system meets more of the requirements than any of the other systems. Next in order would be CARS, then HCRS, and lastly IRIS.

Having said that, while one system may meet more of the requirements, it does not necessarily mean that it outranks the other systems as not all requirements bare the same ranking (i.e. not all requirements are of equal weight or cost for implementation) and this is not taken into consideration in this document. It should also be noted that if MDT makes any change (addition or deletion) to the requirements, it would alter these results and possibly change which system would best fit the agency's needs. Another significant piece of information to consider is the number of unknowns. One third of the requirements are unknown for CARS and HCRS and one half are unknown for IRIS. Gaining more information on these systems may change which system meets more of the requirements.

The final conclusion that must be made is that, although there are a lot of unknowns and there are systems that meet more of the requirements with the amount of information currently known, there is no significant evidence to eliminate any of the systems as options to potentially meet MDT's needs.

2. INTRODUCTION

Road reporting systems are the backbone of many traveler information dissemination techniques including 511 traveler information phone numbers, traveler information websites, local department of transportation phone recordings, emails, and faxes. Having an easy-to-use efficient road reporting system is key to providing accurate and up-to-date information via the traveler information dissemination techniques.

Currently, the Montana Department of Transportation (MDT) uses two separate road reporting systems: a summer reporting system and a winter reporting system. The summer reporting system has the ability to store information about incidents, construction and maintenance, load and speed restrictions for spring thaw, and facility information. The winter reporting system has the ability to store information about road conditions, winter road closures, emergency travel only advisories, and chain requirements.

Having two separate road reporting systems creates several challenges for MDT personnel, such as learning the operation procedures and shortcuts for two different systems. In addition, there are certain periods of the year when staff members may need to use both reporting systems at one time (e.g. in October when construction and winter weather can occur simultaneously in Montana). Along with challenges due to the separate reporting systems, there are also limitations within each reporting system due to insufficient functionality and automation.

To remedy the challenges, MDT partnered with the Western Transportation Institute (WTI) at Montana State University Bozeman to research the possibilities for obtaining a new road reporting system that can accomplish all of MDT's needs. Phase One of this project was a requirements analysis that included the determination of stakeholder needs and formalization of the requirements for a new reporting system (1).

This report documents Phase Two, which includes the identification of off-the-shelf reporting system vendors that currently exist, a review of their reporting systems, and a comparison of these reporting systems to MDT's requirements for a new reporting system from Phase One. The results of these two phases will allow MDT to create a Request For Proposal (RFP) to purchase a new reporting system.

MDT has six options for how to proceed with its road condition reporting system, which was deemed inadequate in the previous requirements document (see chapter 4: Identify Stakeholder Challenges and chapter 5: Identify Stakeholder Needs). The six options include:

- Do nothing: In this scenario, MDT continues using the current road condition reporting systems as they are, with no modifications.

- Build Custom System: In this scenario, a software company creates a road condition reporting system to exactly match the requirements.

- Modify Existing System(s): In this scenario, MDT modifies the existing road condition reporting system(s) to meet the requirements for a new system.

- Purchase CARS: In this scenario, MDT purchases the CARS off-the-shelf system created by Castle Rock Consultants and has it updated to fully meet MDT's requirements.

- Acquire HCRS: In this scenario, MDT gains access to the HCRS software from NDOR or ADOT and hires OZ Engineering (or another suitable company) to adjust the system to meet MDT's requirements.

- Purchase IRIS: In this scenario, MDT purchases the IRIS off-the-shelf system created by Meridian Environmental Technology, Inc. and has it adapted to fully meet MDT's requirements.

The three off-the-shelf systems will be further defined in the next chapter.

It is important to note that the event phrases used by MDT do not currently follow any standards, which would make this information difficult to share with other agencies. The off-the-shelf vendors do follow national standards. CARS and IRIS both follow the Traffic Management Data Dictionary (TMDD) standard, which uses International Traveler Information System (ITIS) phrases as part of the standard; whereas HCRS just follows the ITIS standard. MDT will need to decide if it is willing to adopt the national standards; if so, it may need to adjust some of the current description phrases. All current MDT conditions are supported by ITIS phrases or a combination of two phrases.

3. OFF-THE-SHELF REPORTING SYSTEMS

There are several off-the-shelf road reporting systems that exist, including the Conditions Acquisition Reporting System (CARS), the Highway Closure and Restriction System (HCRS), and the Integrated Road Information System (IRIS). Each of these systems will be discussed in more detail below.

3.1.   Condition Acquisition and Reporting System (CARS)

The Condition Acquisition Reporting System (CARS) was created in 1998 by Castle Rock Consultants. It is currently being used by ten states including Minnesota, Iowa, Missouri, Alaska, Washington State, New Mexico, Kentucky, Maine, Vermont, and New Hampshire.

CARS has the ability to store information about incidents, traffic conditions, roadwork, road and lane closures, detours and alternate routes, weather conditions, disturbances, sporting events, special events, restrictions, and winter driving indexes. CARS follows the TMDD standard, which uses ITIS phrases.

CARS can be accessed by authorized users from any computer with an internet browser. It uses a Windows-like environment, and the main page for input is a map. It is possible for the main page map to display just your state or also neighboring states. The system can also be set up so that information can be viewed internally as well as by other agencies, such as city and county departments of transportation, transit agencies, and emergency response agencies. The map has pan and zoom and can be customized for a particular region.

The home page map indicates the current situations that have been reported. To find out more information on a particular situation, users can click on the icon. This information can then be edited or deleted. There is also a text list available for showing current situations. This list can be sorted by situations authored in a user's group (e.g. all situations created by their district), situations the user authored (e.g. all situations that particular person created), creation time, start time, end time, author, location, phrase, priority, and access. Situations also have whole and brief descriptions available.

Along with reporting the types of information listed above, CARS has the ability to store radio logs, action plans or responses for specific situations, mobile situations, and user profiles.

The system also has security features that notify users if they are attempting something that they are not authorized to do.

To enter a situation, users must right click on the map near where the situation occurred. The exact location can be adjusted later. A pop up box will appear, and on a task bar along the bottom of the box there will be options for changing the screen view to enter different pieces of information about the situation, including: location and description (which are mandatory); and times, quantities, more info, and text (which are optional).

Users start by selecting if the road/location type used to define the situation should be nearby roads, nearby counties, nearby landmarks, or statewide. Once this is selected, available options for this type will appear (e.g. if a user chose nearby roads, a list of

nearby roads would be populated). Users then choose where the situation began and ended, either via location or mileage. The information they have chosen then shows up in a current situation description box. Users then select the description screen to continue situation creation. In this screen, users choose a category and phrase to describe their situation. The top ten categories are listed in a scrolling box, to view all of the categories, users must click on the "more" button. The phrases are populated based on which category is chosen. After selecting a phrase, a user must decide if it should appear in front of the roadway name as a statement of fact or as a cause at the end of the roadway name as the cause of the incident. It is mandatory that one phrase be included for a situation. After a phrase is added, a priority is automatically added and the default is high. The priority level can be changed under the more info screen.

The description screen also allows users to input a situation duration or end time. Users can choose to enter this information on the times screen instead for a more detailed time. The default is until further notice which indicates that the situation will not expire in CARS until it is edited. If a duration is chosen, the system assumes that the event starts immediately. If the situation starts in the future, the times screen must be used.

Lastly, users can enter the direction of the situation; if no direction is chosen the default is both. As information is added, the current situation description box continues to update. At this point, the message can be posted. If users are required and authorized to create a radio log, then they will automatically be taken to the radio log screen.

The times screen allows a start and end time to be entered, gives users the option of entering recurrent times for situations that repeat, or allows users to select the duration of an event similar to what was available on the description screen. Although it is possible to start an event in the past, it is not recommended. The default start time, if not defined by the user, is effective immediately. An event will automatically be deleted at the specified end time. For recurrent times, users must select the time zone, the days of the week, and the times.

The quantities screen allows users to add information, such as restriction weight, restriction length, or changed speed limit. Once a quantity description is chosen, users must input the information in the value box (e.g. the new speed limit). All quantity values must be integer numbers.

The more info screen allows users to input additional situation information such as person/agency that detected/reported the situation, message statistics such as priority, certainty/accuracy of situation, access to authorize who can view information, response plan, entering/suggesting an alternate route, and entering lane closure data.

The text screen allows users to manually enter information such as a district number, project number, engineer information, contractor information, project description, public message, internal comment, and group comments.

To edit situations, users can select the situation from either the map or from the situation list. The situation list is color coded: situations set to expire in an hour are red, new situations created in the last hour are green, archived situations are yellow, and all others are in black. Each situation also has an ID to uniquely identify it. There is also a sort menu bar to help make it easier to find situations. Examples of sorts available include,

but are not limited to seeing only situations that were created by users within their group or viewing lists of construction in their district only. The CARS system can be set up so that only the agency that created the message can edit it or only the group within an agency that created it can edit it.

If two situations occur in the same vicinity, users can either create two separate situations or use the elements feature to add several elements at one time. There is an elements button on every screen that will allow them to be added. All of the previous screens are available for adding element information; and location, phrase, and duration are mandatory information for each element.

CARS also allows users to create a mobile situation by clicking on each roadway on the map that will be effected by the mobile situation. Each of these road segments will then be considered as a separate element as described above.

The CARS system also allows users to create action plans ahead of time that are stored in the database. When a situation occurs, users must simply select the appropriate action plan to implement. This is also a way to automatically notify people of the events that have occurred and the action plan that has been put into place.

The CARS system also allows for radio logs to be created. This allows users to create a record of activities that are transmitted over the radio. A radio log can also be automatically created from an event report message. Radio logs can be linked and referenced to previous logs to retain the chain of messages. Once a log is created it can be added to, but not edited. There is also a place on the radio log to add a supervisor log, which provides information such as supervisor name, technical lead, mile, route, area, and section.

In 2005-06, Castle Rock Consultants added a new module to the database called CARS-segment. To operate this package, users select a specific road, then select one or more predefined segments on that road with the option of selecting all segments. Users then select road conditions (e.g. dry pavement, icy patches, packed snow, etc), weather conditions (e.g. rain, light snow, dense fog, etc), and special conditions (e.g. avalanche, snow chains recommended, rock fall, etc). After the conditions are entered, the information is automatically sent from CARS-segment to CARS, and from CARS to CARS-web and CARS-511. If adjacent segments have the same conditions, then the information is aggregated when it is sent from CARS-segment to CARS.

3.2.   Highway Closure and Restriction System (HCRS)

Currently there are two versions of the Highway Closure and Restriction System (HCRS). The first version was created for Arizona Department of Transportation (ADOT). After HCRS was completed, ADOT made its version available to other DOTs at no charge as long as the DOT was willing to sign an agreement that it would not sell the code. The requesting DOT was then responsible for hiring a programming company to adapt the system to its needs.

Nebraska Department of Roads (NDOR) took advantage of this offer. It requested the ADOT version of HCRS and hired Oz Engineering (the original creators) to adapt the original version to meet NDOR's needs.

The NDOR HCRS' main page has the following options available: today's announcements, manual, frequently asked questions (FAQ), contact us, and start HCRS. Once users select start HCRS, they are prompted to enter a username and a password. This information allows a user ID and user name to be attached to any information that is input.

The system then provides a map of the state. Users can choose from two different layers, one for counties and one for NDOR districts (the ADOT version also had a layer for organizations). Users can also select from several ITIS filters/icons including: incident/accident, closures, lane restrictions, traffic congestion, obstruction hazards, delays, construction zones, road conditions, and information. Lastly, viewers can choose to see the map with colored road segments rather than icons. Colors exist for the following conditions: seasonal/normal, caution, extreme caution, closed, and no report.

The event edit window allows users to input information regarding highway location, ITIS category/event type and description, and duration (all available on the phone and website); restrictions and public notes (also available on the website); and internal notes, priority, and whom the information was entered by (available only to authorized HCRS users). ADOT has several additional options including an incident management section and a 511 preview button.

Event locations are either by highway location, street location, or segment location. All information input into these sections comes from drop down menus. For both highway location and street location, users have the ability to enter an offset to the nearest intersection (in the current MDT systems, this is manually entered). The predefined segments are first chosen by picking the DOT area, then the segment location.

The ITIS category/event types available to choose are incident/accident, closures, lane restrictions, traffic congestion, obstruction hazards, delays, construction zones, road conditions, and information.

Event durations include options for scheduled events and unscheduled events. For a scheduled event, a user must enter when the event will begin (even if in the future) and when it will end. For an unscheduled event, users only enter when the event is likely to end. Users can open a drop down calendar to input the dates. There is also an option to make the closing date open-ended. Lastly, there is a place to enter continuous versus recurring events, their frequency, which days they occur and whether they occur at day or night.

The restrictions section allows users to enter vehicle height, length, width, and weight restrictions, as well as if hazmat is prohibited and if an escort vehicle is required.

The public and internal notes sections allow for the entry of manual notes.

The priority tab allows users to select low, medium, or high priority. There is an incident criteria box that depicts the criteria for choosing each respective priority level.

The entered by tab is used to identify which operators are able to edit information, because operators are only allowed to edit information from their own organization.

There are also a few additional functions. For example, users can terminate an event if the event was created by their organization, users can print events, the system validates

the milepost information, and there is an event list option on the menu bar that when chosen shows all of the events currently being displayed on the map (this is another way to edit events if someone prefers this to choosing an event from a map icon). There is also an auto search function for entering the ITIS categories and descriptions (therefore if a user starts to type in information, the drop down will automatically scroll to that information).

Some policies associated with HCRS that NDOR enforces include:

- events that are entered in advance will display in HCRS and on the website, but will not post on 511 until the event is current.

- if an end date and time are not set, HCRS will remove the event in two hours. It is recommended that road conditions have an estimated end time and date rather than be left open ended.

- if FHWA must be notified, set the priority level at 1 and the agency will automatically be notified.

Information mentioned in the ADOT manual that may also be part of the NDOR version includes:

- when a condition is saved, there is a window confirming this action.

- when an event is one minute from expiring, a pop up window will open for the event owner (if he or she is connected to HCRS) as a reminder of the expiration. This allows the owner to let the event run out, terminate the event, or extend the end time.

- this version also allows an operator to know when a floodgate (aka alert) is active and opens a message editor which tells what the floodgate says.

NDOR continues to adjust its version of HCRS. As HCRS was not originally created with a GIS map for color coding roadways, this was added for the NDOR version. NDOR continues to work out issues as they arise in the customization process. For example, not all ITIS categories and descriptions are available to users, but NDOR is still adjusting which are available. Currently HCRS can send information in XML, but cannot receive it that way. NDOR plans to fix this in the next iteration. The next iteration will also have a text entry screen without the map due to remote offices with limited bandwidth.

3.3. Integrated Road Information System (IRIS)

The Integrated Road Information System (IRIS) was originally created as a research project for the South Dakota (SD) Department of Transportation in 2003 and was completed in 2004. It is now being used in South Dakota and Nevada. When users start IRIS the system will automatically check to see if they are authorized users based on their computer login information. If they are not recognized, they will be asked to enter a username and password. When the system opens, the main page is a map of the state centered on the user's area. IRIS follows the TMDD standard, which uses the ITIS phrases.

The next step is to select the road segments for which information will be entered. This can be done in several ways including: by selecting all segments in an area, all segments in a unit, all segments in a shop, by individual road segment, or all segments on a highway. When roadways have been selected, they appear on the map with thicker gray lines. More than one of these selections can be combined; however, any segments selected at the same time should have the same road conditions. The South Dakota version of IRIS limits staff's ability to input information for certain areas of the state based on a predefined authority structure.

After selecting the road segments, a user chooses the assign conditions box which allows the conditions window to appear. This window shows the highways that have been selected with their common highway number, DOT official highway number, and starting and ending milemarkers; and allows users to select conditions, visibility, restrictions, and duration.

A user must first choose a road surface condition from the drop down box. The qualifier and extent drop downs are then populated based on the conditions, and the appropriate options can be chosen by the user. Some conditions will have default qualifiers and extents. A user can specify multiple road conditions, but must remember that any condition chosen will be related to all roadways listed in the selected highways box.

Users can then specify a reduction in visibility. The default is 'not impacting travel' which means that visibility is greater than a half mile. If visibility is less than this, the user can choose the reduction in visibility via a drop down box. Another drop down box allows the user to choose the cause for the reduced visibility along with the qualifier and extent. A user can also select restrictions based on the road conditions. Restrictions may include: road closed, no travel advised, reduced speed, chains required, road blocked, and chains recommended. Lastly, users can select when the condition will end. The default is 1:00 PM on the following weekday.

After the conditions have been submitted, they are depicted on the map via color coding. Some examples of color coding include: a gray roadway indicates that no information has been entered into the system about this particular segment, black indicates a dry road, and an increased line thickness indicates that information has been entered on that segment. The best way to depict multiple conditions on a particular road segment is still being decided. Note that even if conditions are dry and not impacting travel, this must be input, because blank road segments indicate unknown conditions, not dry.

IRIS also has the ability to enter "controls" (otherwise known as restrictions) in the control interface by either clicking on a roadway segment or by clicking on the highway shield to select the entire route. Controls can be set for requirements such as open with no controls, closed, controls (chains or snow tires required), chains (snow chains mandatory), and road closed due to avalanche control; and advisories such as wind advisory and wind warning. Only one control can be set at a time in each of the two categories (requirements and advisories). For concurrent highways, controls can only be set on the primary highway, not the secondary.

Construction information can be entered via the controls interface, although users need to switch from the controls to construction mode by clicking on the button in the bottom right hand corner. To enter construction information, users click on the new construction

button in the lower right hand corner. The highway information must be entered in the drop down box, not chosen on the map. A starting and ending milepost along with a direction must be entered. The system allows for checking information; if the correct parameters are not entered, the text will be red until it is fixed. If it is submitted with red text, the system will provide a pop up box stating what needs to be fixed.

Construction descriptions and extents must be added using the drop down buttons. The extent default is none. Users can enter restrictions associated with construction. Restrictions that can be turned on and off with a checkmark include: road closed, pilot car, flaggers, routing to opposing lanes, no passing, and local traffic only. Restrictions that require value limits include: lanes reduced to, width limit, height limit, length limit, gross weight limits, axle weight limit, speed limit, truck speed limit, detour, truck detour, and travel delay. Durations must be entered; this can be done by either entering the start and end dates and times for continuous work or choosing the days and times for recurring work. The recurring work days and times defaults are everyday and at all times, respectively. After a construction project has been submitted it will show up on the map as an orange road segment. These can then be edited or deleted by clicking on the applicable road segments.

Event information can also be entered via the controls interface by changing the mode to events in the lower right hand corner. To enter an event, users click on new event. This information is entered in a similar way to the construction information, where the highway information must be selected from the drop down menu and not from the map. Starting and ending mileposts are needed, as well as roadway direction. This information will also be checked for parameter mistakes by the system. Detailed information includes category, description, and extent, all of which are available in drop down menus. The default extent is none. Descriptions and extents of traffic conditions due to the event can also be entered, as well as restrictions. Restrictions that can be turned on and off with a checkmark include: road closed, on-ramp closed, off-ramp closed, local traffic only, consider alternate route, pilot car, flaggers, routing to opposing lanes, and no passing. Restrictions that require value limits include: width limit, height limit, length limit, gross weight limits, axle weight limit, lanes reduced to, speed limit, truck speed limit, travel delay, detour, and truck detour. Durations must be entered; this can be done by either entering the start and end dates and times for continuous work or choosing the days and times for recurring work. The recurring work days and times defaults are everyday and at all times, respectively.

4. EVALUATION OF VENDOR AND EXISTING SYSTEMS

The objective of this report is to provide MDT with a comparison of the requirements created for them against the six options that are available to them. Throughout the rest of the report, only four of the six options are specifically evaluated relative to each requirement: the three vendor systems and the existing MDT system. It is assumed that the "modify existing system" and "build custom system" options would meet all MDT requirements.

Researchers compared the four systems to each of the specific requirements to determine if each system fully meets requirements, partially meets requirements, does not meet requirements, or if it is unknown/unclear. To evaluate the three vendor systems, researchers consulted user manuals, web sites, and the test system for Alaska CARS.. Castle Rock Consultants provided the research team with a CARS user manual (2) and an addendum that addresses the CARS-Segment module (3). Arizona Department of Transportation (ADOT) provided the research team with their HCRS Training Guide (4), and Nebraska Department of Roads (NDOR) also provided the research team with their HCRS Training Guide (5). Meridian Environmental Technology, Inc provided the research team with the RCRS Training Guide (6), the South Dakota Department of Transportation (SDDOT) Improved Road Condition Reporting Final Report (7), and an RCRS addendum (8).

Due to the fact that most of the information for these systems was taken from written material, some of which is dated, it was not always clearly evident whether or not a system could meet a specific requirement. In these cases, the research team was careful to indicate that it was unclear or unknown if a vendor's system can meet a requirement (or a part of a requirement), rather than just saying that the system does not meet the requirement. It is assumed that the manuals are not all inclusive, and that the systems probably have functionality that would not be necessary to describe in a user/training manual provided to all staff. However, the vendor system's ability to meet MDT requirements, as written in the previous requirements document, was evaluated using only these manuals. Therefore, while researchers needed to document that there was no indication that a system could meet a requirement, vendors were given the benefit of the doubt that the system may indeed meet the requirement and it is just not acknowledged in the manual.

It should also be noted that several of the requirements from the previous document are specific to MDT (e.g. MDT organizational structures, Montana roadways, etc), and as such, none of the vendor systems could possibly meet them without customization. Therefore, if the vendor has met a similar requirement with information specific to another state DOT, it was considered to be able to meet the MDT requirement with modification (e.g. South Dakota roads would be modified to be Montana roads).

To match the organization of the previous requirements document, this evaluation is broken into three chapters: Data Definitions and Requirements; Functional Requirements for System Features; and Other Requirements.

5. DATA DEFINITIONS AND REQUIREMENTS

This chapter evaluates how the four systems handle data creation, storage and usage, as defined in the data definitions and requirements portion of the requirements document. Information discussed in this chapter includes system data, lists, MDT road network, contexts, events, facilities, and alerts.

5.1. System Data

System data addresses how certain types of data are stored for system operations. These are defined in the DataDef.System portion of the requirements document. In short, system data includes storage of user accounts, logs, and archives.

5.1.1. User Accounts

There are a variety of system users with different roles. Therefore, the system shall be able to assign accounts to all types of users. Each account will retain user information uniquely identifying the user in the system. The system should be able to create user accounts including a name and password. It should also be able to retain detailed user account information such as contact information, MDT affiliation, user type, and profile. It is noted that implementing user accounts may be done in a variety of ways, including integration with the operating system.

5.1.1.1.   CARS

CARS provides support for user accounts. Users must be able to login with their unique user name and password, through an internal mechanism. In addition users may be able to change their own profile, which includes their user name, password, time zone, preferred unit of measurement, privileges, default map boundaries, email address, and a list of email addresses to be notified if the user performs certain system actions. It should be noted that these functionalities can be customized for a particular state's system. For example, not all states' systems may allow all users to change passwords or privileges.

5.1.1.2.   HCRS

Both versions of HCRS (NDOR and ADOT) allow user accounts to be specified. Users must login with a user name and password through an internal mechanism. There is a user permission structure in the ADOT version of HCRS based on the ADOT classification hierarchy and in the NDOR version of HCRS based on organization. Therefore, there seems to be support for agency affiliation. It is unknown if there is support for user preferences.

5.1.1.3.   IRIS

IRIS provides support for user accounts. There are two ways of user authentication. The system first checks the network logon to determine if the user is authorized. If this does not work, a logon screen is provided. The details of the network logon (which network must be utilized) are unknown. There seems to be support for agency affiliation since maps are, by default, centered on the user's geographical location. It is unknown if there is support for user preferences.

5.1.1.4.   MDT Existing System

The existing system supports user accounts. However, it is unclear what information is stored about each user, so some modifications may be needed.

5.1.1.5.   Summary

All three vendor systems and the current MDT system provide support, in some form, for user accounts. All three systems limit users' privileges based on information in user accounts. It is unknown if contact information, profile, and user type are supported by the vendors or the current system. If the systems do not support these items, they must be modified to meet requirements.

5.1.2.   Logs

Logs are records of user events. They can be used to show event creation and editing in the system, or public access to system information (such as public use of the web page).

5.1.2.1.   CARS

CARS offers log support since events are tagged with author name, date of event entry, and a history of changes. CARS tracks public website hit data, including which pages were visited, length of time spent on each page, and other relevant statistics.

5.1.2.2.   HCRS

Both versions of HCRS state that user information is attached to any data entered or modified in the system. It is unclear if website hit data is tracked.

5.1.2.3.   IRIS

It is unclear whether logs, other than website hit data, are supported by IRIS.

5.1.2.4.   MDT Existing System

It is unclear whether logs are supported by the system. If not, modifying the existing system would involve adding support for all desired logs. There was a field labeled "updated by" in the winter system, but it appears to have been changed in subsequent versions to only indicate update by the system.

5.1.2.5.   Summary

CARS and both versions of HCRS attach user information to entered events and to all changes to existing events. It can not be confirmed without more information if logon/logoff records or public website records are supported in IRIS. IRIS and CARS support website hit information. More information about all vendor systems and the current system must be gathered and evaluated to determine if modifications are needed to meet requirements.

5.1.3.   Archives

Archiving and retrieval of certain information, such as events and reports, must be supported in the system.

5.1.3.1.   CARS

More information is needed about how CARS handles archiving; however, it is known that an archival process exists in this system, because archived situations appear on the situations list, colored in yellow. Users can select an archived situation from this list. However, it is not known how long archives are kept.

5.1.3.2.   HCRS

More information about HCRS archiving is needed to make an evaluation.

5.1.3.3.   IRIS

More information about IRIS archiving is needed to make an evaluation.

5.1.3.4.   MDT Existing System

The existing system supports archives of constructions projects and road conditions. Not all of the changes to these events are saved, however. Also, it is a cumbersome process to retrieve these archives. The system must be modified to support archiving of all events to meet requirements.

5.1.3.5.   Summary

Little is known about these products concerning archiving. Therefore more information is needed. It is known that CARS can display archived situations, but no further details were available. The current system does not support archival of all events and would need to be modified to do so to meet requirements.

5.2.   Lists

The system must support stored lists which feed form lists for the entry or modification of events or facilities. These are defined in detail in the DataDef.Lists portion of the requirements document. Such lists include those for work types, conditions, vehicle types, field elements, contacts and notifications.

5.2.1.   Work Types List

The system must have a list of work types which describe the nature of a construction or maintenance project. The work types must be automatically prioritized.

5.2.1.1.   CARS

CARS maintains a list of work types corresponding to those in the TMDD standard. TMDD uses the ITIS phrases for work type. ITIS phrases only cover roughly 25 percent of the MDT work types. ITIS phrases tend to be more general than MDT phrases in this

area. CARS seems to use all possible ITIS phrases; therefore, it is unknown if a subset can be used. The system has the ability for users to manually prioritize events.

5.2.1.2.   HCRS

Both versions of HCRS maintain a list of work types corresponding to ITIS phrases. However, each version of HCRS uses a different subset of the phrases, indicating flexibility about the types of items on the list. The system has the ability for a user to manually prioritize events.

5.2.1.3.   IRIS

IRIS also uses TMDD standards to define work types. Again, a subset of the standard is used indicating IRIS is flexible. Priority information was not addressed in the manual.

5.2.1.4.   MDT Existing System

The current list is defined in section DataDef.Lists.WorkTypes of the requirements document. If standards are adopted, this list must be modified. This would require making the work types much more general than they currently are.

5.2.1.5.   Summary

All three vendors support lists of work types in some fashion. Also, all three use ITIS phrases to populate those lists. This is beneficial for interaction with other systems using the same standards. IRIS and both versions of HCRS can limit the choices on the list; it is unknown if CARS can do the same.   The one challenge is the lack of correlation between MDT work types and TMDD standard ITIS phrases. Either the vendors will have to allow non-ITIS phrases for work type lists or MDT will have to adopt the TMDD standard.

CARS and HCRS allow users to prioritize events; however, it is not an automatic prioritization. It is unknown if IRIS allows for prioritization.

5.2.2.   Conditions List

Condition lists populate lists of road conditions for entry or modification. The current MDT list has point and line conditions for one specific location or a segment respectively. The items in this list should have automatic prioritization.

5.2.2.1.   CARS

CARS maintains a conditions list according to TMDD standards, which use ITIS phrases. Most MDT conditions can be covered by one ITIS phrase or a combination of two phrases. CARS uses all possible phrases, flexibility for subsets is unknown. This system has the ability for users to manually prioritize events.

5.2.2.2.   HCRS

HCRS uses ITIS phrases to populate the conditions lists. It appears flexibility is supported, as a different subset of phrases appears on the ADOT and NDOR versions of HCRS. This system has the ability for users to manually prioritize events.

5.2.2.3.   **IRIS**

IRIS uses TMDD standards to populate the conditions list. The SD version has only nine elements, indicating subsets of the phrases are supported. It is unknown if users can prioritize items in IRIS.

5.2.2.4.   **MDT Existing System**

The current list is defined in section DataDef.Lists.Conditions. However, this list may change if a standard is adopted. All MDT conditions are supported by ITIS phrases or a combination of two phrases.   It should be noted that priorities are not handled automatically by the system. Rather, the human operator assigns priorities to conditions. The system must be modified to automatically prioritize conditions to meet requirements.

5.2.2.5.   **Summary**

All three vendors support conditions lists based on ITIS phrases, and all MDT conditions are supported by the phrases.   The ITIS phrases do not differentiate between line and point conditions like in the existing system (though both sets of conditions themselves are covered); rather, it is assumed that this information is combined with location information to glean the same result (i.e. point milepost vs. to and from mileposts).

Two of the three vendors have the ability for manual prioritization; however automatic prioritization is needed, and therefore none of the vendors can meet requirements without adjustments to their systems. In order to meet requirements two of the vendors would need to change manual prioritization to automatic and the third vendor would need to modify the product to attach priorities to condition list items and then further handle the priorities throughout other products. The current MDT system must change prioritization to automatically occur to meet requirements.

5.2.3.   Vehicle Types List

The vehicle type list populates the elements concerning the types of vehicles affected by restrictions on the data forms.

5.2.3.1.   **CARS**

CARS conforms to TMDD standards, therefore it includes and exceeds the requirements. HCRS

HCRS relies on ITIS phrases; hence it also includes and exceeds the requirements.

5.2.3.2.   **IRIS**

IRIS uses TMDD, like CARS and HCRS, so it includes and exceeds the requirements.

5.2.3.3.   **MDT Existing System**

There is no support for a vehicle type list. The current system embeds vehicle types in restrictions or conditions. For instance, a high priority condition reads "Chains Required on Towing Units…" There is not a separate list to handle the types of vehicles affected

by a condition or restriction. The system must be modified to maintain and use such a list.

5.2.3.4.   Summary

All three vendors meet and exceed the requirements for maintaining a vehicle type list. The current system must be modified to support a vehicle types list to meet requirements.

5.2.4.   Field Elements List

A field elements list contains entries concerning information about external devices such as Road Weather Information Systems (RWIS), camera, and Dynamic Message Signs (DMS). Such information includes locations, name, and readings.

5.2.4.1.   CARS

More information is needed to evaluate CARS on this point. Castle Rock indicates that support for RWIS automated events and DMS message notification exist in CARS. Therefore, it is implied, but unknown, that a table of these field elements is stored.

5.2.4.2.   HCRS

It is unknown how HCRS supports field element lists. However the ADOT website graphically displays message signs, cameras, and weather sensors as icons on a map. The icons can be clicked and information is shown. It is therefore implied, but unknown, that a field element list is supported. It is unknown if the NDOR version of HCRS uses or supports field element lists.

5.2.4.3.   IRIS

It is unknown if IRIS supports field element lists.

5.2.4.4.   MDT Existing System

There are links from maps on MDT's website to RWIS and cameras. However this information is not a part of the road reporting system. The DMS are part of a separate system and not yet listed on the website.

5.2.4.5.   Summary

More information must be known to effectively evaluate the vendors' support for field element lists. It is implied, but unknown, if this exists in CARS and HCRS. IRIS capability is unknown. The current MDT system must be modified to support all field elements to meet requirements.

Assuming there is presently no support for a field elements list, all vendors would have to modify their products to meet requirements.

5.2.5.   Contact List

A contact list, separate from the users list, may be kept to facilitate communication. It may include internal MDT contacts and external agency contacts. The contact list might

also include a listing of regular contacts that provide information used in the system such as snow plow drivers.

5.2.5.1. CARS

CARS does allow users to maintain an email list of contacts for each user; however, it is unknown if CARS meets all aspects of this requirement. The organization names and contact information specific to each event must be freely typed.

5.2.5.2. HCRS

There is contact information storage and automatic notification available in HCRS; although it may not be in list form. However, it is unknown if HCRS meets all aspects of this requirement.

5.2.5.3. IRIS

It is unclear if IRIS maintains a contact list; there are no occasions where contact information is mentioned in the user manual.

5.2.5.4. MDT Existing System

The current MDT system does not support contact lists. Instead, users keep this information in binders at their desks. There is also no automatic contact or notification via this system.

5.2.5.5. Summary

CARS and HCRS both allow users to enter contact information and have automatic notification; however, it is unknown if these systems fully meet the requirements. Information on IRIS is unknown. The current system must be modified to support integrated contact lists to meet requirements.

5.2.6. Notification Lists

Notification lists contain people who must be contacted in the case of specific incidents, such as an incident involving a fatality.

5.2.6.1. CARS

Contacts are automatically notified via email when the user creates an event report or when that event expires. Notification lists are stored in the action plan module. If a predefined action plan is implemented, automatic notification occurs.

5.2.6.2. HCRS

HCRS has notification lists that are attached to the priority of an event in the NDOR HCRS version and in the Incident Management section of the ADOT HCRS version.

5.2.6.3. IRIS

It is unknown if IRIS supports notification lists.

5.2.6.4.   MDT Existing System

The current system does not have notification lists integrated into the system. The internal notification lists are saved in Microsoft Outlook, and the external notification lists are kept on paper and notification occurs manually. The current system must be modified to support a notification list to meet requirements.

5.2.6.5.   Summary

CARS and HCRS support notification lists. It is unknown if IRIS supports this. The current system does not support notification lists and must be modified to do so.

5.2.7.   MDT Road Network

The Montana Department of Transportation represents the state road network in its TIS database using multiple route identification systems. Elements from this database shall be imported or linked into the road condition reporting system to provide the necessary information to describe the road network for internal and public purposes. Different layers of the MDT road network that need to be considered include MDT organizational layers such as district, divisions, and sections, and roadway layers such as segments, corridor routes, and sign routes.

5.2.7.1.   CARS

It is unknown if CARS supports DOT organizational subdivisions such as district, division, and section. Therefore, more information is needed.

However, CARS has recently created a new module called CARS-segment in order to meet requirements for Wyoming and Idaho 511. This module supports predefined segments denoted by one or more sign route mileposts. Therefore, it can be modified for MDT-specific segments.

CARS does not appear to support a route system other than a sign route system, such as a corridor route. CARS does; however, support sign routes.

5.2.7.2.   HCRS

The NDOR version of HCRS supports maintenance supervisor areas. ADOT HCRS supports division by county, organizations, and districts. Therefore it is assumed that modifying HCRS to support MDT Districts, Divisions, and Section requirements is feasible.

Both versions of HCRS support user-defined segments via sign route mileposts. Also, NDOR HCRS supports predefined segments based on sign routes and sign route mileposts. HCRS does not appear to support a route system other than sign routes. Therefore, a corridor route system is likely not supported.

HCRS also supports sign route names, numbers, direction, and mileposts. Sign route affiliation with agency-specific geographical entities appears to be supported in NDOR HCRS segment specification. The program appears to know which sign routes and corresponding segments are located within a given area. It is unclear if alternate names

or correspondence with other route systems are supported or if seasonality of a sign route can be specified.

5.2.7.3. IRIS

IRIS supports comparable SDDOT subdivisions. Therefore, it is assumed that modifying IRIS to meet the DOT organizational requirements can be done.

IRIS does support predefined segments for road conditions. In fact, winter condition reporting is accomplished in terms of one or more predefined segments corresponding to SDDOT official highway numbers.

IRIS supports another route system for specifying road condition locations. It is unclear if this route system (referred to as SDDOT official highway numbers in IRIS documentation) meets the requirements and can handle the corridor route system currently used by MDT.

IRIS supports sign route name, number, direction, and mileposts as defined. It is unclear if alternate naming is supported by IRIS. It is unclear if seasonality of a sign route can be specified.

5.2.7.4. MDT Existing System

The current system meets requirements by supporting MDT Districts, Divisions, and Sections as well as MDT Segments as defined. The current system also meets requirements concerning corridor and sign routes.

5.2.7.5. Summary

Of the five parts to this requirement, only one is met by all four systems. All systems support sign route name, number, direction, and milepost. CARS can support alternate route names. IRIS and HCRS (NDOR) can handle sign route association with agency-specific geographic entities. IRIS can also handle other route systems, but it is unclear if an active correspondence between route systems is achieved. The current system satisfies all of the requirements.

5.3. Contexts

Contexts characterize incidents in terms of their location, the times in which they impact travel (effective period), the impact they have on travel (restrictions), and the source of the information provided for them. Contexts are defined in more detail in the DataDef.Contexts portion of the requirements document.

5.3.1. Location

The location includes a physical location on a road network and its specification according to MDT geographic classifications. The system must allow event and facility locations to be specified.

5.3.1.1.   CARS

CARS allows users to specify a sign route name, so it appears there is some flexibility in naming the route. Further, users can specify either a point or a general segment using either cross streets, mileposts, or exact mileage. Locations can also be selected by predetermined segments. The direction of the highway can also be specified. It is not known if a location can be classified according to geographic classifications specific to a transportation department. Users can also specify whole regions (boroughs in Alaska), states, and landmarks. It is possible that these boroughs correspond to internal classifiers. Support for off-network roads is unknown but not likely since CARS mainly constructs its messages using pre-stored data (such as the road network).

5.3.1.2.   HCRS

The ADOT HCRS allows users to specify sign route, direction, and point or general segment information as a function of milepost or cross street. Support for arterials also exists but it is unknown if this information is in the road network; although it is assumed to be. NDOR HCRS supports the same location specification functionality as ADOT HCRS and more. NDOR HCRS allows users to specify locations as maintenance supervisor areas, an agency-specific geographical classification, and predetermined segments within that area. It is unclear if there is support for off-network location information.

5.3.1.3.   IRIS

IRIS allows users to select predetermined segments for conditions reporting. The segments are referenced by sign route name and agency-specific highway number. Multiple segments can be selected individually or by geographic classification (area, shop in SDDOT). Construction locations are specified using sign route name and start and end mileposts. It is unclear if off-network locations, text descriptions, or arterials are supported.

5.3.1.4.   MDT Existing System

The current MDT system allows locations, as outlined in the requirements document, to be specified. No modification is needed to meet requirements.

5.3.1.5.   Summary

The current system is the only one that fully meets the requirements. None of the vendors appear to support off-network location specification. All vendors allow users to specify sign routes, and from/to mileposts as well as predefined segments. CARS and HCRS also support arterials. IRIS and the NDOR HCRS also support agency-specific geographical classifications.

5.3.2.   Effective Period

The effective period is the time and/or date where events affect travel or a facility is open.

5.3.2.1. CARS

CARS satisfies all of the requirements.

5.3.2.2. HCRS

HCRS (both versions) satisfies the requirements.

5.3.2.3. IRIS

IRIS satisfies the requirements.

5.3.2.4. MDT Existing System

The current system does not support weekly schedule, recurrence or exceptions. It is assumed that start times for conditions are effective immediately.

5.3.2.5. Summary

All vendor systems meet requirements. The current MDT system; however, would require some modifications.

5.3.3. Restrictions

These requirements involve defining restrictions for normal travel due to an event.

5.3.3.1. CARS

CARS meets and exceeds system requirements for restrictions. CARS uses the ITIS phrases for restrictions; there are corresponding phrases for all MDT needed restrictions.

5.3.3.2. HCRS

NDOR HCRS only explicitly provides vehicle dimension, load, payload, and pilot car restrictions. ADOT HCRS provides those restrictions and the ability to specify which lanes are blocked. It appears that other restrictions can be specified using the ITIS phrases as well.

5.3.3.3. IRIS

IRIS provides support for restrictions. All conditions restrictions and construction restrictions in the requirements are addressed.

5.3.3.4. MDT Existing System

The current system provides support for restrictions but it would have to be modified to fully meet the requirements. Restrictions currently omitted entirely include payload, pilot car, and passing.

5.3.3.5. Summary

Both IRIS and CARS support the required restrictions, although slight modifications may need to be done in each to fully meet requirements. HCRS supports the requirements in

that it is likely that all of the restrictions can be specified with some modifications.   The current system must add several types of restrictions to meet requirements.

5.3.4.   Information Source

The information source is the main person/agency/device of origin for event or facility information.

5.3.4.1.   CARS

CARS provides support for specifying author name, agency, and creation time of the reporting.

5.3.4.2.   HCRS

HCRS allows for contact specification in the internal notes section. It is unknown if there is support for the time and date of the reporting.

5.3.4.3.   IRIS

It is unknown if IRIS supports source information.

5.3.4.4.   MDT Existing System

There is no support for source information in the current system. Modifications would have to enable reporters to specify the source of the information (or have this automatically specified).

5.3.4.5.   Summary

CARS meets requirements as is, HCRS partially meets requirements, and it is unclear if IRIS meets requirements. The current system requires modifications in order to meet requirements.

5.4.   Events

The term "events" applies to Construction or Maintenance Projects, Road Conditions, Spring Thaw Load and Speed Restrictions, Incidents, and Special Events. These are defined in more detail in the DataDef.Events section of the requirements document.

5.4.1.   Construction and Maintenance Projects

Construction and maintenance projects must be supported as defined in the requirements document.

5.4.1.1.   CARS

CARS supports construction and maintenance projects as situations.   All project attributes can be specified in situations except project status and project type.   It is unclear if project IDs can be associated with MDT fields.

5.4.1.2.   HCRS

HCRS supports construction and maintenance projects as events. All project attributes can be specified in events except project status and project type (i.e. whether construction or maintenance). It is unclear if project IDs can be associated with MDT fields.

5.4.1.3.   IRIS

IRIS supports construction projects. There is no differentiation between maintenance and construction projects. Location, restrictions, work type, and effective times are supported. However, it is unclear whether a project ID is supported. It is unknown if an information source, internal/external notes, project type and status are supported.

5.4.1.4.   MDT Existing System

The current system supports construction and maintenance projects. Information source is not supported. The remarks sections allow for users to enter either internal or external notes, but not explicitly.

5.4.1.5.   Summary

All vendor systems and the existing system support construction and maintenance projects in some fashion, although none meet requirements in their current versions. None of the vendors support project type and project status. It is unclear if project IDs (where available) can be dynamically linked to agency-specific fields.

5.4.2.   Road Conditions

Road conditions must be supported as defined in the requirements document. This section will not discuss the manner of entry, only if road conditions are supported as defined.

5.4.2.1.   CARS

CARS supports road conditions as events. All road conditions attributes are handled by CARS.

5.4.2.2.   HCRS

HCRS supports road conditions as events. It should be noted that only one phrase can be chosen at a time. This indicates that only one condition can be chosen, which effectively limits the attachment of certain restrictions onto that condition.

5.4.2.3.   IRIS

IRIS supports road conditions, handling all attributes of road conditions as defined in the requirements except for source and internal/external notes.

5.4.2.4.   MDT Existing System

The current system meets all requirements except internal and external notes and information source.

5.4.2.5.   Summary

All vendors and the existing system support conditions in some fashion. CARS and HCRS cover all attributes of road conditions as defined in the requirements document. The current system and IRIS cover most aspects of road conditions except notes and source.

5.4.3.   Spring Thaw Load and Speed Restrictions

The system must support load and speed restrictions as defined in the requirements document. Spring thaw load and speed restrictions are not to be confused with generic load and speed restrictions capable of being placed on any event.

5.4.3.1.   CARS

It is unclear if CARS provides support for spring thaw load and speed restrictions merely using the ITIS phrases. In other words, there exists no convenient phrase for describing events in this way. However, CARS supports generic load and speed restrictions, and it may be possible to attribute these to spring thaw through the free-form text fields. This is not an ideal option, though.

5.4.3.2.   HCRS

It is unclear if HCRS, like CARS, supports spring thaw load and speed restrictions. HCRS also uses the ITIS phrases, which are inadequate for describing spring thaw. However, HCRS supports load and speed restrictions for generic events, so it may be possible to specify an event generally using the phrases and specifically as spring thaw with free-form text. This is not an ideal option, though.

5.4.3.3.   IRIS

IRIS, using ITIS, does not support spring thaw events. It is assumed that the load and speed restrictions can be specified since they exist for construction projects.

5.4.3.4.   MDT Existing System

The current system does support spring thaw restrictions as defined in the requirements. Essentially no modifications would need to be done.

5.4.3.5.   Summary

No vendor currently supports spring thaw events. However all can provide support for the actual restrictions. The extent of modification needed to provide support for spring thaw is unknown. Since they all rely on the ITIS standards, it may involve adding an additional phrase. Therefore, none of the vendors can meet requirements as is; however, the existing system meets requirements.

5.4.4.   Incidents

The system must support incidents as defined in the requirements document.

5.4.4.1. CARS

CARS supports incidents as events. There are several incident descriptions available in the ITIS phrases under the "Accidents and Incidents" section. CARS allows users to specify all attributes of an incident.

5.4.4.2. HCRS

HCRS supports incidents as events. All attributes of an incident, as defined, can be specified using HCRS. However, only the ADOT version supports the incident-specific times and the number of injuries and fatalities in the IM Report tab.

5.4.4.3. IRIS

Incidents are input in IRIS under the events module. It is unknown if injuries and fatalities can be specified.

5.4.4.4. MDT Existing System

The current system supports incidents. They are lumped with special events (users must specify). They are limited to no restrictions unless freely typed. In fact none of the incident-specific information (such as lane closure time, lane reopen time, vehicle types, injuries, and fatalities) is supported unless freely typed.

5.4.4.5. Summary

All vendors support incidents. CARS and HCRS satisfy the requirements as is; however, it is unknown if IRIS supports specific entries regarding injuries and fatalities. The current system supports incidents, but most of their attributes are not supported unless freely typed.

5.4.5. Special Event

The system must support special events as defined in the requirements document.

5.4.5.1. CARS

CARS supports special events as events. There are numerous ITIS phrases describing special events under the "Special Events" or "Sporting Events" groupings. CARS meets requirements for supporting special events as defined.

5.4.5.2. HCRS

It is unclear if the ADOT version supports special events as is, but the NDOR version has limited support (users can specify fairs, football games, and a few other similar events). However, since HCRS uses ITIS phrases, adding enough phrases to cover most special events should not be too difficult. Therefore, some modifications will be needed.

5.4.5.3. IRIS

IRIS supports special events via the event module. There are numerous phrases such as "air show", "concert", "fair", etc.

5.4.5.4. MDT Existing System

The current system provides some limited support for special events. Users can specify that an incident is a special event. However a more specific description must be handled by the remarks section; therefore, users must freely type the description. Also, the current system does not support an information source for special events.

5.4.5.5. Summary

CARS and IRIS satisfy the requirements as is. HCRS may need some modifications. The current system depends on free-form description of special events for anything more specific than "special event," and so must be modified to meet requirements.

5.5. Facilities

The term "facility" applies to rest areas, border crossings, and weigh stations. More detail on these requirements is available in the DataDef.Facilities portion of the requirements document.

5.5.1. Rest Area

The system must be able to support rest areas as defined in the requirements document.

5.5.1.1. CARS

CARS does not seem to support rest areas as defined. There is one ITIS phrase "at rest area," but it does not allow users to enter specific information about a rest area. It is unknown if CARS can be modified to support rest areas.

5.5.1.2. HCRS

It is unknown if HCRS supports rest areas presently or can be modified to do so in the future. There is no mention of rest areas in the ADOT or NDOR versions.

5.5.1.3. IRIS

It is unknown if IRIS supports rest areas. There is no mention in SDDOT or Nevada documentation.

5.5.1.4. MDT Existing System

The current system supports rest areas as defined.

5.5.1.5. Summary

It is unclear if any of the vendors support rest areas as defined. However, the current system supports rest areas. More information must be known to evaluate the products.

5.5.2. Border Crossing

The system must support border crossings as defined in the requirements document.

5.5.2.1.   CARS

It is unknown if CARS supports border crossings as defined. However, a "customs point" phrase exists in ITIS. It is unknown if this phrase can be used to define a border crossing.

5.5.2.2.   HCRS

It is unclear if HCRS supports border crossings. The ITIS phrase "customs point" also applies to HCRS. There is no mention of border crossings in the ADOT or NDOR documentation.

5.5.2.3.   IRIS

It is unclear if IRIS supports border crossings. The ITIS phrase "customs point" applies to IRIS as well. There is no mention of border crossings in the SDDOT or Nevada documentation.

5.5.2.4.   MDT Existing System

The current system does not support border crossings.

5.5.2.5.   Summary

Neither the vendor systems nor the current system support border crossings. An ITIS phrase, "customs point," may be applicable, but it is unclear if the definition can be supported using the phrase. All four systems would need to be modified.

5.5.3.   Weigh Station

The system must support weight stations as defined in the requirements.

5.5.3.1.   CARS

CARS does not seem to support weigh stations as defined, but an ITIS phrase, "at weigh station," exists. It is unclear if the phrase can adequately cover the definition.

5.5.3.2.   HCRS

There is no mention of weigh stations in the ADOT or NDOR documentation. The ITIS phrase "at weigh station" applies to HCRS.

5.5.3.3.   IRIS

There is no mention of weigh stations in the SDDOT or Nevada documentation. The ITIS phrase "at weigh station" applies to IRIS.

5.5.3.4.   MDT Existing System

The current system does not support weigh stations. New database tables, forms, and reports need to be created to support weigh stations.

5.5.3.5. Summary

Neither the vendor systems nor the existing system support weigh stations. It is unclear if the "at weigh station" ITIS phrase, in combination, with other ITIS phrases, can adequately cover the definition of weigh station. All four systems would need modifications.

5.6. Alerts

Alerts must be supported as defined in the DataDef.Alerts portion of the requirements document. There can be homeland security, AMBER, and general transportation alerts. Alerts can be non-interruptible and be conveyed at the call greeting (i.e. a floodgate message) or under a sub-menu. This requirement, however, pertains specifically to entering the alert message via a database rather than by phone.

5.6.1. CARS

It is unclear if CARS supports alerts as defined in the requirements. More information must be known to determine if CARS supports the specification of alerts and can control the nature of the dissemination of the alert. Castle Rock is developing an AMBER software module for CARS capable of handing AMBER alerts, but more information is needed to determine if other alerts are supported and if the handling of AMBER alerts meets requirements.

5.6.2. HCRS

ADOT HCRS supports user-specified floodgate messages. However, slight modifications would be needed to completely meet requirements. NDOR HCRS does not appear to support floodgate messages.

5.6.3. IRIS

It is unclear if IRIS supports alerts of any type. More information must be known to determine how easily IRIS can be modified to satisfy the alert requirements.

5.6.4. MDT Existing System

The current system does not support alerts of any type. To meet requirements, alerts would have to be added entirely.

5.6.5. Summary

ADOT HCRS is the only system that even partially meets the requirements. This system would still need some modifications to fully meet requirements.

6. FUNCTIONAL REQUIREMENTS FOR SYSTEM FEATURES

This chapter evaluates how the four systems handle general data, event, facility and alert entry, modification and deletion; report generation; public interface; private interface; notification; user administration; and data management.

6.1.   Data Entry and Modification Interfaces

This section evaluates products based on their ability to meet the data entry and modification requirements including data entry, modification, deletion, cancellation, and saving.

6.1.1.   Data Entry Interface

The system must be able to provide an interface to enter new events or facilities upon request. The interface will only allow users to enter fields for which they are authorized. The interface may support preloading data if applicable. The database is not updated until the data is saved. This is defined in more detail in the Features.DataEntry Interface section of the requirements document.

6.1.1.1.   CARS

CARS provides both a map and a form interface for data entry. It limits data entry to fields that are allowed for the particular user's authorization. Clicking on the map at a certain location automatically fills in location fields in the subsequent form interface, which is also preloaded with lists for other possible locations and descriptions. The lists are dynamic in nature; hence they change accordingly based on user input.   The information is not saved until a 'Done' button is pressed.

6.1.1.2.   HCRS

The ADOT version of HCRS provides a map and form interface for entry; the form interface uses preloaded lists. Location data from the map may be loaded to the form during 'Easy Entry' mode. Data is not saved until the "OK" button is pressed. It is unknown if entry interfaces are limited by user authorization. The NDOR version only provides a data entry form interface. Note that there is a map interface, but it is used for selecting existing data and not entering new data. In any case both versions provide a data entry interface that meets requirements.

6.1.1.3.   IRIS

IRIS provides a map interface leading to a form interface for conditions entry. The map must be used first. IRIS provides a form-only interface for construction entry.   In either case lists are preloaded, and entry is geographically limited based on user profile. Information is not saved until the "Submit" button is pressed.

6.1.1.4.   MDT Existing System

MDT currently provides form interfaces for entry of construction, conditions, incidents, and load and speed restrictions. An interface for all facility type entry is not supported

(i.e. currently only rest areas are actually supported), although rest area information can be modified. Facility status (open or closed) can be modified. No preloaded data exists on these forms; instead users must explicitly run queries to populate lists. Information is not saved until "Save" button is pressed.

6.1.1.5. Summary

All vendor systems and the current system satisfy the basic requirement of having an interface for data entry. CARS, ADOT HCRS, and IRIS provide multiple data interfaces. All vendors do not allow databases to be updated until the data is saved. All vendors provide preloaded form data in some fashion and appear to restrict entry to allowable fields. Vendors providing a map interface for data entry include CARS, IRIS, and ADOT HCRS. All vendors and the existing system provide a form interface for data entry.

6.1.2. Data Modification Interface

Users must be able to choose existing data to modify and be able to change modifiable data if authorized. Automatic population of fields corresponding to those currently stored in the database must be supported. Changes are not committed to the database until the data is saved. This requirement is described in more detail in the Features.DataModificationInterface section of the requirements document.

6.1.2.1. CARS

CARS allows users to select objects for modification from the map and a list. All data currently stored is loaded into the entry form for modification. As is the case in data entry, changes are not committed until the 'Done' button is pressed.

6.1.2.2. HCRS

NDOR HCRS allows users to select an event for modification from a list or map. The data stored in the database for the selected event is loaded to the modification interface form. The database is updated when the "OK" button is pressed. The same is true for ADOT HCRS.

6.1.2.3. IRIS

IRIS allows users to select multiple segments on a map interface for modifying road conditions. Only one construction project may be selected at a time. The data from the corresponding condition(s) or project is loaded into a data form after selection. The database is not changed until the "Submit" button is pressed.

6.1.2.4. MDT Existing System

The current system displays data for modification using the same forms used for entry.

6.1.2.5. Summary

All vendor systems and the current system support a data modification interface. CARS and HCRS allow data to be selected using a map and a list, while IRIS only allows map selection. The current system allows querying.

6.1.3.   Data Save Options

The system must allow users to save input data. The system should validate the input before saving to avoid entry of errant or missing information. If the data is within preset bounds of reason and is complete, it must be saved. If the data is errant or missing, then the system must not save the data and specify the errant or missing fields to the user. This is described in more detail in the Features.DataSaveOptions portion of the requirements document.

6.1.3.1.   CARS

There is adequate data save functionality present in CARS. CARS also has some data validation capabilities. For instance, if no event description is specified, there is a message box stating that fact. However the extent of the validation must be determined. Note that this is directly correlated to the specific data required to be specified to compose an event. CARS does not require a time to be specified.

6.1.3.2.   HCRS

The system allows users to save information. It is, however, unclear if HCRS uses data validation before a save operation. Note that the ADOT and NDOR manuals warn users not to save data if no changes were made to the incident. This leads one to believe that the degree of validation specified in the requirements document is not met with HCRS. Also note that mileposts are verified in real time (not before a save). Errant mileposts will be highlighted in red.

6.1.3.3.   IRIS

This system also allows users to save information. IRIS performs real time location verification similar to HCRS. Errant location values are highlighted in red until corrected. Furthermore, the system displays warnings to the user if a save is attempted with these errant values. A save is blocked if errant location values are present.

6.1.3.4.   MDT Existing System

The current system allows users to save information. It is unclear if any data validation is performed. Most fields can be freely typed and are thus prone to error, making data validation particularly important and difficult to accomplish.

6.1.3.5.   Summary

All vendor systems and the current system have save capabilities. The three vendor systems also have some data validation capabilities. HCRS and IRIS perform milepost checks to ensure that a valid location is specified. CARS ensures that event descriptions are specified. More research must be undertaken to understand the extent of the data validation. The current system's reliance on free-form data entry makes data validation difficult.

All systems support data saving operations, but more information must be known to adequately evaluate each product against the validation requirements.

6.1.4.   Data Cancel Options

The system must allow users to cancel the data entry or data modification process. The cancel operation results in a user prompt requiring confirmation. If the user confirms the cancel command, the new/modified values are cleared and the database is not updated. If the user declines the cancel, the process is resumed. This is described in more detail in the requirements document in the Features.DataCancelOptions section.

6.1.4.1.   CARS

CARS allows users to cancel data entry and modification, but it is unclear if a user prompt is supported.

6.1.4.2.   HCRS

HCRS provides the cancel option, but it is unclear if a user prompt is supported.

6.1.4.3.   IRIS

IRIS allows user to cancel data operations, but it is unclear if a user prompt is supported.

6.1.4.4.   MDT Existing System

It is unclear if a user can cancel data operations without exiting the whole system. There is no mention of canceling in the manual. It is understood that exiting the system is the means for canceling.

6.1.4.5.   Summary

All vendors support the cancel operation; however, it is unclear if any vendors support the user prompt. Therefore more information is needed. The current system requires exiting the system as a means for canceling.

All vendors provide data cancel options, but none meet all requirements as is.

6.1.5.   Data Deletion Options

The system must allow data deletion of events or facilities by authorized users. If the user requests a deletion, the user prompt is shown as with cancellation. If the event or facility is deleted, the information is permanently deleted from the database. All deletions are to be   logged.   This   requirement   is   described   in   more   detail   in   the Features.DataDeletionOptions section of the requirements document.

6.1.5.1.   CARS

CARS allows for deletions and provides the user prompt. It is unclear whether logging takes place or whether user privileges dictate deletion functionality.

6.1.5.2.   HCRS

HCRS provides a "terminate" option to users who have ownership over the event. This option removes the event from the map and list. It is assumed that this also removes it

from the database. It is unclear if a user prompt is issued upon deletion request or if this operation is logged.

6.1.5.3.   IRIS

IRIS supports deletions for construction projects and events, but not road conditions (since these are considered continuous). A user prompt is offered and the manual explicitly states that deleted projects cannot be recovered. It is unclear if logging is supported.

6.1.5.4.   MDT Existing System

The extent to which the current system supports deletions is unclear. There is a delete button on the summer system GUI but no mention of it in the user manual.

6.1.5.5.   Summary

All vendors support deletions in some regard. Since both CARS and HCRS treat conditions as events, they can be deleted, unlike IRIS which treats conditions as continuous (similar to the method of handling conditions in the current system). It is known that IRIS and CARS both have user prompts. It is unknown if any system supports logging of deletions.

More information must be known about the products to assess their ability to log and to assess HCRS's ability to provide a user prompt.

6.2.   Event and Facility Data Entry and Modification Requirements

This section evaluates the vendors and the current system based on their ability to meet requirements for allowing users to enter, modify, and delete the specific events and facilities from the requirements document.

6.2.1.   Project Entry

The system must allow entry and storage of construction or maintenance projects, including a description, location, time, and the effects on travel for each project. This is described in more detail in the Features.ProjectEntry section of the requirements document.

6.2.1.1.   CARS

CARS allows users to enter construction/maintenance projects as situations. CARS automatically assigns ID numbers to projects. However, there is no differentiation between construction and maintenance projects. It is unclear if the ID numbers can be tied to construction or maintenance tables. Locations are selected from a map or form, and/or both, satisfying the requirements. Work types are auto-populated according to the preset ITIS phrases. Users can save or cancel project entry.

6.2.1.2.   HCRS

HCRS allows users to enter construction/maintenance projects as events. Project location information can be specified in a form or map. All events automatically receive an ID,

but there is no distinction between construction and maintenance projects so it is unclear if HCRS ID numbers can be tied to MDT database tables. Work types are automatically populated. Users can save or cancel project entry.

6.2.1.3.   IRIS

IRIS allows users to enter a construction/maintenance project (there is a separate form for projects.) Project location information can only be entered with a form. The work types are automatically generated.   IRIS does not distinguish between construction and maintenance projects types. Users can save or cancel the project.

6.2.1.4.   MDT Existing System

MDT distinguishes between construction and maintenance projects. Users can manually choose to generate a list of possible IDs from which to select. Locations are only specified via form. Users can manually generate a list of possible work types from which to choose. Users can save entries, but it is unclear if users can cancel the entry. No lists are automatically populated.

6.2.1.5.   Summary

All systems allow for construction/maintenance project entry; however, no vendors distinguish explicitly between construction and maintenance projects; therefore, it is unclear if IDs for construction and maintenance projects can be directly tied to the correct entities. The current system does make this distinction and IDs are tied to the correct tables. CARS and HCRS allow for location specification via map, form, or both while IRIS only allows for specification via form. All vendors automatically generate lists such as work types. The current system does not automatically generate any lists but users can manually generate the lists by clicking the proper form buttons.

None of the systems meet all requirements for project entry as is and therefore modifications are needed.

6.2.2.   Project Modification

The system must allow authorized users to modify existing projects as specified in the requirements document. All fields are modifiable except project ID. More detail about this requirement is in the Features.ProjectModification section of the requirements document.

6.2.2.1.   CARS

CARS allows users to select and modify existing projects. All fields are modifiable except project ID. Users can save or cancel the modifications. CARS only allows authorized users to modify existing projects.

6.2.2.2.   HCRS

HCRS allows users to select projects for modification. It is unclear which fields are modifiable. Users can save and cancel modifications.

6.2.2.3. IRIS

IRIS allows users to select projects for modification. All fields are modifiable (since it is unclear if an ID is used, it is assumed that project IDs, if they exist, are not modifiable). Users can both save and cancel the modifications.

6.2.2.4. MDT Existing System

The current system allows users to select existing projects for modification. Project IDs can not be modified, but it appears that all project information is modifiable. Users can save the modifications and it is presumed, but not confirmed, that users can cancel the modifications.

6.2.2.5. Summary

All vendors, and the current system, allow modifications to existing projects. CARS and the current system meet the requirements, while it is unclear which fields are modifiable in HCRS and if IDs exist and are modifiable in IRIS.

Without further information, only CARS and the current system can meet requirements as is.

6.2.3. Project Deletion

The system must allow authorized users to delete existing projects as specified in the requirements document. Deleting an existing project permanently removes the project from the database. This is described in more detail in the Features.ProjectDeletion portion of the requirements document.

6.2.3.1. CARS

CARS allows users to delete existing projects and provides a user prompt.

6.2.3.2. HCRS

HCRS provides a "Terminate" button to delete events. It is unclear if a user prompt is provided.

6.2.3.3. IRIS

IRIS allows users to delete projects and provides a user prompt.

6.2.3.4. MDT Existing System

Users can delete projects in the existing system.

6.2.3.5. Summary

All vendors allow users to delete existing projects. IRIS and CARS fully meet requirements while more knowledge is needed to assess HCRS. The current system allows project deletion.

6.2.4.   Road Conditions Entry

The system must allow authorized users to enter road conditions as defined in the requirements. Users can specify location using a map, form, or both. The system will automatically populate a list of weather conditions. There also must be support for quickly entering road conditions for all segments in a section (as is currently done). More detail about this requirement is in the Features.RoadConditionEntry section of the requirements document.

6.2.4.1.   CARS

CARS allows users to enter road conditions. Users can specify locations using a form and choose from a list of available road conditions. It is also possible to enter conditions about multiple segments at the same time. Users can save or cancel entry of conditions.

6.2.4.2.   HCRS

HCRS allows users to enter road conditions as events. Users can specify locations using a form (ADOT or NDOR) or map (ADOT). A list of road conditions is automatically generated. It is unclear if HCRS can be modified to quickly enter multiple segments within a section. Presently, in both NDOR and ADOT, conditions are entered for one location at a time. Users of NDOR HCRS, however, can choose from a drop-down menu of predefined segments for an area. This is close to the functionality required and suggests that modifying HCRS to quickly enter all segments in an area may be feasible. Users can save and cancel entry of conditions.

6.2.4.3.   IRIS

IRIS allows users to specify road conditions with a dedicated form. Users select locations using a map. A variety of locations can be selected, by agency-specific divisions, segments, or highways. Multiple segments can be entered at once assuming they share common conditions. A list of road conditions is automatically generated. Users can save or cancel entry.

6.2.4.4.   MDT Existing System

The current system allows users to specify location using forms only. A list of conditions is not automatically generated until the user requests the list. The ability to enter all segments in a section is supported and serves as the only means of entry. The system can generate all segments in a section (sign route or division) by doing a query for the desired area. The system brings them to the screen for scrolling, but does not provide an immediate list. Users can save conditions only when all segments have been reported and cancel to go to the main menu.

6.2.4.5.   Summary

All systems allow entry of road conditions. The current system, IRIS, and CARS treat these as specific entities, whereas HCRS treats them as a generic event. None of the vendors allow rapid entry of all segments in a section (or the equivalent) in the same way as the current system. IRIS and CARS come the closest to realizing this goal but

multiple locations can be entered only if they all share common road conditions, whereas the current system allows for different conditions of various segments in a section. NDOR HCRS also approaches this goal, because it provides a drop-down menu of all predefined segments in a given area.

While all systems allow users to enter road conditions data, only the current system meets the requirements as is.

6.2.5.   Road Conditions Modification

The system must allow authorized users to modify existing road conditions as per the requirements. All fields must be modifiable except location, which must correspond to the predefined segments. Users must be able to cancel or save modifications. More detail on this requirement is presented in the Features.RoadConditionsModification section of the requirements document.

6.2.5.1.   CARS

CARS allows users to modify existing road conditions like any other situation. All fields, except ID and predefined segments, are modifiable.   Users can save or cancel the conditions.

6.2.5.2.   HCRS

HCRS treats conditions as an instance of a generic event. It is unclear which fields are modifiable in HCRS but it is assumed that all are modifiable. It is assumed that HCRS NDOR predefined segments cannot be modified by the user during road conditions modification. Users can save or cancel the modifications.

6.2.5.3.   IRIS

IRIS allows users to modify existing conditions. Locations can be modified but not freely so. In other words, one set of conditions may apply to several different, non-contiguous segments. Modifying the conditions may involve adding a new segment or removing a segment which no longer shares the same conditions. Users can save or cancel the modifications.

6.2.5.4.   MDT Existing System

The current system fulfills the requirements for modifying road conditions except for the ability to select conditions for modifications using a map.

6.2.5.5.   Summary

All three vendors and the current system allow users to modify conditions and therefore fulfill the requirements.

6.2.6.   Spring Thaw Load and Speed Restrictions Entry

The system must allow users to enter spring thaw load and speed restrictions as described in the Features.SpringThawLoadandSpeedrestrictionsEntry section of the requirements

document. Users must be able to enter location information via a map, form, or both. Furthermore, users must be able to save or cancel the entry.

6.2.6.1.   CARS

It is unclear if CARS supports spring thaw load and speed restrictions. Assuming spring thaw load and speed restriction entry corresponds to that of other events and that CARS can be modified to support these restrictions, CARS would allow users to select locations from the map and/or form interface as well as save and cancel the restrictions. However, it is unknown if this is currently possible or how much CARS would have to be modified to do so.

6.2.6.2.   HCRS

It is unknown if both NDOR and ADOT HCRS can support spring thaw load and speed restrictions as defined. Assuming HCRS could be modified to treat spring thaw restrictions like other events, HCRS would be able to offer map and/or form-based location selection and save or cancel options. However, it is unknown if HCRS could be modified to do so at this time.

6.2.6.3.   IRIS

It is unknown if IRIS supports spring thaw load and speed restrictions as defined.

6.2.6.4.   MDT Existing System

The current MDT system does support spring thaw load and speed restrictions and their subsequent entry. However, location selection is currently only supported via a form. Modifying the current system to allow users to select location via a map interface would allow the current system to meet requirements.

6.2.6.5.   Summary

The current system is the only one that meets requirements as is. The extent of modification to CARS, HCRS, and IRIS to meet requirements is unknown.

6.2.7.   Spring Thaw Load and Speed Restrictions Modification

The system must allow users to modify spring thaw load and speed restrictions by selecting the restrictions, modifying any modifiable fields, and saving or canceling the modifications. This requirement is described in more detail in the Features.SpringThawLoadandSpeedRestrictionsModifications portion of the requirements document.

6.2.7.1.   CARS

It is unclear if CARS can support spring thaw load and speed restrictions and therefore modifications of these restrictions.

6.2.7.2. HCRS

It is unclear if either version of HCRS supports spring thaw load and speed restrictions and therefore modifications of these restrictions.

6.2.7.3. IRIS

It is unclear if IRIS can support spring thaw load and speed restrictions and therefore modifications of these restrictions.

6.2.7.4. MDT Existing System

The current MDT system does allow users to select, modify, save and cancel spring thaw load and speed modifications, thereby meeting the requirements.

6.2.7.5. Summary

The current system is the only one to meet requirements.

6.2.8. Spring Thaw Load and Speed Restrictions Deletion

The system must allow users to delete spring thaw load and speed restrictions. Deleted spring thaw items are permanently removed from the database. This requirement is described in more detail in the Features.SpringThawLoadandSpeedRestrictionsDeletion portion of the requirements document.

6.2.8.1. CARS

It is unclear if CARS can support spring thaw load and speed restrictions and therefore deletion of these restrictions.

6.2.8.2. HCRS

It is unclear if either version of HCRS can support spring thaw load and speed restrictions and therefore deletion of these restrictions.

6.2.8.3. IRIS

It is unclear if IRIS can support spring thaw load and speed restrictions and therefore deletion of these restrictions.

6.2.8.4. MDT Existing System

The current MDT system allows for spring thaw load and speed restriction deletion.

6.2.8.5. Summary

It is unknown if any of the products other than the current system support spring thaw load and speed restriction deletion. The current system supports spring thaw load and speed restriction deletion.

6.2.9.   Incident Entry

The system must allow users to enter incidents as defined in the requirements document. Users must be able to specify location using forms and/or maps and be able to save or cancel the entry. The system must provide each incident a unique ID automatically. The Features.IncidentEntry section of the requirements document describes this requirement in more detail.

6.2.9.1.   CARS

CARS meets the requirements, because users can select incident location using a map, form, or both. A unique ID is automatically assigned to each incident. Users can save or cancel the entry.

6.2.9.2.   HCRS

HCRS allows users to enter incidents, meeting the requirements for unique ID and the ability to save or cancel. Locations may be specified via a map (ADOT HCRS Quick Entry) and/or form (both versions).

6.2.9.3.   IRIS

IRIS meets the requirements, as users can select incident locations via a form. Users can save or cancel the entry. It is unknown if there is an ID associated with the incidents.

6.2.9.4.   MDT Existing System

The current system allows users to enter incidents. Location can only be specified via a form. The system generates a unique ID for each incident. Users can save and presumably cancel incident entry.

6.2.9.5.   Summary

All systems allow users to enter incidents and therefore meet requirements, other than not knowing whether IRIS assigns an ID to incidents.

6.2.10.   Incident Modification

The system must allow users to modify existing incidents per the requirements. The user must be able to select the incident, modify any modifiable fields, and save or cancel the modifications. All fields are modifiable except the ID. This requirement is described in more detail in the Features.IncidentModification section of the requirements document.

6.2.10.1.   CARS

CARS meets the requirements for incident modification. Users can select the incident via a map or a list. All fields are modifiable except ID. Users can cancel or save the modifications.

6.2.10.2.   HCRS

HCRS allows users to modify existing incidents and for selection of that incident via map or list. Users can save or cancel the modifications. However, it is unclear which fields are modifiable.

6.2.10.3.   IRIS

Modifications can be made by clicking on colored road segments. Users can save or cancel modifications. All fields are modifiable, although it is unknown if there is an associated ID.

6.2.10.4.   MDT Existing System

It is assumed that users can select and modify existing incidents, although it is not explicitly stated in the documentation. It is unclear which fields are modifiable.

6.2.10.5.   Summary

All systems meet the requirements, other than not knowing if IRIS assigns an ID.

6.2.11.   Incident Deletion

The system must allow users to delete existing incidents, permanently removing them from the database. When deleting, there must be a user prompt verifying that the user wants to delete the incident. This is described in more detail in the Features.IncidentDeletion section of the requirements document.

6.2.11.1.   CARS

CARS allows users to delete existing incidents and a user prompt is provided; thus CARS meets requirements for incident deletion.

6.2.11.2.   HCRS

The "Terminate" button of HCRS allows users to delete existing incidents. It is unclear if a user prompt is provided.

6.2.11.3.   IRIS

IRIS has a delete button to delete existing incidents and a user prompt is provided.

6.2.11.4.   MDT Existing System

It is unclear if the current system allows users to delete existing incidents or if a prompt is provided.

6.2.11.5.   Summary

CARS and IRIS meet the requirements for incident deletion. It is unclear if HCRS has a user prompt and unclear if the current system allows for deletions.

6.2.12.   Special Event Entry

The system must allow users to enter special event information as described in the Features.SpecialEventEntry section of the requirements document. Users must be able to enter location information via a map, form, or both. Users must also be able to save or cancel the entry.

6.2.12.1.   CARS

CARS allows users to enter special event information. Users can specify location using the map and/or form and can save or cancel the entry. CARS meets requirements as is.

6.2.12.2.   HCRS

HCRS has limited support for special events (particularly in NDOR). Other than this, HCRS allows users to save and cancel special event entry and select location via map and/or form since the special event is treated as a generic event. Adding more ITIS phrases concerning special events would allow HCRS to meet requirements.

6.2.12.3.   IRIS

IRIS supports special events in its event module. Users can specify location via a form and can save or cancel the entry.

6.2.12.4.   MDT Existing System

The current system allows users to specify special events as incidents, but descriptions are freely typed. Users can only select location via a form and cannot specify an information source.

6.2.12.5.   Summary

CARS and IRIS meet requirements for special event entry. HCRS could benefit from adding more ITIS special event phrases, helping that product to fully meet requirements. The current system does not currently meet requirements.

6.2.13.   Special Event Modification

The system must allow users to modify existing special events by selecting events, modifying any modifiable fields, and saving or canceling the modifications. This is described in further detail in the Features.SpecialEventModification section of the requirements document.

6.2.13.1.   CARS

CARS allows users to select existing special events, modify everything except for the ID, and save or cancel the modifications; therefore, CARS meets the requirements.

6.2.13.2. HCRS

Although HCRS provides only limited support for describing special events, they are treated as a generic event and can therefore be selected, modified, saved, and canceled. It is unclear which fields are modifiable, however.

6.2.13.3. IRIS

IRIS allows users to select existing special events via the map and modify fields. It is unknown if there is an ID associated with special events.

6.2.13.4. MDT Existing System

It is unclear if the system allows users to modify existing special events, although it is assumed that users can do so. It is also unclear which fields are modifiable.

6.2.13.5. Summary

CARS meets requirements as is. HCRS, IRIS, and the current system (assuming users of the current system can modify existing special events) come close, but it is unclear which fields are modifiable or if an ID exists.

6.2.14. Special Event Deletion

The system must allow users to delete existing special events. Deleted events are permanently removed from the database. There must be a user prompt to verify deletion. The Features.SpecialEventDeletion section of the requirements document describes this requirement in more detail.

6.2.14.1. CARS

CARS meets requirements.

6.2.14.2. HCRS

HCRS meets requirements except it is unknown if a user prompt is provided.

6.2.14.3. IRIS

IRIS meets requirements.

6.2.14.4. MDT Existing System

The current system allows users to delete special events.

6.2.14.5. Summary

CARS and IRIS fully meet requirements for special event deletion. It is unknown if HCRS can provide a user prompt. It is unclear if the current system can allow special event deletion.

6.2.15.   Rest Area Entry, Modification, and Deletion

The system must allow authorized users to enter, delete, and modify rest areas per the requirements in the Features.RestAreaEntry, Features.RestAreaModification, and Features.RestAreaDeletion sections of the requirements document.

6.2.15.1.   CARS

It is unclear if CARS supports rest areas, so an evaluation of its rest area entry, modification, and deletion functionality is not provided.

6.2.15.2.   HCRS

It is unclear if HCRS supports rest areas, so an evaluation of its rest area entry, modification, and deletion functionality is not provided.

6.2.15.3.   IRIS

It is unclear if IRIS supports rest areas, so an evaluation of its rest area entry, modification, and deletion functionality is not provided.

6.2.15.4.   MDT Existing System

The current system does support rest areas, but the entry or deletion of rest areas is not yet supported. Users can only modify existing rest areas by specifying them as open or closed.

6.2.15.5.   Summary

The current system is the only one that definitely supports rest areas, but the support for operations on rest areas is limited to modifying existing rest areas from open to closed or vice versa. It is unclear if any of the vendors support rest areas. Therefore more information is needed.

6.2.16.   Border Crossing Entry, Modification, and Deletion

The current system must allow users to enter, modify, and delete border crossings per the requirements in the Features.BorderCrossingEntry, Features.BorderCrossingModification, and Features.BorderCrossingDeletion sections of the requirements document.

6.2.16.1.   CARS

It is unclear if CARS supports border crossings, so an evaluation of its entry, modification, and deletion functionalities is not provided.

6.2.16.2.   HCRS

It is unclear if HCRS supports border crossings, so an evaluation of its entry, modification, and deletion functionalities is not provided.

6.2.16.3.   IRIS

It is unclear if IRIS supports border crossings, so an evaluation of its entry, modification, and deletion functionalities is not provided.

6.2.16.4.   MDT Existing System

The current system does not support border crossing data. Therefore, the database would have to be capable of storing border crossings and interfaces for entering new stations, or modifying/deleting existing border crossings must be developed to meet requirements.

6.2.16.5.   Summary

It is unclear if any vendors support border crossings and the associated operations. The current system does not support border crossings.

6.2.17.   Weigh Station Entry, Modification, and Deletion

The system must allow authorized users to enter, modify, and delete weigh stations per the requirements in the Features.WeighStationEntry, Features.WeighStationModification, and Features.WeighStationDeletion sections of the requirements document.

6.2.17.1.   CARS

It is unclear if CARS supports weigh stations, so an evaluation of its entry, modification, and deletion functionalities is not provided.

6.2.17.2.   HCRS

It is unclear if HCRS supports weigh stations, so an evaluation of its entry, modification, and deletion functionalities is not provided.

6.2.17.3.   IRIS

It is unclear if IRIS supports weigh stations, so an evaluation of its entry, modification, and deletion functionalities is not provided.

6.2.17.4.   MDT Existing System

The current system does not support weigh station data. Therefore, the database would have to be capable of storing weigh stations and interfaces for entering new stations, or modifying/deleting existing stations must be developed to meet requirements.

6.2.17.5.   Summary

It is unclear if any vendors support weigh stations and the associated operations. The current system does not support weigh stations.

6.2.18.   Alert Entry, Modification, and Deletion

The system must support the entry, modification, and deletion of alerts into the database per the requirements in sections Features.AlertEntry, Features.AlertModification, and Features.AlertDeletion of the requirements document.

6.2.18.1.   CARS

It is unclear without further investigation if CARS can support alerts as defined. Development of an AMBER alert software module is currently underway but details of the module are unknown. Therefore, an assessment of CARS' ability to allow alert entry, modification, and deletion is not provided.

6.2.18.2.   HCRS

It is unclear if NDOR HCRS can support alerts of any type, so an evaluation of NDOR HCRS regarding alert entry, modification, and deletion is not provided. ADOT HCRS supports user specified floodgate messages. However, ADOT HCRS does not provide choices concerning the type of message, whether or not the message can be interrupted, the manner in which the message is presented to the phone user, or the expiration date of the message. Additionally, it appears that the messages are read-only and cannot be modified. The messages can, however, be deleted. Therefore, modifications of ADOT HCRS are necessary to meet alert entry, modification, and deletion requirements.

6.2.18.3.   IRIS

It is unclear without further investigation if IRIS can support alerts as defined in the requirements document. Therefore, an assessment of IRIS' ability to allow alert entry, modification, and deletion is not provided.

6.2.18.4.   MDT Existing System

The current MDT system does not provide support for alerts and their subsequent entry, modification, and deletion. New functionality must be added to the system to meet requirements.

6.2.18.5.   Summary

ADOT HCRS is the only vendor that supports alerts. However, ADOT HCRS would have to be modified to meet entry, modification, and deletion requirements. None of the other vendor systems, including NDOR HCRS, or the current system appear to support alerts. Therefore, major modifications to these systems would be necessary to meet requirements.

6.3.   Report Generation

This section evaluates the vendors and the current system based on their ability to meet requirements for generating reports.

6.3.1.   Report Generation

The system must support the automatic and on-demand generation of specific reports per the requirements in section Features.ReportGeneration of the requirements document.

6.3.1.1.   CARS

It is unclear if CARS supports reports in any way. Therefore, an evaluation of its report generation functionality is not provided.

6.3.1.2.   HCRS

The ADOT version of HCRS supports report generation through the incident management functionality. It appears that the report is dynamically created upon data entry. However it is unclear if users can save, edit, or archive reports. Each report is labeled with the identification of the particular event for which the report is valid. In fact, each report appears to only respond to a single event and the aggregation of events on a report may or may not be supported.

6.3.1.3.   IRIS

It is unclear if IRIS supports reports and consequently report generation. Therefore, an evaluation of its report generation functionalities is not provided.

6.3.1.4.   MDT Existing System

The current system automatically generates some reports, while others are generated on demand. Some reports are editable (the area reports) while others are not. All automatically generated reports can also be generated manually. All reports are automatically archived at set intervals (currently about every 30 minutes). To bring the current system up to speed, the ability to automatically generate all reports is needed. Also the system would have to allow users to edit and save all report modifications.

6.3.1.5.   Summary

Of the three vendors, only HCRS appears to support reports in any fashion. However, the manner in which reports are treated appears to be much different than what is specified by the requirements. The current system is close to meeting requirements, but it needs some added consistency concerning automatic generation and edibility of all reports.

6.3.2.   Individual Reports

This section is organized differently than the previous sections in relation to the requirements document. This section will evaluate products based on their ability to meet requirements of each individual report. Normally each system is assigned its own section for each of the report types but since it is unclear if any of the vendors can meet requirements of report generation, only the current system is evaluated below. This evaluation method drastically reduces redundancy. Each report name appears as a heading. The corresponding paragraph for each report serves as an evaluation of the "MDT Existing System."

6.3.2.1.   Construction Report

The requirements for this report are listed in the Features.ReportGeneration.ConstructionReport. The structure of the current construction report must be altered to meet requirements. The current report is organized first by region ("Western", "Southwestern/Central", etc) and then alphanumerically by the sign route name's most significant digit (MT-41 appears before MT-219). The report must be arranged to be first organized by project status ("Completed", "In Progress", and "No Work in Progress"). Each status heading must then be sorted by sign route name in

alphanumeric order. Furthermore, each route name heading must then have a list corresponding to all projects pertaining to that route heading. The list is in geographic order. All of the information that is needed to organize the entries is known although it may prove difficult to order the list geographically and may involve heavy use of TIS. However, this may be as simple as organizing projects on a given route by starting milepost. At this point, it is unclear. A time associated with generation must also be added.

6.3.2.2. Statewide Road Conditions

The requirements for this report are listed in the Features.ReportGeneration.StatewideRoadConditionsReport. The current system supports a statewide road conditions report that meets requirements. It appears that the conditions are geographically ordered by segment under sign route headings. The only possible enhancement to meet requirements is to alphanumerically order the sign route headings.

6.3.2.3. Area Road Condition Report

The requirements for this report are listed in the Features.ReportGeneration.AreaRoadConditionsReport. The current system supports an area road condition report as specified in the requirements. The only enhancement may be to have the actual time of report generation appear on the report. Support for local roads causes problems with completely automated generation.

6.3.2.4. Pass Report

The requirements for this report are listed in the Features.ReportGeneration.PassReport. The current system does not support a pass report so an evaluation of the current system in this regard is not provided.

6.3.2.5. AP Road Condition Report

The requirements for this report are listed in the Features.ReportGeneration.APRoadConditionReport. The current system supports a report, the statewide concise road conditions report, which is similar to the AP report in the requirements. However, the concise report does not meet continuity requirements as specified. Contiguous segments with the same conditions must be combined to meet requirements. Also, a section for closed road segments must be added.

6.3.2.6. Road Closure / Emergency Travel Only Report

The requirements for this report are listed in the Features.ReportGeneration.RoadClosureETOReport. The current system supports a road closure/ETO report. To meet requirements, the time of report generation must be added along with the already provided report date. Otherwise requirements are met.

6.3.2.7. Spring Thaw Load and Speed Restrictions Report

The requirements for this report are listed in the Features.ReportGeneration.SpringThawLoadandSpeedRestrictionsReport. The current

system supports a spring thaw load and speed limit restrictions report that meets requirements.

6.3.2.8. Incident Report

The requirements for this report are listed in the Features.ReportGeneration.IncidentReport. The current system supports a combined ETO/Closures/Incident report. The incident portion of the report appears to meet requirements as is. Therefore the incident portion of this report would just need to be separated.

6.3.2.9. Rest Area Report

The requirements for this report are listed in the Features.ReportGeneration.RestAreaReport. The current system only maintains a static list of rest areas on its website, which does not meet requirements. In order to meet requirements, there must be route headings with entries of rest areas on each route. Each entry would need information about its amenities and status, which currently they do not.

6.3.2.10. Border Crossing Report

The requirements for this report are listed in the Features.ReportGeneration.BorderCrossingReport. The current system does not provide a border crossing report and hence cannot be evaluated.

6.3.2.11. Weigh Station Report

The requirements for this report are listed in the Features.ReportGeneration.WeighStationReport. The current system does not provide a weight station report and hence cannot be evaluated.

6.3.2.12. Summary

The current system needs to be modified to meet requirements for providing most of the above reports. Many existing report structures need to be modified to meet requirements while some reports do not currently exist. In the case where the reports do not exist, the system would need to be modified to support these reports. Note that the other systems do not support any of the above reports and would need to be modified to support all of them.

6.3.3. Report Generation Distribution

The system shall automatically or manually disseminate reports to other agencies, as designated in the Features.ReportGeneration.Distribution section of the requirements document.

6.3.3.1. CARS

As it is unclear whether or not this system can produce reports, report distribution cannot be evaluated.

6.3.3.2. HCRS

As it is unclear whether or not this system can produce reports, report distribution cannot be evaluated.

6.3.3.3. IRIS

As it is unclear whether or not this system can produce reports, report distribution cannot be evaluated.

6.3.3.4. MDT Existing System

The current system can distribute reports manually.

6.3.3.5. Summary

It is unclear if any of the vendor systems can distribute reports, because it is unclear if they can even create reports. The current system does meet requirements.

6.4. Public Interface

The system shall facilitate a public interface to traveler information. This interface will consist of sub-interfaces focusing on interactive maps and reports.

6.4.1. Public Interface

This requirement is described in more detail in the Features.PublicInterface portion of the requirements document. The system must have a public interface for traveler information such as maps and reports as specified in the requirements. The system will display an interactive map interface and allow users to select the types of information they want to see. The selected information must then be displayed to the user. Similarly, users must be able to select which of the reports they are interested in reading. This includes which of the area reports they are interested in. Upon selection, the report(s) will then display.

6.4.1.1. CARS

CARS provides a map interface and text-based listing of events. However, it is unclear if there is any support for reports as defined in the requirements, so there appears to be no support for a report interface.

6.4.1.2. HCRS

HCRS facilitates a public interface via a map interface and text-based listing of events. However, it is unclear if there is any support for reports as defined in the requirements, so there appears to be no support for a report interface.

6.4.1.3. IRIS

IRIS provides an interactive map interface publicly available online. There is also a text report provided on the SDDOT website that shows winter driving conditions. However, it is unclear if there is any support for reports as defined in the requirements, so there appears to be no support for a report interface.

6.4.1.4. MDT Existing System

The current system satisfies requirements as is by providing a map interface and reports online.

6.4.1.5. Summary

It appears that all three vendor systems and the current system provide a public map and some form of text interface. However, the vendors do not provide the reports to the public as they do not have the report functionality.

6.4.2. Public Interactive Map Interface

The system must provide a public web-based interactive map interface. Users can choose the data they would like to see on the map, and navigate to different regions and zoom levels of the map. Also users can select events or facilities on the map for more information. A more detailed description of this requirement is in the Features.PublicInterface.MapInterface section of the requirements document.

6.4.2.1. CARS

CARS provides a public interactive map. Users can choose different types of events to display on the map and navigate with zooming and panning. There are also options to show specified regions. Users can choose and will receive more information about a specific situation / event.

6.4.2.2. HCRS

It is unknown if HCRS provides a map interface. Both NDOR and ADOT have a map, but it is unclear if it is part of HCRS.

6.4.2.3. IRIS

IRIS partially satisfies the map interface requirements. An interactive map showing winter driving conditions and construction projects is provided. Users can select regions to focus the map from the default state view. Also users can select segments on the map for further information concerning events. However, zoom, pan, and re-centering functionality is not clearly supported. Users do not seem to be able to choose the types of events to view on the map.

6.4.2.4. MDT Existing System

The current MDT system provides a public map interface that has limited interaction potential. Users can select a region of Montana or the entire state to view. Many map navigation enhancements are needed to meet requirements concerning panning, zooming, and re-centering. Also, the current map is only for road conditions and therefore would need to be modified to include other events and facilities. Also, there is currently no way to gain more information on the road conditions via the map, the only thing available is color coding for a section of roadway.

6.4.2.5.   Summary

The CARS system fully meets requirements, while IRIS and the existing system need modifications. It is unclear if HCRS has map ability.

6.4.3.   Reports Interface

The system must support a web-based public report interface as defined in the requirements. Users must be able to specify which of the reports they are interested in, including the eleven area reports. This requirement is described in more detail in the Features.PublicInterface.ReportsInterface portion of the requirements document.

6.4.3.1.   CARS

It is unclear if CARS supports reports as defined. However, CARS does support a method of viewing the traveler information that does not involve the map and is text-based and publicly accessible via a web page. Although this is clearly not a report, the text-based interface contains lists of event entries, which can loosely be interpreted as a report (though lacking in detail required by MDT). The text-based lists are not selectable based on the type of event or facility. However, the list can be tailored to a particular region and is color-coded by event characteristics such as if the event is a closure or an alert.

6.4.3.2.   HCRS

Like CARS, it is unclear the degree to which HCRS supports reports as defined in the requirements. However, HCRS also provides a text-based alternative to viewing the traveler information via a web page. The information appears as a list of events organized by sign route. Users in both the Nebraska and the Arizona systems can choose a region to filter events but cannot choose the type of events to appear on the list.

6.4.3.3.   IRIS

It is unclear if IRIS supports reports as defined. However, SDDOT provides a text-based method of viewing traveler information. Users can choose a region to view winter conditions, for instance. The user is then shown a brief report with conditions for that region.

6.4.3.4.   MDT Existing System

The current system currently provides a public report interface that meets requirements.

6.4.3.5.   Summary

It is unclear if any of the vendors support reports, let alone a report interface, as defined. However, many of them clearly provide a text-based alternative to publicly viewing traveler information via a map alone. The existing system is the only one to meet requirements.

More information is needed about the ability of each vendor to provide a public report interface.

6.5.   Private Interface

The system shall facilitate access to maps and reports via a private interface intended for MDT staff.

6.5.1.   Private Interface

The system must provide a private interface to traveler information consisting of a map, reports, and an interface for allowing authorized users to enter, delete, and modify system data. This is described in more detail in Features.PrivateInterface.MapInterface.

6.5.1.1.   CARS

CARS provides a private interface including maps and a private listing. It is unclear if CARS supports reports as defined but an interface to a text list of events is provided.

6.5.1.2.   HCRS

Both versions of HCRS provide a private interface to maps and to private listings for data entry and modification. The ADOT version of HCRS provides an interface to reports as well, thus it fully meets this requirement. The NDOR version of HCRS does not clearly support these reports and, thus, does not provide the private interface.

6.5.1.3.   IRIS

IRIS supports a private interface to maps and a listing for data modification and entry. It is unclear if IRIS supports reports as defined or a text-based listing of events and facilities in the system. It appears IRIS would have to be modified significantly to meet these requirements.

6.5.1.4.   MDT Existing System

The current system satisfies these requirements, as there are forms that can be used: therefore no modification is necessary.

6.5.1.5.   Summary

The current system and the ADOT version of HCRS satisfy the requirements completely. CARS, NDOR HCRS, and IRIS require modifications.

6.5.2.   Map Interface

The system must provide authorized users with a private map interface to events and facilities. The users must be able to select the information and boundaries of the map in a similar way to the public map interface in Section 6.4.2. However, the private map interface must also contain private data and the ability to select existing events and facilities for editing via the map. The system shall facilitate access to maps and reports via a private interface intended for MDT staff. Additional detail is provided in the Features.PrivateInterface.MapInterface portion of the requirements document.

6.5.2.1.   CARS

CARS meets requirements for private map interface except perhaps for allowing users to select the types of information available on the map. It appears that users are, instead, shown all events currently in the system.

6.5.2.2.   HCRS

Both versions of HCRS meet requirements as is with no further modification.

6.5.2.3.   IRIS

It is unclear if IRIS allows users to select the types of information displayed on the map or allows the users to navigate the map with zoom and pan functions. IRIS does allow users to select existing events to modify via the map. However, it appears that IRIS would have to be modified to meet requirements.

6.5.2.4.   MDT Existing System

The current system does not provide a private map interface and does not meet requirements in any way. Therefore the functionality would have to be developed entirely and integrated into the existing system.

6.5.2.5.   Summary

HCRS completely meets requirements. CARS and IRIS appear to need some modifications involving the map navigation in order to meet requirements. The current system does not meet requirements.

6.5.3.   Event, Facility, and Alert Listings

The system must provide a private interface as an events, facilities, and alerts listings. Users can view a summary of each item on the list, request more information, and sort the list using various criteria. Users must be able to select the list items for modification or deletion where applicable. This requirement is described in more detail in the Features.PrivateInterface.EventFacilityAndAlertListings section of the requirements document.

6.5.3.1.   CARS

CARS meets requirements regarding the private listing with the possible exception of searching and report type. The degree of modification for meeting these requirements is unclear.

6.5.3.2.   HCRS

Both versions of HCRS provide an event list. This list partly meets requirements. However, the items on the list do not cover the level of detail required, even though the type of event is indicated by an icon. There appears to be no way of searching for a particular item in the list or sorting the list, thus HCRS will likely need to be modified to meet requirements. The degree of modification needed is unknown.

6.5.3.3.   **IRIS**

IRIS does not appear to provide an event listing in any way. It is unclear if the functionality exists.

6.5.3.4.   **MDT Existing System**

The existing system would require modifications to completely meet requirements.

6.5.3.5.   **Summary**

CARS and HCRS both provide event listings but both fail to meet requirements as is. The existing system needs modifications and IRIS appears to have none of the functionality required.

Allowing the system to have an event listing without searching or report types would allow CARS to meet requirements as is. Further relaxing the requirements to allow a listing without sorting and specifying which information must appear in each list item would allow HCRS to comply as is.

6.5.4.   Archived Data Interface

The system shall allow an authorized user to access archived event and facility data. This requirement   is   described   in   more   detail   in   the Features.PrivateInterface.ArchivedDataInterface section of the requirements document.

6.5.4.1.   **CARS**

It is unclear if CARS has an archival process, let alone an interface for archived data retrieval.

6.5.4.2.   **HCRS**

It is unclear if HCRS has an archival process, let alone an interface for archived data retrieval.

6.5.4.3.   **IRIS**

It is unclear if IRIS has an archival process, let alone an interface for archived data retrieval.

6.5.4.4.   **MDT Existing System**

The current system has an archival process, and computer programmers can retrieve this information, but modifications would need to be made to make this interface easier for the everyday user.

6.5.4.5.   **Summary**

It is unclear if any of the vendor systems have an archived data interface. The existing system does; however, modifications would be needed for ease of use.

6.6.   Notification

The system shall facilitate notification of entities when certain events are entered within the system. Ideally such notification will be electronic, with email as a possible means. More information can be found at Features.Notification in the requirements document.

6.6.1.   Database Update

The system must facilitate notifications due to event and facility updates in the database (i.e. when events or facilities are entered, modified, or deleted.) Also the system shall provide notifications indicating that all segments are reported. This requirement is defined in more detail in Features.Notification.DatabaseUpdate.

6.6.1.1.   CARS

CARS appears to support notifications via email to addresses in a notification list for each user. Emails are sent when the user creates a situation or when the situation expires. It is unclear if any other modes of notification or if notifications in response to situation modifications are supported. Also unknown is the content of the email.

6.6.1.2.   HCRS

ADOT HCRS supports notifications through the Incident Management module; however, it is unclear if any other modes of notification or if notifications in response to situation modifications are supported. Also unknown is the content of the email.

It is known that the ADOT version of HCRS displays an event window to users one minute before an event entered by them expires. This does not fit the description of notifications as defined in the requirements, but it is possible that a similar mechanism can be used to satisfy requirements (although this cannot be confirmed).

6.6.1.3.   IRIS

It is unknown if IRIS provides any notifications. Therefore, an evaluation of its database update notification functionality is not provided.

6.6.1.4.   MDT Existing System

The current system only facilitates one area of notification. A notification is provided when all divisions have reported their winter road conditions. Although other forms of notification are mentioned, they are all accomplished via a manual email and are therefore not considered part of the system. To meet requirements, these notifications would have to occur automatically.

6.6.1.5.   Summary

CARS, HCRS, and the existing system require modifications, while it is unclear if IRIS can support notifications at all.

6.6.2.   Events

The system must facilitate automatic notifications to the members of a notification list in response to certain incidents being entered into the system. This is described in more detail in the Features.Notification.Event in the requirement document.

6.6.2.1.   CARS

CARS appears to support notifications as discussed previously. However it is unknown if CARS allows the terms of the notification to be defined by users.

6.6.2.2.   HCRS

HCRS appears to support notifications; however, it is unknown if HCRS allows the terms of the notification to be defined by users.

6.6.2.3.   IRIS

It is unknown if IRIS supports notifications or, if IRIS allows the terms of the notification to be defined by users.

6.6.2.4.   MDT Existing System

All incident modifications are accomplished manually and involve users looking up members of the list in an office book. Therefore, the current system does not meet requirements and must be modified to do so.

6.6.2.5.   Summary

While CARS and HCRS support notifications, modifications are needed to meet the requirements. It is unclear if IRIS supports notifications, while it is known that the existing system does not.

6.7.   User Administration

The system shall facilitate the administration of system users.   User administration includes adding new users, editing existing users, and deleting user accounts.   More information can be found at Features.UserAdministration in the requirements document.

6.7.1.   User Entry

The system must facilitate entry of new user accounts with all components of a user as defined in the Features.UserAdministration.UserEntry portion of the requirements document.

6.7.1.1.   CARS

It is unknown if CARS supports new user entry. It is assumed that CARS does facilitate this capability since user accounts are supported. However, no information concerning the details of entry is known.

6.7.1.2.   HCRS

It is unknown if HCRS supports new user entry. It is assumed that HCRS does facilitate this capability since user accounts are supported. However, no information concerning the details of entry is known.

6.7.1.3.   IRIS

It is unknown if IRIS supports new user entry. It is assumed that IRIS does facilitate this capability since user accounts are supported. However, no information concerning the details of entry is known.

6.7.1.4.   MDT Existing System

The current system appears to support new user entry since "NEW MDT USER ENTRY" is one of the main menu items.. Assuming that this feature works correctly, the current system meets requirements. However, no details of the entry are known, nor is this entry used.

6.7.1.5.   Summary

It is unknown if any of the vendor systems support new user entry. However, since all systems support users, it is assumed that user entry is supported. This cannot be confirmed without further information since there are potentially other ways to enter new users into the system. Therefore, more information must be known to effectively assess the vendor systems. The existing system meets requirements.

6.7.2.   User Modification

The system must support modifying existing user accounts as defined in the Features.UserAdministration.UserModification section of the requirements document. Users should be able to modify all information in a user account.

6.7.2.1.   CARS

It appears CARS allows users to modify their own user account information. It does not appear that all attributes of the account are modifiable. It is unknown if CARS can be configured to allow all user account fields to be modifiable. CARS does, however, meet the basic requirements of user modification.

6.7.2.2.   HCRS

It is unknown if HCRS allows user modification and therefore an assessment cannot be effectively done without further information.

6.7.2.3.   IRIS

It is unclear if IRIS allows user modification and therefore an assessment cannot be effectively done without further information.

6.7.2.4.   MDT Existing System

It is unknown if the current system allows user account modification and therefore the extent of modifications needed to meet requirements is unknown.

6.7.2.5.   Summary

It is unknown if any system but CARS can support user account modification.

6.7.3.   User Deletion

The system must facilitate the deletion of existing user accounts. More information can be found at Features.UserAdministration.UserDeletion.

6.7.3.1.   CARS

It is unknown if CARS supports user account deletion. Therefore, an evaluation is not provided.

6.7.3.2.   HCRS

It is unknown if HCRS supports user account deletion. Therefore, an evaluation is not provided.

6.7.3.3.   IRIS

It is unknown if IRIS supports user account deletion. Therefore, an evaluation is not provided.

6.7.3.4.   MDT Existing System

User profiles are maintained by MDT programmers, so this functionality does not appear to be directly available to primary users of the system.

6.7.3.5.   Summary

It is unknown if any of the products, including the current system, support user account deletion. More information is needed to effectively assess each system. Note that the existing system requires intervention by programmers to accomplish this and does not directly support the feature.

6.8.   Data Management

The system must allow users to manage lists such as data lists (work types, conditions, etc), RWIS/DMS/Camera field elements, and contact lists. Users must be able to add new items, delete existing items, and modify existing items on the lists.

6.8.1.   List Item Add, Modification, and Deletion

The system shall allow an authorized user to add, modify, and delete items on a list. The system shall immediately reflect the changes to the list throughout all system interfaces. This is described in more detail in the Features.DataManagement.ListItemAdd,

Features.DataManagement.ListItemModification,   and
Features.DataManagement.ListItemDeletion portions of the requirements document.

6.8.1.1.   CARS

It is unknown if CARS allows management of data or field element lists. However, CARS does allow management of contact email lists. It is unknown how exhaustive this contact list is, however. For instance, there may be other items on the list that the user can not manage.

6.8.1.2.   HCRS

It is unknown if HCRS can support management of any lists as required. Therefore, an evaluation is not provided.

6.8.1.3.   IRIS

It is unknown if IRIS can support any list management functions as required. Therefore, an evaluation is not provided.

6.8.1.4.   MDT Existing System

The current system does not provide list management and must be modified to do so.

6.8.1.5.   Summary

It is unknown if any of the systems, except for CARS' contact list management, support list management. More information is needed to make an effective evaluation. The existing system does not meet requirements.

6.8.2.   Segment Change

The system shall allow users to change road segments by adding new segments, editing mileposts of existing segments, or deleting existing segments.

6.8.2.1.   CARS

CARS supports predefined segments, but it is unclear if it allows users to change the segment parameters.

6.8.2.2.   HCRS

NDOR HCRS supports predefined segments, but it is unclear if it allows users to change the segment parameters. It is unclear if ADOT HCRS supports predefined segments so an evaluation of its ability to allow users to change segment parameters is not provided. More information is needed to determine if either version of HCRS must be modified to meet requirements.

6.8.2.3.   IRIS

IRIS does support predefined segments but it unclear if it allows users to change the segment parameters. More information is needed to determine if IRIS must be modified to meet requirements.

6.8.2.4.   MDT Existing System

The current system supports predefined MDT segments.   These can be modified, although that is considered an administrative function.

6.8.2.5.   Summary

More information is needed to determine if the vendor systems allow users to change segment parameters. Documentation suggests that none of these systems currently allow users to change segment parameters; therefore all of them would have to be modified to do so.   The current system does allow for the modification of segments as an administrative function.

7. OTHER REQUIREMENTS

This chapter evaluates the ability of vendor systems and the MDT existing system to meet the following requirements: hosting capabilities, external interfaces, user interfaces, hardware interfaces, software interfaces, communication interfaces, performance, usability, legal, and apportioned requirements.

7.1. Hosting Requirements

The system must either be hosted by MDT or externally hosted by a vendor. In addition, MDT must own all data and be able to archive the data on the MDT network, regardless of hosting. More information about this requirement can be found at Other.HostingRequirements.

7.1.1. CARS

CARS has a variety of hosting options and can be either internally or externally hosted. Ownership of the data for a system hosted by CARS, as well as archival processes, is unknown.

7.1.2. HCRS

HCRS is hosted by the states and therefore the data is owned by the state. Information about the archival process is unknown.

7.1.3. IRIS

IRIS appears to be hosted by the state of South Dakota. It is unknown if other hosting options are available. Ownership of the data and the archival processes are unknown.

7.1.4. MDT Existing System

The current system is hosted by the state of Montana. The data is owned and archived by MDT.

7.1.5. Summary

All vendor systems fit one or both of the hosting options. It is unknown, though, who owns the data and if data archival is possible. The existing system meets requirements.

7.2. External Interface Requirements

The system must be able to exchange data with external systems. The exchange is both automatic and manual with the system both sending and receiving data from external systems and vice versa. More information can be found at Other.HostingRequirements.ExternalInterfaceRequirements in the requirements document.

7.2.1.   CARS

CARS can interact with external systems but the specific details of the interaction are unknown. It is known that adjacent CARS state systems are capable of allowing public users in one state to access information about the other states. However, it appears that this functionality is only available if neighboring states employ CARS. More information must be gathered for a full evaluation.

7.2.2.   HCRS

HCRS can interact with external systems but the specific details of the interaction are unknown. More information is needed.

7.2.3.   IRIS

IRIS can interact with external systems but the specific details of the interaction are unknown. More information is needed.

7.2.4.   MDT Existing System

The current system interacts with Meridian by feeding their 511 product, with MMS by populating data lists with values from MMS tables, and with TIS by populating location lists with TIS data. The system must be modified to support interaction with the 511 systems of neighboring states or other condition reporting systems to meet minimum requirements.

7.2.5.   Summary

All vendor systems and the current system interact with external systems in some fashion. However, more information must be known about how the vendor systems interact for a full evaluation. The current system needs to be modified to exchange data with neighboring states' 511 and road condition reporting systems.

7.3.   User Interfaces

The system shall interface with the users through a graphical user interface conforming to industry-standard design principles and containing standard components. More information about this requirement can be found at Other.HostingRequirements.UserInterfaces.

All vendor systems appear to use standard components and design principles. The current system uses non-intuitive, outdated graphical user interface methods and components. The current system must redesign its interface to use current industry-standard design principles.

7.4.   Hardware Interfaces

The system must operate on standard hardware devices conforming to MDT, ITSD and other applicable agency and industry standards. More detail on this requirement is at Other.HostingRequirements.HardwareInterfaces in the requirements document.

The current MDT system appears to conform to MDT and ITSD standards. More information is needed to determine if the vendor systems run on standard equipment conforming to MDT and ITSD standards.

7.5.   Software Interfaces

The system must interface with a variety of specific software products, dependent on if the system is standalone or web-based. More detail on this requirement is at Other.HostingRequirements.SoftwareInterfaces in the requirements document.

More information about the specific software to be interfaced with the system is needed to determine if the current MDT system or vendor systems can meet requirements.

7.6.   Communications Interfaces

The system must use industry-standard communication protocols and operate on the local MDT intranet. More detail on this requirement is at Other.HostingRequirements.CommunicationsInterfaces in the requirements document.

More information about the vendor systems is needed to determine if they can meet requirements without modification. It appears that the current MDT system meets requirements.

7.7.   Performance Requirements

The requirements stipulate that the system meet specific performance requirements in the following areas: reliability, availability, security, maintainability, robustness, precision, scalability, deployment, extensibility, and reactivity. More detail on this requirement is at Other.HostingRequirements.PerformanceRequirements in the requirements document.

An evaluation of the vendor systems' ability to meet performance requirements requires more information. It is highly recommended that the vendor systems be tested prior to selection to determine if the systems meet performance requirements. Below are bulleted points, evaluating the existing MDT system, for each area of performance requirements. While not a complete evaluation of the existing system, the bulleted points are derived from MDT challenges in Chapter 4 of the requirements document and MDT interviews. It is recommended that the MDT system itself be thoroughly used to provide a more complete evaluation.

7.7.1.   Reliability

- The current system suffers from some occasional downtime. The downtime is often due to the larger MDT network system maintenance. It is not known if downtime results from a failure of the road condition reporting system itself and, if so, the Mean Time Between Failure. More information about the level of redundancy of the system must be known to determine if the current system must implement increased redundancy to meet requirements. There is no evidence that downtime or failures are caused by the current road reporting system.

- The current MDT system is implemented on enterprise-level hardware and software. However, the MDT network itself suffers from reliability issues, which trickle down to the road condition reporting system. Modifications to either the road condition reporting system or the larger MDT network are required to increase redundancy and meet reliability requirements.

7.7.2.   Availability

- Refer to the above comments concerning downtime of the current system. Either modifications to the current system or the larger MDT network must be performed to increase availability via redundancy.

7.7.3.   Security

- The current system provides user authentication, but more information is needed to assess the encryption techniques and other security measures.

- The current system must be modified to log all changes to data and all access to data.

- The current system will have to be modified to support restricted functionality for new user classes specified in the requirements.

7.7.4.   Maintainability

- The system must be modified to automatically incorporate new or reassigned MDT road segments or corridor routes from TIS as it is currently done manually.

- More information about the downtime required for maintenance is needed to evaluate the current system's ability to meet maintenance requirements.

- It is unclear if the traveler information coordinator receives advanced warning of system maintenance. More information is needed to determine if modifications are needed to meet requirements.

7.7.5.   Robustness

- The current system must be modified to support more concurrent private users since it has a tendency to perform slowly and sporadically during periods of increased data entry. It is unknown if performance suffers because of many concurrent public users.

- It is unknown if the system operates on a non-interruptible power supply, if data integrity is preserved during interrupted transactions and downtimes, and the storage capacity for events and facilities. More information is needed.

- Modifications to the archiving process of the current system must be done to meet requirements. Events and changes to those events are currently not archived.

7.7.6.   Precision

- The current system meets precision requirements as is.

7.7.7.   Scalability

- It is unknown if the current system allows additional capacity for user accounts, concurrent public users, concurrent private users, event and facility storage, report storage, and archive storage. More information is needed to determine if the system must be modified to meet scalability requirements.

7.7.8.   Deployment

- The current system would need to be modified to provide a separate, fully-functional training environment.

- The current system is deployed on the MDT network, thus requiring no modifications concerning network deployment.

7.7.9.   Extensibility

- The current system does not allow users to add new types of events, facilities, reports, maps, or other interfaces without significant changes. The current system will have to be modified to meet extensibility requirements.

- It is unknown if the system will be able to interface with new external or internal MDT systems. More information is needed.

7.7.10.   Reactivity

- The length of time before the current system is updated due to entered, modified, or deleted data is unknown. More information is needed to determine if the current system must be modified to meet reactivity requirements.

7.8. Usability Requirements

The requirements stipulate that the system meet specific usability requirements in the following areas: ease of use, ease of learning, accessibility, and user support. More detail on this requirement is at Other.HostingRequirements.UsabilityRequirements in the requirements document.

An evaluation of the vendor systems' ability to meet usability requirements requires more information. It is highly recommended that the vendor systems be tested prior to selection to determine if the systems meet usability requirements. Below are bulleted points, evaluating the existing MDT system, for each area of usability requirements. While not a complete evaluation of the existing system, the bulleted points are derived from MDT challenges in Chapter 4 of the requirements document and MDT interviews. It is recommended that the MDT system itself be thoroughly used to provide a more complete evaluation.

7.8.1.   Ease of Use

- The current MDT system potentially allows users to quickly enter conditions for all segments in a division after reaching the data entry interface. However, users wishing to update segment conditions must first delete the existing condition and then enter the new data. Attempts to simply overwrite the data produce errors. The current system will have to allow users to overwrite existing conditions to meet usability requirements. In addition, users must manually specify the priority of road conditions if more than one condition applies to a segment. The system must be modified to automatically handle condition priorities to meet ease of use requirements.

- The current system employs two separate systems -- a winter system and a summer system. Users cannot access both systems at the same time and must close one to open the other. This process is confusing and cumbersome for users. The current system must be modified to provide a unified system to meet ease of use requirements.

- The current system contains a non-intuitive user interface making navigation to data interfaces and the actual entry of data cumbersome and confusing. Modifications to the interface are needed to meet ease of use requirements.

- The current system requires users to request that the system populate lists by pressing a button. This causes delays in entering or modifying data. The current system must implement automatic list population to meet ease of use requirements.

- The time required to generate and view reports upon request by private users is unknown. Note that the current system uses a somewhat non-intuitive method whereby users print the report to the screen. More information is needed to determine if the current system must be modified to meet requirements.

- The current system allows public users to quickly navigate to the road condition map and specific map area rather quickly after first coming to the public website. However, the map is currently only available for road conditions. Further investigation is needed to determine if the system is able to meet requirements after the mapping functionality of the system is sufficiently modified.

- The current system does not allow users to request more information about particular events or facilities. The system will need to be modified to support additional information upon user request under the time constraints in the usability requirements.

- The current system allows public users to quickly request and receive reports via the web page. Further investigation is needed to determine if the system is able to meet requirements after additional reports, specified in the requirements, are implemented. Additional reports may cause changes to the way public users request and receive reports.

- The current system does not automatically provide notifications when necessary. Instead, all notifications are done manually by email and telephone. The current system will have to be modified to provide automatic notifications within the time constraints of the ease of use requirements.

- The current system often gives cryptic error messages to users. The system must be modified to offer meaningful error messages to meet ease of use requirements.

- The current system requires the Traveler Information Coordinator to request access to archived data and that data be archived. The system must be modified to automatically archive data to meet ease of use requirements.

- The current system does not allow users to determine the exact location of point conditions via the map. Instead, point condition icons are placed arbitrarily along the segment on which it is located. The current system must be modified to place point condition icons properly on the map to meet ease of use requirements.

7.8.2. Ease of Learning

- Specific information about how long workers must be trained to effectively use the current system is unknown. However, it was noted that consistency and accuracy of road condition entry is a challenge in the current system. The current system must be modified to allow users to learn to use the system under the time constraints specified in the requirements, where applicable.

- The current system requires users to spend significant time learning how to deal with system idiosyncrasies. Temporary staff or those who do not use the system frequently have difficulty learning or relearning how to use it. The current system must be modified to meet ease of learning requirements.

- The length of time required for first-time public users to learn to navigate to their desired navigation is unknown. More information is needed.

7.8.3. Accessibility

- It is unknown if the current system is Section 508 compliant. Additional information is needed. The current system does produce text reports, but it is unclear if those reports are sufficient for compliance.

7.8.4. User Support

- The current system's original user manual is not complete because it did not contain instructions for the fastest ways to use the reporting system. The manual must be modified to meet user support requirements.

7.9. Institutional Requirements

The system must meet certain legal and apportioned requirements. More detail on this requirement is at Other.HostingRequirements.InstitutionalRequirements in the requirements document. More information is needed to determine if the vendor systems

can meet these institutional requirements. It is assumed that the current MDT system meets these requirements.

8. SUMMARY

This report was used to evaluate the vendors' systems and the existing MDT road condition reporting system against the requirements outlined in the previous requirements document.

There were a total of sixty nine quantitative requirements that were examined, as well as several subjective requirements (performance, usability, and institutional requirements). The quantitative requirements are organized in Table 1 in order to provide a comparison of the different vendors and existing systems. In this table, an "x" represents that the vendor's current system can fully meet the requirement; a "p" represents that the vendor's current system can partially meet the requirements, but will require some modifications; and a "u" indicates that either it is unknown if the current system can fulfill the requirements (vendors) and a "-" that the system does not meet the requirements.

Due to the fact that the information about the vendor systems was mostly gathered through user manuals, it was assumed that these manuals may not be an exhaustive list of the functionality of the system; therefore, when dealing with the vendor systems, if the manual did not directly address a requirement (or portion there of), the vendor was given the benefit of the doubt that the system may be able to do the given function and therefore just addressed as an "unclear" or "unknown" and placed in the "u" category. It was not evaluated as being unable to fulfill the requirement. With the existing system; however, manuals were available as well as interviews with staff that use the system; therefore, the evaluation could be more definitive to say that either the system does or does not have a capability "-".

Table 1: The Vendors and Existing Systems' Ability to Meet Requirements

Higher Level Requirement	Requirement	CARS	HCRS	IRIS	Existing System
System Data	User Accounts	p	p	p	p
	Logs	x	p	p	u
	Archives	p	u	u	p
Lists	Work Types	p	p	p	p
	Conditions	p	p	p	p
	Vehicle Types	x	x	x	P
	Field Elements	u	u	u	-
	Contact Lists	p	p	u	-
	Notification Lists	x	x	u	-
	MDT Road Network	u	x	x	x
Contexts	Location	p	p	p	x
	Effective Period	x	x	x	p
	Restrictions	x	p	x	p
	Information Source	x	p	u	p
Events	Construction and Maintenance Projects	p	p	P	p
	Road Conditions	x	x	P	p

Higher Level Requirement	Requirement	CARS	HCRS	IRIS	Existing System
	Spring Thaw Load and Speed Restrictions	p	p	P	x
	Incidents	x	x	P	p
	Special Events	x	p	x	p
Facilities	Rest Area	u	u	u	x
	Border Crossing	u	u	u	-
	Weigh Stations	u	u	u	-
Alerts	Alerts	u	p	u	-
Data Entry and Modification Interfaces	Data Entry Interface	x	x	x	x
	Data Modification Interface	x	x	x	x
	Data Save Options	p	p	P	p
	Data Cancel Options	p	p	p	p
	Data Deletion Options	p	p	p	p
Event and Facility Data Entry and Modification Requirements	Project Entry	p	p	p	p
	Project Modification	x	p	p	x
	Project Deletion	x	p	x	x
	Road Conditions Entry	p	p	p	x
	Road Conditions Modification	x	x	x	x
	Spring Thaw Load and Speed Restrictions Entry	u	u	u	x
	Spring Thaw Load and Speed Restrictions Modifications	u	u	u	x
	Spring Thaw Load and Speed Restrictions Deletion	u	u	u	x
	Incident Entry	x	x	p	x
	Incident Modification	x	x	p	x
	Incident Deletion	x	p	x	x
	Special Event Entry	x	p	x	p
	Special Event Modification	x	p	p	p
	Special Event Deletion	x	p	x	x
	Rest Area Entry, Modification, and Deletion	u	u	u	p
	Border Crossing Entry, Modification, and Deletion	u	u	u	-
	Weigh Station Entry, Modification, and Deletion	u	u	u	-
	Alert Entry, Modification, and Deletion	u	p	u	-
Report Generation	Report Generation	u	p	u	p
	Individual Reports	u	u	u	p
	Report Generation Distribution	u	u	u	x
Public Interface	Public Interface	p	p	p	x
	Public Interactive Map	x	u	p	p

Higher Level Requirement	Requirement	CARS	HCRS	IRIS	Existing System
	Interface				
	Reports Interface	u	u	u	x
Private Interface	Private Interface	p	p	p	x
	Map Interface	p	x	p	-
	Event, Facility, and Alert Listings	p	p	u	p
	Archived Data Interface	u	u	u	p
Notification	Database Update	p	p	u	p
	Event	p	p	u	-
User Administration	User Entry	u	u	u	x
	User Modification	x	u	u	p
	User Deletion	u	u	u	p
Data Management	List Item Add, Modification, and Deletion	p	u	u	-
	Segment Change	u	u	u	x
Other Requirements	Hosting Requirements	p	p	p	x
	External Interface Requirements	p	p	p	p
	User Interfaces	x	x	x	-
	Hardware Interfaces	u	u	u	x
	Software Interfaces	u	u	u	u
	Communications Interfaces	u	u	u	x

To better understand how the four systems compared to each other overall, their ability to meet the requirements (fully, partially, or not at all) were tallied. These results are shown in Table 2.

Table 2: Tallied Results for Systems' Ability to Meet Requirements

	CARS	HCRS	IRIS	Existing System
Fully Meets Requirements (x)	23	13	13	25
Partially Meets Requirements (p)	22	32	24	26
Unknown (u)	24	24	32	5
Does Not Meet Requirements (-)				13

These results indicate that if the requirements were used as written, the options to modify the existing system and the custom build approach would fully meet the requirements. However, it may be more difficult and time consuming to modify the existing system or create a custom built system, then it would to modify one of the vendor systems.

Of the four systems that would require modifications, the existing system meets more of the requirements than any of the other systems; however, not by much. Next in order would be CARS, then HCRS, and lastly IRIS.

Having said that, while one system may meet more of the requirements, it does not necessarily mean that it outranks the other systems as not all requirements bare the same

ranking (i.e. not all requirements are of equal weight or cost for implementation) and this is not taken into consideration in this document. It should also be noted that if MDT makes any change (addition or deletion) to the requirements, it would alter these results and possibly change which system would best fit the agency's needs. Another significant piece of information to consider is the number of unknowns. One third of the requirements are unknown for CARS and HCRS and one half are unknown for IRIS. Gaining more information on these systems may change which system meets more of the requirements.

Other qualifications on the findings include that a higher ranking for CARS than other systems may also be due to the fact that researchers had access to the Alaska CARS test system and did not have this access for the other vendor's systems. This supplemented the manuals in eliminating more of the unknowns and provided a slight advantage over the other systems. It should also be noted that the existing system would obviously rate high due to the requirements being based off the positive and negative aspects of this system. Therefore, this system has a slightly higher bias towards it. It should also be noted that this ranking is only based on the quantitative requirements and many of the issues with the existing system are due to the qualitative/subjective requirements (performance, usability, and institutional requirements).

Several observations about HCRS need to be stated. These include that if MDT did a request for proposals, it is unknown if HCRS would be in the running as MDT would need to first obtain permission from either ADOT or NDOR to use HCRS and then find a software firm to complete the modifications. Nebraska selected to use OZ Engineering, the firm that originally created HCRS for ADOT, to complete their modifications. It also needs to be noted that the NDOR HCRS system more closely meets the needs of MDT, because the weather conditions, and therefore reporting requirements, are similar in the two states.

The final conclusion that must be made is that, although there are a lot of unknowns and there are systems that meet more of the requirements with the amount of information currently known, there is no significant evidence to eliminate any of the systems as options to potentially meet MDT's needs.

9. REFERENCES

1 Graham, S., D. Galarus, and J. Eidswick, *MDT Traveler Information Reporting System Requirements Analysis Draft*. Western Transportation Institute, MSU Bozeman. June 2006.

2 Castle Rock Consultants, *Condition Acquisition and Reporting System (CARS) User Manual.* February 2004.

3 Castle Rock Consultants, *CARS-Segment Winter Road Condition Reporting for a Specific Road Addendum*. August 2006.

4 OZ Engineering, *Highway Condition Reporting System Training Guide Version 2.38*. Arizona Department of Transportation, February 2005.

5 OZ Engineering, N*ebraska Department of Roads Highway Condition Reporting System Training Guide Version 4.0*. Nebraska Department of Roads, October 2004.

6 Meridian Environmental Technology, Inc, *Draft SDDOT Road Condition Reporting System Users Manual*. South Dakota Department of Transportation, August 2004.

7 Meridian Environmental Technology, Inc, *Improved Road Condition Reporting Study SD2001-15 Final Report*. South Dakota Department of Transportation, November 2004.

8 Meridian Environmental Technology, Inc. *NVIRIS Operator Instructions*. Nevada Department of Transportation, August 2006.