Computerized Crash Reports Usability and Design Investigation

Final Report

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16. Abstract (Limit: 250 words)

Electronic crash reports are advantageous because they can limit missing data, transcription errors, and the space limitations of a single sheet of paper. Advancing electronic reports through user-centered design affords an opportunity to improve law enforcement officer's (LEOs) ability to accurately, timely, and efficiently document crashes. Minnesota's commencement of a new crash records database offered a unique opportunity for a redesign of its electronic crash report to best support LEOs. A well-designed electronic report will not only support LEOs in the line of duty but will also lead to more useful, complete, and accurate data for various state and federal agencies for analysis and policy decision making. The objectives of this project were to: 1) improve crash data reliability and validity, 2) develop a framework crash report interface based on human factors principles and usability requirements, and 3) reduce the mental workload and required steps for users. Project tasks included: heuristic and hierarchical task analysis, cognitive walkthroughs, validity and reliability testing, interviews, beta testing, and usability testing. The human factors principles and user-centric approach lead the iterative design process to produce a product with high levels of usability and intuitiveness. The project featured a cooperative approach among university researchers, state agencies, and a private developer to ensure that the knowledge, design, and results of the research effort was fully transferred into the final product. The resulting interfaces preliminarily suggest improved user satisfaction, along with data completeness and accuracy, and provide a resource for replication in multiple domains.

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Final Report

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EXECUTIVE SUMMARY

Law enforcement personnel are not only responsible for protecting and serving the public, but they also must keep accurate records of each incident to which they have responded. Motor vehicle crash reports can be a time consuming and frustrating task for officers due to the multiple steps, each governed by specific rules, required to complete an entire report. To meet the goals of Minnesota's Toward Zero Deaths (TZD) initiative (2013), it is important for crash reports to be completed in a highly detailed manner. The existing system for crash reporting in Minnesota is primarily computerized but does not have high user acceptance or consistency across departments. Adopting a data-driven, evidence-based approach is the strategy behind Minnesota's TZD initiative, with the goal of identifying problematic areas and developing countermeasures to mitigate serious injury and fatal crashes (MN TZD, 2013). Crash reports describe the events and environmental conditions surrounding the circumstances of a crash, the vehicles, and persons involved. Data trends from crash reports provide rationale for implementing traffic safety programs and countermeasures; therefore, the onus is placed on the law enforcement personnel to accurately record critical data points when completing the crash form (Porter, 2011). Due to urgency involved in drafting the crash reports at a crash site, there is risk of errors and missing data, which are difficult to recover post hoc (Wickens & Hollands, 1999). Further, the inconsistencies in crash report forms across law enforcement agencies leads to reliability problems in reporting across different departments (Farmer, 2003). It is important to provide a system that can assist officers in recording detailed crash reports in a simplified manner for Minnesota's TZD initiative to accomplish the goals set forth.

Minnesota commenced transitioning into a new crash record database and reporting system in 2014 to incorporate new technologies to improve data accuracy (e.g., MnGeo, a smart mapping tool, to more accurately locate crashes). Other new features include increased data standardization to permit interstate comparison (Model Minimum Uniform Crash Criterion or MMUCC, 2012), increased resource integration for more efficient data entry, and incorporation of advanced features, such as spell check and autofill functions, to increase data quality. This created an opportunity for the Minnesota Traffic Records Coordinating Committee (TRCC) at Minnesota DPS and MnDOT to sponsor the research team from the HumanFIRST Laboratory at the University of Minnesota to restructure the electronic crash report interface into a more intuitive and user-friendly electronic interface. The goal of this computerized crash report usability and design project was to provide a resource for accurate, reliable, and meaningful crash report data. Additional aims were to decrease training time, improve speed of performance, and address error rates by utilizing human factors techniques and drawing on the experience and knowledge bank of Minnesota law enforcement personnel.

Assisting in the collection of quality data begins with leveraging technology to create a standard computerized crash report form. Due to the complexity of this goal, experts from many fields and agencies were involved in the project. Accounting for influences such as database architecture, development limitations, and data security were important considerations. While collaboration with all resources was key for this investigation, this report focuses on the human factors approach to the front-end design and user experience (UX) of the crash report redesign effort. Researchers conducted interviews, surveys, and cognitive walkthroughs with law enforcement officers across Minnesota to capture their needs in designing the new report. By seeking feedback from the law enforcement personnel during the design phase, an intuitive

interface emerged that can be used for crash reporting statewide. The stages of indexing crash variables, designing interfaces, and testing prototypes are explained in this report. The collaboration between the University of Minnesota research team, state agencies (Minnesota Department of Public Safety (DPS), Minnesota Department of Transportation (MnDOT), and Minnesota Crash Data Users Group), and, most importantly, law enforcement personnel across the state of Minnesota capitalized on a "Design by Committee" approach to integrate expert knowledge and experience into creating a superior tool for crash data collection (Lidwell, Holden, & Butler, 2003). With positive feedback from the end-user (law enforcement personnel), the inter-disciplinary team of researchers, developers, and state administrators envisions Minnesota's Crash Report interface to be a future model for standardized reporting in other states.

The goal of this project was to use human factors analysis methods to restructure the Minnesota electronic crash report into a more user-intuitive design. In total, 82 Minnesota law enforcement agencies (including Minnesota State Patrol, 66 local police departments, and 15 county sheriff's departments) directly participated in this research effort. This project went through seven stages in the process of creating a computerized version of the Minnesota Crash Report. The *hierarchical task analysis* (HTA) organized logical goals into necessary steps and actions so that operations could be carried out in a step-by-step process (Annett, 2003; Kirwan, 1994). *Cognitive walkthroughs and interviews* provided researchers with first-hand insight into the goals of the end-user (law enforcement officers) (Kuniavsky, 2003; Polson, Lewis, Rieman, & Wharton, 1992). *Card sorting* tasks were presented to 167 officers, from 67 agencies, for the benefit of designing an interface with a logical flow and grouping of the queries and information within the crash report (Spencer, 2009). These research activities guided the design of the report prototype interfaces.

During the *prototype build,* two different mock systems, a form-based interface and a wizard-based interface, were designed giving researchers additional flexibility in meeting usability standards as well as the preferences of end-users. The UIs were created, using the Justinmind software tool, by incorporating information obtained through the HTA, cognitive walkthrough, survey, and card sorting tasks. Both interfaces were built to accommodate a single unit crash, a two-unit crash, a commercial motor vehicle/fatal injury crash, and a non-motorist involved crash. The wizard interface used sequential dialog boxes to lead users through the required steps. The appearance of the wizard UI was similar to software installation interfaces which some users may have had experience. The second, Form, interface was a more traditional UI that allowed users to enter information in multiple fields on one screen. Each UI type presented the research and development team with advantages and challenges for usability and accuracy of data entry.

Officers were able to experience the flow of each system during *usability testing* of the wireframe interfaces and give feedback, which guided an iterative design cycle. Usability testing was conducted to inform the design and modification of both interfaces. The researchers recruited 54 law enforcement officers from 19 agencies to test the front-end (wireframe) of the interface. All participants interacted with both interfaces (counterbalanced) by using predetermined mock-crash scenarios. Sessions lasted for approximately 1.5 hours and were recorded through screen video imaging and audio recording using Morae software. A "think aloud" method was used to elicit the officer's ability to understand and work with the interfaces. Measurements included error rates, task duration, subjective usability, subjective mental

workload, and user preference. Based on the feedback from usability testing, final versions of the Wizard and Form were completed by the researchers. The finalized wireframes gave the sponsoring agencies a basis for the redesign of the state's system.

Following the research prototype handoff to the state vendor, Appriss, the researchers were responsible for *beta testing* each interface prototype to ensure research outcomes were implemented and to prevent errors during early deployment. The beta testing stage entailed on-going review of the prototypes during the back-end development process (Appriss LLC). The goal of beta testing was to determine the extent to which the interfaces adhered to the established user requirements and best usability practice. During beta testing, the team of researchers at HumanFIRST met with the developers at Appriss on a regular basis to be briefed on system updates and share knowledge on the overall progress. The team also guided the internal user acceptance testing conducted by crash data experts of Minnesota Department of Public Safety and Department of Transportation.

At the conclusion of beta testing, the research team re-engaged with officers in *final usability testing* involving all three of the MNCrash interfaces to identify and recommend any additional enhancements or changes to improve usability and data quality prior to product state-wide launch. The results and final recommendations of this process concluded the final phase of design revisions of the system prior to its statewide deployment. The goal of the final usability testing with the final vendor prototypes was to ensure that: a) The final prototypes adhered to best human factors principles and practices, b) Prototypes were free of previously established moderate and high-critical issues, and c) User acceptance evaluations of the prototypes were satisfactory to accepted standards.

The new MNCrash reporting system launched on January 1, 2016, and experienced overwhelmingly positive feedback from users. The MNCrash report owes the superb usability qualities to the user-centric approach of design during each step of the development process. These qualities include the concise presentation of data entry fields, rich descriptions of report requirements within each screen, user-centric help guides, and flexibility between program platforms and interfaces. In the end, the enhanced MNCrash reporting system was forged by the law enforcement officers across Minnesota. Their needs were heard, limitations accommodated, and feedback put into practice in a tangible way. Investing in the user and leveraging their expertise and intuition was not only a sound decision by the state of Minnesota to improve its data accuracy, but it also lends great support and appreciation to the law enforcement officers who serve the state. This study exemplifies the power of the implementation of human factors usability research principles in real-world production environments and establishes a precedence for motor vehicle crash reporting nationwide. This project is the first known of its kind in the United States to apply an in-depth usability practice in a statewide interface.

Chapter 1: **INTRODUCTION**

1.1 State of Minnesota's Crash Data Records

As technology becomes more ubiquitous there is a desire to transition from paper to electronic crash reports. Electronic crash reports are advantageous because they can limit missing data, transcription errors, and are not subject to the space limitations of a single sheet of paper. The transition to electronic reports affords an opportunity to improve law enforcement officers' ability to accurately, timely, and efficiently complete these reports. The state of Minnesota underwent this shift from paper to electronic submission with the implementation of its legacy electronic accident reporting system which was in use from 2004 to 2015. This system was successful upon its implementation by improving the timeliness of crash reporting within a 30-day timeframe and reducing the former six-week backlog process of paper reports (Fleming, 2010).

Minnesota's legacy system largely matched the flow of entry of the prior paper report and was structured in a way that most closely resembled how data analysts viewed the data. Its structure, however, was not a true reflection of how the user, the reporting officer, viewed the scene or the flow of information of the crash. Additionally, as requirements and data elements changed, the governing rules of the electronic report often left the user in a place of frustration due to its inflexibility and failure to respond dynamically to new information submitted by the officer. The resulting user experience of the legacy system lead some local agencies or individual users to submit paper reports in protest or to create their own, separate electronic system to document crash data. Most users, however, viewed the process as a necessary, but painstaking process required of them as a part of their duty to serve. Figure 1.1 perfectly illustrates the frustration and avoidant tendencies that the laborious and inefficient design of the legacy system produced among its users.

Figure 1.1 Duluth, MN officer's frustration with the legacy electronic crash report.

The historic engineering approach to improving a user's accuracy and perception of a complex system, like an electronic crash report, was to simply offer ample training on the system or select users with the pre-existing traits required to better interact with the system (Norman, 1986). While such approaches are means to an end, these are costlier solutions long-term and ensures that user dissatisfaction and errors will remain a persistent problem. A more appropriate solution does not include extensive training or a selection criterion of tech-savvy law enforcement officers, but instead addresses the root cause of the problem by creating the system with the user in mind. A well-designed electronic crash report will not only support law enforcement in the line of duty, but will also lead to more useful, complete, and accurate data for various local, state, and federal agencies for analysis and policy decision making.

1.2 Identifying the Need for Improved Data Collection

In 2013, Minnesota's Traffic Records Coordinating Committee (TRCC) began its preparation to rebuild the state's crash records database and discard the legacy system. This rebuild would require, along with a new back-end housing system, a redesign of the crash report interface. The new reporting system was scaled to incorporate new technologies to improve data accuracy (e.g., a smart mapping tool to more accurately locate crashes). Other new proposed features included increased data standardization to permit interstate comparison (Model Minimum Uniform Crash Criterion or MMUCC, 2012), increased resource integration for more efficient data entry, and incorporation of advanced features, such as spell check and autofill functions, to increase data quality. These proposed changes would not only involve an extensive software design, but would also require laborious training of the entire state's law enforcement officers to properly use the new report.

The HumanFIRST research team proposed an innovative approach using human factors principles which would support the software design of the new system and would limit the training demands of law enforcement officers. The proposed computerized crash report usability and design project emphasized the importance of user-centered, iterative design to create a final product that would be intuitive and user-friendly. A report created through the lens of law enforcement officers' capabilities, limitations, and preferences would not only improve user satisfaction, but would also decrease training time and ultimately improve performance. With a good interface, there should be a fit between the user's needs and the service that the system provides. Often times, usability issues are not considered until later in the design cycle, after many technological decisions have been made and implementation of system change has become too difficult and expensive—this often results in a less than satisfactory design to which the users must adapt, creating a poor user experience in the process (Norman, 1986).

This project aimed to mitigate this potential issue by adopting an iterative design and user-centered approach to the development and testing of the new interface (Van Der Peijl, Klein, Grass, & Freudenthal, 2012). This process involved: a) capturing user requirements through a participatory design approach, b) developing different solutions for how the content should be structured, the flow of information, allocation of tasks between user and the system, and how the system should behave, c) translating these abstract ideas into interactive forms for user evaluation, and d) ascertaining whether user requirements have been correctly understood and properly incorporated through usability testing (Figure 1.2).
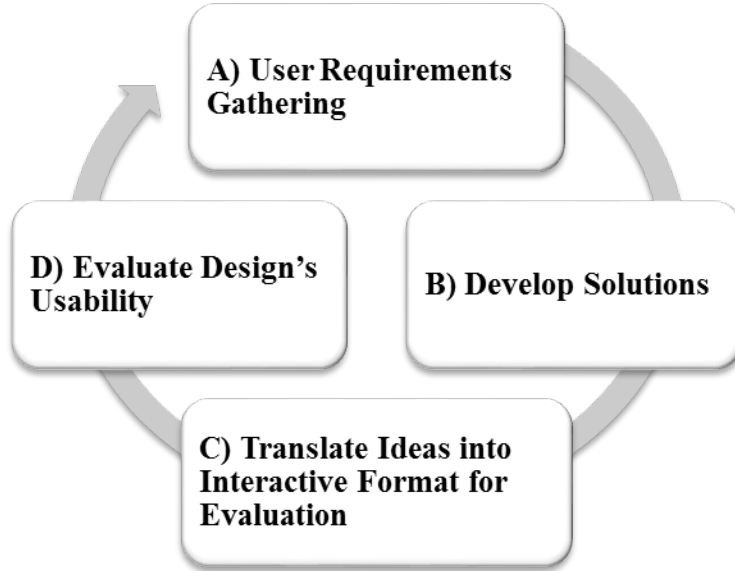
Figure 1.2 A user-centered and iterative approach to designing new crash report interface.

Overall, the intended goal of the project was to design, create, and implement an electronic crash reporting system that prioritized the user, equipping law enforcement with the tools necessary to complete high quality crash reports that resulted in accurate, reliable, and meaningful crash report data. This was to be accomplished by continuously inventorying usability and user acceptance alongside each design revision or feature modification, consistently throughout the development process. HumanFIRST proposed to serve as a bridge between the legacy system and final build of the new electronic report, ensuring that the appropriate requirements for high quality usability, catered to Minnesota's law enforcement officers, and data accuracy were met. Additional aims were to improve speed of performance, crash report timeliness, and address error rates by utilizing human factors techniques in hand with drawing on the experience and knowledge bank of Minnesota law enforcement personnel. This project is the first known of its kind in the United States to apply an in-depth usability practice in a statewide interface.

Chapter 2: HUMAN FACTORS EXAMINATION OF EXISTING SYSTEM AND CURRENT PRACTICE

2.1 Phase One: Human Factors Analyses

A human factors approach to design provides a framework for implementing system-wide changes that adhere to human capacities and account for cognitive processes that occur during a given task (Endsley, 1995). Basic examples of human factors in the domain of display design include reducing the screen clutter, strategically grouping similar functions together, and designing icons and actions in a way that allows users to discern their function (Galitz, 2007). In the case of recording complex information on a form (e.g., the Minnesota Crash Report), it is important to give attention to the end-user (e.g., law enforcement personnel) so that the number of errors remains low, and data accuracy and completeness are maintained. The accuracy of crash reports is especially important when costly infrastructural changes are being considered or educational programs are being implemented in order to mitigate high-risk crash scenarios indicated by crash report data. Reliable and complete data leads to more accurate prioritization of road safety improvements and effective allocation of funding resources for these improvements. Applying the principles of human factors design to achieve these goals required a series of analyses to be conducted both internally and with the user population.

2.1.1 Heuristic Analysis

A team of human factors experts conducted a heuristic evaluation of the legacy crash report and identified problem areas in the interface to prioritize for the redesign. A heuristic analysis is an expedited approach to evaluate an interface through subjective, observational methods and is performed by the research team (Stanton, Salmon, Walker, Baber, & Jenkins, 2005). This process allows overt usability problems, identified through comparison to usability principles or heuristics, to be documented and addressed to initiate the first cycle of iterative design (Nielsen & Molich, 1990; Nielsen, 1994).

Minnesota's legacy electronic crash report form (see Figure 2.1) fell short of some usability best practices (US DHHS, 2006). The following subjects emerged as the primary goals that needed to be addressed in the new crash report:

1) Error recovery option: explicit message to help user recognize and correct an error
2) Account for cognitive constraints:
    a. Group icons and graphics by orientation, color, size, and shape
    b. Organize screen information logically
    c. Eliminate display clutter
3) Incorporate assistive techniques and tooltips
4) Reduce mental workload:
    a. Restrict the number of possible actions
    b. Condense decision making
    c. Reduce erroneous attempts

Figure 2.1 Minnesota's original electronic crash report featuring abbreviated queries, coded user input, and no dynamic content.

2.1.2 Hierarchical Task Analysis

A Hierarchical Task Analysis (HTA) describes the tasks that users need to perform to achieve their goal(s) using a given system (Stanton, et al., 2005; Kirwan, 1994). In an HTA, tasks are represented through a hierarchy of abstract goals, operations (concrete action steps to accomplish the goals), and plans (any decisions and planning on the users' end to carry out the operations) (Stanton, et al., 2005). Completing an HTA was an important step in the research effort by creating a resource to enable the team in understanding the priority levels of each task and the consecutive steps that could be performed under each task. The HTA created in this project highlighted how the task of documenting a crash, using the legacy electronic interface, was shared between the user and the computer system. Additionally, it provided a formulaic package to assist the back-end developers in designing business logic and validations. An HTA was identified by the research team as a valuable process for this project because it would grant insight into the performance of the crash system and its degree of usability proficiency for the officer end-users.

2.1.2.1 *HTA Procedure*

The Hierarchical Task Analysis provided an overview for the necessary actions users must take to complete their task at hand. The HTA itemized the legacy crash reporting system and its required actions to complete a standard report. The HTA was comprised of three major components:
1) Hierarchy of abstract goals (e.g., data pertinent to a collision to create a report)
2) Required operations to satisfy the system's requirements in order to achieve the goals (e.g., data entry)
3) Decision-making and planning by the user (e.g., sketching an outline on paper)

5

HumanFIRST designed the crash report HTA based upon protocol obtained by the Crash Data Collection Training Course (CDCTC). The HTA was created to define the aspects of an effective crash reporting system:

1) Procedural requirements on law enforcement to document collisions on the Minnesota Accident Report and Fatality Report Form (e.g., the stepwise procedure to correctly enter a crash report)
2) User-centered interface design system that is conducive for ease of use and satisfactory user willingness to operate
3) Any protocol, procedure, command or input required on either the user's end, or the system's end, that guarantees successful operation and completion of the report (e.g., specific rules for entering data)

Graphical depictions of HTA provide an easy visualization of the system flow, interconnectivity, and governing rules. Such depictions are difficult to convey when the number of steps of a system are quite large. The entire crash report HTA was created in a tabular version due to the extensive number of elements within it. Figure 2.2 offers a small example of the initial steps required of officers to complete the crash report. This visualization allows for an easy analysis of which required steps could be automated (e.g., Officer Name, Rank, Agency, Badge #, and Patrol Station #) to reduce the workload and time requirements in completing a report.
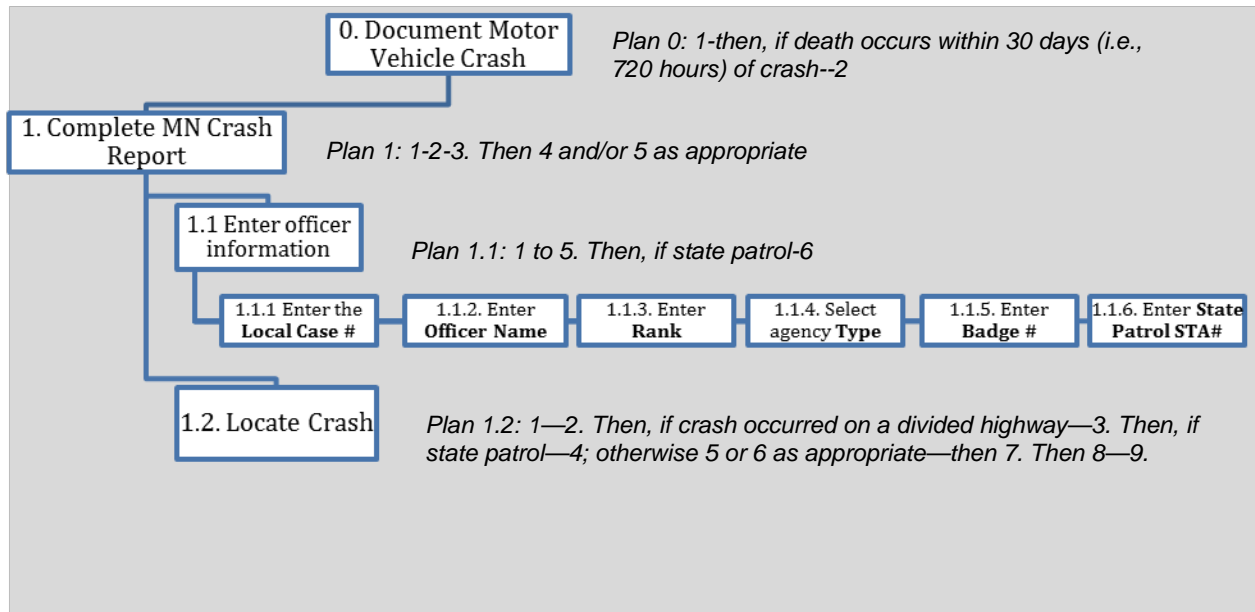
Figure 2.2 Graphical depiction of the crash report HTA displaying the initial required steps to complete a crash report.

2.1.2.2 *HTA Results*

The HTA revealed several challenges over crash reporting system limitations, crash data element wording, meaning response options, and wording of the instructions that can cause errors and confusion. According to the HTA analyses:

- 22 crash report data elements were not clearly defined and require more intuitive explanations.
- Some fields that were optional were not perceived as optional by law enforcement.
- Six opportunities were initially identified in which data could be auto populated through a driver's license swipe and officer log-in.
- There was no space to define or clarify when officers select "other" for a data element.
- Multiple instances of error reduction through restriction of possible actions (i.e., menu dropdown rather than manual data entry).
  - Some fields were open text which limited the uniformity of the crash data
- Multiple data elements in which the legacy system limited responses to one, but more than one option was applicable.
- The number of fields in which the prototypes could auto-populate based on advanced logic or database information was increased, which shifted the ratio of user-to-system responsibilities from 151:24 to 104:71.

The analysis and creation of the HTA provided the groundwork needed to create a new crash reporting system. Additionally, defining key aspects of the report allowed HumanFIRST researchers to better understand the needs and wants from the officers, so that the new system could be tailored to those desires.

Defining the division of responsibility between the user and the system was an important consideration for the development of an effective HTA. HumanFIRST inventoried the amount of required steps to perform a comprehensive crash report with the legacy system, and found that a total of 175 steps were needed (151 user-reliant, 24 system-provided). This profound disparity of divided responsibility in the report is a prime example of when human factors principles and information architecture can be used to improve user experience, as well as data volume and quality. These findings led researchers to set a priority goal for the future iterations of the crash report to shift more responsibilities to the system.

2.1.3 Cognitive Walkthrough

Observing user interaction with the legacy crash report interface was an important task for the research team to effectively redesign Minnesota's crash reporting system. To investigate how a motor vehicle crash would be documented in everyday practice and to gain a better insight into system use, the research team conducted a series of cognitive walkthroughs and testing sessions with law enforcement officers (Polson et al., 1992). A cognitive walkthrough is a human factors tool used in usability studies, one that allows researchers to understand the perspective of the user in usability. The purpose of the method is to identify the key problems of usability that users encounter or report while completing a specific task. In this case, the cognitive walkthrough is utilized to a) benchmark the legacy system and user performance, b) identify areas of the system that inhibit productivity and accuracy, and c) establish a working plan to address the issues

identified. Results of a walkthrough can also help researchers better understand the tactics users make to complete the task, and from that understanding new approaches that better suit the user can be made.

2.1.3.1 *Participants*

Twelve law enforcement officers participated in the cognitive walkthrough exercises. Participating agencies included seven throughout the Minneapolis metro region: West Hennepin, Bloomington, Richfield, Apple Valley, Minneapolis, and Eden Prairie Police Departments (see Table 2.1). Two officers from the Minnesota State Patrol were also asked to participate in these usability exercises. Although the sample was inherently biased due to the locational proximity of the departments, researchers made the decision to use this sample of officers because of feasibility in recruitment. Time and availability conflicts for police departments and researchers alike guided the make-up of this sample for the initial round of usability testing.

Each officer who participated had a working knowledge of the legacy crash reporting system, with most having multiple years of experience associated with the report. Table 2.2 notes the number of years participants had worked with the legacy report and Table 2.3 documents the range of law enforcement ranks among participants.

Table 2.1 Recruited Agencies

State Agency	N
West Hennepin	1
Bloomington	2
Richfield	2
Apple Valley	3
Minneapolis	1
Eden Prairie	1
MN State Patrol	2
TOTAL	**12**

Table 2.2 Legacy Report Experience

Years of Report Experience	N
1-5	2
6-10	4
11-15	5
20 or more	1
AVERAGE	**10**

Table 2.3 Law Enforcement Rank

Rank	N
Officer	8
Sergeant	3
Investigator	1
TOTAL	**12**

2.1.3.2 *Cognitive Walkthrough Procedure*

The objective of the cognitive walkthrough was to encourage officers to "think aloud" regarding the manner in which they completed the original crash report. This exercise is a common method of prompting users to identify common errors and issues through observing their interaction with the system during an entire process.

The process was scheduled to take place in squad cars during ride-alongs with officers to maintain a real-life context for the officers. Many officers, however, did not complete the crash report in their squad car. Rather, a majority of officers completed crash reports in the station at a desktop computer. Researchers videotaped and observed officers filling out the report. The goal was for researchers to better understand the step-by-step procedure the officers follow when completing the form. Researchers noted specific features that officers commonly interact with

and identified concerns that occur when filling out the report. When required, the researcher posed questions to the participants to clarify any ambiguities about what is being observed or have the officers justify what they have just done. Probing helped provide insight into users' difficulties with response and control, allowing the researchers to identify features on the interface and wording of the instructions that may be contributing to the errors and confusion. Interviews were conducted to extract information about the needs and preferences of officers to assist in the user-centered design process (Kuniavsky, 2003).

2.1.3.3 *Cognitive Walkthrough Results*

The cognitive walkthrough was utilized to gauge the inwards thinking processes of officers during the phases of completion in the report. The process presented an opportunity for researchers to gather qualitative data about the officer thought-process that might otherwise not be recorded by conventional means (e.g., survey responses). Results of the cognitive walkthroughs (along with the hierarchical task analyses) exposed critical issues with the report. Aspects of the legacy report prove to be confusing for officers at times. The uncertainty of both the rules and requirements of data entry in a crash report led to erroneous use of the system.

Officers were observed entering extraneous units in the circumstance of a hit and run without information on the offending vehicle. Officers would enter "2" for the amount of units in the collision, which was incorrect and did not reflect the actual crash at hand. Further, the entry of incorrect information pertaining to the amount of vehicles involved in the crash would create issues later in the report: officers entered driver and driver position in the offending vehicle, an erroneous vehicle 2, as well as estimated injury status of the unknown driver. Unfortunately, the legacy report does not have a field for an "unknown" choice at this level of the report, meaning that any data entered for traffic records analysis was completely inaccurate and may lead to skewed

The opportunity for improper data entry in the legacy report was also observed in the scenario of a parked and unoccupied car, where users were accustomed to entering incorrect data regarding drivers of the unoccupied vehicle. Again, this extraneous data entry which officers performed to simply satisfy the requirements of the legacy report exemplify the need for a redesign of the crash reporting system in Minnesota; officers were observed entering confounding and problematic "junk" data in the system to complete the report, which ultimately arrives to the Department of Public Safety's traffic records statisticians for analysis. These observations on usability, using the cognitive walkthrough and hierarchical task analysis methods, underline the need for a user-guided development procedure to ensure quality collision records.

Issues related to improper data entry were further documented. Officers appeared to rely heavily on the narrative portion of the report as a means to clarify or justify information they had entered in the report. For example, in scenarios where many passengers were involved, officers were apt to enter the general information of the passengers in the narrative, rather than the entry fields in the report. This misuse of the report can prove problematic for traffic records data analysts.

A formatting issue with the report and the printed copies of the reports for distribution to affected drivers was identified in the insurance company and policy number portion of the paper report. Insurance provider and policy numbers were often abbreviated or shortened due to the fact that

the patrol car-based printers would not allow the information to be printed on one line. Another critical human factors issue was identified in the paper report, as it was explained to researchers that officers and drivers alike had to refer to a coding key to understand portions of the report.

2.1.4 Card Sorting Usability Exercise

Card sorting exercises are a well-established technique to reveal how people logically organize information in their mind. It is frequently used to inform a system's design, such as information architecture, menus, websites, and workflow, by placing the user at the center of the design (Dickstein & Mills, 2000). Card sorting is most effective if the items included are limited to no more than 40 and the strength of the analysis is most powerful if there are at least 40 participants included. HumanFIRST utilized this technique as a means of establishing the information architecture, in conjunction with the hierarchical task analyses. The goal of this exercise was to establish logical categories and an organizational structure based on how officers process the information (potentially much different from the categories in the legacy system) to improve the intuitiveness of the crash report.

2.1.4.1 *Participants*

Survey responses were received from officers across 67 law enforcement agencies (police departments (PD), Sheriff's departments (SD), and MN State Patrol) and are shown in Table 2.4 (listed in alphabetical order by name and number of participants noted (N)).

Table 2.4 List of Participating Law Enforcement Agencies by Name and Number of Respondents from Each Department

City	N	City	N	City	N	City	N	State/County	N
Albany PD	3	Eagan PD	1	Melrose PD	1	Robbinsdale PD	1	Benton Co. SD	7
Apple Valley PD	4	East Grand Forks PD	3	Minneapolis PD	6	Roseville PD	1	Carlton Co. SD	1
Avon PD	1	Edina PD	3	Moorhead PD	7	Saint Peter PD	1	Clay Co. SD	2
Belle Plaine PD	1	Farmington PD	3	New Prague PD	1	Sartell PD	3	Dakota Co. SD	3
Bemidji PD	1	Fergus Falls PD	2	North Mankato PD	3	Sauk Center PD	2	Douglas Co. SD	1
Bloomington PD	3	Hopkins PD	4	Owatonna PD	3	Sauk Rapids PD	2	Mahnomen Co. SD	1
Blue Earth PD	1	La Crescent PD	1	Park Rapids PD	1	So. Lake Minnetonka PD	2	MN State Patrol	21
Brainerd PD	4	Lake Benton PD	1	Paynesville PD	1	St. Cloud PD	19	Norman Co. SD	1
Burnsville PD	5	Lake City PD	1	Princeton PD	1	Truman PD	1	Polk Co. SD	1
Cannon Falls PD	1	Lake Crystal PD	1	Prior Lake PD	1	Waseca PD	1	Sterns Co. SD	7
Coon Rapids PD	2	Le Center PD	1	Red Lake Nation PD	1	Wayzata PD	1	Wadena Co. SD	1
Cottage Grove PD	1	Mankato PD	2	Rice PD	1	Willmar PD	1		
Deephaven PD	1	Marshall PD	1	Richfield PD	3	Zumbrota PD	1		

A total of 167 law enforcement officers participated in the card sorting usability exercise. The participant population had a great deal of demographic variance, with experience using the legacy report ranging from one year of familiarity, to decades of regular use (*M*=19.9, *SD*= 10.9). Years of experience on the force varied similarly, as well (*M*=15.6, *SD*= 13.72). An impressive number of agencies, 67 in total, participated in the exercise. Table 2.4 details

(alphabetically) the location of the agency, the type of agency (MN State Patrol, SD sheriff's department, and PD Police Department).

2.1.4.2 *Method*

Researchers provided instructions to the officers on how to complete the card sorting task. The online vendor OptimalSort was employed for the exercise, as it would have not been feasible for researchers to perform the card sorting task in person. The exercise was available online for law enforcement officer access from February 28th, 2014 to March 20th, 2014. Officers grouped key words and characteristics of crashes (e.g., road characteristics, contributing factors, accident types) into stacks, as if they were sorting playing cards by suit. The grouping of the different variables of crashes and report-related fields provided HumanFIRST with a qualitative data set that shaped the design of the user interface mock-ups used for testing, which would ultimately reflect the final product development performed by the state's vendor, Appriss.

2.1.4.3 *Card Sorting Task Results*

Items within the legacy crash report were reduced to 38 items of interest and the results of the card sorting are displayed in Figure 2.3 and Figure 2.4. Two methods of analysis, actual agreement method and best merge method, were used and are described below. The conclusions of the analysis follow.

Card Sorting Dendrogram: Actual Agreement Method
This method, also known as the "skeptical dendrogram", depicts the factual relationships only. This is built based upon the number of instances in which participants agreed with items belonging together or within a grouping (any conflicting items are discounted) and represents the frequency that they agreed with the naming of a grouping. The x-axis indicates the percent of participants which agreed to a certain grouping. Labels which had consistent agreement across participants are listed on the figure. For example, 60% of respondents agreed that *drugs and alcohol*, *physical condition*, *driver's licenses* and *driver violations* belong together in one group and had high agreement to call that group "Driver's License Related".
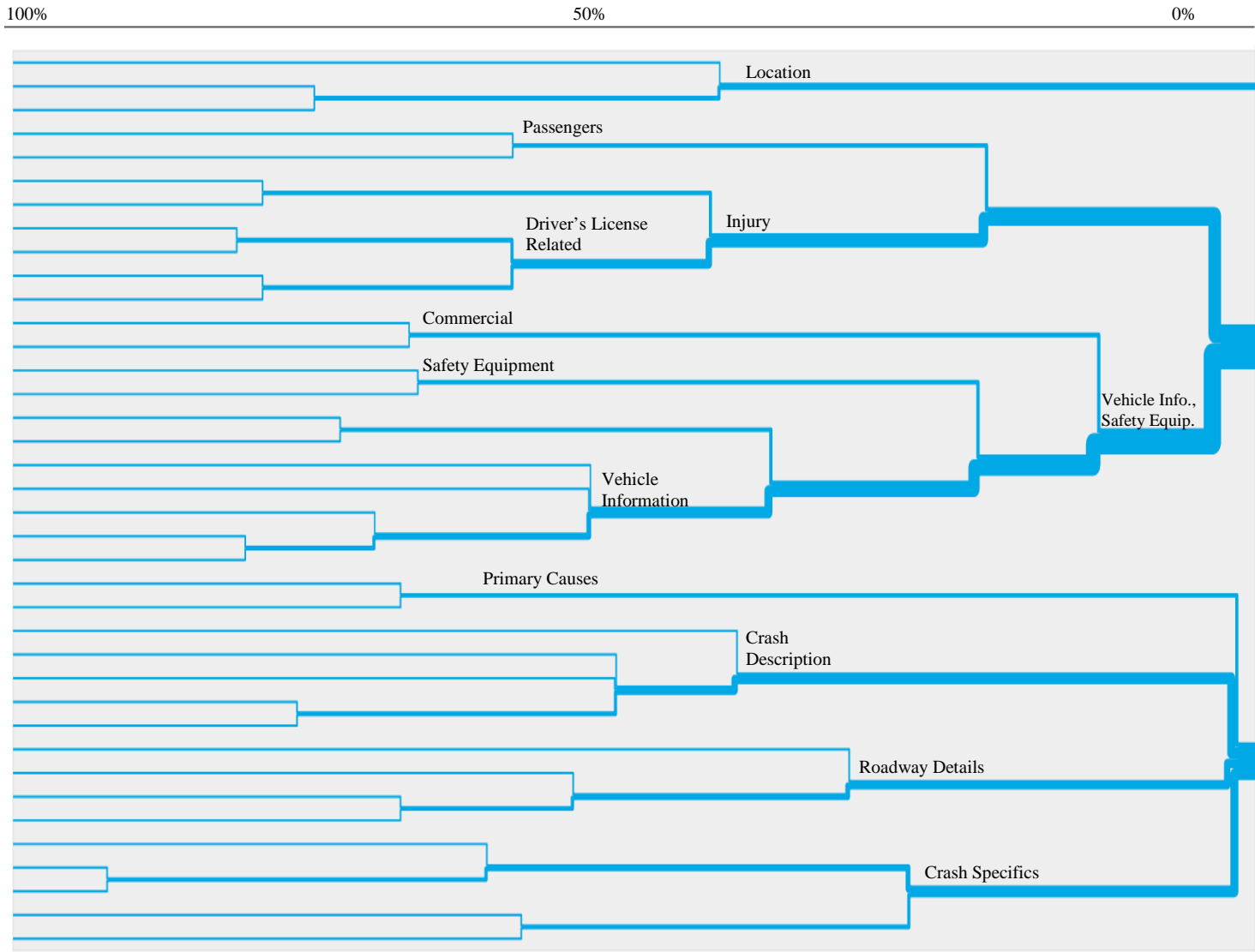
Figure 2.3 Graphical depiction of percentage of agreement for item grouping. Line thickness denotes the number of items associated with a grouping and the point at which the lines converge demonstrates the percentage of users who agree with the grouping (x-axis: high agreement on left and low agreement on right).
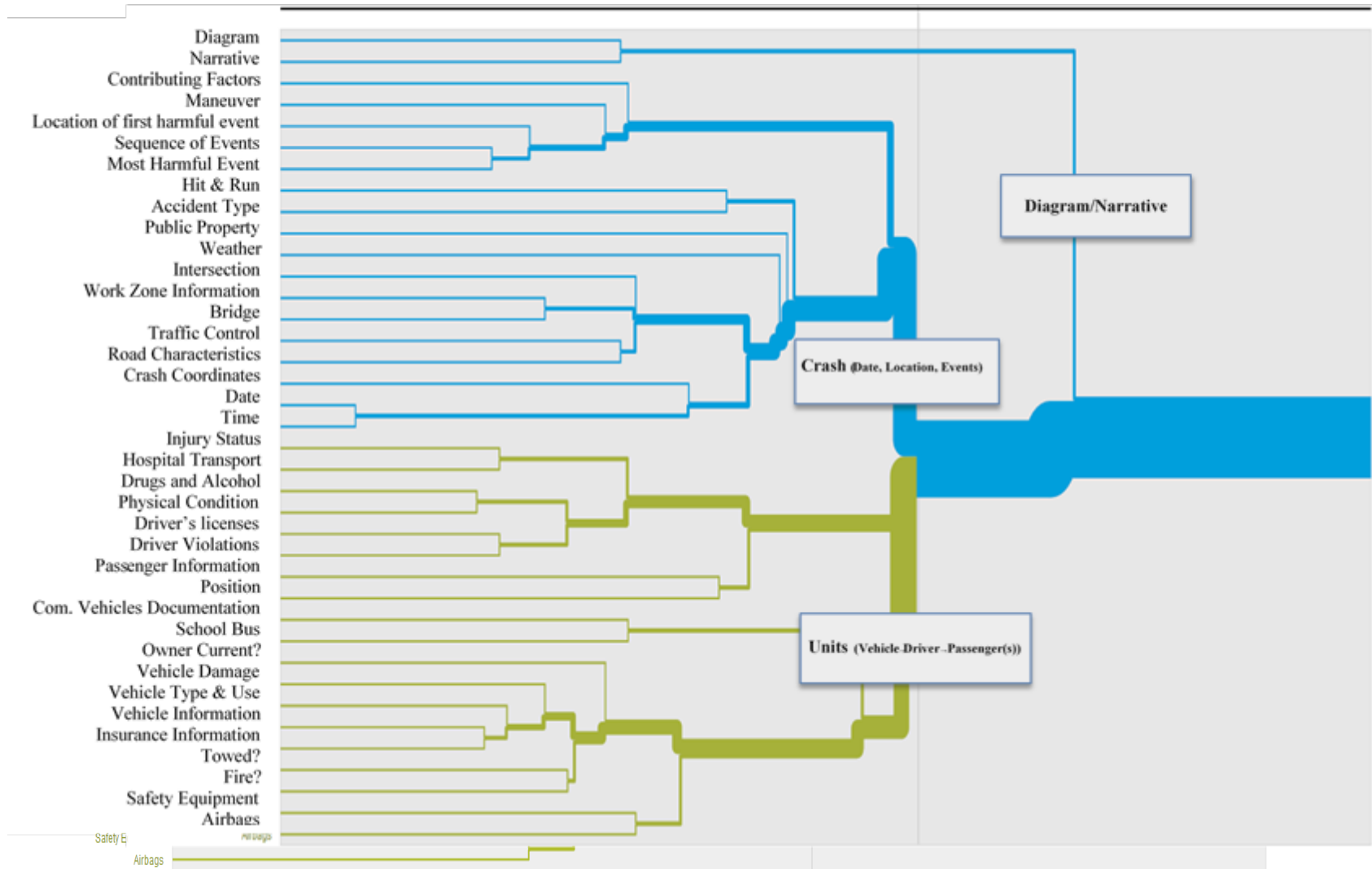
Figure 2.4 Graphical Depiction of Agreement for Item Grouping Based on Actual Agreement and Best Merge Method Algorithm.

The similarity matrix shown in Table 2.5 demonstrates the percentage of participants who agree with each card pairing. For example, 73% of users agreed that *Bridge* and *Work Zone Information* belong together in a group. The highest ranking pairings for each item were used in the Best Merge Method algorithm to form larger group clusters than what was depicted in the actual agreement method.

Table 2.5 Similarity matrix depicting percent of agreement across users for each pairing combination

```
Date
94 Time
63 62 Crash Coordinates
46 47 55 Intersection
29 29 43 66 Road Characteristics
23 24 40 62 69 Traffic Control
22 21 38 55 65 63 Bridge
15 16 29 44 54 58 73 Work Zone Information
36 37 40 41 40 47 48 40 Public Property
47 47 42 32 25 31 23 20 45 Hit & Run
53 54 49 40 37 37 27 20 44 60 Accident Type
55 54 47 49 49 44 39 33 35 37 50 Weather
19 20 30 30 34 36 23 21 30 29 40 31 Location of first harmful event
12 13 22 19 28 29 16 17 26 27 37 25 77 Most Harmful Event
16 15 20 19 27 29 18 14 26 29 38 25 71 80 Sequence of Events
10 11 13 16 22 25 14 11 21 22 34 21 55 66 66 Manuever
11 11 13 16 25 26 14 14 18 24 32 29 48 62 60 64 Contributing Factors
2 2 2 2 2 3 1 3 2 5 2 5 5 9 11 19 33 Drugs and Alcohol
0 0 3 2 4 4 3 2 2 3 3 3 7 11 13 20 26 80 Physical Condition
1 1 4 2 3 3 4 5 2 3 4 1 6 8 9 17 23 70 72 Driver's licenses special cases
3 3 3 3 3 2 1 3 1 5 4 3 4 9 8 19 28 70 66 79 Driver Violations
4 4 3 3 2 3 0 0 1 4 2 4 5 7 7 14 22 66 63 59 61 Injury status
2 2 2 1 3 3 4 4 3 3 2 3 6 8 10 14 19 61 61 57 52 79 Hospital Transport
5 4 8 7 6 7 4 4 3 4 5 4 10 12 13 22 22 46 48 52 50 54 50 Position
3 3 1 1 1 1 0 1 0 4 0 3 1 4 5 9 13 37 39 44 40 46 42 58 Passenger Information
1 1 0 0 1 0 2 3 3 8 3 0 7 7 7 15 5 14 18 26 22 14 13 25 31 Owner Current?
3 3 2 3 2 1 0 2 2 12 2 2 5 6 6 15 4 7 8 11 9 9 7 18 24 73 Vehicle Information
3 3 1 2 0 2 0 1 3 11 1 2 3 4 4 14 3 11 13 15 13 11 11 17 24 68 82 Insurance information
2 2 4 4 7 5 5 3 5 11 7 3 11 11 12 21 7 5 12 12 7 5 5 16 16 66 81 72 Vehicle Type & Use
1 1 3 3 3 4 2 3 8 11 6 3 11 11 11 21 7 4 7 8 6 7 5 16 15 65 78 71 74 Vehicle Damage
2 2 3 3 4 7 3 3 9 17 6 4 7 7 8 16 5 7 7 6 7 9 10 11 14 61 76 66 70 73 Towed?
6 7 9 10 12 13 13 14 18 25 14 11 14 16 15 22 11 7 7 5 4 9 14 7 11 48 55 50 55 54 70 Fire?
3 3 3 3 4 6 3 3 4 10 3 3 9 8 7 17 7 12 14 13 11 24 20 25 22 51 63 58 60 62 60 49 Airbags
2 2 3 4 5 7 3 5 4 9 4 3 7 8 8 18 14 29 29 33 31 37 33 38 29 36 44 42 44 42 44 34 65 Safety Equipment
4 4 8 6 9 15 27 32 17 14 8 8 9 6 7 10 6 3 4 6 2 3 9 9 7 34 38 33 42 36 37 40 31 22 School bus
1 1 4 1 3 7 13 17 8 8 3 3 3 6 7 11 4 5 5 8 3 4 8 10 11 37 41 37 42 35 38 37 31 21 65 Commercial Vehicle Documentation
17 16 18 20 16 16 13 11 17 16 22 13 22 18 23 14 16 3 4 1 3 7 5 6 3 2 4 3 4 4 9 7 3 7 6 3 Diagram
16 15 13 11 8 7 6 6 11 11 16 11 16 16 21 13 13 5 4 1 5 7 4 5 3 1 1 2 1 2 3 3 2 3 1 3 67 Narrative
```

2.1.4.4 *Card Sorting Task Conclusions*

On average, the 155 users sorted the cards into 7 groups. There was certain amount of variability across users in terms of how many groups they feel are appropriate and what items belong in those groups. Based on the Best Merge Method and conclusions drawn from the cognitive walkthroughs and surveys, the design of the report is suggested to be centered on 3 main groups with several subgroups, approximately 7 major groups. The Figure 2.5 graphical depiction below demonstrates one possible organization of a future crash report. The structure would follow a one-to-many format (i.e., one crash-to-many units (one driver-to-many passengers)). The final proposed format will be determined after beta testing and iterative usability testing with users.
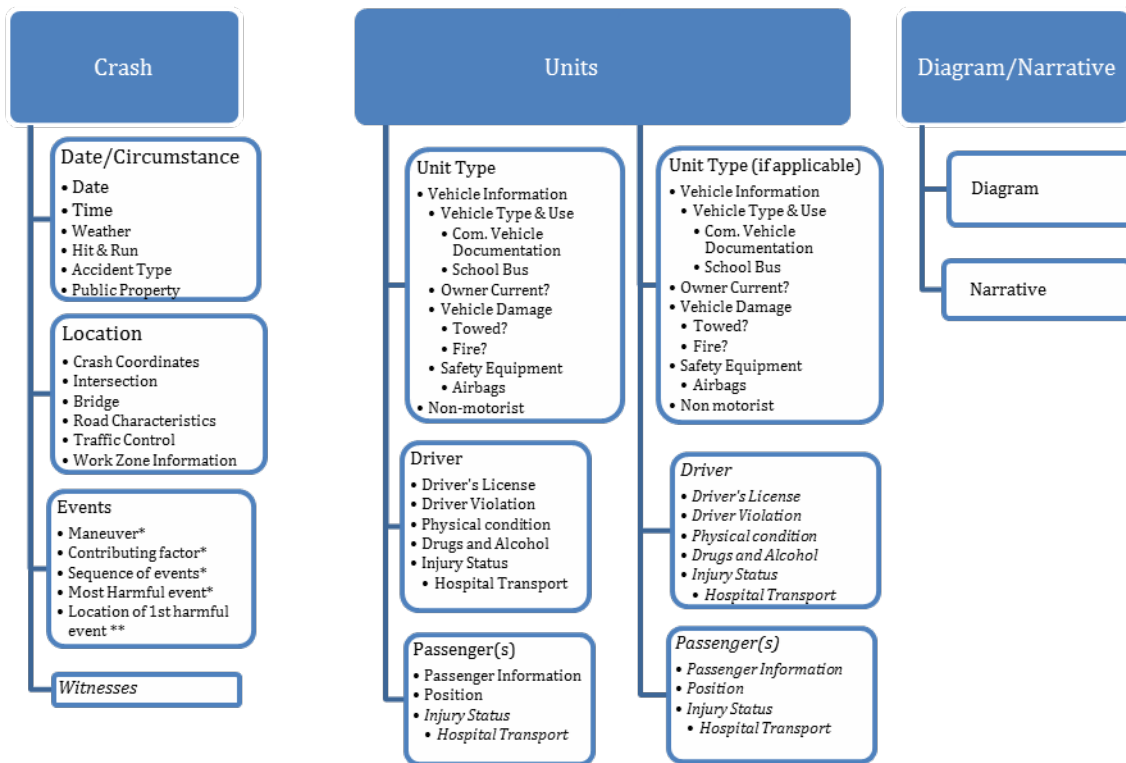
Figure 2.5 Graphical Depiction of Possible Organization of Items Within the Crash Report.
* represent items which require more consideration because they are applicable to all units.
Italicized items represent items not included in the card sorting exercised or have been repeated.

2.2 Improving the Legacy Crash Report

HumanFIRST researchers developed an outline focused on the detailed analysis of the cognitive walkthroughs, interviews, hierarchical task analyses, and card sorting task. The proposed fixes expand on the issues discovered by the heuristic evaluation and identified more areas for improvement in the legacy report.

2.2.1 Plans for Crash Report Prototype

Ten general plans for action regarding the redesign of the crash report were implemented in a preliminary outline by HumanFIRST. These plans describe the areas of the report where each planning step for improvement should occur, however, although this list does not include the

entirety of design revision suggestions. Rather, it provides an outline for the initial approach to solving critical problematic traits of the legacy crash report system. These guidelines were incorporated into the design plan to minimize user effort, maximize the user's efficiency while completing the report, and reduce the level of erroneous data submitted to the state:

1. Clearly describe what exactly each variable is asking for
2. Clearly describe the necessary/optional fields
3. If/then logic application to specific data entry fields
4. Incorporate auto-populate functions (MN-Fill, DL #)
5. Description boxes if "other" is selected
6. Internal consistency of the report system
7. Error prevention by restricting the number of possible actions (e.g., dropdown menus).
8. Standardized format throughout the report
9. Autocomplete function (providing suggestions as you type in the field)
10. Eliminate character limits, increase number in narrative portion

The structure and flow of the report were guided largely by the results of the card sorting exercises and interviews. A one-to-many structure and ordering was preferred among officers (see Figure 2.6) over the more fragmented and many-to-one order of the legacy system.
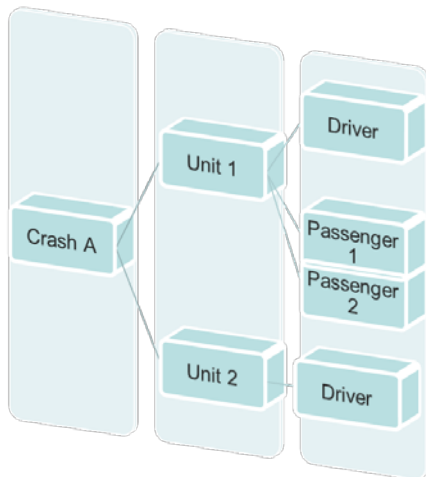
Figure 2.6 One-to-many structure proposed for the new crash report system.

2.3 Phase One Summary

The outcomes of these analyses set the foundation on which to develop the new crash report. The results of these human factors queries provide the guidance to specifically attend to the needs of users, ensuring that the human component would drive the redesign. This user-centric approach to the development of MNCrash is regarded as one of the most critical components to its success.

Chapter 3: CRASH REPORT MOCK-UP AND USABILITY TESTING

3.1 Phase Two: Iterative Design and Usability Testing Introduction

The outcome of the Phase One exercises assisted researchers to establish logical categories and an organizational structure to improve the intuitiveness of the crash report to require minimal training and time to complete. Overall, officers communicated that a one-to-many structure and ordering (i.e., crash level, vehicle level, driver level, and passenger level) was most preferred for future iterations of the report. Additionally, the information gathered from the interviews with local and state law enforcement informed researchers of potential reliability issues within the report, areas of common problems or misunderstanding, and desired features for the future report. All of this information was integrated into an initial mock-up to begin the iterative design and testing process.

3.1.1 Initial Mock-Up and Usability Testing

The conclusions drawn from interviews and officer feedback were that there was no clear direction relating to the general type of interface which would be the most logical fit for the new electronic crash report. Many officers reported a level of comfort with the legacy system's "form-style" interface, while other officers touted the high user satisfaction experiences with the e-charging system's "wizard-style" interface. Both interface options were seen as viable tools for the future report given the varying degrees of computer proficiency and comfort among Minnesota's officer population; however, researchers sought law enforcement input to determine which option would have the greatest user acceptance. Relying on the legacy system's form-style interface as a comparison to a wizard-style interface was seen as problematic since researchers would be unable to control for differences in functionality, content, and design which would otherwise likely bias user feedback. As a solution, two novel interface prototypes were created using largely the same functionality, order, and content of information for an equal comparison of the Wizard and Form-based interfaces. The aim of this exercise was to determine which of the two interfaces had the most user acceptance. The intent was to proceed with development of the more preferred interface option. The initial crash report testing utilized single-unit crash scenarios that researchers felt would clearly result in a preference for one interface over the other, once officers had used both in similar mock-crash report data entry exercises.

Wizard Interface

A wizard-based interface queries users through a step-by-step series of dialog boxes (see Figure 3.1). It is beneficial because it has the capability to: a) lead the users through a predetermined road map – this prevents navigational errors and minimizes mental effort on users' end since they simply just have to follow the instructions and answer each question accordingly instead of having to determine the entire system structure, b) break up the task into manageable chunks, and thereby reducing clutter on any given screen, and providing more space for explanations and illustrations, and c) dynamically change the information presented downstream based on logic structuring. The drawbacks to the wizard-based interface are that it: a) restricts the navigational paths the users can take which can be frustratingly rigid and limiting for the users and b) provides little context making it harder for the user to formulate a mental model of how the pieces fit together.
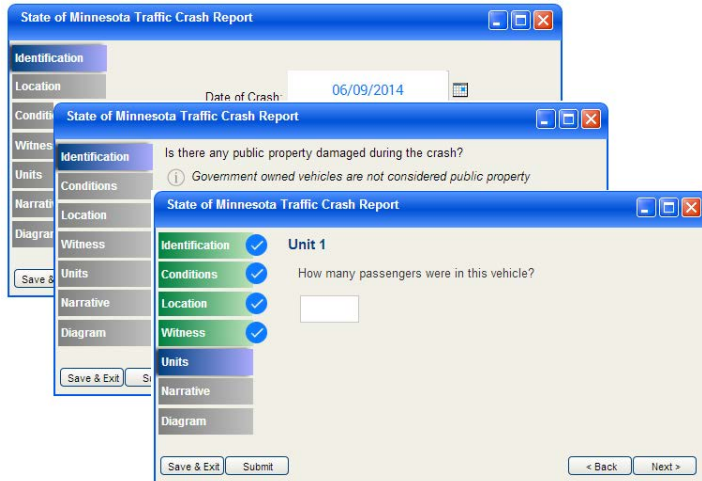
Figure 3.1 Example of the Wizard interface prototype.

Form Interface

The Form interface was seen as an attractive alternative solution as it allows the information structure to more closely adhere to the user requirements established through the card sorting exercise and interviews (see Figure 3.2). It is beneficial because: a) users know what to expect since more information is presented at once, b) users can more efficiently navigate between entry fields through keystrokes, and c) each section is accessible should users choose to skip from section to section at their own discretion. The drawbacks to the Form interface are that it: a) contains more clutter, typically requiring more mental effort, and b) requires the user to make more navigational decisions and may require more training.
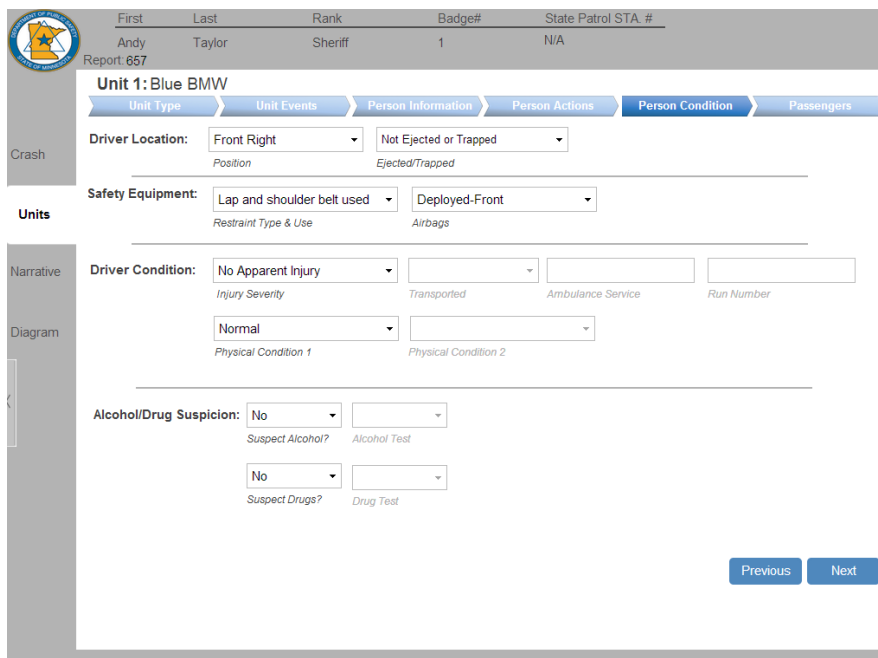
Figure 3.2 Example of the Form interface prototype.

Independent of preference, HumanFIRST researchers were interested in assessing officers' needs when entering data into both prototype crash report interfaces. Since users of the new system

would vary greatly in age, experience using the legacy crash report, years of law enforcement experience, and exposure rates to crashes, researchers understood the need for flexibility in an interface that would meet the requirements of the diverse user population. The development of two interfaces, the Wizard and the Form, were created with the variability in officer demographic in mind in order to satisfy the unique needs for officers statewide.

3.1.1.1 *Participants*

The intended users of the new computerized crash report would include law enforcement personnel from agencies across the state of Minnesota who would vary in rank and years of experience working with the legacy crash report system. Given the time constraints, however, it was not possible to attain a representative sample of participants. While convenience sampling is subject to biases, it was a necessary trade-off for this phase of research.

A total of five law enforcement officers were recruited from agencies within the 5-county metro (see Table 3.1). The sample size was appropriate for this stage of study because the number of problems identified have been found to increase with sample size but plateaus after 5-6 people (Wickens, Lee, Liu, & Gordon Becker, 2004). The participants in this study varied in rank and years of experience working with the legacy crash report (see Table 3.2 and Table 3.3).

Table 3.1 Recruited Agencies

Agencies	N
West Hennepin	1
Richfield	1
Minneapolis	1
MN State Patrol	2
TOTAL	**5**

Table 3.2 Legacy Report Experience

Years of Report Experience	N
0-5	3
6-10	1
11-15	1
AVERAGE	**5**

Table 3.3 Law Enforcement Rank

Rank	N
Officer	2
Sergeant	3
TOTAL	**5**

3.1.1.2 *Materials*

Wizard and Form interfaces were created using Justinmind Prototyper Pro software. Variables and attributes were used from the existing Hierarchical Task Analysis (HTA) from Phase One and from the most up-to-date version of the Crash Data Users Group (CDUG) crash variables spreadsheet. The prototypes were limited in functionality, did not contain a comprehensive inclusion of the crash variables, and were designed to best accommodate a single vehicle crash only. The Wizard interface featured standard wizard design which queried through a sequence of dialog boxes featuring detailed questions on each screen. Conversely, the Form interface featured a less structured flow of information, with larger screens containing many entry points, and less detailed questions presented within each screen.

The Wizard interface contained 37 separate screens containing an average of 1.6 questions on each screen. The Form interface contained 10 separate screens containing an average of 13.6 questions on each screen. Both interfaces were converted into an interactive HTML format and were emailed to law enforcement participants ahead of the testing session so that they could be

accessed from the officer's computer. A computer mouse and keyboard were necessary for data input into both interfaces.

3.1.1.3 *Method*

Law enforcement participants met with researchers at their home stations. The order of interface presentation was counterbalanced across participants. Law enforcement participants spent approximately 20 minutes examining each interface. Participants were provided a brief background of the state of the prototypes and were asked to review each prototype through an open-ended, exploratory test (i.e., participants were given no structure by which to examine the report and were not asked to input any specific information). Participants were encouraged to "think aloud" as they navigated through the interface, noting the features which might seem confusing, they liked, or disliked, etc. When required, researchers posed questions to the participants to clarify any ambiguities about what was being observed or have the participants justify what they had just done. Probing helped provide insight into participants' difficulties with response and control, which allowed the researchers to identify features on the interface and wording of the instructions that may cause errors or confusion. Once participants had navigated through each interface to their satisfaction, they were provided a brief survey assessing their subjective rating of the interface (see Appendix C) and any comments were documented about their likes or dislikes regarding the interface.

3.1.1.4 *Results*

Participants rated their perceived usability of each interface. The total rating possible was 20 points: expressing they found the interface essentially useful, very easy to learn, very easy to use, and very satisfying to use. Overall, the participants showed slightly higher usability ratings for the Wizard interface ($M = 18$, $SD = 1.2$) and slightly lower usability for the Form interface ($M = 16.8$, $SD = 1.9$). The difference between the two was not significant, however.

Form Interface: Issues raised
There were multiple aspects of the interface that were deemed problematic or confusing by participants. In general, the main issues for concern brought to the researchers' attention were:
- Confusion over creating unique label of the crash report
- The orientation of the Crash Type and Sequence of Events subsections and the selection of each subsection
- Confusion over the manipulation of the unit tabs, (e.g., adding units and determining which unit was currently in use)
- The use of driver's license MnFill features in the passenger and witness sections

Wizard Interface: Issues raised
Similarly, there were multiple issues documented with the Wizard interface. The main issues which were brought to the researchers' attention were:
- Users found it quite cumbersome to have to click to open up the help systems
- Lack of perceived affordance with the interactive help systems
- Some participants did not bother to consult the help systems
- Visibility of important keywords in the instructions for Sequence of Events
- Poor user reception of the radio button design for Crash Type and Sequence of Events

The outcome for interface selection from this stage in testing and development was inconclusive. Both interfaces received generally positive reviews from users. Based upon the feedback researchers received, the best option for advancement of the project was to continue development of both interfaces. It was hypothesized that upon further development (i.e., capability to receive more complex crash scenarios) of each interface type, a clearer preference for a single interface format would become more apparent. The comments and problems identified for both interfaces in the initial testing were addressed immediately so that the next stage of prototype testing included the updated designs.

3.1.2 Formal Mock-up and Usability Testing: Two-Unit Crash

Given that there was no clear preference between the interface options after the user testing of the initial mock-ups, more extensive development of both interfaces, i.e., Wizard and Form-based reports, was carried out and guided by the initial feedback from officers. The aim of this round of iterative design was to create both interfaces with known variables for the future crash report pertaining to a two-unit, injury crash and to test the user acceptance of each among law enforcement around the state of Minnesota.

3.1.2.1 *Participants*

A total of twelve law enforcement officers were recruited from agencies across Minnesota (see Table 3.4). Researchers specifically recruited law enforcement agencies outside of the Twin Cities metropolitan region to best capture the diverse needs of users across the state. The participants in this study varied in rank and years of experience working with the current crash report (see Table 3.5 and Table 3.6).

Table 3.4 Recruited Agencies

Agencies	N
St. Cloud	1
Sterns County: St. Cloud	1
Sartell	1
Albany	1
St. Peter	1
North Mankato	1
Farmington	1
Cannon Falls	1
Eagan	1
Apple Valley	3
TOTAL	**12**

Table 3.5 Legacy Report Experience

Years of Report Experience	N
6-10	5
11-15	4
20 or more	3
AVERAGE	**13**

Table 3.6 Law Enforcement Rank

Rank	N
Officer	9
Sergeant	2
Captain	1
TOTAL	**12**

3.1.2.2 *Materials*

Wizard and Form interfaces were further developed using Justinmind Prototyper Pro software. Additional variables and attributes were added to each interface based on additional information provided by the CDUG group; all variables and attributes had not been fully defined by CDUG,

so the interfaces did not contain all fields which are expected to be implemented at later stages. The prototypes contained improved functionality, but were limited in keystroke capabilities (i.e., tabbing into dropdown boxes and buttons) and were designed to accommodate a two vehicle crash only. The designs of both were continually improved throughout this round of user testing. This allowed for less experimental control across participants (i.e., each participant may have experienced a slightly different interface than those preceding them); however, this was a necessary aspect of the study to continue the iterative design process.

The Wizard interface contained 57 separate screens containing an average of 3.4 questions on each screen. The Form interface contained 19 separate screens containing an average of 14.3 questions on each screen. The interfaces were presented in the Justinmind Simulation Mode to officers on the researchers' laptops (with external mouse). The sessions were recorded through screen video imaging and audio recording using Morae software which allowed for all activities on the screen to be recorded and documented for later analysis.

Form Interface: Issues addressed from initial mock-up
The aspects of the Form interface that were deemed problematic or confusing in previous testing were addressed in the iterative design. Overall, the main sections modified were:
- Changing the naming report feature to a simple report number query
- Reorienting Crash Type subsections to a vertical alignment
- Removing the need for radio buttons from the Crash Type and Sequence of Events sections
- Removing the unit tabs and replacing them with a discrete screen for listing unit numbers and names
- Including driver's license MnFill features within the passenger and witness sections and clarifying their optional status (see Figure 3.3).

Wizard Interface: Issues addressed from initial mock-up
The aspects of the Wizard interface that were deemed problematic or confusing in previous testing were addressed in the iterative design. The following design changes were implemented:
- Revealing pop-up boxes on 'hover' as opposed to 'click'
- Increasing perceived affordance: presenting interactive elements in blue, underlined text so that it invites clicking
- Wherever space permits, displaying *directly on the screen* any extraneous information that would help the officer fill out the report
- Highlighting system status so that the users are aware of where they are in the system when filling out the Sequence of Events

Both Interfaces: Issues addressed from initial mock-up
- Implementing nested menu structures for Crash Type and Sequence of Events sections (see Figure 3.4).

Figure 3.3 Example of the additional auto-population functions (MN Fill) to passengers and witnesses.

Figure 3.4 Example of the Wizard sequence of events nested menu structure.

Two survey tools were used during testing. The System Usability Scale (SUS), was administered after each interface session to measure subjective usability through a ten-item attitude Likert scale (see Appendix B). The second, the Rating Scale Mental Effort (RSME), was administered after each SUS to measure subjective mental workload (see Appendix A).

3.1.2.3 *Method*

Law enforcement participants met with researchers at their home stations. The order of interface presentation was counterbalanced across participant. Law enforcement participants spent approximately 20-25 minutes examining each interface. Participants were provided a brief background of the state of the prototypes and were asked to enter information about a two vehicle crash involving a witness and passengers (see Appendix D for an example scenario).

Participants were asked to review the crash details before beginning, were allowed to review the document for their reference, but could also ask researchers questions regarding the crash. Participants were encouraged to "think aloud" as they navigated through the interface and entered data. Researchers also encouraged the participants to express their thoughts on the usability of the system, aspects of the report that they felt were either helpful or exhibited shortcomings, as well as general opinion and preference for any specific trait in the MNCRASH client. Morae software recorded all activities on the screen while the participant interacted with the interface as well as collected the audio commentary of participants while they navigated each. Once participants had entered all of the crash information into each, they were provided the SUS and the RMSE to rate the interface usability and their perceived mental workload while interacting with the task. Once participants completed crash detail entry into both interfaces and completed both sets of surveys, each were asked to state which of the two interfaces best represented an interface they would like to see developed for use in the field and to state the reasoning for their answer.

3.1.2.4 *Results*

Task Duration

The duration of each crash report entry was examined for each interface of each participant. Three durations were examined for the purposes of this analysis: total duration, sequence of events duration (Vehicle 1), and passenger 1 and 2 information duration (Vehicle 2), see Table 3.7. These three where chosen because they were seen as important to highlight the potential differences in completion times which may be impacted by the interface type. Total duration is presented in two columns. The first is the overall duration from start to finish for each interface. The second is a controlled duration with the time to complete the user registration from the Form interface and the time to complete the vehicle damage information from the Wizard interface removed. These two elements were removed from the time sequence because they contained specific elements which were not found in the other interface and did not allow for an equal comparison. The average time (*M*) across all participants and the standard deviations (*SD*) are presented in the table below.

Table 3.7 Task duration across both interfaces

	Total Duration	Controlled Duration	Seq. of Events Duration	Passenger Info. Duration
Form Interface	M = 24.4 min SD = 6.5 min	M = 23.5 min SD = 6.5 min	M = 1.6 min SD = 1.0 min	M = 2.0 min SD = 46 sec
Wizard Interface	M = 25.3 min SD = 8.1 min	M = 20.4 min SD = 7.1 min	M = 1.4 min SD = 56 sec	M = 1.2 min SD = 43 sec

*Differences are not statistically significant.

It is important to note that, although participants were slightly faster to complete tasks in the Wizard, no differences were found to be statistically significant. Thus, no conclusion could be drawn at this iteration of the design, especially since each interface did not contain exactly the same number of variables. The Wizard interface contained approximately 191 data entry fields and the Form interface contained approximately 272 fields. Additionally, participants were much

faster (M = 7.2 min) to complete an interface when it was presented second in order. This effect was controlled for, however, by counterbalancing presentation across participants.

System Usability Survey (SUS)
Participants rated their perceived usability of each interface on the SUS. The best possible rating was 100 points, expressing that they would like to use the interface, they did not find it unnecessarily complex, it was easy to use, and well integrated, etc. Overall, the participants showed slightly higher usability ratings for the Form interface (M = 73.8, SD = 18.8) and slightly lower usability for the Wizard interface (M = 72.9, SD = 19.0), see Table 3.8. The difference between the two was not significant, however. A SUS score of 68 is considered to be above average, so overall, both interfaces were rated with generally high usability

Rating Scale Mental Effort (RSME)
Participants rated their perceived mental workload on the RSME. The best possible rating was 0, expressing that they had to use absolutely no mental effort to complete the task with the interface. Overall, the participants showed slightly lower mental effort ratings for the Form interface (M = 31.0, SD = 13.1) and slightly higher mental effort for the Wizard interface (M = 32.1, SD = 11.4), see Table 3.8. The difference between the two was not significant, however. The average RSME score of approximately 30 places the participants perceived mental effort for both interfaces as just above "a little effort" and below "some effort." Overall, these scores are considered low mental effort and indicate a positive outlook for both interface types.

Overall Preference
Participants were asked to decide which interface they would choose to best represent the actual future report. Overall, participants reported a slight preference for the Form interface (see Table 3.8), although this difference in interface preference is not statistically significant. Perceived mental effort (RSME, Appendix A) and overall usability ease (SUS, Appendix B) metrics were split relatively evenly, in addition to the close preference split. As found with duration, there was a slight order effect observed in that the second interface presented was more likely to be chosen as the preferred interface. This is likely due to a recency effect and confounded by the amount of time spent on each interface (i.e., the second interface took less time due to practice with the crash details and thus would be more preferable). Counterbalancing of the presentation order provided a control for the potential recency effect.

Table 3.8. Subjective rating scores

	SUS Scores	RSME Scores	Preference
Form Interface	M = 73.8, SD = 18.8	M = 31.0, SD = 13.1	58.3%
Wizard Interface	M = 72.9, SD = 19.0	M = 32.1, SD = 11.4	41.7%

Form Interface: Issues encountered
The modifications to the interface based on previous testing outcomes greatly improved many aspects of the interface. More sections were added to this iteration of design and testing which highlighted new issues to be addressed. The following observations were noted:
- Users failed to notice additional items which populated the screen after selecting a certain attribute (e.g., additional questions regarding damage if any amount of damage severity was indicated)

- Users feeling uneasy if information popped away after selecting a certain attribute (e.g., additional questions about transportation of the injured removed if no injury was reported)
- Confusion over selecting only one subsection dropdown list from the Sequence of Events questions
- Users erroneously placing the driver's license number into the First Name box in the Witness section

Wizard Interface: Issues encountered
The Wizard interface was also found to contain a few key usability items of concern.

- Terminology and comprehension issues with the attributes for Damage Location
- Poor visibility of important keywords in the instructions for Damage Location
- Lack of flexibility for user control in Sequence of Events
- Redundant data entry

Consistent with the previous round of usability testing, the outcome for interface selection from this task was inconclusive. Both interfaces received generally positive reviews from users. Overall, the users reported preference for how the Wizard guided them through the process step by step, but were opposed to its rigidity and limitations in terms of navigation compared to the Form interface. Based upon the feedback researchers received, the best option for advancement of the project was to continue development of both interfaces based on user feedback.

3.1.3 Formal Mock-up and Usability Testing: Fatal Crash/Hit-and-run/CMV

Each interface was further developed to receive data involving a two-unit crash with more complex attributes. The attributes added to the mock crash scenarios were: hit-and-run, commercial motor vehicles (CMV), and a fatal injury. These attributes were also added into the functionality and capabilities of the two prototypes. It was hypothesized that the differences in the number of screens or the assistance in being guided through more data entry involving additional units would create the right test bed to parse out which interface type best suited the needs of Minnesota's law enforcement officers.

3.1.3.1 *Participants*

Minnesota State Patrol officers are the users who are most likely to complete crash reports for commercial motor vehicle crashes and fatal crashes, according to information provided to researchers. Given the participant constraints, however, not all participants were State Patrol officers and a small subset included was local police officers and sheriff's deputies.

Twelve law enforcement officers were asked to participate in the second round of usability testing in Phase Two of the crash report development. Participating agencies included the Beltrami County Sheriff's Department, Bemidji Police Department, and the Minnesota State Patrol (see Table 3.9). Each officer who participated had a working knowledge of the legacy crash reporting system. Table 3.10 notes the number of years participants had working with the legacy report and Table 3.11 documents officer rank.

Table 3.9 Recruited Agencies			Table 3.10 Legacy Report Experience			Table 3.11 Law Enforcement Rank	

Table 3.9 Recruited Agencies

Agencies	N
MN State Patrol	8
Bemidji Police Department	2
Beltrami County Sheriff's Department	2
TOTAL	12

Table 3.10 Legacy Report Experience

Years of Report Experience	N
0-5	2
6-10	9
11-15	1
AVERAGE	7

Table 3.11 Law Enforcement Rank

Rank	N
Trooper	7
Officer	1
Sergeant	2
Captain	1
Deputy	1
TOTAL	12

3.1.3.2 *Materials*

Wizard and Form interfaces, created using Justinmind Prototyper Pro software, were expanded to include the following two-unit crash scenarios: hit-and-run, commercial motor vehicles, non-motorists, and fatalities. Table 3.12 provides a summary of the total screens, average number of fields per screen, and the total number of user-system input required for typical completion of a 2-unit crash. If-then logic was implemented to present a button (see Figure 3.5) to open a separate pop-up window containing commercial motor vehicle information (see Figure 3.6) if certain criteria (e.g. more than 10,000lbs, School Bus, Displaying HazMat Placard, etc.) was met from other unit descriptions. Both interfaces were converted into an interactive HTML format and were presented to the officers on the researchers' computers. A computer mouse and keyboard were necessary for data input into both interfaces.

Figure 3.5 Example of the CMV button activated by Vehicle Type criteria being met with a Medium/Heavy Truck (more than 10,000lbs).

COMMERCIAL MOTOR VEHICLE INFORMATION

Motor Carrier Identification:

| | Auto Fill | | |
| USDOT Number | Motor Carrier Name | Carrier Type |

Address | City | State | ZIP Code | Country

Motor Vehicle Type:

Weight Rating (Gross/Gross Combination) | Vehicle Configuration

Cargo Body Type

Hazardous Materials:

HazMat Placard? | HazMat ID# | Class #

Was Inspection Waived?

Waived? | Inspection Number | Inspector's Badge ID#

Release of HazMat?

Done

Figure 3.6 Example of the CMV pop-up window with auto-fill and progressive reveal functions to limit data entry.

Two survey tools were used for this task. The first, the System Usability Scale (SUS), was administered after each interface session to measure subjective usability through a ten-item attitude Likert scale (see Appendix B). The second, the Rating Scale Mental Effort (RSME), was administered after each SUS to measure subjective mental workload (see Appendix A).

Table 3.12. Crash Prototype Screen and Field Summary for a 2-Unit CMV Crash

	Form	Wizard
Total # Screens	20	97
Avg. Fields/Screen	16.95	3.25
Required User Entry	165	151
Possible System Entry	174	164
Total Entry Fields	339	315

Note: Both interfaces contain the same required entry fields; however, the summary is the best approximation for the screens presented for a scenario-specific two-unit crash, which is more restrictive with the Wizard.

Form Interface: Issues addressed from two-unit crash testing
The aspects of the Form interface that were deemed problematic or confusing by participants in the two-unit crash testing were addressed prior to the Fatal Crash/Hit-and-run/CMV testing. Overall, the main sections which were modified were:
• Information boxes to clarify rules for reporting on "Damage to Private Property"
• Query regarding any persons present in a parked vehicle and form routing accordingly
• Reordered "Person Conditions" tab to occur after "Person Actions" tab

Both Interfaces: Issues addressed from two-unit crash testing

Problematic elements identified in the Wizard in previous testing were addressed and duplicated into both interfaces.

- Clarifying instructions and functions of the "all damaged areas" diagram selection tool (see Figure 3.7)
- Added "Test Result" (type of drugs) for any "Positive Test" result to accommodate FARS (see Figure 3.8)
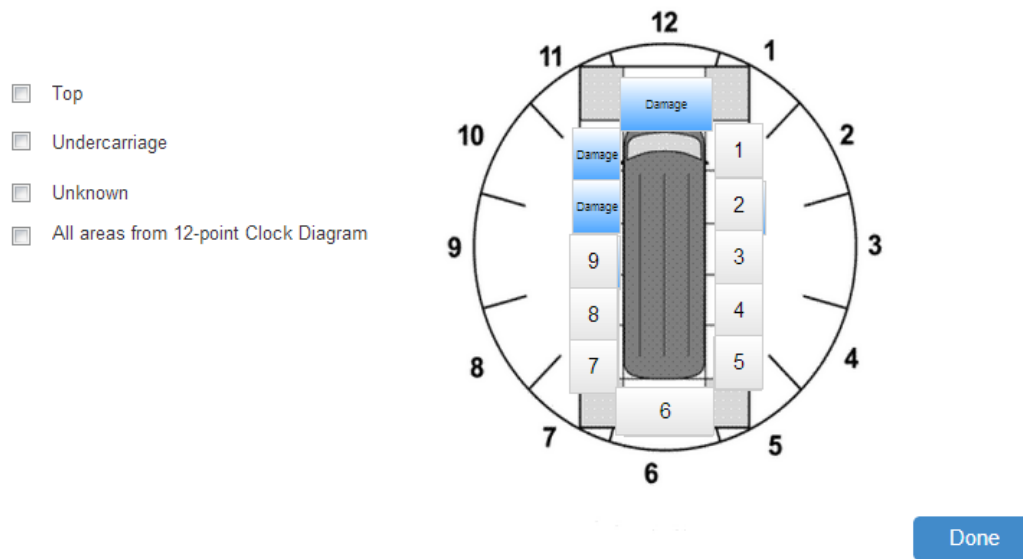
Figure 3.7 Example of the All Damaged Areas diagram selection tool with auto-populated bus based on earlier vehicle type selection.
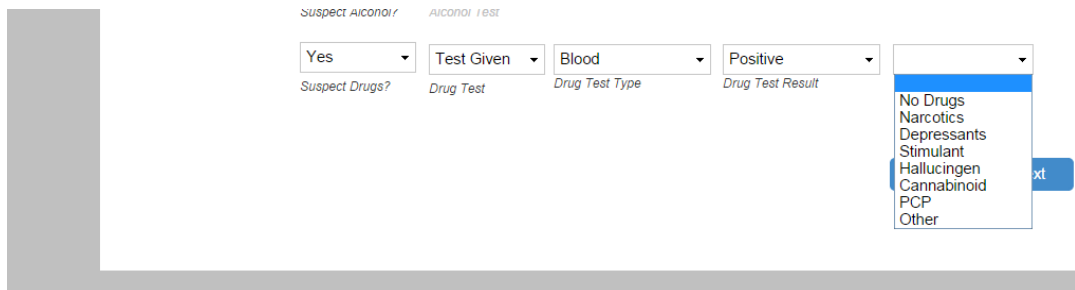
Figure 3.8 Example of the FARS Test Result incorporation if Drug Test Result is Positive.

3.1.3.3 *Method*

HumanFIRST researchers visited law enforcement officer participants at their local departments across the state. Participants were provided with a brief scenario of a collision, which in this exercise involved an incident consisting of a hit and run vehicle striking an occupied parked car, and a two-unit collision consisting of a CMV and school bus resulting in a fatality of a driver (see Appendix D for an example). Officers were given a paper copy of these scenarios, which included major details pertinent to the crash, and were encouraged to make up details not

provided by the researchers. This allows for unique data entries for each report trial, which can help expose bugs and other issues with report fluidity during testing that otherwise may not be discovered.

Officers were instructed to complete the first scenario while "thinking aloud" during the reporting process, so that researchers could reference their stream of conscious thought while performing the task. Morae usability recording software documented these conversations, in addition to important usability aspects, such as use of cursor, time spent per screen, and the procedural development of the report as officers completed the data entry. The second scenario required officers to input information into the interfaces as fast as possible, therefore, researcher interaction and "think-alouds" were discouraged during this test. Officers were instructed to complete the System Usability Survey (SUS) and Rating Scale Mental Effort (RSME) usability aids upon completion of each round of report testing.

The presentation of information and segmentation of fields by screen differed dramatically between the two interfaces. The Form presented many fields on each screen and had few steps required by officers to progress (i.e., select "next") on to new screens (i.e., 20 screens total). In contrast, the Wizard presented few fields on each screen, but required many steps to progress to new screens (i.e., 97 screens total). The total number of screens to complete the report, average data entry fields per screen, and total entry fields are shown in Table 3.12. These numbers are a general benchmark for the amount of data entry needed for a two-unit collision. Researchers provided the necessary materials for completion of the usability testing with the mock-up report, including computers and associated ancillaries.

3.1.3.4 *Results*

System Usability Survey (SUS)
Participants reported marginally higher usability ratings for the Form interface ($M = 73.8$, $SD = 18.0$) and slightly lower ratings for the Wizard interface ($M = 69.0$, $SD = 17.6$), see Table 3.13.

Rating Scale Mental Effort (RSME)
Overall, the participants reported slightly lower mental effort ratings for the Form interface ($M = 34.3$, $SD = 22.9$) compared to the Wizard interface ($M = 36.0$, $SD = 20.1$), see Table 3.13.

Table 3.13 Subjective Rating Scores

	SUS Scores	RSME Scores	Preference
Form Interface	$M = 73.8$, $SD = 18.0$	$M = 34.3$, $SD = 22.9$	70%
Wizard Interface	$M = 69.0$, $SD = 17.6$	$M = 36.0$, $SD = 20.1$	30%

Overall Preference

Officers provided researchers with their overall preference of interface when completing their crash report entry task. A strong preference for the Form interface was reported by users, where 70% of officers preferred using that interface, while only 30% of users would have liked to use the Wizard over the Form, given the scenarios researchers provided (see Table 3.13). This disparity in preference may come from the laborious data entry required to complete the scenarios, which consisted of data-heavy and complex crash types. Adding multiple passengers and injuries, fatalities, and commercial motor vehicles greatly increases the amount of information, therefore effort, to satisfy the crash reporting requirements by the state.

Researchers noted a potential ordering effect on preference of interface. This may have influenced officer opinion on which interface they preferred, because of the increased familiarity and reduced time spent completing the report. The recency effect was controlled for experimentally by strict counterbalancing of stimuli (type of interface) presentation.

3.1.4 Timed Sessions: Formal Mock-Up and Usability Testing

Each interface was further developed to receive data involving a three-unit crash, commercial motor vehicles (CMV), or even a fatality. While it was no longer a strong hypothesis, researchers expected that the complexity of a crash involving a CMV and a fatality could spur a clear preference in interface type due to the crash scenarios lengthy data entry requirements.

3.1.4.1 *Participants*

A total of twelve law enforcement officers were recruited from agencies across Minnesota (see Table 3.14). The participants in this round of usability testing varied in rank, role of duty, and years of experience working with the legacy crash report (see Table 3.15 and Table 3.16).

Table 3.14 Recruited Agencies

Agencies	N
St. Paul	3
Clay County Sheriff's Department	3
Moorhead Police Department	3
Richfield Police Department	1
Duluth Police Department	2
TOTAL	**12**

Table 3.15 Legacy Report Experience

Years of Report Experience	N
1-5	8
6-10	2
11-15	1
16 or more	1
AVERAGE	**6**

Table 3.16 Law Enforcement Rank

Rank	N
K9 Handler	1
Officer	6
Sergeant	3
Deputy	2
TOTAL	**12**

3.1.4.2 *Materials*

The Wizard and Form interfaces did not undergo any significant structural changes prior to testing; however, some final functionalities were put into place and each interface was expanded

to allow for a 3-unit crash. Table 3.17 provides a summary of the total screens and average number of fields per screen for typical completion of a 3-unit crash. Both interfaces were converted into an interactive HTML format and were presented to the officers on the researchers' computers. A computer mouse and keyboard were necessary for data input into both interfaces.

Two survey tools were used for this task. The first, the System Usability Scale (SUS), was administered after each interface session to measure subjective usability through a ten-item attitude Likert scale (see Appendix A). The second, the Rating Scale Mental Effort (RSME), was administered after each SUS to measure subjective mental workload (see Appendix B).

Table 3.17 Crash Prototype Screen and Field Summary for a Three-Unit Crash

	Form	Wizard
Total # Screens	27	120
Avg. Fields/Screen	14.5	2.8

Both Interfaces: Issues addressed from two-unit CMV crash testing

- The shift of roadway characteristics from the crash level to the unit level was reported to feel repetitive in data entry, especially when few to no elements changed for the roadway of each unit.
- An autofill functionality was added to allow users to indicate when the roadway characteristics entered for Unit 1 were the same for subsequent units. An indication of the characteristics being the "same as Unit 1" would auto-populate five previously entered elements into the drop-down boxes (see Figure 3.9).
- The rule governing a "motor vehicle in transport" for a parked or stalled motor vehicle required a detailed inquiry to determine a unit's eligibility for that status, determine whether it was legally or illegally parked, and to allow officers the freedom to indicate if they considered a person a driver of the vehicle for DWI purposes regardless of parked status.
- Additional wording and query was added to determine if a person in the parked/stalled motor vehicle was considered a "driver, operator, or person in physical control of the vehicle" to match the state statute used to prosecute DWI, otherwise, the report would skip driver-related queries for parked/stalled motor vehicles not considered "in transport" or those without a driver/operator present (see Figure 3.10).
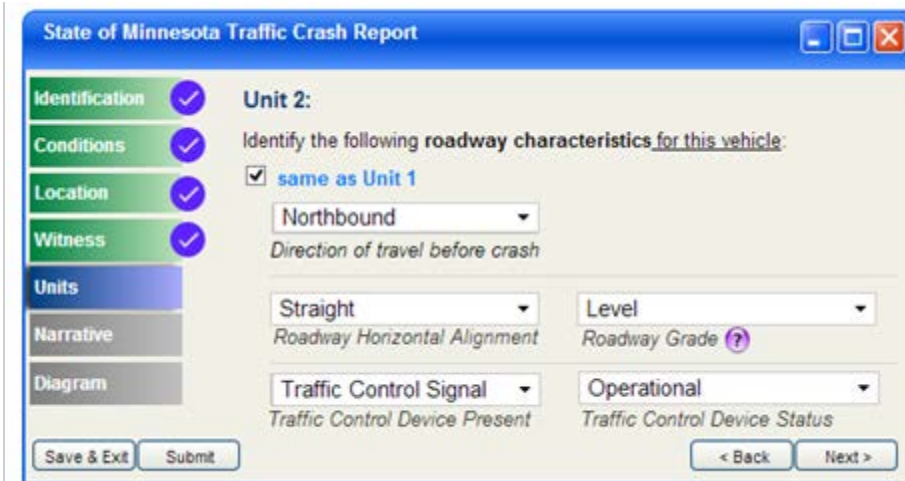
Figure 3.9 Example of the autofill function for Unit 1 roadway characteristics on subsequent units.
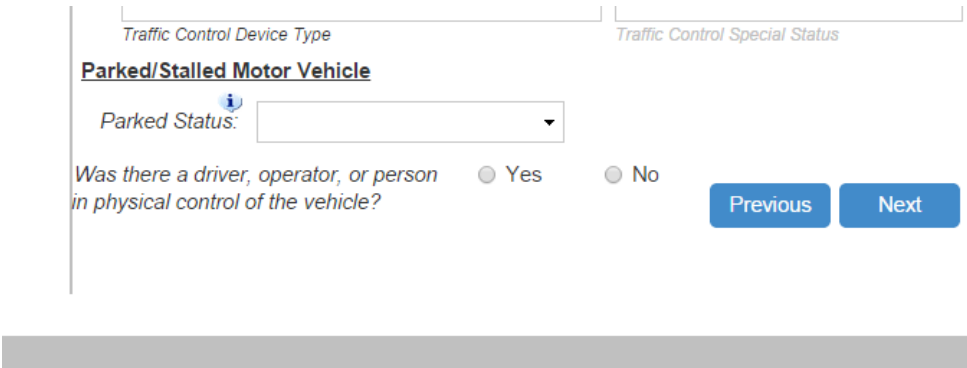
Figure 3.10 Example of the parked/stalled vehicle query function.

3.1.4.3 *Method*

HumanFIRST researchers visited law enforcement officer participants at their local departments across the state. Participants were provided with a brief scenario of a collision, which in this exercise involved an incident consisting of a MNDOT snowplow operator (plow up) striking a pedestrian in a crosswalk, in addition to a two-unit, head-on collision between two motor vehicles (passenger cars) in transit. Officers were given a paper copy of these scenarios, which included major details pertinent to the crash, but were encouraged to make up details not provided by the researchers (see Appendix D for an example). This allows for unique data entries for each report trial, which can help to expose bugs and other issues with report fluidity during testing that otherwise may not be discovered.

Officers were instructed to complete the first scenario while "thinking aloud" during the reporting process, so that researchers could reference their stream of conscious thought while performing the task. Morae usability recording software documented these conversations, in addition to important usability aspects, such as use of cursor, time spent per screen, and the procedural development of the report as officers completed the data entry. The second scenario required officers to input information into the interfaces as fast as possible, therefore, researcher

interaction and "think-alouds" were discouraged during this test. Officers were instructed to complete the System Usability Survey (SUS) and Rating Scale Mental Effort (RSME) usability aids upon completion of each round of report testing.

3.1.4.4 *Results*

System Usability Survey (SUS)
Participants reported an equal level of usability for each interface, although variability in score for the Wizard was greater ($M = 84.8$, $SD = 10.7$) than that of the Form interface ($M = 84.8$, $SD = 19.0$). These scores of perceived usability in the second round of testing was in fact higher than the first, by an average of about 10, indicating that usability and user acceptance of the system was on an upward trend (see Table 3.18).

Rating Scale Mental Effort (RSME)
The reported mental effort required to complete the crash scenarios was lower in the second test round than the first for each interface. While the Form interface appeared to have been slightly more taxing on users ($M = 29.3$, $SD = 8.2$) compared to the Wizard interface ($M = 27.4$, $SD = 13.1$, see Table 3.18), the overall effort participants felt they exerted while completing the crash scenarios was still in the realm of " a little effort", according to the grading scale of the RSME (see Appendix A).

Table 3.18 Subjective Rating Scores

	SUS Scores	**RSME Scores**	**Preference**
Form Interface	$M = 84.8$, $SD = 9.01$	$M = 29.3$, $SD = 8.2$	50%
Wizard Interface	$M = 84.8$, $SD = 10.7$	$M = 27.4$, $SD = 13.1$	50%

Interface Type and Time for Completion

Twelve law enforcement officers participated in the second round of usability testing of the crash report, which was timed to gauge effort required to complete the Form and to provide an estimate officer efficiency with each interface. One officer's crash entry was not included for analysis due to user error. Researchers recorded the overall time required to complete the crash report data entry by officers. For the purpose of this usability exercise, only the total time duration was considered for analysis, as these sessions were more strictly controlled than the previous usability tests.

Table 3.19 Task Duration across Interfaces

	Total Duration
Form Interface	$M = 15.5$ min $SD = 3.3$ min
Wizard Interface	$M = 17.2$ min $SD = 4.4$ min

Table 3.19 describes the amount of time in minutes taken to complete the mock crash scenarios with the Form and Wizard interface. Although participants appeared to have completed the Form based entry ($M = 15.5$ min) more quickly than the Wizard interface ($M = 17.2$ min), the difference in time needed for completion was not statistically significant between the two

interfaces. An interesting observation is that although the Wizard interface has many more screens and steps required for users navigate through to enter data, results do not indicate significance in time disparity between the Form and Wizard. While the Wizard has a more guided and user-friendly approach to data entry, the user may be slowed in their completion of the report because of a substantial increase in the amount of text presented by the multitude of additional screens. Results note that order effects by interface exposure in the previous round had less of an effect on duration in the timed usability test; participants also required less time to complete the Form than the Wizard when only examining the last presented interface to officers.

Overall Preference
Upon completion of the timed usability tests, participants were asked to report their preference of interface, see Table 3.18. Officers were split in their choice of interface (Wizard: $N = 6$, Form: $N = 6$). The strong preference for each interface highlights the importance for the consideration of each officer and their needs, further reinforcing the requirement of applied human factors methodology in the design of the crash report.

Overall, users who preferred the Wizard to the Form reported a fondness for the concreteness of procedure through navigating the report. Navigation issues inside the report are reduced with the Wizard, which was reported as reducing the mental effort on the user. This means that officers enjoyed having a sense of security with completing the steps needed to accurately make a report, due to the fact that the Wizard presents each step for the user.

Proponents of the Form interface liked the increased contextual information of the report, as fields pertaining to similar types of information about a crash are chunked together in screens, whereas the Wizard presents these fields in a step-by-step, piecemeal fashion. Officers were pleased with the flexibility in the Form's navigation, which allows users complete freedom to move within the report as they wish, at any time.

3.2 Crash Report Mock-up and Usability Testing Discussion

Officer Preference in Usability Testing
The examination of the usability testing results clearly indicate that officers were without a clear preference of interface between the Wizard and Form versions. Instead, officers reported their desire to have both interfaces implemented, as each version was seen as versatile and appropriate for the dynamic range of circumstances crashes take place in. Each officer that participated in the usability testing disclosed to researchers their willingness to use both interfaces, while some went as far to say that their acceptance of the new report system hinged on the option of using both interface versions.

The single-unit collision scenarios yielded the closest discernable difference in preference during the mock-up testing exercises, however, this 70-30 split was short lived, as the scenarios that contained two-units had equal preference scores of 50-50. Anecdotally, a more measurable approach to interface preference would have been to consider the officers' choice of one interface type to the use of both interfaces, although, this was not the research team's intent.

A reasonably clear preference was reported when officers were confronted with a scenario that consisted of a crash with multiple units involving commercial motor vehicle. The twelve officers

that completed this usability exercise preferred the Form interface to the Wizard, by a 70-30 margin. Researchers explain this choice as indicative of the Form interface's superior data entry detail, and higher level of efficiency due to the increased fields per screen. The additional information, usually dreaded as officers explained during mock-testing, was less taxing on the user when completed using the Form interface. Researchers attributed the detail-oriented nature of the Form interface to this overall preference in data-heavy crashes.

Revisions: Moving Forward in Development
The analysis of the usability testing results made it clear to Minnesota's Department of Public Safety and HumanFIRST that both versions of the mock-up interfaces should be developed. Officer feedback obtained during the initial testing provided insight into the specific needs of the user as they completed the report. These needs, including demographic variability in terms of experience using the legacy report and electronic interfaces for data entry in general, were found to be satisfied best if both interface types were incorporated into the new crash report.

The usability testing exercise also gave researchers feedback on various aspects of the designs, which led to the proposed revisions and modifications to the initial mock-ups. Key items for rework included: sequence of events reordering, more frequent use of automated fill-in fields for driver's license and vehicle registration, witness information, passengers, and dialogue boxes that aid the user in satisfying data fields throughout the report. Officers also recommended a redesign of the damage location diagram. Based on the feedback from usability testing, final versions of the Wizard and Form were completed by the researchers. The wireframes for both the Form and Wizard were presented in a flow chart (see Appendix G for the Form Flow Chart) which detailed many of the skip logic and advanced features of the prototypes. The finalized wireframes gave the sponsoring agencies a basis for the redesign of the state's system and created a visual document of the many steps and screens users would be tasked with navigating in the new report.

Chapter 4: VENDOR PROTOTYPE BETA TESTING

4.1 Introduction- Platform Beta Testing

The testing of Appriss MNCrash prototypes was an important step towards the development of the crash report system redesign, as it allowed the opportunity to evaluate the overall quality of usability within the interfaces before they were finalized into production. Taking a pragmatic approach to evaluating the interfaces for human factors usability principles ensured that design and development of the interfaces provided the end users, officers of law enforcement statewide, with novel improvements to completing the crash report task. The purpose of testing each interface as they were built was to discover and address any problematic elements in the report that would result in poor usability or negatively impact the user experience of the crash report as early as possible, in order to avoid major rework at the later stages of design and implementation of the report. It also ensured oversight of the proper execution of novel design elements which were developed in previous phases by the research team.

Frequent and methodical testing during the Appriss interface development schedule allowed for a thorough assessment of the interface elements, in aims of reducing the potential for extensive, time and resource consuming redesigns at the later stages of development. Since each interface (i.e., Form and Wizard) was duplicated in both a web version and standalone, Windows, version, it was important to address any problems before suboptimal elements were incorporated across platforms, requiring added labor and project delays to address. Finally, in addition to the Form and Wizard interfaces, Appriss proposed a third interface option, called the Quick-Capture. The Quick-Capture was a previously designed interface which allows officers to quickly document the limited crash information required for an exchange of information for all parties at the scene of the crash. This interface would require special attention by the HumanFIRST team to test its existing functions through heuristic evaluation and determine in what ways it must be modified to be consistent with data capture of the other two interfaces.

The first round of prototype beta testing was performed using the standalone and web-based platform versions of the Quick-Capture and Form interfaces. At this time during the development of interfaces, the Wizard interface was not fully developed for suitable use in the beta testing. It was noted by HumanFIRST that the Wizard interface was to be subjected to the same rigorous testing when made available, to ensure consistency in usability and presentation across platforms and interfaces.

The second round of prototype beta testing of the Appriss web platform involved the close study of the Form, Wizard, and Quick-Capture interfaces. At this stage of development, the standalone client of the MNCrash report was not ready to undergo evaluation, however, the designs on the web client were said to be nearly identical to those that would appear in the standalone client. An in-depth review of each interface was performed to verify that usability aspects of the interfaces were sufficient in the design. HumanFIRST researchers were interested in gauging the extent to which user requirements were implemented in the report, in addition to the level of consideration for human factors usability principles. Each iteration of the interface design process was examined to ensure that consideration for the user was of the utmost importance, while also meeting or exceeding the extensive data requirements established by MMUCC (2012).

4.1.1 Standalone and Web-based Platform Beta Testing: Round I

4.1.1.1 *Procedure*

A nine-step guide for evaluating user interface designs was adapted from Rogers, Sharp & Preece (2011) for use in the prototypes beta testing (see Table 4.1). Each aspect of the guideline represented a heuristic for grading the competency of the interfaces, in order to provide a standardized method of scoring for each design revision through the many iterations of the MNCrash report. Each heuristic item on the evaluation rubric covers the psychological needs of the user while they interact with the interface. The criteria consist of elements as basic as overall visibility of features, for example, as well as characteristics as complex as the mental modeling of users, where logic and in-depth thought required to use the system is gauged. The usability testing heuristics guideline adapted by HumanFIRST ensured consistent and reliable evaluation of each interface type, for each interface design iteration throughout development.

Table 4.1 Usability Testing Heuristics (adapted from Rogers et al., 2011)

Usability Heuristic	Performance Criteria
Visibility	Functions and features should be readily visible so that the next course of action for the user is clear.
Feedback	Timely acknowledgement of user actions to instill confidence and permit the user to progress to the next step or correct any detected errors
Constraints	Error prevention by restricting the number of possible actions (e.g., graying out menu items). This will reduce decision making, eliminate erroneous attempts, and reduce mental workload
User's mental model	When encountering a new product for the first time, users will bring their expectations of how it should work based on their previous experiences and culture. To the extent that the system conforms to the users' expectations and information is presented in a natural and logical order, the task of documenting a crash should feel intuitive (e.g., the arrow pointing left is used for a back button).
Affordance	Properties of the given object should provide a clear indication on how it should be used. For example, a button invites hovering/clicking
Error recovery	Explicit messages to help users recognize and correct the error
Clutter	Clutter increases search time and users are more likely to misread or miss items as well. One method of eliminating clutter was to hide information irrelevant to the current task by layering the interface
Grouping	The organization and presentation of display elements or controls takes into account the psychological capabilities of the user. Users tend to perceive objects as belonging together if they are in close proximity or if they share a common visual feature, such as orientation, color, size, or shape. Inappropriate organization of screen information leads to wasted time in interpretation.
Flexibility	Provide users control and freedom so that incorrect actions can be undone and allow them to get out of a place they entered by mistake by putting them back to the previous screen

4.1.1.2 *Beta Testing Round I Results*

Platform Testing Results
Researchers identified various issues within the interfaces during the initial beta testing of the vendor prototypes. The degree to which these issues were inhibitory or restrictive to report completion and data quality varied, as some documented issues ranged from minor errors while others were identified as critical and in urgent need of revision.

Quick-Capture Results
The results of testing indicated that the Quick-Capture interface usability qualities were in need of revision. Aspects of the interface that pertained to effort demands of the user, such as the auto-populated fields (e.g., driver license) and report building (i.e., instantaneous, on-screen updating of units as each are added) were lacking in their effort split between user and system-based responsibilities. That is, the results from beta testing of the Quick-Capture suggested that there needed to be more onus on the effort of the system, rather than requiring more work from the user. This effort disparity between report and user, as identified in the Hierarchical Task Analysis from Chapter 2, was observed in the following results, prompting researchers to further evaluate methods for reducing the workload requirements on the user.

Researchers found that cross-interface (e.g., Quick-Capture to Form) data portability was severely lacking at this stage of development. If users entered in details on Units in the Quick-Capture and switched to the Form mid-report, the information entered would not populate in fields within the Form interface. This inconsistency was observed cross-platforms as well, where the same problem occurred if a user began entering information on a standalone version of the report, and then continued the report on the web version of the interface. Table 4.2 describes the areas of the Quick-Capture (QC) report that required modification to improve usability.

Table 4.2 Examples of Identified Usability Issues- Quick-Capture Interface

Component	Issue	Description
Web	Mapping between QC & Form	Fill out information on a unit through QC> open in Form: That unit will still say 'select unit' in green as if no information has been filled out
Standalone & Web	Consistency	Is 'RMS fill' identical to 'quick copy'? if so, consider using just one to terminology
Standalone & Web	Transparency	Given that 'unit' is general term to refer to any vehicle or non-motorist, users may be confused whether they should click 'add unit' or 'add person' to add a non-motorist
Standalone & Web	Feedback immediacy for adding drivers	Add Person> 'Person-Jane Doe' will be displayed> Select 'Driver.' 'Person-Jane Doe' won't be turned into 'Driver— Jane Doe' and embedded under the unit the driver is associated with until after another unit has been added
Standalone & Web	Error prevention	The "Remove Unit" function is located a bit too close to the "Add Unit" and "Add Person"—this could create potential for error. Perhaps using a feedback message ("Are you sure you want to delete this Unit/Person?")

Form Interface Results
Issues within the Form interface of the report at this stage of development were considered relatively minimal to usability, however, proposed fixes to the issues documented would largely improve the quality of the report. Most of the items recorded during beta testing were based upon front-end display issues, such as labelling of fields (e.g., entry fields without explicit labels), state-changes of screens once data was entered into a field (e.g., tabs for units populate only after a screen progression), and navigation issues and inconsistencies when researchers entered data into report fields (e.g., tabbing did not move the selected field in an expected way, scrolling problems). Table 4.3 contains a brief summary of the problematic areas researchers addressed.

Table 4.3 Examples of Identified Usability Issues- Form Interface

Component	Screen	Description
Web	Type	After entering info for CMV and closing the window, 'edit CMV' button does not turn yellow
Standalone	Person condition	Activation of 'alcohol/drug test' should not be dependent on answer for 'suspect alcohol'
Web	Type	a) If selected 'no' for 'is driver info available', system does not bypass driver info b) if selected 'no' for 'is vehicle info available', system does not bypass the events screen
Standalone and Web	All	Scrolling within a dropdown should be disabled when user clicks outside of dropdown
Standalone & Web	Date/circumstances	Consider replacing 'owner of damaged public property' with 'name & address of the damaged property owner' (note this field(s) is required for both public and private property)

4.1.1.3 *General Issues and Revision Proposals*

Error Prevention
HumanFIRST found three areas of the report that were considered error-prone. The first item of concern was the label for the type of roadway direction for divided highways. The wordiness of the label, "divided highways only: roadway direction" as it appears in the interface, may have been unclear to officers. This field is specifically for those crashes that occur on a divided highway only, and only to be manipulated if the crash at hand was located on a divided roadway. The suggested solution to this ambiguity was to create a logic-step in the interface that only presented the roadway direction to users when the roadway design was selected as "Divided Highway."

Miscellaneous Documentation Issues
Researchers had questions about the requirements of officers that were expected by the Department of Public Safety regarding details of the report. First, researchers were unsure if the protocol for issuing driver violation citations to motor vehicle operators applied to bicyclists, as this would warrant a redesign in the bicycle unit screens. Likewise, if procedure regarding a bicyclist's drug or alcohol test based on officer discretion was the same as it was for motor

vehicle operators, a similar rework of the bicyclist unit screen at that stage of the report would be needed.

The requirements for officers to complete a report when the unit(s) involved were located in a parking lot was unclear for researchers, however, it was found that if in fact officers were to complete crash reports in these locations, the report contained the following fields that were not relevant to parking lot crashes: Motor Vehicle Posted/Statutory Speed Limit, Direction of Travel Before Crash, Trafficway Description, Total Lanes in Roadway, and Roadway Alignment and Grade. The concern here was that extraneous fields would increase officer workload, and therefore effort, by having to attend to these fields to satisfy the requirements of the report. To reduce the tendency to enter in variables to simply satisfy the report, which was an observed problem prior to this beta testing, the fields should be removed from these report screens.

Clutter Reduction
Two items in the interfaces were identified as having an excessive clutter appearance to them, and were documented as needing revision. The first area of concern was the location of text describing instructions on how to enter the 24-hour clock format, located within the Date and Circumstance screen within the Crash-level tab. This text was presented next to the entry field for the time information, and appeared "busy." Researchers suggested that the instructional text remain on the screen, however, it would better suit usability if the text were to be placed within the entry field, instead acting as a text-holder rather than a label near the field.

The second item noted for cluttering the visual presentation of the interfaces was related to the insurance information in the Units-level tab of the report. Here, researchers found that the checkbox for "no insurance" appeared to be unnecessary as a feature on its own, adding to increased workload and visual information during use of this screen. The proposed fix to this cluttering aspect of the screen, which was present in both the standalone and web versions, involved adding the "no insurance" option into the drop-down list adjacent to the checkbox, so that officers could simply choose this detail inside the list. Because officers were very vocal about their reliance on using the "tab" key on their squad car computers, HumanFIRST felt it was appropriate to meet those desires from officers, and therefore suggested the implementation of this proposed fix.

Documented Inconsistencies
Researchers noted a handful of inconsistencies between platforms, many of which were visual components of the report aesthetic (e.g., location/missing buttons, field presentation order, color, and location) that warranted revision. Most of these inconsistencies appeared to be programming differences related to dictated feature color when entering or deleting values in the report.

Progressive Reveal/Enabling Functions
One method to reduce the clutter of the report and reduce the number of required steps for officers was to disable select fields of the report that would only be applicable if prior data entry indicated they were pertinent to the crash at hand. If the requisite data entry to enable the fields is not detected by the system, the disable fields are automatically bypassed for the users. The default disabling and intelligent enabling based on specific data entry is known as progressive reveal or enabling.

These functions were based on complex sets of conditional "if-then" statements and required extensive testing to ensure that the rule-based logic was correctly implemented. Additionally, some of the properly implemented features had unanticipated outcomes as users began to interact with them. Table 4.4 inventories the testing focus on progressive reveal functionality within the MNCrash system. HumanFIRST found that the fields were not conducive to overall fluidity and usability of the report, because of the increased effort users would have to exert to work with the report as it appeared in the present beta testing stage. Managing the progressive field enabling throughout the report interfaces and ensuring their consistency across platforms was a priority for the research team, and as such, the issues were presented to Appriss for revision.

Table 4.4 Progressive Reveal Usability Issues

Component	Description	Screen	Elements
Web	Progressive enabling	Date/circumstances	'weather' 'contributing road circumstance'
		Events	'motor vehicle contributing factor' 'sequence of events'
	No progressive enabling	Driver action	'factor'
		Person condition	'physical condition'
		Non-motorist action	'factor'
		Non-motorist condition	'safety equipment'
Standalone	Progressive enabling	Date/circumstances	'contributing road circumstance'
	No progressive enabling	Date/circumstances	'weather'
		Events	'motor vehicle contributing factor' 'sequence of events'
		Driver action	'factor'
		Person condition	'physical condition'
		Non-motorist action	'factor'
		Non-motorist condition	'safety equipment'

Missing Features

A number of missing features, including missing help buttons, diagrams, and decision points in report progression were catalogued. Those absent features of the report that severely impacted usability are described in Table 4.5. The missing decision points were considered as critical errors that needed immediate correction before proceeding with development and further beta testing.

Table 4.5 Documented Absent Decision Points

Component	Screen	Description
Standalone and Web	Type	After 'parked/stalled motor vehicle' is selected for 'unit type', users need to make a selection for 'parked status' and 'Was there a driver, operator, or person in physical control of the vehicle?'
Standalone and Web	Passenger	Query info about bus passengers, passengers in parked vehicle that are not in transport, and personal conveyance passengers only if they are injured, but we will have mandatory queries for all passengers (injured or not) for all other types of vehicles
Standalone and Web	Type	If 'school bus', 'transit bus', 'motorcoach', or 'other bus' is selected for 'vehicle type', go to 'bus service'; otherwise, go to 'special function' and then if 'police', 'ambulance', 'fire truck', 'non-transport emergency service vehicles', or 'incident response' is selected for 'special function', go to 'emergency motor vehicle use'.
Standalone and Web	Type	If CMV (i.e, a) any vehicle seating 9 or more (i.e, selecting 'school bus', 'transit bus', 'motorcoach', or 'other bus' for 'veh type'), b) any vehicle more than 10,000 lbs (i.e., selecting '10,001-26,000 lbs' or 'More than 26,000 lbs ' for 'Weight Rating (GVWR/GCWR)', or c) any vehicle displaying hazardous materials placard (i.e., selecting 'yes' for 'HM placard')), document info on CMV →This means that 'Weight Rating (GVWR/GCWR)' and hazard material q's should be asked prior to CMV info
Standalone and Web	Date/ Circumstances	if 'crash type' is 'collision w/ motor vehicle in transport'> "manner in which the 2 vehicles initially came together"
Standalone and Web	Date/ Circumstances	'yellow tag' only applies if public property
Standalone and Web	Type: CMV	Missing if/then logic between related fields for 'inspection' and 'hazardous material'
Standalone and Web	Person condition	Missing if/then logic between 'injury severity' and fields related to 'transported'
Standalone and Web	Events	Missing if/then logic between 'TCD type' and 'TCD status'

4.1.2 Form, Wizard, and Quick-Capture Beta Testing: Round II

HumanFIRST performed an internal review of each prototype interface by completing mock-crashes (see Appendix D). The team recorded errors and issues related to usability and user interface design during the review and placed them within the dedicated bug compilation document that was shared with the development team. The testing procedure discussed in this chapter was developed to provide a holistic view of the report that highlighted qualities, while underlining issues that inhibited user efficiency or data acquisition.

To suit the evolution of the report interfaces, researchers revamped the previously used Test Management Plan severity assessment guideline rubric. This ensured that both Appriss and HumanFIRST would remain on the same track as development of usability features continued, which contributed to improved communication between the two teams. The goal of improving the MNCrash report through the various iterations and stages of redesign and modification was realized with the completion of the second beta testing round handled by HumanFIRST. Reaching the interface design goal thus far allowed for the continuation of usability and user acceptance testing discussed further in later sections of the report.

4.1.2.1 *Vendor and Tester Development Plan*

HumanFIRST met with Appriss to create a rubric for determining the severity of errors within the crash report interfaces as they pertained to human factors usability issues. The MNCrash development team identified the need for a universal set of guidelines that clearly define problems discovered when navigating through the vendor prototypes which pertained to the user experience and were distinct from the types of problems uncovered through typical quality control examinations. The previously set definitions for severity levels were too narrowly focused on mere functionality and would place usability issues of properly working functions to fall quite low on the priority level. Ultimately, the stated severity descriptions set by the Test Management Plan undervalued usability issues uncovered by the team and left developers in a state of uncertainty regarding the priority at which they should be addressed.

Table 4.6 describes the separate severity level traits that were defined by the HumanFIRST team to help elevate issues pertaining to the user experience and place them on par with functionality issues. The new descriptions helped individual testers to reference and document errors or poorly usable features which warranted corrective actions. Standardizing the format of documenting bugs, crashes, freezes, missing fields, etc., along with usability issues promoted an increase in the accuracy and reliability of reported errors, provided the context and details required for replication of the issues, and created the space for dialogue between testers and Appriss. The utilization of this testing tool proved to be an effective component of the development process as the crash report progressed towards final production.

Table 4.6 Severity Descriptions from the Appriss/ HumanFIRST Management and Usability Plan

Severity Level	Severity Level	Appriss Test Management Plan Severity Description	HumanFIRST Usability Severity Description
0	Critical	The module/product crashes or the bug causes non-recoverable conditions. System crashes, database or file corruption, potential data loss, or program hangs requiring reboot are all examples.	Any issue that will prevent the task to be completed or prevent user from moving on *(Dumas & Redish, 1993; Molich & Jeffries, 2003)*. The module/product will not enable user be able to properly enter data and user has no workaround *(Wilson, 1999)*. Will cause extreme irritation *(Sauro, 2013)*. Usability catastrophe: imperative to fix this before product can be released *(Nielsen, 1997)*.
1	High	Major system component unusable due to failure or incorrect functionality. Severity Level 1 bugs cause serious problems such as a lack of functionality, or insufficient or unclear error messages that can have a major impact to the user, prevents other areas of the app from being tested, etc. Severity Level 1 bugs can have a work around, but the work around is inconvenient or difficult.	Any issue that will significantly delay the user or will severely compromise the user's ability to enter accurate data *(Molich & Jeffries, 2003)*. Will cause frustration and poor user satisfaction *(Dumas & Redish, 1993)*. Major usability problem: important to fix, so should be given high priority *(Nielsen, 1997)*.
2	Medium	Incorrect functionality of component or process. There is a simple work around for the bug if it is Severity Level 2.	Any issue that will delay user and/or increase error rates *(Molich & Jeffries, 2003; Wilson, 1999)*. Issue will not lead to permanent data loss, but moderate effort will be required to circumvent the problem *(Wilson, 1999; Rubin, 2003)*. Will cause moderate irritation *(Sauro, 2013)*. Issue will increase training time and will cause occasional task failures for some users *(Wilson, 1999; Sauro, 2013)*. Minor usability problem: fixing this should be given moderate priority *(Nielsen, 1997)*.
3	Low	Documentation errors or errors that don't impact the user's ability to complete the test case.	Any issue that will slow down user slightly, but it causes no loss of data *(Wilson, 1999)*. Will cause some hesitation or slight irritation *(Sauro, 2013; Wilson, 1999)*. Issue may be due to inconsistency or is in violation of design standards or guidelines *(Wilson, 1999)*. Cosmetic problem only: fixing this should be given low priority *(Nielsen, 1997)*.

Additionally, the development team created a protocol for documenting the usability and system errors, which was made available to the entire testing and development team of the MNCrash project. DPS made the documentation of errors and usability issues possible by hosting a Microsoft SharePoint for the testing team. The SharePoint spreadsheet detailed pertinent information to the bug or error by implementing the standard format of the Severity Management and Usability Plan (see Table 4.6). An example of a reported error is detailed in Table 4.7 below.

Table 4.7 Examples of Documentation of Usability Issues and System Errors

Component	UI	Description	Issue Type	Screen	Priority
Wizard	Web	Forgot to insert *serving* in "Please indicate whether a school bus or motor vehicle functioning as a school bus or **[serving]** a school-related purpose is involved in the crash. "	Elaborated Requirement	Identification	3 - Low
Wizard	Web	Consider rephrasing "Indicating if a crash is on or off the trafficway" to "Indicate…"	Elaborated Requirement	Location	3 - Low

4.1.2.2 *Procedure*

The internal beta testing of the interface prototypes performed by HumanFIRST occurred over the course of eleven days. Web platform versions of the Quick-Capture, Form, and Wizard interfaces were used in the beta tests, as the standalone versions were not available for beta testing at the time scheduled for testing (Mar-June, 2015). The purpose of the beta testing exercises at this point of development were to gauge the consistency level of user requirements across the interface-types, general degree of overall usability throughout the report, and confirm the consistent adherence of the interfaces to the usability rubric set forth by HumanFIRST.

Researchers were first instructed on the features, functions, and protocols necessary to use each report interface by the vendor Appriss. Beta testing review began with a holistic overview of each interface provided by Appriss, in order to examine the overall design qualities and document any glaring issues identified by testers. Taking the high-level view approach to an initial overview of the interfaces presented the opportunity for researchers to note any inconsistencies among all versions of the report. A detailed analysis of each screen in the display was performed to guarantee that each interface presented the same information in a manner that could easily be understood by a user familiar with any version of the report, ensuring cross-platform consistency and user reliability.

The adherence to the usability requirements established by the HumanFIRST Hierarchical Task Analysis was tested in fine detail by repeated mock-crash data entries. Researchers developed three scenarios that were designed around their ability to flex the capabilities of the report. Each scenario contained steps and data fields that were complex in nature to assess as many nested programming areas of the report as possible. This would hopefully increase the chances of finding internal "bugs", or other problematic interface glitches that would negatively impact officers as they completed a report.

HumanFIRST employed the use of the Usability Testing Heuristics criteria established in the first round of beta testing. The use of this rubric not only ensured consistency throughout the testing process, as it provided detailed guidelines for analysis, it also allowed for an apples-to-apples comparison between testing phases throughout development. The usability heuristic guide adapted from Rogers et al. (2011) for evaluating user interface designs used in the first round of beta testing was again utilized (see Table 4.1).

4.1.2.3 *Beta Testing Rounds II Results*

Results from the second round of prototype beta testing suggested that interfaces were in need of improvement in guiding user's cognitive aspects of the report. Researchers identified that the report required a considerable amount of user training, which was noted as a key drawback to the fluidity and user-friendliness of the report. The system tested in the second round of beta testing did not bridge the requirements of a satisfactory crash report and the knowledge base of the user, meaning the user would have to be trained on using the report. While some training is expected with the release of the MNCrash client, the degree to which researchers felt training would help was not satisfactory from a human factors viewpoint. Cognitive aids were proposed by HumanFIRST, which would reduce the amount of training required to bolster usability and user efficiency, in turn reducing associated monetary and time costs to reach the goal of uniform usability and user acceptance statewide. These aids would also increase the productivity and efficiency of the users, in addition to the likeliness of high data accuracy Table 4.8 contains a summary of the proposed cognitive aids for use in the next interface design revision.

Table 4.8 Examples of HumanFIRST Decision-Making Cognitive Aids for Usability Proficiency

Suggested Cognitive Aids to be Implemented	
1	"unit" is used as the general term to refer to any vehicle or non-motorists. Each non-motorist and [vehicle & driver/passengers associated with said vehicle] is assigned to an unique unit #
2	A vehicle is a "motor vehicle in-transport" if:
	a) Portion of the vehicle is on a roadway travel lane whether vehicle is moving or stopped.
	Note: A) An emergency vehicle is stopped in the traffic lane with emergency lights activated is not a "vehicle in transport" since the presence of the emergency lights has the effect of closing the traffic lane. B) In roadway lanes used for travel during rush hours and for parking during off-peak periods, a parked motor vehicle is "in transport" during periods when parking is forbidden.
<u>OR</u>	
	b) The vehicle is in motion somewhere within the trafficway which runs property line to property line.
<u>AND</u>	
	c) used for transport purposes. Note: if a snowplow is plowing snow, it is being used for road maintenance, not for transport. If the blade is up, and it is being driven back to the garage, then it is a "vehicle in transport" (because it is being used to transport the driver to a destination)
	Inclusions: Motor vehicle in traffic on a highway, driverless motor vehicle in motion, motionless motor vehicle abandoned *on a roadway*, disabled motor vehicle *on a roadway*. In roadway lanes used for travel during rush hours and for parking during off-peak periods, a parked motor vehicle is in transport during periods when parking is forbidden.

Researchers noted the likelihood of officer knowledge regarding the new Model Minimum Uniform Crash Criteria Guideline (MMUCC) to be low, as the MNCrash client incorporated a multitude of new requirements and guidelines for satisfactory crash reporting. The 4th Edition of the MMUCC manual provided the groundwork for the MNCrash report. Officers would not only have to be briefed on the new MMUCC standards, but the new system would require training as well. The release of the new report system would provide an excellent opportunity for officers to learn how to enter crash reports in the system, while reaching an understanding of what is required by the officer to complete the report based on the upcoming changes to MMUCC policies and procedure standards.

Table 4.9 contains a summary of the observed problematic items that researchers desired corrections for. The fixes to each interface would, in turn, bolster a higher level of usability, while decreasing the overall user effort and workload required to complete a crash report.

Table 4.9 Examples of Training Opportunities and Interface Fixes

Level	Element	Attribute	Description
Crash	Location of first harmful event relative to trafficway	Gore	An area of land where two roadways diverge or converge. The area is bounded on two sides by the edges of the roadways, which join at the point of divergence or convergence. The direction of traffic must be the same on both sides of these roadways. The area includes shoulders or marked pavement, if any, between the roadways. For example of gore, see MMUCC_Appendix G: Diagram of an interchange (pg. 131 of MMUCC_4th Ed)
Crash	Crash type		Crash type is defined by the "first harmful event", which is the first occurrence of appreciable damage or injury in a crash
Crash	Manner of crash impact		This data element refers only to crashes where the first harmful event involves a collision between two motor vehicles in transport.
Crash	Property damage	Public property	Government owned vehicles are not considered public property. Units involved in the crash are not included in this section (e.g., privately owned vehicles, bikes, etc.)
Crash	School bus involved?	Yes, School Bus Directly Involved	A school bus, with or without a passenger on board, is directly involved if it is a contact motor vehicle
Crash	Did the "first harmful event" occur within the boundaries of an intersection?		MMUCC_Appendix H: Diagram of an Intersection (see pg. 132 of MMUCC_Guideline_4th_Edition) Note: If two intersections are close together (within 33 feet of one another) then the roadway between the two intersection is also considered to be an intersection. NOTE: Overpasses and underpasses are not parts of intersections.

4.1.3 User Acceptance Testing Support

An additional quality assurance level of testing done on the MNCrash client involved User Acceptance Testing (UAT). The UAT process included testers who were non-law enforcement personnel who were experienced with crash reporting data. They included state analysts from both the Minnesota Departments of Public Safety and Transportation. Due to their experience and expertise, the testers offered unique perspectives and insight into the crash data and were able to expose the system to the typical or unusual crash scenarios which can be submitted. Additionally, the UAT support staff helped to stress-test the system and give an unbiased examination of the performance of the system since most did not have extensive exposure to the design iterations or the intended functions of many of the new interface components.

The UAT process required a systematic approach to test the system in an effective way that would be most likely to expose the weak areas of the report and highlight problematic areas for improvement. Moreover, the testing required proper organization and division of various testing strategies to ensure that as many crash scenarios were covered in the allotted time prior to system launch as possible. The HumanFIRST research team was utilized to help the organization and creation of various crash circumstances and scenarios due to their intimate knowledge of the inner workings of the report, the vulnerable components of the interface, and the most efficient and logical way to construct mock crash details for testing.

HumanFIRST specified 54 MNCrash client incident scenarios for testing in the UAT process. The scenarios included 23 single-unit crashes (see Table 4.10), 17 two-unit crashes, and 14 three-unit crashes. Each test case was a unique combination of possible scenarios in a collision incident. Each test case contained details about various aspects of a collision: crash location, unit crash-type, causal attributes, passenger information, witness accounts, property owners, injury severity, and mapping of roadway coordinates (see Appendix E for additional examples of UAT scenarios). To begin a testing session, a UAT staff member selected a test case from the MyBCA Sharepoint, an online module by which all UAT testers had access. Testers used the key factors outlined in the crash scenario of the test case to guide the important structural elements of the crash; however, they were free to use their own discretion in many of the undefined crash elements, ranging from simple components like weather conditions to complex components like alcohol impairment and violations. This flexibility allowed for each UAT staff member to use their own expertise in each scenario and allowed them to examine how the report responded to the unique crash attributes they selected. Performing the mock-entries into the report also granted the opportunity for testers to identify any usability issues that may have not been exposed by previous testing scenarios.

Table 4.10 Examples of a single-unit UAT test scenario

Use Case Testing	Description
Scenario 1.1	Jack-knife of a trailer pulling vehicle in transport through an intersection. One passenger
Triggering Event	Trailer jack-knife in intersection
Crash Type	Non-collision
Location Factor	Intersections (jack-knife)
Units	Motor Vehicle in Transport
Conditions	No Injury
Additional Persons	Passenger

The UAT mock data entry and documentation of system failures or usability issues was a time intensive process. To aid the UAT testers, the HumanFIRST team supplied a custom rubric of the crash elements they were expected to see with each of the 54 UAT test scenarios (see Appendix F for an excerpt of an example rubric). The test rubrics allowed testers to not only avoid unnecessary and time-consuming documentation of what they elements they experienced, but also helped to guide their expectancies of what elements should be visible, given the logic-driven components of the crash scenario at hand, and help them detect if any omissions occurred.

4.2 Beta Testing Rounds I and II Discussion

The first round of beta testing the Appriss interface prototypes provided the MNCrash development team with quality data on the status of overall usability of the report. The results from the intensive usability testing protocol utilized by HumanFIRST gave insight allowing clear conclusions to be drawn on how the approach of interface revision the next round of interface revision. HumanFIRST's error and revision list summarized the findings presented here, and the development team discussed corrective action on reducing the amount and frequency of the problematic human factors aspects documented. The findings discussed within the results portion of the testing illustrated an overview of where the MNCrash client was in terms of the development from the human factors perspective. While the frequency of low and mid-level errors or areas of concern for human factors principles was relatively high, the report as a whole was positively received by HumanFIRST as proving to be on the right track to high standards of usability, and therefore, garnish high user acceptance rates and overall satisfaction.

The second round of internal beta testing provided the opportunity for further observations on characteristics that were considered problematic and potentially disruptive to the usability and fluidity of the report. These components included the presentation style and traits of the system, missing or undefined aspects of report data that were legally bound, and missing checkpoints within the report that would catch errors before final report submission. Each general area of issues researchers found were inhibitive of quality report creation, at the expense of the report's usability. Attending to and correcting the problems identified by HumanFIRST was predicted to improve user satisfaction and further reduce the required workload, in both time and effort, on users to complete the report.

Chapter 5: **FINAL VENDOR PROTOTYPE USABILITY TESTING**

5.1 **Introduction: Vendor Usability Testing**

The final phase of usability testing of the three MNCrash prototype platforms concluded the final phase of design revisions of the system prior to its statewide deployment

HumanFIRST researchers repeated the protocol from Chapter 3 in the final round of usability testing, which involved the researchers meeting the officer participants at their home departments to engage users in a mock-reporting exercise using fictitious crash scenarios. Observations were performed using the Morae usability documentation suite on researcher laptops, in addition to note-taking done by researchers throughout the usability testing sessions. The goal of the final usability testing with the final vendor prototypes was to ensure that:

a)   The final prototypes adhered to best human factors principles and practices,
b)   Prototypes were free of previously established moderate and high-critical issues, and
c)   User acceptance evaluations of the prototypes were satisfactory to accepted standards.

5.1.1 Vendor Usability Testing: Round One

5.1.1.1 *Participants*

Minnesota State Patrol officers are the users who are most likely to complete crash reports for commercial motor vehicle crashes and fatal crashes, according to information provided to researchers. Given the participant constraints, however, not all participants were State Patrol officers and a small subset included was local police officers and sheriff's deputies.

A total of five law enforcement officers were recruited from the Baudette Police Department, the University of Minnesota's Campus Police Department, and Lake of the Woods County Sherriff's Office (see Table 5.1). The participants in this study varied in rank and years of experience working with the current crash report (see Table 5.2 and Table 5.3).

Table 5.1 Recruited Agencies

Agencies	N
Baudette Police Department	2
Lake of the Woods County Sheriff Office	2
University of MN Campus Police Dept	1
TOTAL	**5**

Table 5.2 Legacy Report Experience

Years of Report Experience	N
0-5	3
6-10	2
AVERAGE	**5**

Table 5.3 Law Enforcement Rank

Rank	N
Officer	3
Deputy	2
TOTAL	**5**

5.1.1.2 *Materials*

Wizard and Form interfaces of the MNCrash client were utilized in testing, and included the following scenarios, a three-unit crash consisting of a pedestrian, motor vehicle, and bicyclist (Scenario A), and a hit and run of a parked vehicle (Scenario B). Scenario C described a one-unit incident of a motorcycle hitting a pothole that resulted in a fatality. Participants were provided with two scenarios which served as scripts that guided them through the interface while they explored the elements and discussed their specific needs and requirements under different contexts.

The SUS (Appendix B) and the RSME (Appendix A) were again used in the vendor usability testing exercises. Connectivity issues made it difficult to systematically include both standalone and web-based platforms in testing procedures.

5.1.1.3 *Method*

Law enforcement participants met with researchers at their home stations. The order of interface presentation was counterbalanced across participants. Law enforcement participants spent approximately 20 minutes examining each interface with each scenario. Sessions lasted approximately 60 minutes in total. Participants were provided a brief background of the state of the prototypes and were asked to enter information about a three-unit crash involving a pedestrian hit by a car, which then swerved and collided with a hydrant and storefront, resulting in a distracted bicyclist hitting the car (see Appendix D for an example scenario). The next crash that the participants documented was a two-unit crash involving a hit and run incident against a legally parked vehicle. Participants were asked to review the crash details before beginning, were allowed to review the document for their reference, but could also ask researchers questions regarding the crash.

Participants were encouraged to "think aloud" as they navigated through the interface, noting the features which might seem confusing, they liked, or disliked, etcetera, and were prompted by researchers to clarify any ambiguities. Morae software recorded all activities on the screen while the participant interacted with the interface, as well as collected the audio commentary of participants while they navigated through the interface. Once participants had entered both crash scenarios into an interface, they were provided the SUS and the RMSE to rate the interface's usability and their perceived mental workload to complete the task. Once participants completed the crash detail entry into both interfaces, they were asked to state which of the two interfaces best represented an interface they would like to see in the final version and to state the reasoning for their answer.

5.1.1.4 *Results*

The HumanFIRST usability acceptance testing at the Baudette Police and Lake of the Woods County Sheriff's Departments provided researchers with useful insight on user opinion within the MNCrash client. Officers were pleased with the client overall, noting disliked and desired features of the program, which mainly consisted of small user interface flaws and areas needing improvement. For example, officers were in agreement that the damage locator feature of the

report was ambiguous, and could use more of an intuitive labelling on the vehicle diagram. An officer from the University of Minnesota's Campus Police Department found that the logic trees within items, such as contributing crash factors, weather, and event chronology, could be better streamlined by having nested menus sit horizontally next to each other, rather than vertically progressing in the Wizard and similarly in the Form. The Wizard platform of the MNCrash client received highly positive feedback from officers during its testing, specifically indicating that it is much preferred in use compared to the conventional paper format of crash reporting. The Form was reported as the most preferred, for reasons including superior usability features (i.e., the navigation tabs) not found in the Wizard and greater flexibility compared to the Wizard. Additionally, officers provided positive feedback regarding the drop down nested menu interface items. Further, the officers liked that they were not forced to make a definitive statement on entry fields that were not supported by information gathered about the crash (e.g., selecting "Unknown" when asked "Does damage to vehicles or property exceed $1000?").

System Usability Survey (SUS)
Participants rated their perceived usability of each interface on the SUS. The total rating possible was 100 points expressing that they: would like to use the interface, it was easy to use, and was well integrated, etcetera. Overall, the participants showed slightly higher usability ratings for the Form interface (*M = 80.6, SD = 4.4)* and slightly lower usability for the Quick-Capture and Wizard interfaces (*SUS = 77.5, n = 1), (M = 76.5, SD = 5.6*), respectively, see Table 5.4. The difference between the two was not significant, however. A SUS score of 68 is considered to be above average, so overall, both interfaces were rated with generally high usability.

Rating Scale Mental Effort (RSME)
Participants rated their perceived mental workload on the RSME. The best possible rating possible was 0, expressing that absolutely no mental effort was used to complete the task with the interface, while a score of 150 indicated that the task was excruciatingly difficult to accomplish. Collectively, the participants showed slightly lower mental effort ratings for the Quick-Capture (*RSME = 28, n = 1)* and Wizard interface (*M=37.6.7, SD = 10.2*) and slightly higher mental effort for the Form interface (*M = 40, SD = 10*), see Table 5.4; however, the difference between the two was not significant. The average RSME score of approximately 35 expresses the participants perceived mental effort for all interfaces as just above "a little effort" and below "some effort." Overall, these scores are considered low mental effort and indicate a positive outlook for both interface types.

Overall Preference
Participants were asked to select which interface they would choose to best represent the actual future report. Overall, participants exposed to the Form and Wizard interface chose the two interfaces equally (50%), see Table 5.4. This was expected given the complexity of the commercial motor vehicle and fatality scenarios presented which required more screen exposure with the Wizard compared to the Form. The Quick-Capture interface was underrepresented in testing, due to noted complications below, however, officers that used the Quick-Capture were quite invested in its usability. One officer testing the Quick-Capture felt that the interface would be most used by himself and his peers, because of its simple layout that allows for fast, concise data entry. As observed with previous testing, there was a slight order effect, in that the second interface presented was more likely to be chosen as the preferred interface. This is likely due to a

recency effect and confounded by the amount of time spent on each interface (i.e., the second interface took less time due to practice with the crash details and report elements and thus would be more preferable). Again, this order effect was controlled for through counterbalancing.

Table 5.4 Subjective rating scores

	SUS Scores	**RSME Scores**	**Preference[α]**	**N**
Form Interface	*M = 80.3, SD = 4.4*	*M = 40, SD = 10*	*40%*	*2*
Wizard Interface	*M = 76.5, SD =5.6*	*M = 37.6, SD = 10.2*	*40%*	*3*
Quick-Capture Interface	*M = 77.5,SD=0*	*M = 28, SD = 0*	*20%*	*1*

[α]The first four officers were not tested on the QC due to time constraints and the last was not tested on the Form due to system failures in connectivity.

5.1.2 Vendor Usability Testing: Round Two

The intended agencies for the final prototype user acceptance testing are listed in Table 5.5. These agencies were specifically chosen by researchers because of their reliance on paper reporting, and the low percentage of electronically submitted reports to Minnesota Department of Public Safety (DPS). After examining the statistics on reports completed by each agency and the modality of the report type (i.e., paper or electronic submission), nine agencies were selected as the ideal population for the intent of reaching the goal in the final usability and user acceptance testing of the vendor prototypes. Specifically, criteria for agency selection was based upon those agencies that exceeded ten reports per year by means of paper, which also accounted for more than a fifth of their overall annually reported crashes. Researchers were interested in examining how receptive officers accustomed to reporting crashes on paper would be to the new electronic crash report. Special consideration was taken for this population of officers, as they are more likely to struggle with the reporting paradigm shift, express discomfort, feel overwhelmed with the new interface, or potentially become dismissive of the new electronic report.

Table 5.5 Targeted Law Enforcement Agencies

Group 1	Eden Prairie (474 paper/514 total)
Group 2	Mower Co Sheriff (30 paper/60 total), Austin PD (69 paper/ 301 total)
Group 3	Wabasha Co Sheriff (27 paper/58 total), Red Wing PD (83 paper/248 total)
Group 4	Isanti PD (15 paper/19 total), Cambridge PD (31 paper/47 total)
Group 5	Cass Co Sheriff (26 paper/76 total), Wadena PD (10 paper/36 total)

The HumanFIRST team felt that if this population of officers prone to submit paper reports would best capture any remaining usability issues not detected among officers of other agencies. Additionally, if the officers of these agencies were to provide positive feedback and report satisfaction with the prototypes, HumanFIRST would consider that feedback as a strong affirmation of the success for the project as a whole.

Unfortunately, agencies from Groups 1, 3, 4 and 5 were either unresponsive to the requests for participation or were unable to provide time and resource to complete the testing. Group 2, the Austin Police Department and their Mower County Sherriff's Department, were able to participate in the usability and user acceptance testing. To make up for the unavailability of the original recruitment targets, researchers made use of the audience at the 2015 Toward Zero

Deaths conference in Saint Cloud, where many officers from across the state expressed interest in hosting HumanFIRST to perform usability testing at their departments.

5.1.2.1 *Participants*

Six agencies from geographically opposing ends of the state volunteered to participate in the study. These departments include the Montevideo Police Department and Chippewa County Sheriff's Department, Rochester Police Department and Olmsted County Sheriff's Department, as well as the Austin Police Department and Mower County Sheriff's Department (see Table 5.6). A total of thirteen law enforcement officers were provided by these departments for the user testing. The rank and role of each officer is presented in Table 5.8, with respective years of experience per officer appearing in Table 5.7.

Table 5.6 Participating Agencies

Agencies	N
Rochester PD	5
Olmsted County Sheriff	1
Montevideo PD	2
Chippewa County Sheriff	2
Austin PD*	2
Mower County Sheriff*	1
TOTAL	**13**

Table 5.7 Legacy Report Experience

Years of Report Experience	N
0-5	3
6-10	3
11-15	7
AVERAGE	**12.5**

Table 5.8 Law Enforcement Rank

Rank	N
Officer	4
Deputy	4
SGT	3
CSO	1
K9	1
TOTAL	**13**

Testing session experienced connectivity problems which negatively impacted usability results leading the usability data and results to be discarded

5.1.2.2 *Materials*

Researchers arrived with the most updated prototypes of the Quick-Capture, Form, and Wizard interfaces installed on laptops. A computer mouse was supplied with each laptop, because officers from previous testing sessions disclosed to researchers that they primarily complete reports on a desktop computer, however, some officers preferred the touch pad for directing the cursor throughout the testing.

Mock-crash scenarios were provided for officers during testing: an angle-striking collision between two motor vehicles located on a two-way undivided highway (Scenario C), a parked vehicle hit and run collision which involved an occupant fatality (Scenario B), as well as a two-unit incident involving a motor vehicle in transit and a pedestrian passing through a crosswalk (Scenario A). An example of these scenarios is detailed in Appendix D.

5.1.2.3 *Method*

HumanFIRST visited law enforcement participants at their home stations for the final round of prototype testing. Officers were briefed on their task and given the mock-crash scenarios: a two-unit crash between a motor vehicle and pedestrian, an angle-oriented crash between two vehicles

in transport at low speed, and a minor collision between two motor vehicles that was intended to showcase the Quick-Capture's efficient and fast driver exchange of information. Researchers were present during the entire testing session to answer general questions about protocol or overall aspects of the system, however, researchers did not offer advice or guidance on specific questions related to completing the mock-crashes, as the purpose of the testing is to identify issues within the system by observing users work their way through the report. Officers were encouraged to talk about their thought processes or opinions on the functionality and design of the prototype interfaces as they progressed through reporting the crash scenarios. Researchers were interested in the user feedback that pertained to subjective opinion on feature qualities in the report (e.g., likes and dislikes of the report, areas of confusion).

When appropriate, officers were instructed to make up details related to the crashes that the scenario briefs did not contain. These details that were not discussed in the scenarios would include items such as weather and lighting conditions, contributing factors to the crash attributed to actions by the driver or vehicle, as well as flexibility in designing the layout of the roadway where the accident occurred. Granting the officers freedom to enter in data at will presents the opportunity for unique combinations of circumstances that not only test the flexibility of the reporting system, but also increases the possibility of discovering bugs with the front and back ends of the program. Additionally, the hands-off approach of letting the officers navigate and fill in the report as they wish establishes a working knowledge with the characteristics of the report, which would hopefully result in user approval of the system. Researchers found that this exercise of testing which gave officers discretion on aspects of the crash details would lead to officers discussing their experience with the new system in comradery. Notes taken during these post-test conversations highlighted officer outlook on the report in a way unique to the think-alouds and usability surveys.

Consistent with previous usability testing performed by HumanFIRST, the Rating Scale Mental Effort (RSME) and System Usability Scale (SUS) usability inventories were completed by officers at the completion of each scenario per interface type.

5.1.3 Final Usability Results

The results of the final vendor prototype testing sessions showcased positive officer reception to the MNCrash system, although exposing a few areas of concern related to human factors principles.

Problems in navigating the report
The most problematic element discovered by this round of usability testing came in the form of users electing to incorrectly select the "Unit" tab below the "Crash" tab on the report, after filling out a case number on the first page of the "Crash" tab. Officers were presented with the landing screen of the crash-level tab, which only included a single entry field for the incident number (see Figure 5.1). The correct operation after entering the unique identifier to the crash was to select the "Next" button illustrated in Figure 5.2, however, officers were consistently selecting the tab beneath the crash-level tab, in aim of progressing to the next screen. Doing so would skip three screens that contain critical crash-level information, and result in dozens of critical errors upon submission of the report that would confuse or frustrate officers. At this point in the report,

officers would be directed to the Crash-level screens to enter the missing data, and then proceed to submit the report once more. To remedy the usability error, HumanFIRST proposed a redesign of the first Crash screen and met with DPS and Appriss to discuss the implementation of the revisions. The redesign moved the crash case number, which at this point was the only field of entry on the entire first screen, to the second screen that included multiple crash data fields. Figure 5.1 depicts the original first Crash-level screen. Figure 5.2 illustrates the revised end-product of the revisions made with Appriss and DPS.

Figure 5.1 Crash-Level Tab First Iteration.

An additional navigation issue was documented, although not as severe as the "Next" button error. If officers had failed to enter in a required item in the report, the final screen prior to report submission would provide a link to the error. After satisfying the requirements of the report by completing a field, some users would use the "Next" button instead of the adjacent "Finish" button to navigate through the rest of the report, screen by screen, in order to arrive at the submission screen. This action appeared to only temporarily negatively impact user satisfaction of the report, but most officers recognized the "Finish" button a short time after continuously relying on the "Next" screen, suggesting this behavior was more likely caused by inexperience with the new report, rather than a human factors related issue.

Figure 5.2 Crash-Level Tab First Screen Revision.

Progressive data field reveal functions

The results of the testing sessions uncovered that portions of the report that allowed users to select multiple, sequential traits of the crash had usability concerns. The functionality of the report included the use of progressive-reveal fields, which were presented as drop-down menus that appear "grayed out" until the user selects an option from the menu. For example, the Weather field on the first Crash-level screen presented two fields: one field is three-dimensional and appears vivid in presentation, and the second field appears to be non-operational and is subtly colored gray. When the first field is satisfied by the user selecting an option, such as "clear" in the example of the Weather field, the second field will become lively in appearance, see Figure 5.3. The enabling of the second field led some officers to report confusion and a feeling of being "forced" to enter a second weather condition, even when a second did not apply. This confusion was observed by the research team to result in a time consuming deliberation process by the officer. A hyperlink added to the label of the first weather field was proposed as the solution to subtly suggest that it is the only required field and to provide an opportunity to clarify the rules of the attribute within the hyperlink. The Contributing Road and Motor Vehicle Circumstances fields within the report were similarly problematic for users. Thus, hyperlinks for the first option of each were also suggested to ameliorate the problem.
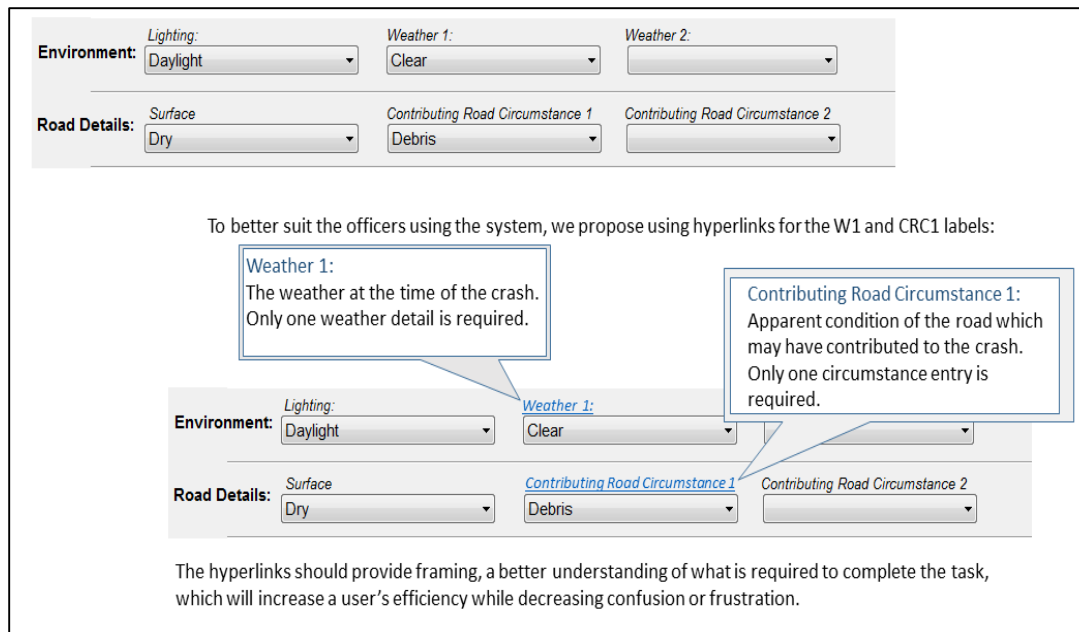
Figure 5.3 Progressive Reveal and Hyperlink Cuing Redesign- Crash-Level.

The potential for confusion regarding the requirement of fields and progressive reveal functions became most apparent in the Sequence of Events field in the Unit-level portion of the report, where officers are instructed to provide the unit's (i.e., motorist and non-motorist) actions that led to the collision in a chronological manner. Officers reported to researchers that they felt entering data in all fields was a requirement of the system, and felt inclined to enter the extraneous details to avoid conflict later in the report. Because data quality and user consistency is of utmost importance to HumanFIRST, a redesign of this field was promptly made. Figure 5.4 depict the before-and-after of the Sequence of Events fields, including the newly implemented hyperlink that provides users with a brief explanation of how to approach entering the data, and what is being asked of the user to satisfy the requirements of the report. The Contributing Factors fields for both motor-vehicle and non-motorist units also received the revision treatment of hyperlinking a dialogue box, which contained a straightforward explanation of what the field was for, what it was asking, and how to complete it. The proposed design revisions relating to the progressive fields were well-received by the development team and were implemented into the MNCrash project deployment.
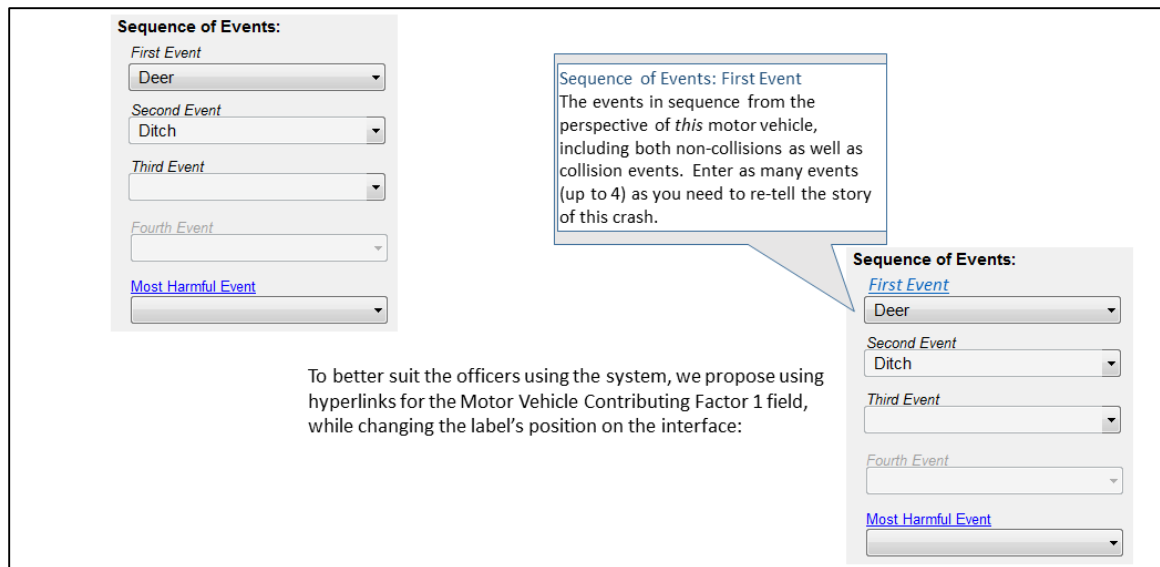
Figure 5.4 Progressive Reveal and Hyperlink Cuing Redesign Sequence of Events Screen-Unit-Level.

Nested menus and drop down listing

HumanFIRST researchers found that fields containing lists of possible selections, namely drop-down boxes and nested menus, were not organized in a user-friendly manner, and at times were cumbersome to new users. Because user efficiency and data accuracy are priorities for the HumanFIRST team, each possible entry field that contained a list of any type was closely examined ensure the highest degree of ease of use for the officers. To do so, each of the 78 lists of elements examined were subject to a human factors analysis. Researchers referenced crash records provided by the state of Minnesota to reorder many of the elements within the lists by their statistical likelihood of occurring. When statistical data was not available, or did not apply to the ordering, researchers organized the lists according to a logically-based rubric. Lengthy lists, e.g., states and territories within the union, were ordered alphabetically and segmented when possible. When fields contained a yes or no value, researchers ensured that these fields were consistently ordered report-wide. These changes are conducive to report fluidity and data entry efficiency, and are well-received by officers, as they had expressed their criticism of the inconsistently or non-intuitively ordered lists that were present in the final round of testing. Table 5.9 details the entirety of the lists in the report, and their new ordering as they appear in the system.

Table 5.9 Examples of List Reordering

Field Variable	Sort Type	Description
Air Bag Deployment	Logically Driven	Sequenced from the driver's seat and most common types
Alcohol Test Type	Logically Driven	Sequenced in order of events for law enforcement
Cargo Body Type	Default ordering	FMCSA Standards
Roadway Design	Statistically Driven	Ordered in frequency of previously selected roadway designs
Drug Test Result	Alphabetical	"Other" lowered to bottom. "Results Unknown" and "No Drugs" disabled for duplication reasons.
States	Alphabetical	MN added to top, foreign States appear after US States/territories

Rating Scale Mental Effort (RSME)
Participants rated the perceived mental workload of the report on the RSME (Appendix A). Overall, participants reported slightly lower mental effort ratings for the Quick-Capture (M = 26.4, SD = 12.5) and Form interface (M= 27.5, SD = 7.5) and slightly higher mental effort for the Wizard interface (M = 32.9, SD = 14.4), see Table 6.7; although, differences in reported effort were not significant. The average RSME score of approximately 35 estimates the participants perceived mental effort for all interfaces as between "a little effort" and "some effort." These scores are considered low mental effort and explain positive reception to each of the report interfaces.

System Usability Survey (SUS)
Participants rated the perceived usability of each interface on the SUS (Appendix B). Participants reported slightly higher usability ratings for the Form interface (M = 86.7, SD = 9.1) and slightly lower usability for the Quick-Capture (M = 84.2, SD=10.0), while the Wizard interface scored lowest on average, with a large degree of variability in score (M = 80.4, SD = 18.2), see Table 5.10. Scoring differences among the three interfaces was not significant, however. A SUS score of 68 is considered to be above average, so overall, each interface was rated with generally high usability.

Interface Preference
Participants in the usability test were asked to state their preference of interface type: Form, Wizard, or Quick-Capture. Those officers that had tested each of the interfaces (N = 6) were asked which of the interfaces suited them best, with four having chosen the Form above the Wizard and Quick-Capture. Officers exposed to the Form and Wizard were collectively supportive of the Form, where three out of three officers reported preferring it over the Wizard. Table 5.10 details feedback on interface preference.

Officers were pleased with the Quick-Capture interface. The feature of the driver exchange of information was received with enthusiasm and satisfaction, especially by the Rochester Department, who had voiced concerns over the standard in-vehicle printing system which was problematic when using the legacy reporting system.

Table 5.10 Subjective Rating Scores

	SUS Scores	RSME Scores	Preference[α]	N
Form-based Interface	*M = 86.7, SD =9.1*	*M = 27.5, SD = 7.5*	*70%*	*7*
Wizard Interface	*M = 80.4, SD =18.2*	*M = 32.9, SD = 14.4*	*10%*	*1*
Quick-Capture Interface	*M = 84.3, SD=10.0*	*M = 26.4, SD = 12.5*	*20%*	*2*

[α]Three officers from Austin PD and Mower Co. were not tested on the Wizard and one officer did not complete the QC or Form exercise due to time constraints stemming from system failures in connectivity.

5.2 Final Usability Testing Discussion

The observed issues discussed in the results section of this testing session exemplify the cooperative framework within the MNCrash development team. When HumanFIRST identified a problem with the report, DPS and Appriss met to discuss the issue and brainstorm potential issues, and each team took responsibility of their strengths to focus on the area in which their specialty and skillset could contribute to the larger group to solve the problem. The issues highlighted within the final usability testing results section clearly illustrate the evolution of the report as HumanFIRST and Appriss continued to work with improving usability and user acceptance levels of the MNCrash system based on officers' feedback. The usability testing discussed in Chapter 5 provided HumanFIRST researchers with qualitative data from officers that was used to redesign portions of the report that improve usability and user satisfaction with the report. Time constraints and data connectivity issues limited the research team's ability to fully evaluate all six user platforms (Form, Wizard, and QuickCapture in both Web and Standalone versions) in the final rounds of usability testing. Researchers urged that both platforms be developed to be as consistent as possible to ensure the highest accuracy and satisfaction is met. Any discrepancies in appearance or functionality across the web and standalone platforms risk user satisfaction and data accuracy.

Chapter 6: GENERAL DISCUSSION AND CONCLUSION

As with all public sectors, roadway safety has limitations in fiscal spending. To control the spending of these limited funds, emphasis was placed on choosing the critical areas of impact and fixing those areas first. For the public to experience the greatest benefit from these changes, it is important that the right areas be emphasized. The foundation for making such decisions begins with crash report data that give insight into high-risk environments throughout Minnesota. The goal of this project was to start at the beginning of the process, crash reporting, and create a standardized method for the reporting of crash circumstances. In doing so, future decisions with regard to road safety changes will be made using highly accurate data.

The result of this investigation yielded a resource that has the potential to transform the manner in which law enforcement personnel perform the duty of completing crash reports. The interfaces that were designed by HumanFIRST assist the user by conforming to human factors and usability principles. The MNCrash development team, consisting of the Department of Public Safety, Minnesota Department of Transportation, the implementation vendor Appriss, and the human factors research laboratory, HumanFIRST, were able to create a successful crash report client in Minnesota through a collaborative process based on the user-centered approach. This collaboration and intense focus on creating a superior experience for the user was successful because human factors were considered early and often. This project is truly a success story of how a user-centric approach taken through all stages of planning, paired with an iterative design process, guided by user testing and feedback, can result in a positive and intuitive experience of even the most complex system.

HumanFIRST's team of human factors researchers tested each design step and complementary development stage in a comprehensive and exhaustive manner, either in-house when necessary, such as the beta testing of prototypes discussed in Chapter 4, or testing in the field with the law enforcement officers, the end-users of the system. The research team was dedicated to involving law enforcement in each aspect of the interface design and development process, to ensure that user needs and desires of the MNCrash client were met. The in-depth user-centric process utilized in this project is underutilized in the realm of user interface development outside of progressive technology companies (e.g., Google) and typically non-existent for government software suites, which establishes this project as a profoundly successful and innovative exercise in human factors-oriented usability and user acceptance. Conventionally, the opportunity to engage the user in each step of the interface and program design through each iteration of development is seldom realized; however, this project's research and development team incorporated the user in the iterative design processes. The qualitative data documented by involving the end-user in the design and testing process of the MNCrash client proved to be the driving force that shaped the report in the most impactful manner.

The varying demographic traits of the law enforcement officers that participated in the usability and user acceptance testing throughout the MNCrash client development process gave the research team a dynamic range of criteria from which to incorporate into the interface designs. Some 80 law enforcement agencies across Minnesota participated with fervor in the various stages of report design, which allowed the research team to consider the needs and requirements

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of the system's design based on the diversity of the user population that would be interacting with the report, with some users potentially using the report on a daily basis.

The new MNCrash reporting system launched on January 1, 2016, and experienced overwhelmingly positive feedback from users. The MNCrash report owes the superb usability qualities to the user-centric approach of design during each step of the development process. These qualities include the concise presentation of data entry fields, rich descriptions of report requirements within each screen, user-centric help guides, and flexibility between program platforms and interfaces. In the end, the enhanced MNCrash reporting system was forged by the law enforcement officers across the state of Minnesota. Their needs were heard, limitations accommodated, and feedback put into practice in a tangible way. Investing in the user and leveraging their expertise and intuition was not only a sound decision by the state of Minnesota to improve its data accuracy, but it also lends great support and appreciation to the law enforcement officers who serve the state. This study exemplifies the power of the implementation of human factors usability research principles in real-world production environments and establishes a precedence for motor vehicle crash reporting nationwide.

Chapter 7: **LIMITATIONS AND FUTURE RESEARCH**

Limitations realized
The MNCrash crash report client is regarded as an enormous success by both the development team and law enforcement agencies that have used the report in real-world crash scenarios since the production release in January 2016. While the crash report exceeds the expectations of users and designers alike, there were problematic components along the way to development that affected the design process and user testing sessions, however, these issues were relatively small in nature, and did not impact the overall quality and functionality of the final production version of the MNCrash client. Instead, these issues mainly consisted of technology problems during usability testing exercises, usually in the form of internet connectivity and contact with the hosting agency of the project, the Minnesota Bureau of Criminal Apprehension (BCA) in the early stages of the massive system integration process. The BCA graciously handled the IT aspect of the MNCrash report, as the nature of crash report records contain various sensitive private data.

The restrictive layers of security in place at the BCA for accessing the MNCrash development environment added complexity and a degree of unreliability when attempting to establish the required internet connection during each test session of the system's design. For example, HumanFIRST researchers had issues connecting to the BCA environment from their home offices at the University of Minnesota, which became problematic at times as they performed various testing and revision exercises of the report. The largest setback experienced during the human factors assessment of usability occurred when a HumanFIRST researcher visited the Austin Police Department in Austin, Minnesota. Inability to connect to the BCA environment, which was not unreasonable due to the amount of different secure networks that the research computer had to proceed through, resulted in very limited functionality of the Standalone platform of the report, consequently resulting in negative feedback and low usability and user acceptance scores. It must be noted that this unfortunate circumstance was the only officially documented negative feedback to the MNCrash client thus far; the 80 law enforcement agencies researchers visited were largely positive in their reception of the report, with many expressing a sense of relief and gratitude towards the state for considering each officer's opinion in the design.

Future research utilizing MNCrash
HumanFIRST researchers propose an in-depth analysis of crash data and report-use characteristics of the new MNCrash reporting system once time allows for a large and diverse data pool. Although the iterative design process and effort creating the new MNCrash interfaces has yielded an impressive crash report system, researchers suggest moving forward with the report data by advancing the crash data accuracy and quality, to ensure that the state agencies that use crash data for policy and planning receive the highest degree of data quality possible. It is the goal of HumanFIRST to highlight the degree of overall data improvement achieved by the MNCrash client. Ensuring that the report system captures a high degree of quality data will provide the groundwork for discussion with the Department of Public Safety of how to further effectively make use of the data acquired from the report system, in aim of improving roadway safety for Minnesota drivers.

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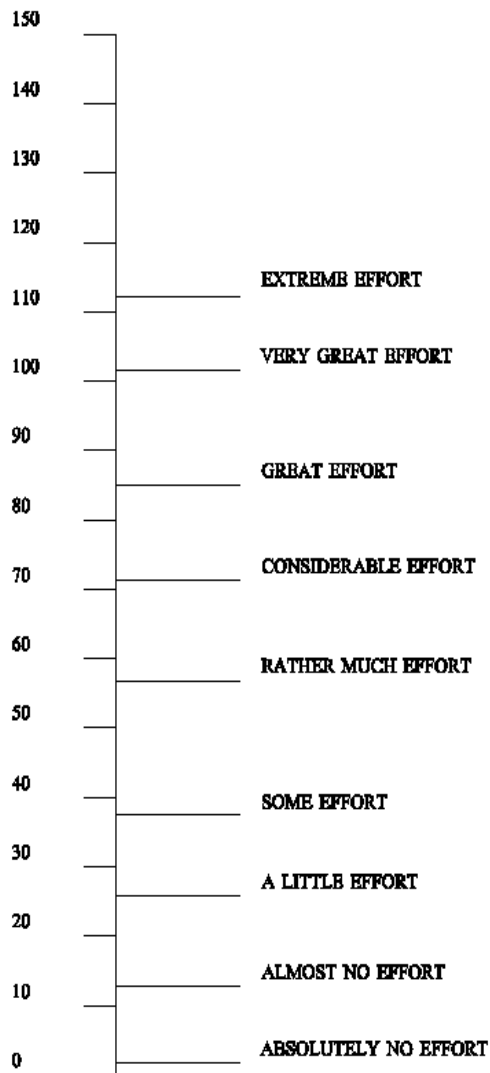Nielsen, J. (1994). Usability inspection methods. In *Conference companion on human factors in computing systems* (pp. 413-414). ACM. Retrieved from http://dl.acm.org/citation.cfm?id=260531

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APPENDIX A: RATING SCALE MENTAL EFFORT (RSME)

RATING SCALE MENTAL EFFORT (RSME)

Please indicate, by marking the vertical axis below, how
much effort it took for you to complete the task you've just finished

```
150 ─
140 ─
130 ─
120 ─
                    EXTREME EFFORT
110 ─
                    VERY GREAT EFFORT
100 ─
 90 ─
                    GREAT EFFORT
 80 ─
                    CONSIDERABLE EFFORT
 70 ─
 60 ─
                    RATHER MUCH EFFORT
 50 ─
 40 ─
                    SOME EFFORT
 30 ─
                    A LITTLE EFFORT
 20 ─
                    ALMOST NO EFFORT
 10 ─
  0 ─                ABSOLUTELY NO EFFORT
```

APPENDIX B: SYSTEM USABILITY SCALE

System Usability Scale (SUS)

For each of the following questions, place an "X" through the one number to indicate your response.
"1" for strongly disagree, "3" for neutral- neither agree nor disagree, "5" for strongly agree.

1. I think that I would like to use this system frequently.

Strongly Disagree		Neutral		Strongly Agree
①	②	③	④	⑤

2. I found the system unnecessarily complex.

①	②	③	④	⑤

3. I thought the system was easy to use.

①	②	③	④	⑤

4. I think that I would need the support of a technical person to be able to use this system.

①	②	③	④	⑤

5. I found the various functions in this system were well integrated.

①	②	③	④	⑤

6. I thought there was too much inconsistency in this system.

①	②	③	④	⑤

7. I would imagine that most people would learn to use this system very quickly.

①	②	③	④	⑤

8. I found the system very cumbersome to use.

①	②	③	④	⑤

9. I felt very confident using the system.

①	②	③	④	⑤

10. I needed to learn a lot of things before I could get going with this system.

①	②	③	④	⑤

APPENDIX C: USER SUBJECTIVE RATINGS SURVEY

User Subjective Ratings Survey

Ask the user to tick the relevant box for each question and add a further comment if they wish.

How useful would you find this system?

Not useful	Very little use	Quite useful	Very useful	Essential

Comment: …………………………………………………………………………………

How easy was the system to learn?

Very difficult	Quite difficult	Neither easy nor difficult	Quite easy	Very easy

Comment: …………………………………………………………………………………

How easy do you now think the system is to use?

Very difficult	Quite difficult	Neither easy nor difficult	Quite easy	Very easy

Comment: …………………………………………………………………………………

How satisfying do you find it to use this system?

Very unsatisfying	Quite unsatisfying	Neither satisfying nor unsatisfying	Quite satisfying	Very satisfying

Comment: …………………………………………………………………………………

APPENDIX D: CRASH SCENARIOS IN USABILITY TESTING

EXAMPLE SCENARIO 1: HIT & RUN + PARKED VEHICLE IN STORE PARKING LOT

A hit & run case occurred on June 9th at 10:30am in the parking lot of Eaton Shopping Center, which was located on Bay Street, 2.5 miles from College Street. **Vehicle 1** which was legally parked in one of the parking spots when it was hit by **Vehicle 2** which took off without leaving his info.

You have the following information on **Vehicle 1** (parked car):

1. Vehicle Plate #: 200DND
2. Vehicle 2 is a passenger car
3. Vehicle 2 has minor damage at the 6 o'clock position.
4. Insurance company: Liberty Mutual
   Policy # 4321
5. Owner of vehicle:
   a. Driver license: D123456789
   b. Name: Minnie Jay
   c. DOB: 05/01/1987
   d. Address: 111 Church St. SE Minneapolis Hennepin 55401
6. No one was in physical control of the vehicle at time of crash, but there were 2 passengers in the back seat of the vehicle:
   Passenger 1:
   a. Not injured

   Passenger 2:
   a) Name: Danny McDonald
   b) DOB: 01/01/2005
   c) Address: 111 Church St. SE Minneapolis Hennepin 55401
   d) Didn't wear seat belt
   e) Sustained minor injuries and not transported to the hospital

EXAMPLE SCENARIO 2: COMMERCIAL MOTOR VEHICLE + PEDESTRIAN

A 2-unit collision occurred on June 14th at 10:30am at the intersection of Church Street SE and University Ave, Minneapolis, Hennepin County, Minnesota. Pedestrian 1 crossed Church St SE walk path on a "Walk" signal. Driver of **Vehicle 1** was travelling on University Ave when he made a right turn onto Church St. SE on a red light and in front of the crossing **Pedestrian 1**, hit Pedestrian 1, and swerved to the right and hit the fire hydrant on the curb.

Environmental conditions did not seem to contribute to the crash—the traffic control signal was present and working, weather was sunny and the road was dry, straight and level. However, Driver of Vehicle 1 was suspected to be under the influence of alcohol so he was given a blood alcohol test—result is still pending.

You have the following information about **Vehicle 1**:
1. Vehicle Plate #: 300DND
2. Vehicle 1 is a MnDOT Sterling 6x6 Snow plow (plow was <u>UP</u> and not plowing snow at the time of the crash)
3. Vehicle 1 has minor damage at the 12 & 1 o'clock positions
4. Insurance company: Travelers Insurance
   Policy # 1234
5. The driver of the vehicle is John Doe. His DOB is 09/01/1986. His address is 10465 45th Ave NE, Sauk Rapids, MN, 56379. His driver license # is A123456789
6. Driver was wearing a lap & shoulder belt at time of crash and was not injured.
7. Commercial Motor Vehicle Information:
   a. USDOT#: 1234567
   b. Motor Carrier Name: MnDOT
   c. Carrier Type: Government Vehicle (Non-commercial use)
   d. Address: 395 John Ireland Blvd
   e. City: St. Paul
   f. ST: MN
   g. Zip: 55155
   h. Country: US

Pedestrian 1:
1. Driver license: C123456789
2. Name: David Downs
3. DOB: 04/01/1997 899
4. Address: N 1st St. Minneapolis Hennepin 55401
5. Minorly injured but not transported

APPENDIX E: USER ACCEPTANCE TESTING DETAILS

Welcome to the MN-CRASH Client Usability Testing workbook.

Below is an overview of the process that you will be completing. Each use case will be provided with general important information. Your role as a tester is to simply follow each use case description as you work within the MN-CRASH Client, ensuring overall operation of the program, and documenting errors when applicable. The tester has flexibility within the crash situation to decide factors of the scenario, as the point of this exercise is to test various levels and aspects of the Client. When details are unclear, in other words, feel free to choose at your discretion. During the testing of each use case, please follow and enter in information about each step, noting problems when they occur.

Scenario	Brief statement of what happens during the incident, when leaving out specific driver/pedestrian details.
Triggering Event	The first point of contact within the crash scenario. Example: Bus impacts pedestrian on crosswalk.
Crash Type	The type of collision involved with the incident.
Location Factor	The type of roadway or roadway feature by which the incident occurred.
Units	The involved parties to the incident.
Conditions	Circumstances adding to, or causing the incident.
Additional Persons	Parties involved in the incident (not including the driver)

Single-Unit Crash Scenario Example

Use Case Testing	Description
Scenario 1.4	Working Vehicle/ Equipment operator struck a road feature in an intersection intoxicated.
Triggering Event	Working vehicle and road feature contact.
Crash Type	Non-collision
Location Factor	Intersection
Units	Working Vehicle/ Equipment
Conditions	Alcohol
Additional Persons	Witness

Two-Unit Crash Scenario Example

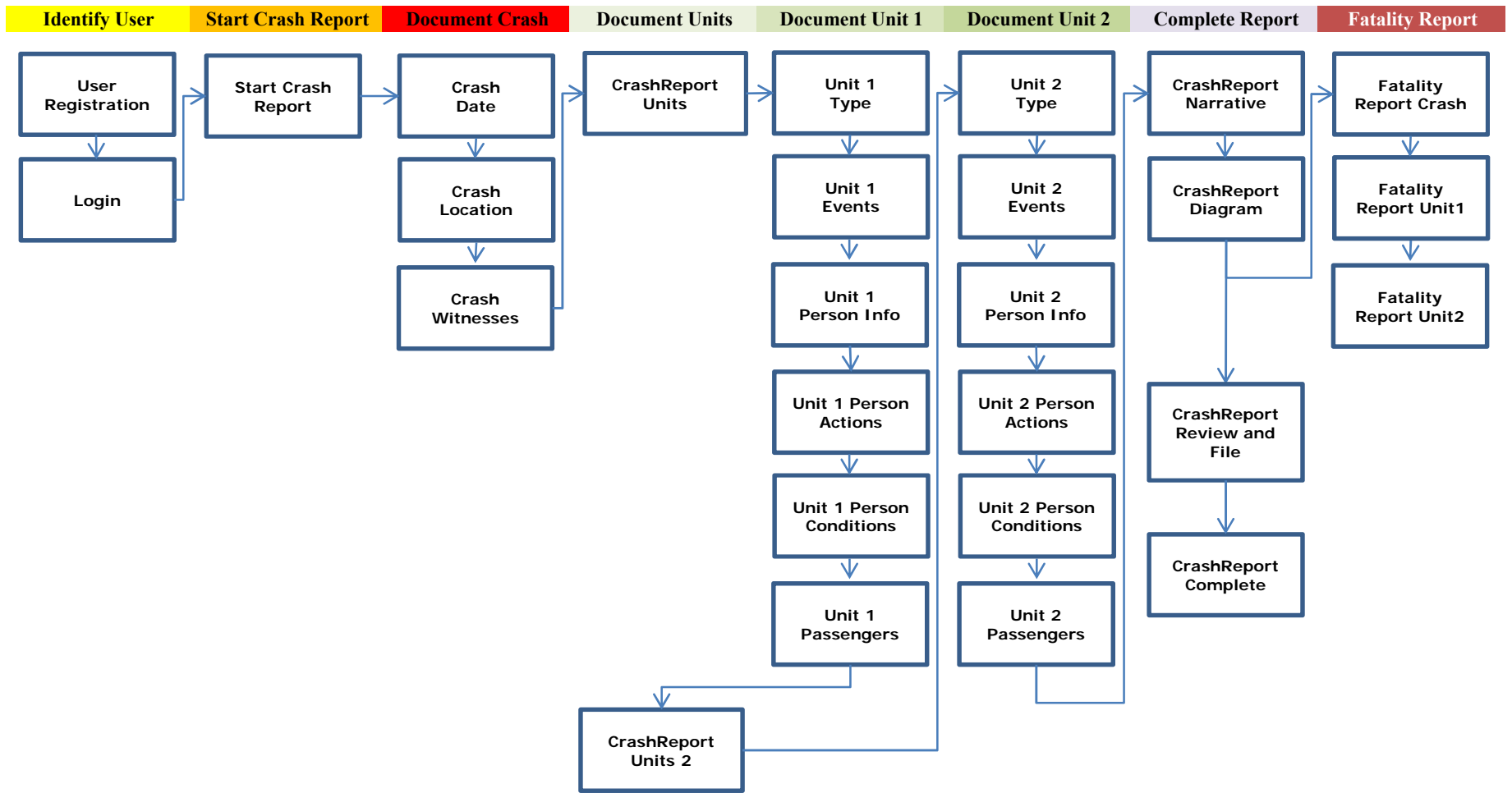| Use Case Testing	Description	Description2
Scenario 2.2	Serious pedestrian injury caused by a vehicle in motion. Witness.	
Triggering Event	Distracted driver striking pedestrian in crosswalk.	
Crash Type	Collision with Fixed Object	
Location Factor	Crosswalk	
Units	Motor Vehicle in Transport	Pedestrian
Conditions	Distraction(phone)/Fatality	
Additional Persons	Witnesses, Passenger	

Three-Unit Crash Scenario Example

Use Case Testing	Description	Description2	Description3
Scenario 3.1	Incident in a crosswalk in inclement weather involving a fleeing hit/run driver, a pedestrian, and bicyclist.		
Triggering Event	Hit and run vehicle striking a pedestrian and bicyclist in crosswalk.		
Crash Type	Collision with Non-Fixed Object		
Location Factor	Crosswalk		
Units	Hit and Run Vehicle (not present)	Pedestrian	Bicycle
Conditions	Snow/sleet		
Additional Persons	Witness		

APPENDIX F: USER ACCEPTANCE TESTING RUBRIC

UAT Crash Report Documentation

Tester:				
Date				
Use Case:				
Report ID:				
Environment:				
Persona:				
Notes:				

CRASH LEVEL DATA					
Step #	**Scenario**	**Description**	**Issues Encountered**		
1		Crash ID			
2		Date of Crash			
3		Time of Crash			
4		Lighting			
5		Weather 1			
6		Weather 2			
7		Road Surface			
8		Contributing Road Circumstance 1			
9		Contributing Road Circumstance 2			
10		Crash Type			
11		Manner of Collision			
12		Damage Value			
13		School Bus related			
14		Photos at scene			
15		Public or private property damage			
16		Witnesses			
17		Yellow Tag			
18		Number of Motorists			
19		Number of Non Motorist			
…		"……………………….."			
27		Roadway Direction (Divided Highway only)			
28		Location Relative to Trafficway			
29		Location Relative to intersection/junction			
30		On Bridge?			
31		Near/In work zone?			
32		Type of work zone			
33		Location of crash related to work zone			
34		Workers Present?			
35		Law Enforcement Present?			

APPENDIX G: FLOW CHART OF FORM INTERFACE

Identify User	Start Crash Report	Document Crash	Document Units	Document Unit 1	Document Unit 2	Complete Report	Fatality Report

Identify User
- User Registration
- Login

Start Crash Report
- Start Crash Report

Document Crash
- Crash Date
- Crash Location
- Crash Witnesses

Document Units
- CrashReport Units

Document Unit 1
- Unit 1 Type
- Unit 1 Events
- Unit 1 Person Info
- Unit 1 Person Actions
- Unit 1 Person Conditions
- Unit 1 Passengers

Document Unit 2
- Unit 2 Type
- Unit 2 Events
- Unit 2 Person Info
- Unit 2 Person Actions
- Unit 2 Person Conditions
- Unit 2 Passengers

Complete Report
- CrashReport Narrative
- CrashReport Diagram
- CrashReport Review and File
- CrashReport Complete

Fatality Report
- Fatality Report Crash
- Fatality Report Unit1
- Fatality Report Unit2

CrashReport Units 2

G-1

User Registration	Login

Screen 1 Steps:

1) Create Username

2) Create Password

3) Enter First Name

4) Enter Middle Initial

5) Enter Last Name

6) Enter Rank

7) Enter Badge #

8) *Enter State Patrol Station #

9) Click Register

(system proceeds to Login)

*If applicable

Screen 2 Steps:

1) Enter Username

2) Enter Password

3) Click Log in

(system proceeds to Start Crash Report)

Screen 1. User Registration

Screen 2. Login

Start Crash Report

Start Crash
Report

Screen 3 Steps:

1) Click Start New Report

2) Create Label for new report

3) Click Begin

(system proceeds to Crash Date)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	

Start New Report

Crash

Units

Narrative

Diagram

Screen 3a. Start Crash Report: Part A

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	

Crash

Start New Report

Create a label for your new crash report (e.g. Local Case Number)

Begin

Units

Narrative

Diagram

Screen 3b. Start Crash Report: Part B

Document Crash

Crash Date → Crash Location → Crash Witnesses →

Screen 4 Steps:

1) Accept Date Autofill OR manually enter date (i)
2) Enter Time (i)
3) Select Lighting
4) Select Weather 1
5) *Select Weather 2
6) Select Surface
7) Select Contributing Road Circumstances 1
8) *Select Contributing Road Circumstances 2
9) Select Crash Type (First Harmful Event) (i)
10) *Select Collision Impact (i)
11) Indicate damage value
12) Select School Bus related (i)
13) Select Photos at scene
14) Indicate if public or private property damage (i)
15) *Enter Private property damage description
16) *Enter Private property damage owner
17) *Enter Public property damage description
18) *Enter Public property damage owner
19) *Enter Yellow Tag number (i)
20) Click Next

(system proceeds to Crash Location)

*If applicable

(i) Help Bubble/Callout Available

Screen 5 Steps:

1) Select County
2) Select City
3) Enter Route # or Street Name (i)
4) Select System
5) Indicate if at intersection (i)
6) *Enter Distance from
7) Enter secondary Route or Street Name
8) Enter secondary System
9) Select Ownership of Land (i)
10) Select On/Off Trafficway (i)
11) *Select Roadway Direction
12) Select Location Relative to Trafficway (i)
13) Select Location Relative to intersection/junction (i)
14) Select On Bridge? (i)
15) Select Near/In work zone? (i)
16) *Select Type of work zone
17) *Select Location of crash related to work zone (i)
18) *Select workers Present?
19) *Select Law Enforcement Present?
20) Click Next

(system proceeds to Crash Witnesses)

Screen 6 Steps:

1) Select Number of Witnesses
2) *Enter Driver's License
3) *Click MN Fill
4) *Enter First Name
5) *Enter Middle Name
6) *Enter Last Name
7) *Enter DOB or click unknown
8) *Select Gender
9) *Enter Phone Number

If additional witnesses

Repeat steps 2-9 for each

10) Click Next

(system proceeds to CrashReport Units)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	

Report: 657

Crash

Units

Narrative

Diagram

| Date/Circumstances | Location | Witnesses |

Crash Occurance: Date: 11/24/2014   Time: _____

Use HHMM 24 Hour Clock Format ⓘ

Environment: [_____▼] [_____▼] [_____▼]

Lighting   Weather 1   Weather 2

Road Details: [_____▼] [_____▼] [_____▼]

Surface   Contributing Road Circumstance 1   Contributing Road Circumstance 2

Crash Type

First Harmful Event: ⓘ [_____▼]

Collision Impact: ⓘ [_____▼]

Additional Crash Details

Damage to vehicles or property exceeds $1000? ○ Yes   ○ No

School Bus related? [_____▼]
ⓘ

Were photos taken at the scene of the crash? [_____▼]

Damage to public or private property?
ⓘ   ☐ No
    ☐ Yes, Public
    ☐ Yes, Private

[Previous] [Next]

Screen 4a. Crash Date: Part A

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	

Report: 657

Date/Circumstances → **Location** → **Witnesses**

Crash

Units

Narrative

Diagram

Crash Occurance: Date: 11/24/2014   Time: 2205
Use HHMM 24 Hour Clock Format

Environment: Dark-Street lights on | Unknown |
Lighting | *Weather 1* | *Weather 2*

Road Details: Dry | None |
Surface | *Contributing Road Circumstance 1* | *Contributing Road Circumstance 2*

Crash Type

First Harmful Event: Motor Vehicle in Transport

Collision Impact: Sideswipe, Same Direction

Additional Crash Details

Damage to vehicles or property exceeds $1000? ⦿ Yes ○ No

School Bus related? No

Were photos taken at the scene of the crash? Yes

Damage to public or private property?

☐ No
☑ Yes, Public
☑ Yes, Private

Public Property Damage

Description of Damaged Property

Owner of Damaged Public Property

Yellow Tag #

Private Property Damage

Description of Damaged Property

Owner of Damaged Private Property

Previous | Next

Screen 4b. Crash Date: Part B

G-10

Help Window 1. Date Calendar (Screen 4)

Help Window 2. Date and Time Help Box (Screen 4)

Help Window 3. Crash Type Help Box (Screen 4)

Help Window 4. Collision Impact Help Box (Screen 4)

Lighting

Weather 4

Road Details: _____

Surface

A school bus, with or without a passenger on board, is *directly involved* if it is a contact motor vehicle

A school bus, with or without a passenger on board, is *indirectly involved* if it is a non-contact motor vehicle.

Crash Type

First Harmful Event: ⓘ _____

Collision Impact: ⓘ _____

Examples:

1. Children struck when boarding or exiting from the school bus

2. Two vehicles colliding as the result of the stopped school bus.

Additional Crash Detail

Damage to vehicles or prope_____

School Bus related? _____
ⓘ

Were photos taken at the scene of the crash? _____

Weather 4

Weather 2

Government owned vehicles are not considered public property.

Units involved in the crash are not included in this section (e.g. privately owned vehicles, bikes, etc.)

Circumstance 2

Damage to public or private property?

ⓘ ☐ No

☑ Yes, Public

☑ Yes, Private

[Help Window 5. School Bus Callout (Screen 4)](#)   [Help Window 6. Public Vehicles Help Box (Screen 4)](#)

We

MINNESOTA DEPARTMENT OF TRANSPORTATION
Damaged Property Tag

Date	ICR #
Law Enforcement Agency Name	
Location	

Follow Instructions Below
1. Attach tag to damaged property.
2. Notify Area Maintenance Headquarters of accident location.
3. If tag is placed by someone other than Highway Patrol, list organization.
4. Local Law Enforcement Agency, Contact MNDOT District Office in your area listed on the back.

MnDOT TP - 17263 (5/14)

C

e 2

Damage

MNDOT supplies damaged-property tags ("yellow tags") to agencies to identify public property (e.g., speed limit sign) that must be repaired or replaced when damaged or destroyed. If yellow tag was used, enter 6-digit number shown on tag. Newer tags may not have a red-stamped number. If no number is present, state "tag left" to indicate one was left on damaged object.

aged Property

Yes

Private Property

Yellow Tag # ⓘ

Previous   Next

[Help Windows 7-8. Yellow Tag Help Box & Yellow Tag Image (Screen 4)](#)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Date/Circumstances — **Location** — **Witnesses**

Crash Location:
Select a county ▼   [   ] ▼   Map Location
County   *City*

[   ]   [   ] ▼
Route # or Street Name ⓘ   *System*

○ At Intersection With: ⓘ   [   ]   [   ] ▼
Route # or Street Name: *System:*

○ [   ] . [   ] ○ MI [   ] ▼ of:
                    ○ FT

Event Location Details: [   ] ▼ [   ] ▼ [   ] ▼
Ownership of Land ⓘ   *On/Off Trafficway* ⓘ   *Divided Highways Only: Roadway Direction*

[   ] ▼   [   ] ▼   [   ] ▼
Location relative to trafficway ⓘ   *Location relative to intersection or junction* ⓘ   *On Bridge?* ⓘ

Work Zone Details: [   ] ▼
ⓘ   *Near/in work zone?*

Previous   Next

Crash
Units
Narrative
Diagram

Screen 5a. Crash Location: Part A

G-13

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Date/Circumstances | **Location** | Witnesses

Crash

Crash Location: Hennepin County ▼   Minneapolis ▼   [Map Location]
County   City

University Ave   10 - Municipal Street -- MUN ▼
Route # or Street Name ⓘ   System

○ At Intersection With: ⓘ

● | 40 | . | 00 | ○ MI   East ▼ of: | Church St. SE | 10 - Municipal Street -- MUN ▼
                    ● FT   Route # or Street Name: System:

Units

Narrative

Event Location Details: Public Property ▼   Trafficway, On Road ▼   ▼
                             Ownership of Land ⓘ   On/Off Trafficway ⓘ   Divided Highways Only: Roadway Direction

Diagram

On Roadway ▼   Not at intersection or junction ▼   No ▼
Location relative to trafficway ⓘ   Location relative to intersection or junction ⓘ   On Bridge? ⓘ

Work Zone Details: Yes ▼
ⓘ   Near/in work zone?

Lane Closure ▼   Activity area ▼
Type of work zone   Location of crash related to work zone ⓘ

Yes ▼   No ▼
Workers Present?   Law Enforcement Present?

[Previous] [Next]

G-14

Help Window 9. Roadway Help Box (Screen 5)

Help Window 10. Intersection Help Box (Screen 5)

Help Window 11. Land Ownership Help Box (Screen 5)

Help Window 12. On Off Trafficway Help Box (Screen 5)

Help Window 13. Trafficway Help Box (Screen 5)

Help Window 14. Relative Location Callout (Screen 5)

Help Window 15. Bridges Callout (Screen 5)

Help Window 16. Work zone Callout (Screen 5)

Help Window 17. Work zone Definition Help Box (Screen 5)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Date/Circumstances **Location** **Witnesses**

Add total number of witnesses: [▼]

Crash

Units

Narrative

Diagram

Previous | Next

Screen 6a. Crash Witnesses: Part A

G-18

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Date/Circumstances　　　　Location　　　　**Witnesses**

Crash

Add total number of witnesses: 2

1 Witness Name: [_____] [_____] [_____] [_____]

Driver's License: Optional [MN Fill] *First* *Middle* *Last*

DOB: [_____] ☐ Unknown   Gender: [_____ ▾]   Phone (Optional): [_____]

Use MM/DD/YYYY Format

Units

2 Witness Name: [_____] [_____] [_____] [_____]

Driver's License: Optional [MN Fill] *First* *Middle* *Last*

Narrative

DOB: [_____] ☐ Unknown   Gender: [_____ ▾]   Phone (Optional): [_____]

Use MM/DD/YYYY Format

Diagram

[Previous] [Next]

Screen 6b. Crash Witnesses: Part B

G-19

Document Units

CrashReport
Units

CrashReport
Units 2
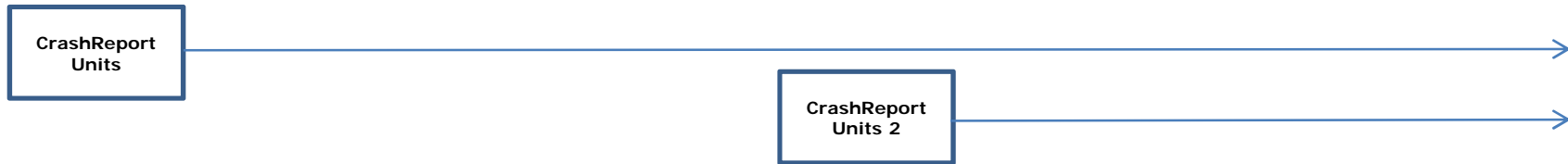
Screen 7 Steps:

1) Select total number of units involved in crash　　ⓘ

2) Create unit label for Unit 1

3) Create unit label for Unit 2

4) Click Begin

(system proceeds to Unit 1 Type)

Screen 14 Steps:

1) *Click Edit for Unit 1

(system proceeds to Unit 1 Type)

2) Click Begin for Unit 2

(system proceeds to Unit 2 Type)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Crash

Units

Narrative

Diagram

ⓘ
Add total number of Units involved in crash: [▾]

Create a unique label for each unit for your reference (e.g. Chevy, Minivan, bicyclist, etc.)

Previous   Next

Screen 7a. CrashReport Units: Part A

G-21

Document Units: CrashReport Units

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Crash

Units

Narrative

Diagram

Add total number of Units involved in crash: 2

Create a unique label for each unit for your reference (e.g. Chevy, Minivan, bicyclist, etc.)

1 Create unit label: Blue Chevy

2 Create unit label: Bicyclist

Begin

Previous   Next

Screen 7b. CrashReport Units: Part B

Document Units: CrashReport Units

First	Last	Rank	Badge#	State Pat
Andy	Taylor	Sheriff	1	N/A

Report: 657

Crash

Add total number of Units involved in crash: 2 ▼

ⓘ

Create a unique label for each unit f   **"Unit"** is used as the general term to refer to   etc.)
any vehicle or non-motorist

1 Create unit label: Blue Chevy

Units

[Help Window 18. Unit Help Box (Screen 7)](#)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Crash

Units

Narrative

Diagram

Total Number of Units: 2

1   Unit Label: Blue BMW   [Edit]

2   Unit Label: Walker   [Begin]

[Previous]   [Next]

Screen 14. CrashReport Units 2

Document Unit 1: Type

Unit 1 Type

If motor vehicle/ parked/ working vehicle → If CMV → Vehicle Information Available → If Hit & Run Vehicle (Not Present) → If Non-Motorist
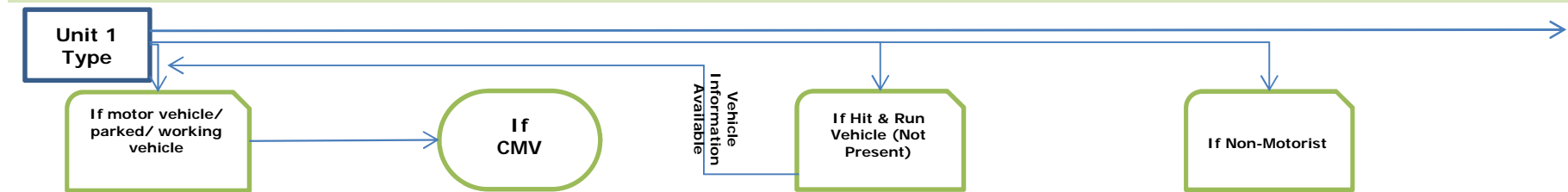
Screen 8/Panel 1 Steps:

1) Select Unit Type ⓘ

If: Motor Vehicle in Transport; Parked/Stalled Motor Vehicle; Working Vehicle/Equipment

2) Enter License Plate Number
3) *Click MN Fill
4) *Enter VIN number
5) *Click MN Fill
6) *Select State Registered
7) *Enter Year Registered
8) *Enter Make
9) *Enter Model
10) *Enter Year
11) *Enter Color
12) *Enter First Name
13) *Enter Middle Name
14) *Enter Last Name
15) Select Owner Current? ⓘ
16) *Enter Address
17) *Enter City
18) *Select State
19) *Enter Zip Code
20) *Enter Phone Number
21) Select Insurance company
22) *Enter Policy Number
23) Select Vehicle Type
24) Select Vehicle Use
25) *Select Bus Use
26) *Select Emergency Vehicle Use
27) Select Pulling Unit Prior to Crash
28) Select Displaying HazMat Placard?

Pop Up Window 1 Steps:

If: CMV (else skip to 49)

29) Click Start CMV
30) Enter USDOT Number
31) *Click Autofill
32) *Enter Motor carrier name
33) *Select Carrier Type
34) *Enter Address
35) *Enter City
36) *Select State
37) *Enter Zip code
38) *Select Country
39) Select Weight Rating
40) Select Vehicle Configuration ⓘ
41) Select Cargo Body Type ⓘ
42) Verify or Correct HazMat Placard?
43) *Enter HazMat ID#
44) *Enter Class #
45) *Select Release of HazMat?
46) Select Inspection Waived?
47) *Enter Inspection Number
48) *Enter Inspector's Badge ID#

49) Click Next

(system proceeds to Unit 1 Events)

Panel 2 Steps:

If: If Hit & Run Vehicle (Not Present)

50) Indicate Was the vehicle information available?

If: Yes

Complete Steps 2-48*

51) Indicate: Was the driver information available?

If: Yes

52) Click Next

(system proceeds to Unit 1 Person Info)

If: No

53) Click Next

(system proceeds to CrashReport Unit 2)

Panel 3 Steps:

If: Pedestrian

54) Click Next

(system proceeds to Person Info)

If: Bicycle; Other Cycle; Skateboard/Skates; or Other Personal Conveyance

55) *Enter Conveyance Description
56) *Enter Driver's License
57) *Click MN Fill
58) *Enter First Name
59) *Enter Middle Name
60) *Enter Last Name
61) *Enter Address
62) *Enter City
63) *Select State
64) *Enter Zip Code
65) *Enter Phone Number
66) *Enter Insurance company
67) *Enter Policy Number
68) Click Next

(system proceeds to Unit 1 Person Info)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Blue Chevy

Unit Type | Unit Events | Person Information | Person Actions | Person Condition | Passengers

Crash

Unit Type: ⓘ [▾]

Units

Narrative

Diagram

[Previous] [Next]

Screen 8. Unit 1 Type

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Blue Chevy

Unit Type → Unit Events → Person Information → Person Actions → Person Condition → Passengers

Crash

Units

Narrative

Diagram

Unit Type: Motor Vehicle in Transport

Vehicle Information: [ ] MN Fill [ ] MN Fill
License Plate Number   VIN (Optional)

[ ] [ ] [ ] [ ] [ ] [ ]
State Registered YR Registered Make Model Year Color

Owner Information: [ ] [ ] [ ] [ ]
First Name   Middle Name   Last Name   Owner Current?

[ ] [ ] [ ] [ ] [ ]
Address   City   State   ZIP Code   Phone (Optional)

Insurance Information: [ ] [ ]
Insurance Company   Policy Number

Vehicle Details: [ ] [ ] [ ]
Vehicle Type   Vehicle Use   Emergency Vehicle Use

[ ] [ ]
Pulling Unit Prior to Crash   Displaying HazMat Placard?

Previous   Next

Dynamic Panel 1a. Unit 1 Type: Motor Vehicle in Transport/Parked/Working Vehicle Dynamic Panel: Part A (Screen 8)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Big Rig

Unit Type ⟩ **Unit Events** ⟩ **Person Information** ⟩ **Person Actions** ⟩ **Person Condition** ⟩ **Passengers**

Unit Type: ⓘ Motor Vehicle in Transport ▾

Vehicle Information: 100DND [MN Fill] 5862419762 [MN Fill]
License Plate Number   VIN (Optional)

MN ▾	2013	Volvo	VNL64T780	1998	BLACK
State Registered	YR Registered	Make	Model	Year	Color

Owner Information: John | James | Doe | Yes ▾
First Name | Middle Name | Last Name | Owner Current? ⓘ

10465 45th Ave NE | Sauk Rapids | MN ▾ | 56379 |
Address | City | State | ZIP Code | Phone (Optional)

Insurance Information: Liberty Mutual ▾ | 1564
Insurance Company | Policy Number

Vehicle Details: Medium / Heavy Trucks (more than 10,000lbs) ▾ | Normal ▾ | ▾
Vehicle Type | Vehicle Use | Emergency Vehicle Use

Yes ▾ | ▾ | [Start CMV]
Pulling Unit Prior to Crash | Displaying HazMat Placard?

[Previous] [Next]

[Dynamic Panel 1b. Unit 1 Type: Motor Vehicle in Transport/Parked/Working Vehicle Dynamic Panel: Part B; CMV by weight (Screen 8)](#)

Unit 1: Yellow School Bus

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit Type: Unit Events | Person Information | Person Actions | Person Condition | Passengers

Crash

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Unit Type: Motor Vehicle in Transport

Vehicle Information: 200DND [MN Fill] 4593117865 [MN Fill]
License Plate Number   VIN (Optional)

MN | 2005 | GMC | Girardin | 2000 | Yellow
State Registered | YR Registered | Make | Model | Year | Color

Owner Information: Mary | Jo | Anne | Yes
First Name | Middle Name | Last Name | Owner Current?

892 University Ave | Minneapolis | MN | 57896 |
Address | City | State | ZIP Code | Phone (Optional)

Insurance Information: Travelers | 684321
Insurance Company | Policy Number

Vehicle Details: School Bus | |
Vehicle Type | Bus Use | Emergency Vehicle Use

| | [Start CMV]
Pulling Unit Prior to Crash | Displaying HazMat Placard?

[Previous] [Next]

Dynamic Panel 1c. Unit 1 Type: Motor Vehicle in Transport/Parked/Working Vehicle Dynamic Panel: Part B; School Bus/CMV (Screen 8)

Document Unit 1: Type

[Help Window 19. Working Vehicle Callout (Screen 8)](#)

[Help Window 20. Owner Current Callout (Motor Vehicle in Transport/Parked/Working Vehicle Dynamic Panel: Screen 8)](#)

COMMERCIAL MOTOR VEHICLE INFORMATION

Motor Carrier Identification:

USDOT Number [Auto Fill]	Motor Carrier Name	Carrier Type ▼
Address	City	State ▼ ZIP Code Country ▼

Motor Vehicle Type:

Weight Rating (Gross/Gross Combination) ▼	Vehicle Configuration ▼
Cargo Body Type ▼	

Hazardous Materials:

HazMat Placard? ▼   HazMat ID#   Class #

Release of HazMat? ▼

Was Inspection Waived?

Waived? ▼   Inspection Number   Inspector's Badge ID#

[Done]

Pop Up Window 1. Unit 1 Type: Motor Vehicle in Transport/Parked/Working Vehicle Dynamic Panel: CMV Pop Up Window (Screen 8)

Document Unit 1: Type

Select Vehicle Configuration

Vehicle 10,000lbs or Less Placarded For Hazardous Materials	Tractor/Semi Trailer (One Trailer)	Single Unit Truck or Pickup less than 10,000 GVWR
Single-Unit (2 Axles, 6 Tires)	**Truck Tractor/Double (Two Trailers)**	Single Unit Truck or Pickup Greater Than 10,000 GVWR NONBUSINESS
Single-Unit (3 or More Axles)	**Truck Tractor/Triple (Three Trailers)**	Single Unit Truck or Pickup Greater Than 10,000 GVWR BUSINESS
	Truck More Than 10,000 lbs, Cannot Classify	**Truck Tractor, Overweight/Oversized**
Truck Pulling Trailer(s)	**Bus (9-15 Seats, Including Driver)**	**Unknown**
Truck Tractor (Bobtail)	**Bus (16 or More Seats, Including Driver)**	

HazMat Placard?   HazMat ID#   Class #   Waived?   Inspection Number   Inspector's Badge ID#

Release of HazMat?   Done

[Help Window 21. Vehicle Configuration Help Box (CMV Pop Up Window; Screen 8)](#)

Select Cargo Body Type

No Cargo Body	Log	Auto Transporter
Bus (9-16 or more, Including Driver)	Intermodal Chassis	Garbage/Refuse
Van/Enclosed Box	Vehicle Towing Motor Vehicle	**Other**
Grain, Chips, Gravel	Flat Bed	**Not Applicable –** (motor vehicle 10,000 lbs or less not displaying HM placard)
Pole	Dump	**Unknown**
Cargo Tank	Concrete Mixer	

ate Carrier

Type

United States

Country

Inspector's Badge ID#

[Help Window 22. Cargo Body Type Help Box (CMV Pop Up Window; Screen 8)](#)

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First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Blue Chevy

Unit Type | Unit Events | Person Information | Person Actions | Person Condition | Passengers

Crash

Unit Type: ⓘ Hit & Run Vehicle (Not Present) ▾

Was the vehicle information available? ⚬ Yes   ⚬ No

Was the driver information available? ⚬ Yes   ⚬ No

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Dynamic Panel 2. Unit 1 Type: Hit and Run Vehicle (Not Present) Dynamic Panel (Screen 8)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Pedestrian

Unit Type | Unit Events | Person Information | Person Actions | Person Condition | Passengers

Crash

Unit Type: ⓘ   Pedestrian ▾

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Dynamic Panel 3. Unit 1 Type: Pedestrian Dynamic Panel (Screen 8)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Bicyclist

Unit Type | Unit Events | Person Information | Person Actions | Person Condition | Passengers

Unit Type: Bicycle ▼

Personal Conveyance Description:
(Optional)

Owner Information: MN Fill
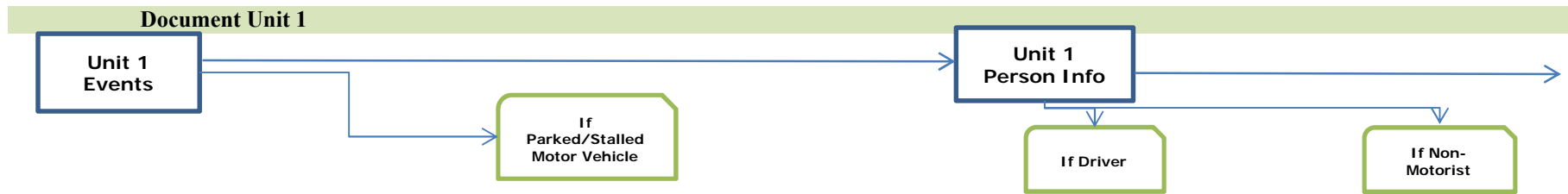(Optional)   Driver's License (Optional)   First Name   Middle Name   Last Name

               Address   City   State   ZIP Code   Phone (Optional)

Insurance Information:
(Optional)   Insurance Company   Policy Number

Previous   Next

Dynamic Panel 4. Unit 1 Type: Bicycle/Other Cycle/Skateboard/Skates/Other Personal Conveyance Dynamic Panel (Screen 8)

Document Unit 1

```
┌──────────────┐                              ┌──────────────┐
│   Unit 1     │─────────────────────────────▶│   Unit 1     │──────────▶
│   Events     │                              │ Person Info  │
└──────────────┘                              └──────────────┘
        │                                        │        │
        │        ┌──────────────┐         ┌──────────┐  ┌──────────┐
        └───────▶│     If       │         │ If Driver│  │ If Non-  │
                 │Parked/Stalled│         │          │  │ Motorist │
                 │Motor Vehicle │         └──────────┘  └──────────┘
                 └──────────────┘
```

Screen 9 Steps:

1) Select Direction of travel
2) Select Horizontal Alignment
3) Select Roadway Grade ⓘ
4) *Enter Speed limit
5) *Indicate if speed limit is N/A or Unknown
6) Enter Total # of Lanes ⓘ
7) Select Trafficway Design
8) Select Traffic Control Device Type
9) *Select Traffic Control Status
10) Select Motor Vehicle Contributing Factor 1
11) *Select Motor Vehicle Contributing Factor 2
12) Select Maneuver Prior to Crash
13) Select First Event
14) *Select Second Event
15) *Select Third Event
16) *Select Fourth Event
17) Select Most Harmful Event
18) Select Initial Point of Contact ⓘ
19) Select Damage Severity
If: Minor, Functional, or Disabling Damage
20) Select all areas of damage ⓘ
If: No damage or Unknown (skip 20)
21) Select Towed?

Panel 5 Steps:

If: Parked/Stalled Motor Vehicle (else Skip to 25)
22) Select Parked Status ⓘ
If: Parked Illegally by hours or Stalled in lane of travel
(system documents Unit as Motor Vehicle in Transport)
If: Parked legally or Illegally by location
(system documents Unit as Parked Vehicle-
Not in Transport)
23) Indicate if driver/operator/person was
     in control of vehicle
If:No
24) Click Next
(system proceeds to Unit 1 Passengers)
If: Yes
25) Click Next
(system proceeds to Unit 1 Person Info)

Screen 10/Panel 6 Steps:

If: Driver
1) Enter Driver's License
2) *Click MN Fill
3) *Indicate driver same as owner
4) *Enter First Name
5) *Enter Middle Name
6) *Enter Last Name
7) *Enter DOB
8) *Select Sex
9) *Select Class
10) *Select Endorsement
11) *Select Status
12) *Select Restriction
13) *Select Recommendations?
14) *Enter Address
15) *Enter City
16) *Select State
17) *Enter Zip Code
18) *Enter County
19) Select Address Correct?
20) *Enter Phone number
21) Click Next
(system proceeds to Unit 1 Person Actions)

Panel 7 Steps:

If: Non-Motorist
1) Enter Driver's License
2) *Click MN Fill
3) *Indicate driver same as owner
4) *Enter First Name
5) *Enter Middle Name
6) *Enter Last Name
7) *Enter DOB
8) *Select Sex
9) *Enter Address
10) *Enter City
11) *Select State
12) *Enter Zip Code
13) *Enter County
14) Select Address Correct?
15) *Enter Phone number
16) Click Next
(system proceeds to Unit 1
Person Actions)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Yellow School Bus

Unit Type → **Unit Events** → Person Information → Person Actions → Person Condition → Passengers

Unit Roadway Characteristics:

Direction of Travel ▾   Horizontal Alignment ▾   Roadway Grade ⓘ ▾   Speed Limit   ○ Not Applicable ○ Unknown   Total # of Lanes ⓘ

Trafficway Design ▾   Traffic Control Device Type ▾   Traffic Control Status ▾

Unit Events:

Motor Vehicle Contributing Factor 1 ▾   Motor Vehicle Contributing Factor 2 ▾   Maneuver Prior to Crash ▾

First Event * ▾   Second Event ▾   Third Event ▾   Fourth Event ▾

Most Harmful Event * ▾

Damage Information:

Initial Point of Contact ▾   Damage Severity ▾   All Damaged Areas

Towed? ▾

Previous   Next

Screen 9. Unit 1 Events

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Help Window 23. Grade Help Box (Screen 9)

Help Window 24. Lanes Callout (Screen 9)

Help Window 25. Initial Point of Contact Help Box (Screen 9)

Help Window 26. Other Damage Help Box (Screen 9)

Unit 1: Yellow School Bus

Unit Type | **Unit Events** | Person Information | Person Actions | Person Condition | Passengers

Unit Roadway Characteristics:

Direction of Travel | Horizontal Alignment | Roadway Grade | Speed Limit | ○ Not Applicable ○ Unknown | Total # of Lanes

Trafficway Design | Traffic Control Device Type | Traffic Control Status

Unit Events:

Motor Vehicle Contributing Factor 1 | Motor Vehicle Contributing Factor 2 | Maneuver Prior to Crash

First Event * | Second Event | Third Event | Fourth Event

Most Harmful Event *

Damage Information:

Initial Point of Contact | Damage Severity | All Damaged Areas

Towed?

Parked/Stalled Motor Vehicle   Parked Status:

Was there a driver, operator, or person in physical control of the vehicle?   ○ Yes   ○ No

Previous   Next

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First | Last | Rank | Badge# | State Patrol STA. #
Andy | Taylor | Sheriff | 1 | N/A
Report: 657

Dynamic Panel 5. Unit 1 Events: Parked/Stalled Motor Vehicle (Screen 9)

Parked Status:

Parked Legally:
If the vehicle is parked legally, it is not considered a motor vehicle in transport and any occupants not considered in control of the vehicle are considered passengers.

Parked Illegally (by location):
If the vehicle is parked illegally, but only by location (i.e. blocking fire hydrant), it is not a motor vehicle in transport and any occupants not considered in control of the vehicle are considered passengers.

Parked Illegally (by time):
If the vehicle is parked illegally, but by time (i.e. parking prohibited during certain hours and is otherwise a lane of travel), it is considered a motor vehicle in transport. Any individuals which can be considered the driver should be documented.

Stalled in Lane of Travel:
If the vehicle is parked or stalled in a lane of travel, it is considered a motor vehicle in transport. Any individuals which can be considered the driver should be documented.

[Help Window 27. Parked Status Callout (Screen 9)](#)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Blue BMW

Unit Type ⟩ Unit Events ⟩ **Person Information** ⟩ Person Actions ⟩ Person Condition ⟩ Passengers

Person Type: Driver

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Identification: [   ] [MN Fill] ☐ Same as Owner
Driver's License

[   ] [   ] [   ] [   ] [▼]
First Name   *Middle Name*   *Last Name*   *DOB*   *Sex*

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License Information: [▼] [▼] [▼] [▼]
Class   *Endorsement*   *Status*   *Restriction*

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[▼] [▼]
License Jurisdiction *Recommendations?*

Contact Information: [   ] [   ] [▼] [   ] [   ]
Address   *City*   *State*   *ZIP Code* *County*

[▼] [   ]
Address Correct? *Phone (Optional)*

[Previous] [Next]

Screen 10. Unit 1 Person Info
Dynamic Panel 6. Unit 1 Person Info: Driver (Screen 10)

Unit 1: Walker

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit Type · Unit Events · **Person Information** · Person Actions · Person Condition · Passengers

Person Type: Pedestrian

Crash

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Identification: [_____] [MN Fill]
Driver's License (Optional)

[_____] [_____] [_____] [_____] [____▼]
First Name   Middle Name   Last Name   DOB   Sex

Narrative

Diagram

Contact Information: [_____] [_____] [__▼] [_____] [_____]
Address   City   State   ZIP Code   County

[_____▼] [_____]
Address Correct?   Phone (Optional)

[Previous] [Next]

Dynamic Panel 7. Unit 1 Person Info: Non-Motorist (Screen 10)

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Document Unit 1

**Unit 1
Person Actions**

**Unit 1 Person
Conditions**

If Driver

**If Non-
Motorist**

If Driver

**If Non-
Motorist**
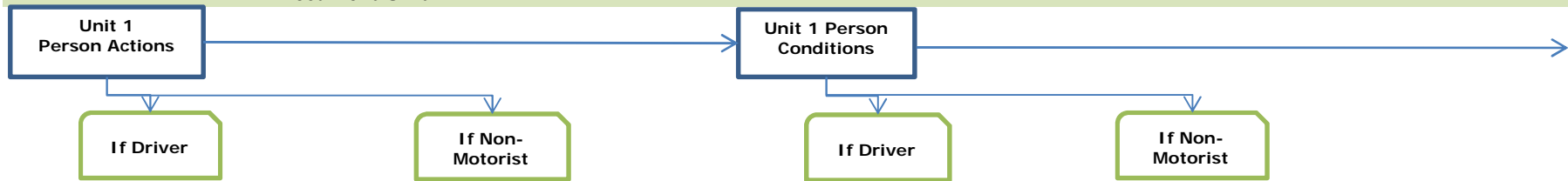
Screen 11/Panel 8 Steps:

If: Driver

1) Select Factor 1
2) *Select Factor 2
3) *Select Factor 3
4) *Select Factor 4
5) Select Distracted Driving?
6) Select Speeding?
7) Select Citations Issues #1
8) *Enter Citation/Ordinance Code #1
9) *Select Citations Issues #2
10) *Enter Citation/Ordinance Code #2
11) Click Next
(system proceeds to
Unit 1 Person Conditions)*

Panel 9 Steps:

If: Non-Motorist

1) Select Movement Prior to Crash
2) Select Factor 1
3) *Select Factor 2
4) Select Citations Issues #1
5) *Enter Citation/Ordinance Code #1
6) *Select Citations Issues #2
7) *Enter Citation/Ordinance Code #2
8) Click Next
(system proceeds to
Unit 1 Person Conditions)*

Screen 12/Panel 10 Steps:

If: Driver

1) Select Position
*If: Moped/Motorscooter; ATV;
Snowmobile; Motorcycle (else Skip 2)*
2) Select Helmet Use (Skip 3-4)
3) Select Eject/Trapped
4) Select Restraint Use
5) Select Airbags
6) Select Injury Severity
7) *Select Transported
8) *Enter Ambulance Service
9) *Enter Run Number
10) Select Physical Condition 1
11) *Select Physical Condition 2
12) Select Suspect Alcohol?
13) *Select Alcohol Test
14) *Select Alcohol Test Type
15) *Select Alcohol Test Result
16) *Enter Alcohol Test Value
17) Select Suspect Drugs?
18) *Select Drug Test
19) *Select Drug Test Type
20) *Select Drug Test Result
21) *Select Positive Drug Type
22) Click Next
(system proceeds to Unit 1 Passengers)

Panel 11 Steps:

If: Non-Motorist

1) Select Position
2) Select Safety Equipment 1
3) *Select Safety Equipment 2
4) Select Injury Severity
5) *Select Transported
6) *Enter Ambulance Service
7) *Enter Run Number
8) Select Physical Condition 1
9) *Select Physical Condition 2
10) Select Suspect Alcohol?
11) *Select Alcohol Test
12) *Select Alcohol Test Type
13) *Select Alcohol Test Result
14) *Enter Alcohol Test Value
15) Select Suspect Drugs?
16) *Select Drug Test
17) *Select Drug Test Type
18) *Select Drug Test Result
19) *Select Positive Drug Type
20) Click Next
(system proceeds to Unit 1 Passengers)

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First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Blue BMW

Unit Type | Unit Events | Person Information | **Person Actions** | Person Conditions | Passengers

Contributing Factors:

⌄	⌄	⌄	⌄
Factor 1 *	Factor 2	Factor 3	Factor 4

⌄	⌄
Distracted Driving?	Speeding?

Violations:

⌄	
Citation Issued? #1	Citation/Ordinance Code #1

⌄	
Citation Issued? #2	Citation/Ordinance Code #2

Previous | Next

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Diagram

Screen 11. Unit 1 Person Actions
Dynamic Panel 8. Unit 1 Person Actions: Driver (Screen 11)

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First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Walker

| Unit Type | Unit Events | Person Information | **Person Actions** | Person Conditions | Passengers |

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Non-motorist Actions:

[▼]
Movement Prior to Crash

[▼]
Factor 1

[▼]
Factor 2

Violations:

[▼]
Citation Issued? #1

[ ]
Citation/Ordinance Code #1

[▼]
Citation Issued? #2

[ ]
Citation/Ordinance Code #2

[Previous] [Next]

Dynamic Panel 9. Unit 1 Person Actions: Non-Motorist (Screen 11)

G-45

Unit 1: Blue BMW

Unit Type → Unit Events → Person Information → Person Actions → **Person Condition** → Passengers

Driver Location: Front Right ▼   Not Ejected or Trapped ▼
Position   *Ejected/Trapped*

Safety Equipment: Lap and shoulder belt used ▼   Deployed-Front ▼
Restraint Type & Use   *Airbags*

Driver Condition: No Apparent Injury ▼   ▼   [   ]   [   ]
Injury Severity   *Transported*   *Ambulance Service*   *Run Number*

Normal ▼   ▼
Physical Condition 1   *Physical Condition 2*

Alcohol/Drug Suspicion: No ▼   ▼
Suspect Alcohol?   *Alcohol Test*

No ▼   ▼
Suspect Drugs?   *Drug Test*

Previous   Next

First: Andy   Last: Taylor   Rank: Sheriff   Badge#: 1   State Patrol STA. #: N/A
Report: 657

Crash

Units

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Screen 12. Unit 1 Person Condition
Dynamic Panel 10a. Unit 1 Person Condition: Driver: Part A (Screen 12)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Harley

Unit Type › Unit Events › Person Information › Person Actions › **Person Condition** › Passengers

Crash

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Diagram

Driver Location: DRIVER(INCL MOTORCYCLE) ▾
Position

Safety Equipment: No Helmet ▾   Not Applicable ▾
Helmet use   *Airbags*

Driver Condition: Possible Injury ▾   EMS Ground ▾   HCMC   8975
Injury Severity   *Transported*   *Ambulance Service*   *Run Number*

Had been drinking Alcohol ▾   ▾
Physical Condition 1   *Physical Condition 2*

Alcohol/Drug Suspicion: Yes ▾   Test Given ▾   Blood ▾   Pending ▾
Suspect Alcohol?   *Alcohol Test*   *Alcohol Test Type*   *Alcohol Test Result*

No ▾   ▾
Suspect Drugs?   *Drug Test*

Previous   Next

Dynamic Panel 10b. Unit 1 Person Condition: Driver (Motorcycle/Moped/Motor Scooter/LSV/ATV/Snowmobile): Part B (Screen 12)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Walker

| Unit Type | Unit Events | Person Information | Person Actions | Person Condition | Passengers |

Crash

Person Location: [_____ ▼]
Position

Units

Safety Equipment: [_____ ▼] [_____ ▼]
Safety Equipment 1   *Safety Equipment 2*

Narrative

Person Condition: [_____ ▼] [_____ ▼] [_____] [_____]
Injury Severity   *Transported*   *Ambulance Service*   *Run Number*

Diagram

[_____ ▼] [_____ ▼]
Physical Condition 1   *Physical Condition 2*

Alcohol/Drug Suspicion: [_____ ▼] [_____ ▼]
Suspect Alcohol?   *Alcohol Test*

[_____ ▼] [_____ ▼]
Suspect Drugs?   *Drug Test*

[Previous] [Next]

Dynamic Panel 11a. Unit 1 Person Condition: Non-Motorist: Part A (Screen 12)

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First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Walker

Unit Type > Unit Events > Person Information > Person Actions > **Person Condition** > Passengers

Crash

Units

Narrative

Diagram

Person Location: Intersection – unmarked crosswalk
Position

Safety Equipment: None |
Safety Equipment 1 | *Safety Equipment 2*

Person Condition: Suspected Serious Injury | EMS Ground | HCMC | 1654
Injury Severity | *Transported* | *Ambulance Service* | *Run Number*

Had been drinking Alcohol | Had been taking Illicit Drugs
Physical Condition 1 | *Physical Condition 2*

Alcohol/Drug Suspicion:
Yes | Test Given | Data Master (DMT) | Value | .09
Suspect Alcohol? | *Alcohol Test* | *Alcohol Test Type* | *Alcohol Test Result* | *Alcohol Test Value*

Yes | Test Given | Blood | Positive | Narcotics
Suspect Drugs? | *Drug Test* | *Drug Test Type* | *Drug Test Result* | *Positive Drug Type*

Previous | Next

[Dynamic Panel 11b. Unit 1 Person Condition: Non-Motorist: Part B (Screen 12)](#)

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Document Unit 1: Passengers

```
┌──────────────┐
│   Unit 1     │ ─────────────────────────────────────────────────►
│  Passengers  │
└──────────────┘
        │                           │                           │
        ▼                           ▼                           ▼
┌──────────────┐         ┌────────────────────┐        ┌──────────────┐
│  If Driver   │         │     If Bus or      │        │   If Non-    │
│              │         │ Parked/Stalled Motor│        │   Motorist   │
└──────────────┘         └────────────────────┘        └──────────────┘
```
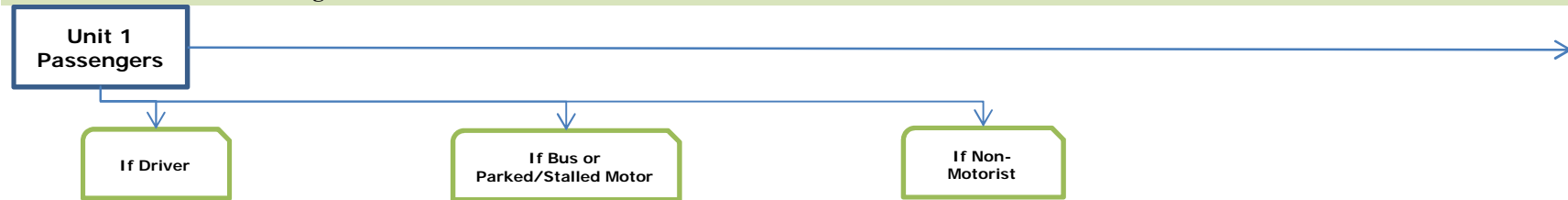
Screen 13/Panel 12 Steps:

If: Driver

1) Select total number of passengers

If: 1 or more passengers

2) Enter Driver's License

3) *Click MN Fill

4) *Enter First Name

5) *Enter Middle Name

6) *Enter Last Name

7) *Enter DOB

8) *Select Sex

9) Select Position

10) Select Eject/Trapped

11) Select Airbags

12) Select Injury Severity

13) *Select Transported

14) *Enter Ambulance Service

15) *Enter Run Number

If additional Passengers

Repeat steps 2-15 for each

16) Click Next

(system proceeds to CrashReport Units 2)

Panel 13 Steps:

If: Bus

OR If: Parked/Stalled Vehicles

(not considered in transport)

1) Select total number of passengers

2) Select total number of injured passengers

If: 1 or more injured passengers

3) Enter Driver's License

4) *Click MN Fill

5) *Enter First Name

6) *Enter Middle Name

7) *Enter Last Name

8) *Enter DOB

9) *Select Sex

10) Select Position

11) Select Eject/Trapped

12) Select Airbags

13) Select Injury Severity

14) *Select Transported

15) *Enter Ambulance Service

16) *Enter Run Number

If additional Injured Passengers

Repeat steps 2-15 for each

17) Click Next

(system proceeds to CrashReport Units 2)

Panel 14 Steps:

If: Non-Motorist

1) Select total number of passengers

2) Select total number of injured passengers

If: 1 or more injured passengers

3) Enter Driver's License

4) *Click MN Fill

5) *Enter First Name

6) *Enter Middle Name

7) *Enter Last Name

8) *Enter DOB

9) *Select Sex

10) Select Position

11) Select Eject/Trapped

12) Select Airbags

13) Select Injury Severity

14) *Select Transported

15) *Enter Ambulance Service

16) *Enter Run Number

If additional Injured Passengers

Repeat steps 2-15 for each

17) Click Next

(system proceeds to CrashReport Units 2)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Harley

Unit Type | Unit Events | Person Information | Person Actions | Person Conditions | **Passengers**

Add total number of passengers: [▼]

Crash

Units

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Screen 13. Unit 1 Passengers

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Unit 1: Harley

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit Type | Unit Events | Person Information | Person Actions | Person Conditions | **Passengers**

Add total number of passengers: 2 ▼

1

[ ] MN Fill [ ] [ ] [ ]
Driver's License (Optional)   First Name   Middle Name   Last Name

[ ] [▼]
DOB   Sex

[▼] [▼] [▼] [▼]
Position   Ejected/Trapped   Restraint Type & Use   Airbags

[▼] [▼] [ ] [ ]
Injury Severity   Transported   Ambulance Service   Run Number

2

[ ] MN Fill [ ] [ ] [ ]
Driver's License (Optional)   First Name   Middle Name   Last Name

[ ] [▼]
DOB   Sex

[▼] [▼] [▼] [▼]
Position   Ejected/Trapped   Restraint Type & Use   Airbags

[▼] [▼] [ ] [ ]
Injury Severity   Transported   Ambulance Service   Run Number

Previous | Next

Crash

Units

Narrative

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[Dynamic Panel 12. Unit 1 Passengers: Driver (Screen 13)](#)

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Document Unit 1: Passengers

First | Last | Rank | Badge# | State Patrol STA. #
Andy | Taylor | Sheriff | 1 | N/A

Report: 657

Unit 1: School Bus

Unit Type | Unit Events | Person Information | Person Actions | Person Conditions | **Passengers**

Crash

Add total number of passengers: 18 | Add total number of injured passengers: 1

1 | | MN Fill | | |
Driver's License (Optional) | | First Name | Middle Name | Last Name

Units

DOB | Sex

Narrative

Position | Ejected/Trapped | Restraint Type & Use | Airbags

Injury Severity | Transported | Ambulance Service | Run Number

Diagram

Previous | Next

Dynamic Panel 13. Unit 1 Passengers: Bus/Parked/Stalled Motor Vehicle (Screen 13)

First	Last	Rank	Badge#	State Patrol STA. #
Andy	Taylor	Sheriff	1	N/A

Report: 657

Unit 1: Tandem Bike

Unit Type	Unit Events	Person Information	Person Actions	Person Conditions	**Passengers**

Add total number of passengers: 1 ▾   Add total number of injured passengers: 0 ▾

Crash

Units

Narrative

Diagram

Previous   Next

Dynamic Panel 14. Unit 1 Passengers: Non-Motorist (Screen 13)

Unit 2

If motor vehicle/ parked/ working vehicle

If CMV

Vehicle Information Available

If Hit & Run Vehicle (Not Present)

If Non-Motorist

Steps:

1) Select Unit Type   ⓘ

If: Motor Vehicle in Transport; Parked/Stalled Motor Vehicle; Working Vehicle/Equipment

2) Enter License Plate Number
3) *Click MN Fill
4) *Enter VIN number
5) *Click MN Fill
6) *Select State Registered
7) *Enter Year Registered
8) *Enter Make
9) *Enter Model
10) *Enter Year
11) *Enter Color
12) *Enter First Name
13) *Enter Middle Name
14) *Enter Last Name
15) Select Owner Current?   ⓘ
16) *Enter Address
17) *Enter City
18) *Select State
19) *Enter Zip Code
20) *Enter Phone Number
21) Select Insurance company
22) *Enter Policy Number
23) Select Vehicle Type
24) Select Vehicle Use
25) *Select Bus Use
26) *Select Emergency Vehicle Use
27) Select Pulling Unit Prior to Crash
28) Select Displaying HazMat Placard?

Steps:

If: CMV (else skip to 49)

29) Click Start CMV
30) Enter USDOT Number
31) *Click Autofill
32) *Enter Motor carrier name
33) *Select Carrier Type
34) *Enter Address
35) *Enter City
36) *Select State
37) *Enter Zip code
38) *Select Country
39) Select Weight Rating
40) Select Vehicle Configuration   ⓘ
41) Select Cargo Body Type   ⓘ
42) Verify or Correct HazMat Placard?
43) *Enter HazMat ID#
44) *Enter Class #
45) *Select Release of HazMat?
46) Select Inspection Waived?
47) *Enter Inspection Number
48) *Enter Inspector's Badge ID#

49) Click Next

(system proceeds to Unit 1 Events)

Steps:

If: If Hit & Run Vehicle (Not Present)

50) Indicate Was the vehicle information available?

If: Yes

Complete Steps 2-48*

51) Indicate: Was the driver information available?

If: Yes

52) Click Next

(system proceeds to Unit 1 Person Info)

If: No

53) Click Next

(system proceeds to CrashReport Unit 2)

Steps:

If: Pedestrian

54) Click Next

(system proceeds to Person Info)

If: Bicycle; Other Cycle; Skateboard/Skates; or Other Personal Conveyance

55) *Enter Conveyance Description
56) *Enter Driver's License
57) *Click MN Fill
58) *Enter First Name
59) *Enter Middle Name
60) *Enter Last Name
61) *Enter Address
62) *Enter City
63) *Select State
64) *Enter Zip Code
65) *Enter Phone Number
66) *Enter Insurance company
67) *Enter Policy Number
68) Click Next

(system proceeds to Unit 1 Person Info)

Unit 2
Events

Unit 2
Person Info

If Parked/Stalled
Motor Vehicle

If Driver

If Non-Motorist

Steps:

1) Indicate if Roadway Characteristics
   are same as Unit 1

If: Yes, verify and change, 2-10 as needed

2) *Select Direction of travel

3) *Select Horizontal Alignment

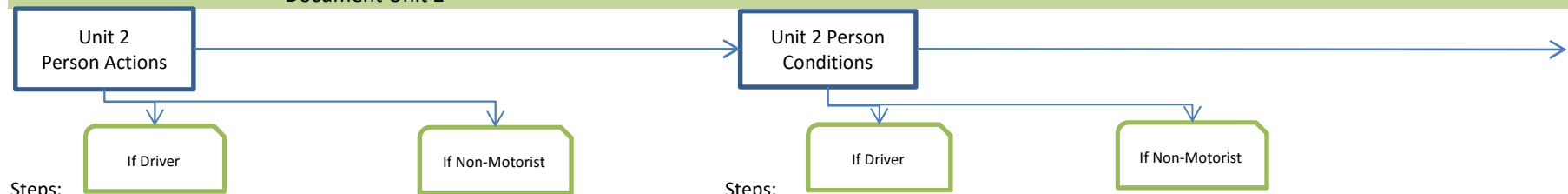4) *Select Roadway Grade ⓘ

5) *Enter Speed limit

6) *Indicate if speed limit is N/A or Unknown

7) *Enter Total # of Lanes ⓘ

8) *Select Trafficway Design

9) *Select Traffic Control Device Type

10) *Select Traffic Control Status

11) Select Motor Vehicle Contributing Factor 1

12) *Select Motor Vehicle Contributing Factor 2

13) Select Maneuver Prior to Crash

14) Select First Event

15) *Select Second Event

16) *Select Third Event

17) *Select Fourth Event

18) Select Most Harmful Event

19) Select Initial Point of Contact ⓘ

20) Select Damage Severity

If: Minor, Functional, or Disabling Damage

21) Select all areas of damage ⓘ

If: No damage or Unknown (skip 21)

22) Select Towed?

If: Parked/Stalled Motor Vehicle (else Skip to 26)

23) Select Parked Status ⓘ

If: Parked Illegally by hours or Stalled in lane of travel

(system documents Unit as Motor Vehicle in Transport)

If: Parked legally or Illegally by location

(system documents Unit as Parked Vehicle-Not in Transport)

24) Indicate if driver/operator/person was
    in control of vehicle

If:No

25) Click Next

(system proceeds to Unit 1 Passengers)

If: Yes

26) Click Next

(system proceeds to Unit 1 Person Info)

Steps:

If: Driver

1) Enter Driver's License

2) *Click MN Fill

3) *Indicate driver same as owner

4) *Enter First Name

5) *Enter Middle Name

6) *Enter Last Name

7) *Enter DOB

8) *Select Sex

9) *Select Class

10) *Select Endorsement

11) *Select Status

12) *Select Restriction

13) *Select Recommendations?

14) *Enter Address

15) *Enter City

16) *Select State

17) *Enter Zip Code

18) *Enter County

19) Select Address Correct?

20) *Enter Phone number

21) Click Next

(system proceeds to Unit 1 Person Actions)

If: Non-Motorist

1) Enter Driver's License

2) *Click MN Fill

3) *Indicate driver same as owner

4) *Enter First Name

5) *Enter Middle Name

6) *Enter Last Name

7) *Enter DOB

8) *Select Sex

9) *Enter Address

10) *Enter City

11) *Select State

12) *Enter Zip Code

13) *Enter County

14) Select Address Correct?

15) *Enter Phone number

16) Click Next

(system proceeds to Unit 1 Person Actions)

Document Unit 2

Unit 2 Person Actions		Unit 2 Person Conditions	
If Driver	If Non-Motorist	If Driver	If Non-Motorist

Steps:

If: Driver

1) Select Factor 1
2) *Select Factor 2
3) *Select Factor 3
4) *Select Factor 4
5) Select Distracted Driving?
6) Select Speeding?
7) Select Citations Issues #1
8) *Enter Citation/Ordinance Code #1
9) *Select Citations Issues #2
10) *Enter Citation/Ordinance Code #2
11) Click Next

(system proceeds to

Unit 1 Person Conditions)

If: Non-Motorist

1) Select Movement Prior to Crash
2) Select Factor 1
3) *Select Factor 2
4) Select Citations Issues #1
5) *Enter Citation/Ordinance Code #1
6) *Select Citations Issues #2
7) *Enter Citation/Ordinance Code #2
8) Click Next

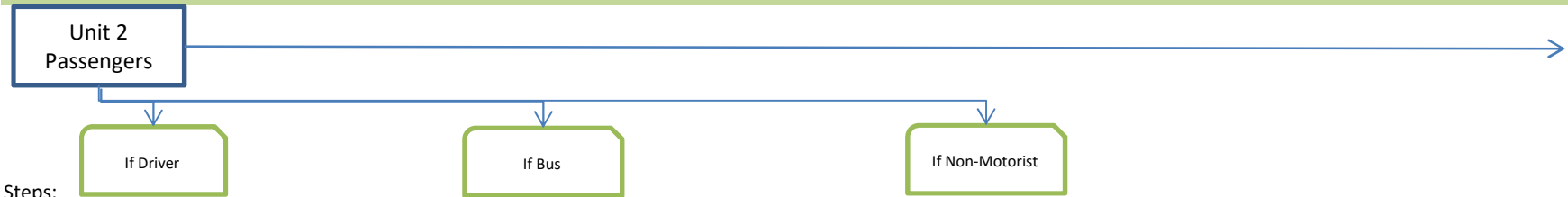*(system proceeds to*

Unit 1 Person Conditions)

Steps:

If: Driver

1) Select Position

If: Moped/Motorscooter; ATV;
Snowmobile; Motorcycle (else Skip 2)

2) Select Helmet Use (Skip 3-4)
3) Select Eject/Trapped
4) Select Restraint Use
5) Select Airbags
6) Select Injury Severity
7) *Select Transported
8) *Enter Ambulance Service
9) *Enter Run Number
10) Select Physical Condition 1
11) *Select Physical Condition 2
12) Select Suspect Alcohol?
13) *Select Alcohol Test
14) *Select Alcohol Test Type
15) *Select Alcohol Test Result
16) *Enter Alcohol Test Value
17) Select Suspect Drugs?
18) *Select Drug Test
19) *Select Drug Test Type
20) *Select Drug Test Result
21) *Select Positive Drug Type
22) Click Next

(system proceeds to Unit 1 Passengers)

If: Non-Motorist

1) Select Position
2) Select Safety Equipment 1
3) *Select Safety Equipment 2
4) Select Injury Severity
5) *Select Transported
6) *Enter Ambulance Service
7) *Enter Run Number
8) Select Physical Condition 1
9) *Select Physical Condition 2
10) Select Suspect Alcohol?
11) *Select Alcohol Test
12) *Select Alcohol Test Type
13) *Select Alcohol Test Result
14) *Enter Alcohol Test Value
15) Select Suspect Drugs?
16) *Select Drug Test
17) *Select Drug Test Type
18) *Select Drug Test Result
19) *Select Positive Drug Type
20) Click Next

(system proceeds to Unit 1 Passengers)

Unit 2
Passengers

If Driver

If Bus

If Non-Motorist

Steps:

If: Driver

1) Select total number of passengers

If: 1 or more passengers

2) Enter Driver's License

3) *Click MN Fill

4) *Enter First Name

5) *Enter Middle Name

6) *Enter Last Name

7) *Enter DOB

8) *Select Sex

9) Select Position

10) Select Eject/Trapped

11) Select Airbags

12) Select Injury Severity

13) *Select Transported

14) *Enter Ambulance Service

15) *Enter Run Number

If additional Passengers

Repeat steps 2-15 for each

16) Click Next

(system proceeds to CrashReport Narrative)

If: Bus

1) Select total number of passengers

2) Select total number of injured passengers

If: 1 or more injured passengers

3) Enter Driver's License

4) *Click MN Fill

5) *Enter First Name

6) *Enter Middle Name

7) *Enter Last Name

8) *Enter DOB

9) *Select Sex

10) Select Position

11) Select Eject/Trapped

12) Select Airbags

13) Select Injury Severity

14) *Select Transported

15) *Enter Ambulance Service

16) *Enter Run Number

If additional Injured Passengers

Repeat steps 2-15 for each

17) Click Next

(system proceeds to CrashReport Narrative)

If: Non-Motorist

1) Select total number of passengers

2) Select total number of injured passengers

If: 1 or more injured passengers

3) Enter Driver's License

4) *Click MN Fill

5) *Enter First Name

6) *Enter Middle Name

7) *Enter Last Name

8) *Enter DOB

9) *Select Sex

10) Select Position

11) Select Eject/Trapped

12) Select Airbags

13) Select Injury Severity

14) *Select Transported

15) *Enter Ambulance Service

16) *Enter Run Number

If additional Injured Passengers

Repeat steps 2-15 for each

17) Click Next

(system proceeds to CrashReport Narrative)

Complete Report

| CrashReport Narrative | → | CrashReport Diagram | → | CrashReport Review and File | → | CrashReport Complete |

Steps:

1) Enter Crash Narrative

2) Click Next

(system proceeds to CrashReport Diagram)

Steps:

1) Select all components to complete Diagram

2) Click Next

If Fatal Injuries reported

(system proceeds to Fatality Report Crash)

If No Fatal Injuries reported

(system proceeds to CrashReport Review)

Steps:

1) Review all sections of report

2) Modify sections as needed

3) Click File

(system proceeds to CrashReport Complete)

```
┌─────────────┐      ┌─────────────┐      ┌─────────────┐
│  Fatality   │      │  Fatality   │      │  Fatality   │
│  Report     │ ───▶ │  Report     │ ───▶ │  Report     │ ───▶
│  Crash      │      │  Unit1      │      │  Unit2      │
└─────────────┘      └─────────────┘      └─────────────┘
```

Steps:

1) Enter Time EMS Notified

2) Enter Time EMS Arrived at Scene

3) Enter Time EMS Arrived at Hospital

If Work Zone involved Crash

4) *Select Work Zone Type

5) Click Next

(system proceeds to Fatality Report Unit1)

Steps:

1) *Enter Unit's travel speed

2) *Indicate if speed limit is N/A or Unknown

3) Select Avoidance Maneuver

4) Select Violations Charged

5) Verify Total Occupants

6) Select Occupant's Position

7) Select Ejection Through Type

8) *Select Ejection Through Location

If additional Occupants

Repeat steps 6-8 for each

9) Click Next

(system proceeds to Fatality Report Unit2)

Steps:

1) *Enter Unit's travel speed

2) *Indicate if speed limit is N/A or Unknown

3) Select Avoidance Maneuver

4) Select Violations Charged

5) Verify Total Occupants

6) Select Occupant's Position

7) Select Ejection Through Type

8) *Select Ejection Through Location

If additional Occupants

Repeat steps 6-8 for each

9) Click Next

(system proceeds to CrashReport Review and File)

Flow Chart Legend

Prototype Screen

Dynamic Panel within Screen

Pop-Up Window over Screen

Help Box, Callout, or Decision Aid