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Evaluation of the Records Management System for the Michigan Center for Truck Safety

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16. Abstract

This report documents the development of recommendations for a record-keeping system to help the Michigan Center for Truck Safety monitor and document their training activities easily, accurately, consistently, and securely, and to improve the reliability of the data for evaluations of the Center's programs. The Center's existing database and structure were reviewed, and the Center's staff was interviewed about their use of the database system. It is recommended that the Center retain but enhance its existing Microsoft Access Database Management System. The services of a Microsoft Access programmer are recommended to add validity checks and input masks for data input, to develop templates for standard reports, and to develop a set of frequently-used queries. Barcode readers to read driver license numbers and use of DOT numbers are recommended to improve the accuracy of driver and company identification. These data are needed for linkages to driver records and to the Federal Motor Carrier Management Information System (MCMIS) carrier files for evaluations of the Center's programs. It is recommended that data security is ensured through antivirus, malware protection, internet firewalls, and password protection for the computer and database; that trainees be informed that their privacy is protected; and course evaluations not be linked to individual trainees.

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Evaluation of the Records Management System for the Michigan Center for Truck Safety (MCTS)

1. Introduction

The Michigan Center for Truck Safety (MCTS) is a non-profit organization that conducts safety educational and training programs for Michigan's trucking community. These services and programs are funded by a grant from the Michigan Truck Safety Commission (MTSC). Over the past decade, approximately 25,000 people participated in MTSC courses.

In a recent evaluation of the MCTS training program[1] we identified quantifiable safety benefits of the training program, but also found the record-keeping system of course participation to be cumbersome and challenging. Because participant records in MCTS database were manually entered into electronic form by MCTS staff from forms filled out by the trainees, without built-in checks, there were problems associated with accuracy, duplication, completeness, and ambiguities of the records. One-third of the participant records had invalid driver license numbers, either because the trainees did not enter the correct number on their course registration forms or mistakes were made when the numbers were transcribed into the database. These data problems make it more difficult to manage MCTS programs, in addition to complicating the evaluation of the effectiveness of the programs.

One of the suggestions from the evaluation was that ways of obtaining more accurate information that would benefit the MCTS and future evaluations should be explored. Accordingly, the MTSC asked us to critically examine the record-keeping methods and data structures, and propose ways to enhance their utility.

The goal of this project was to develop recommendations for a record-keeping system to help the MCTS monitor and document their training activities easily, accurately, and consistently. While the first priority of the record system is its usefulness to the MCTS, it should also be flexible enough to be used for research purposes—such as testing and measuring the value of the program. In addition, the record system should be secure to protect the identities of the trainees in any research studies that use this database.

[1] Kostyniuk, Blower, Eby, Molnar, Zanier, St. Louis (2013). *Evaluation of the Michigan Center for Truck Safety: Effectiveness of Training Programs*, UMTRI Report 2013-32, University of Michigan Transportation Research Institute, Ann Arbor, MI.

This report documents our process of evaluating the record-keeping system, and presents our recommendations for the MCTS record-keeping system of its training activities.

2. What we did

To gain an understanding of the present record-keeping system used for the MCTS training program we reviewed the existing database and its structure. We visited the MCTS and interviewed MCTS staff about their use of the database. We sent our questions to MCTS personnel before our visit so they could be prepared and to make sure we didn't overlook anything (see Appendix A). During our visit, we asked staff to demonstrate how data are entered and how queries and reports are run. We also asked what works well, what is difficult, and what improvements or changes they would like to see. We then reviewed the appropriateness of the specific software used, identified problem areas, examined alternatives, and developed recommendations.

3. The present Database Management System and its use

MCTS uses Microsoft Access database management system (DBMS) to manage the records of the different educational activities of the Center.[2] These records include a number of different types:

- Records for the drivers and other persons who have taken courses and other training;
- A table listing the companies and other entities with which the drivers are associated;
- Lists of courses completed for each trainee, including the date completed;
- A table of the courses themselves;
- Instructors for each of the courses;
- Locations where the instruction was delivered;
- Survey responses from the trainees, recording their satisfaction with the courses; and,
- Records for drivers who have qualified for the Home Run for Safety award.

The DBMS is structured as a relational database, meaning that the actual information is contained in a number of tables, which are linked together by identifiers. This structure provides for efficient and flexible storage of data. For example, each driver is identified uniquely by his or her driver license number. In the driver table, there is one record for each driver. Drivers can take more than one training course. Rather than appending to each driver record information on each course taken, there is a separate table that has one record for each person who took a training course. Each record includes the driver license number of the trainee, the type of course, date that the course was taken, instructor, and location. To

[2] The Michigan Truck Safety Center (MTSC) is also referred to as the Center in this report.

determine all the courses taken by each trainee, the driver record is linked to the records in the driver-course table to determine each course taken by each trainee. This is a more efficient and flexible database design than just appending to the trainee's record information on each course taken by the trainee.

Data are entered into the database primarily through a form-based interface. When the database is first loaded, the user is presented with a form allowing the user to select among driver information, company information, or editing the lists of courses, instructors, locations, and trainee types (see Figure 1). For example, to enroll a new trainee, the user clicks the "view driver" button (see Figure 1) to pop-up another form that can be used to search for an existing trainee or enter data for a new trainee. The same procedure is used for the other classes of information used.

Figure 1 Record Management System Interface

This DBMS is used for most of the record-keeping functions of the Center. It tracks all the trainees and their associated companies or schools, courses offered and taken, instructors, and locations. It is used to identify candidates for the Home Run for Safety award[3]. Center personnel regularly query the database or generate reports to summarize the data for various purposes.

[3] The award is given to drivers who complete the Center's professional driver advanced safety training curriculum.

Just as importantly, the DBMS is also used to track and document the educational activities of the Center. The data are used to track the number of drivers and other students who received training from the different MCTS training courses. The MTSC is the primary sponsor of the Center, and being able to give accurate counts and to fully describe the activities of the Center to the MTSC is critical in justifying continued and even expanded support. It should also be pointed out here that the DBMS was the foundational resource used in the recent evaluation by UMTRI of the Center's programs. Without these data, it would have been impossible to evaluate the programs of the Center.

4. Problems identified

Microsoft Access is powerful desktop DBMS package. It is fully programmable, meaning that a programming language can be used to perform any supported function, and includes many built-in functions for ease of use and data integrity. It is not difficult to create forms for data entry, to program complex queries to analyze data, and to design automated reports on the data. Microsoft Access is a very strong choice for the Center's database, and we do not recommend any change there.

However, in our review of the Center's database, we found that many of the built-in features and capabilities of Microsoft Access were not being used. These features can significantly enhance ease-of-use as well as reduce errors and improve the accuracy of the data. In this section we describe the specific problems we identified and present ways to address these problems.

4.1 Data validation constraints

Some of the fields in data entry forms do not include simple data validation constraints. For example, the data fields include contact name and phone number for companies. However, for some records the contact name field contains a phone number and the field for phone number is blank. Microsoft Access includes built-in tools that can reduce the incidence of this kind of error through "data validation." The contact name field could be defined to allow only alphabetic characters in the contact name field. The phone number field could be programmed to accept only a properly formatted 10-digit number. Microsoft Access, for example, provides various input masks, including for phone numbers, which can be used to help input valid data. Simple changes like this would prevent many input errors and would improve the integrity of the data.

Some of the data entry forms use drop-down boxes. This is a good idea, because the drop-down box can present the data entry person with a limited list of possibilities, and the entries can be restricted to that list only. For example, when entering driver course information, the Position list presents six different possibilities, such as Student, Driver, Management, and so on.

However, the field containing the data from that entry is not limited to those possibilities and strings such as “o”, “s”, and “de” were also found there. If the form used for collecting the data was limited to a fixed list of possibilities and would not accept anything else, these errors (not numerous!) would be eliminated.

It is clear that the convenient data validation properties were not programmed into the Center’s DBMS when it was originally set up. Many of the data integrity problems would be addressed if this feature of Microsoft Access is programmed into the data entry forms.

4.2 Report Generation

One of the recurring uses of the database is to generate reports that summarize Center activities and productivity over different periods of time. These reports are used to report quarterly and annual activities to the MTSC, as well as for other purposes. As demonstrated to us, the procedure for generating these reports is cumbersome and *ad hoc*. Microsoft Access includes a set of tools that can be used design a set of report templates. However, there were none contained in the present DBMS. Each time a report was generated, it was developed from the beginning. Again, it is clear that the original set up of the Center’s Microsoft Access database did not include development of report templates.

Separate templates should be designed for each of the standard and recurring reports that are generated from the database. These templates would be stored in the Microsoft Access database, just like the various subforms used to enter data are stored. When run, the templates would automatically extract, summarize, and print the information that is wanted.

In fact, there could be a reporting module accessible through the interface displayed in Figure 1. In one possible implementation of this idea, when the Reporting button is clicked, a dialogue box would popup and the user could select the report type, date range, and other items for the report. The report would then be run and printed out or used however desired. The reporting functionality within Microsoft Access is designed for exactly this type of use. Some variant of this system should be implemented in any modification of the Center’s record management system.

4.3 Running Queries

Queries are used to answer specific questions about the data that would be difficult to answer by looking at table data directly. Queries perform many functions with the data including filtering, summarizing, and performing calculations.

MCTS staff indicated that running queries was difficult and time-consuming. In the course of their work, there are needs to run a trainee-level, instructor-level, or course-level query. As in the case of report generation, the process was cumbersome and *ad hoc*, and each query was essentially developed from the beginning every time.

Such queries can be developed easily and run using the tools available in Microsoft Access. As with reports, these were not programmed when the original DBMS was developed for the Center. Two approaches could address problems related to running queries.

In the first, a standard set of queries could be written and set up in advance. MCTS staff could work with a programmer to identify the queries that are run frequently. These standard queries could then be written by the programmer, and then run by Center staff when needed. Microsoft Access programming is flexible and powerful enough so that the queries could be programmed to be tailored to specific questions at run-time. For example, a query on the number of students in specific courses in a specific time period could be programmed to allow the user to choose the courses and select the time period when run. With care, it is likely that most query needs could be taken care of through a standard set of well-designed queries. Essentially, a catalog of queries could be set up and documented. The user could then select the needed query and run it to retrieve the desired information.

However, not all information needs can be anticipated, so it is likely that there will still be a residual need for some *ad hoc* queries. Staff currently does a very credible job of creating queries as needed, but a little training in query design could ease the burden on staff. The training should be specifically tailored to the existing dataset, with immediate applicability to the work of the MCTS. This training in simple query design could be delivered by any competent Microsoft Access programmer.

4.4 Accuracy of driver license numbers

Accurate identification of trainees is important. Because all driver license numbers are different and the number for each driver does not change over time, driver license numbers are ideal for keeping track of the Center's trainees, their courses, and other services accessed over time. Drivers may have similar names and they may change their usage, (e.g., Bill, Billy, and William), but the license number will stay the same, (unless they change their state of residence and get a new license). Thus, the driver license number is a convenient token to uniquely identify each individual, it is clearly related to the mission of the MCTS, and it does not have the same sensitivity as a social security number.

The current Center DBMS uses the driver license number to keep track of individual drivers in tracking the courses taken and identifying candidates for the Home Run for Safety Award. The number is also used to count the number of trainees for accounting purposes and to document the work of the Center. Finally, and critically, the driver license number is an indispensable datum in evaluating and demonstrating the value of the MCTS to truck safety in Michigan. For example, driver license number was critical for linking in driver history records to demonstrate that students in one MCTS course became safer drivers after taking the course.

However, as noted earlier, we found about one-third of the driver license numbers in the Center's database to be invalid. Michigan driver license numbers consist of a letter corresponding to the first letter of the holder's last name and 12 numbers. Because trainees write their driver license number on their course registration form, and the information on the form is manually keyed into the data entry screen, there are many opportunities for errors. Requiring a letter and 12 numbers in the data entry form for Michigan driver's licenses[4] will not solve the problem of drivers incorrectly writing their number on the registration form, but it will reduce the problem.

We explored scanning registration forms and bar code readers as ways to address the problem. We rejected scanning approaches using Optical Character Recognition (OCR) and scannable forms with Optical Mark Recognition (OMR) because the trainee would still have to write down the driver license number, special software would have to be purchased to read the forms, and in the case of scannable forms, special registration forms would have to be developed. Furthermore, while OCR software can read text, it is currently not reliable with handwriting. The scannable form/OMR systems are good at recognizing bubbles and Xs on forms, and can read text if letters are printed in block letters within boxes, but are also poor at reading cursive writing. We concluded that the currently available scanning approaches are not reasonable options for this application.

On the other hand, capturing the driver license number with a bar-code reader is feasible, accurate and inexpensive. A barcode reader that plugs into a USB port of a laptop computer, at this time, costs about $125. The license number goes into an Excel spreadsheet,[5] and can easily be transferred into registration input form. Figure 2 shows a barcode reader and driver license.

[4] There are trainees from other states and Canadian provinces. The input form should allow for identifying the state or province, and then have the appropriate format for each state and province.

[5] The exact process would have to be specified depending on the input form. However, it should be noted that there would be a need to link the scan of license number to the input form at the time of the scan.

Figure 2 Barcode reader

4.5 Data security and privacy

One of the issues raised by MCTS staff in meeting with us was the concern of some of their trainees for protecting their privacy, and the reluctance of some to give their driver license number. This is a legitimate issue and one that needs to be addressed seriously. Researchers in the academic community deal with privacy issues on a continuing basis and have developed effective means of protecting individuals' data and privacy while still conducting important research.

It should be noted here that every driver record in the database had a driver license number. From this, we conclude that continuing to obtain the driver license number and using it as the unique driver identifier is viable. Protecting drivers' privacy is a separate issue. Drivers have a legitimate interest in protecting their privacy which must and can be respected. This is routinely accomplished in the research community and can be here.

In terms of the physical security of the data, they should be kept on secure computer systems, using firewalls and antivirus protection, on fully-patched systems. The computer system must be password-protected, and if it is on a network, the network must be secure and password-protected. Microsoft Access also supports encryption, so the database itself could be password protected. The Center's DBMS could be kept on a computer accessible only to a limited number of MCTS staff members. These are standard protections and should be implemented, if they are not already, by MCTS.

In addition, the MCTS could provide trainees with formal reassurance about the security of their data. In the academic world, this is part of the process of securing informed consent. Researchers state the purpose of the data collection, how the data will be used and protected, and identify any plausible risks to the individual. In the context of the MCTS, trainees could be given a short statement that states how the data will be used, how it is protected, and assured that the data collection poses no risk to them and that personally-identifiable information will

never be released. A draft version of such a statement is included as an example in the Appendix B

4.6 Accuracy of company names

Trainees provide the name of their company, agency, or school when registering for course. However, examination of existing files shows that company names are inconsistent. Frequently there were several names for the same company, including variations, abbreviations, and misspellings, making it difficult to track who the MCTS programs serve. This problem could be reduced by using DOT numbers as unique identifiers for companies. All interstate commercial motor vehicle (CMV) operations require DOT numbers and Michigan requires an intrastate US DOT number for all intrastate CMV operations if they use vehicles with gross vehicle or combination weight or rating exceeding 10,000 lbs.

However, not all trainees come from specific carriers. Students from various truck driving schools and employees from state, county and municipal agencies enrolled in MCTS courses will not have US DOT numbers. A dummy number could be used in such cases, with a flag identifying it as a dummy number, so that it is not mistaken for a real US DOT number. The number would have to be unique to the specific entity, and so would require care in assigning at the time of data entry.

US DOT numbers can be linked to the Federal Motor Carrier Management Information System (MCMIS) carrier file, which gives a reasonably updated set of information about carriers. This information could be used to learn about the carriers served, where they are located, how many trucks and drivers they have, and what types of loads they carry. In addition, this information is a valuable resource to expand the reach of the MCTS, by identifying carriers who may be unaware of MCTS programs.

4.7 Course Evaluations

The Center's DBMS has data entry forms for surveys that have been used to record class evaluations for the Michigan Center for Decision Driving (MCDD) training courses. The trainees are asked whether they strongly agree, agree, are neutral, disagree, or strongly disagree with 10 statements about the course. The statements refer to usefulness, relevancy and applicability of course content to their job, instructor's knowledge of material and effectiveness and clarity of presentation, usefulness of handouts and visual aids, length of course, and overall satisfaction. Basically, these are the types of questions that are used regularly for evaluating training sessions, and provide program management with valuable information on how well the courses are going and how well they are being received.

However, the evaluations in the Center's DBMS were linked to individual trainees. While recording course evaluations is a good idea, the evaluations should be anonymous. De-identified evaluations are more likely to be completed accurately and honestly and also are

more likely to provide useful feedback to tailor the courses to better meet the needs of the students. In addition, the students may be concerned about the potential of their responses being exposed to their companies or to the trainers.

The simplest though labor-intensive method would to continue to manually enter the evaluation responses as was done up to now for the MCDD course, linking them only to the specific course, its date and location and not to the trainee filling out the form. However, the amount of staff effort is large in this approach, and even now, evaluations for other courses are recorded only in hard copy form.

Another approach is to use web-based survey services such as "Survey Monkey". A basic Survey Monkey survey that has up to 10 questions with a total of up to 100 respondents is free. Web-based survey services for more questions, more respondents, and more detailed questions can be obtained from Survey Monkey for about $300-$780/year. Survey Monkey provides various statistics and summaries of the data, and the more advanced versions allow downloads of data in various formats, including PDF or data files that can be read into Microsoft Access and queried or analyzed as desired. Other web-based survey services are similar. The use of web-based surveys, however, requires that the trainees have access to the Internet, so they can complete their survey. Experience has shown that for maximum response, the evaluation should be completed right away, before the trainees leave the training site. Thus, providing Internet access to all the trainees at some point at the end of the session might be a challenge. However, as more people acquire and carry tablets and smart phones, it may be possible to have them go to the survey web-site at the end of the session, and complete the evaluation.

The third option is to develop a simple scannable form, where the responses are marked with Xs or bubbles and read using specially designed machine-readable data capture software. Costs are about $3500. While this was not a good option for registration data input forms, it could work for evaluations.

5. Findings and recommendations

This project set out to develop recommendations for a record-keeping system to help the MCTS monitor and document their training activities easily, accurately, and consistently. While the first priority of this record system remains its usefulness to the MCTS, the flexibility of the system to be used for research purposes--such as testing and measuring the value of the program is also important. In addition, security of the records and the ability to protect the privacy of the trainees in any research studies that use this database was also important. The following are the recommendations developed by this study.

- **Retain existing Microsoft Access DBMS but enhance to make more secure, accurate, and useful.**

Microsoft Access is a powerful, flexible, and ubiquitous program. There is no need to change the program to something proprietary. The MCTS staff is familiar with it and use it well. All that is needed are some additions and corrections to make it more useful, more accurate, and easier to use for MCTS staff.

- **Employ a Microsoft Access programmer to update the program, add data validity checks, and input masks.**

Microsoft Access includes tools to help ensure each field contains only data of the appropriate type. The tools include such things as input masks which make sure that, for example, phone numbers are entered in the proper format or Michigan driver license numbers start with a capital letter that is the first letter of the driver's last name. Fields can be set up to accept only numbers for phone numbers and alphabetic characters for name fields. Fields can also be set up to accept only certain values. A competent Microsoft Access programmer should be able to easily add validation and consistency checks for each field in the data. These checks will not eliminate all errors, but they will help make data entry more accurate.

- **Develop a standard set of queries and provide basic training to MCTS staff.**

MCTS staff should identify a standard list of queries that they run, (i.e., a frequently-needed-queries list). A good Microsoft Access programmer would then program these queries and make them available. These queries could include features for the user to specify time periods, and any other constraints, at run time, for maximum flexibility and usefulness.

In addition, since it is unlikely that all needed queries can be designed in advance, training should be provided to the appropriate MCTS staff in basic query design. The staff does a very credible job of using Microsoft Access, but a little training in building queries would reduce the burden on the staff.

- **Automate report generation through the use of report templates.**

The programmer should also be tasked to develop a set of templates for standard reports to be incorporated into the Center's DBMS. Such standard forms would make report generation much quicker and much less cumbersome for MCTS staff. The report-generating facility in Microsoft Access is flexible and powerful, and a good Microsoft Access programmer should be able to design a set of easily-used report templates.

- **Capture driver license number using barcode readers.**

Driver license numbers are already captured, but not as accurately as they should be. Using barcode readers to capture driver license number from driver's licenses simplifies data entry and makes it much more accurate. The readers are inexpensive and can interface with Microsoft Access.

- **Use US DOT numbers for company identification.**

US DOT numbers can serve the same function for companies as the driver license number serves for drivers, as a unique identification of the company. In the existing file, there can be several variations of company name, which can make it difficult to track who the MCTS programs serve. The use of US DOT numbers would solve that problem. Not all trainees come from specific carriers, so a dummy number could be used where necessary, with a flag identifying it as a dummy number. Dummy numbers must be unique to the specific entity.

- **Link US DOT numbers to the MCMIS carrier file.**

With the US DOT number, information about the carrier can be linked in from the Federal Motor Carrier Management Information System carrier file, which provides a reasonably updated set of information about carriers. This information could be used to learn about the carriers served, where they are located, how many trucks and drivers they have, and what types of loads they haul. In addition, company information could be a valuable resource to expand the reach of the MCTS, by identifying carriers who may be unaware of MCTS programs.

- **Ensure data security, and inform all trainees about the safety of their data.**

Make sure that all the layers of data security are in place and up to date. This includes antivirus and malware protection, Internet firewalls, and password protection for both the computer and the Microsoft Access database. Consider using a dedicated computer for data management, to further isolate from "phishing" attacks.

In addition, incorporated into the training materials should be a statement to course participants about data security and privacy protection. We have included a draft of a possible statement that might be used for this purpose in Appendix B. The statement need not be elaborate, in part to avoid suggesting that there is a significant risk to privacy. There is very little risk to the driver's privacy if the simple steps recommended here are followed. However, a straightforward statement of the principles of data security and privacy would address any reasonable concerns.

Consider web-based survey for course evaluations

Consideration of a web-based survey services such as "Survey Monkey" is recommended for course evaluations. Web-based surveys provide various statistics and summaries, and the more advanced versions allow downloads in various useful formats. The use of web-based surveys, however, requires that the trainees have access to the Internet, so they can complete their survey. As more people carry tablets and smartphones, this may be a viable option.

Strip trainee identification from evaluations.

Whatever approach is used for course evaluations, the identity of trainees should be not be linked to the evaluation records. De-identified evaluations are more likely to be completed accurately and honestly. Anonymous evaluations are more likely to provide useful feedback in tailoring the courses to better meet the needs of the students. In addition, the students may be concerned about the potential of their responses being exposed to their companies or to the trainers.

Appendix A. Questions to MCTS staff

1. What is the information system used for? What tasks do you use if for, in managing Center activities?
2. What would you like to be able to do that you currently either can't do, or it's difficult and time-consuming to do?
3. What functions in the system are working well? What parts are a good idea and you wouldn't want to see change?
4. Thinking about using the system, what parts of it seem to require a lot of work? What parts are a pain to use?
5. Are there any data fields you would like to see added? Any information not currently captured that would be helpful to have in the system?
6. What would the ideal system be like? In terms of:
    a. Types of data in the system, including any new fields.
    b. Ease of data entry.
    c. Accuracy of data entry.
    d. Ease of querying the data.
    e. Flexibility in querying the data. This includes the ability to tailor queries to specific questions and easily and accurately implement new queries.

Appendix B. Example statement about protection of privacy

The Michigan Center for Truck Safety (MCTS) is a non-profit organization dedicated to improving highway safety on Michigan's roadways, through comprehensive safety educational programs for Michigan's trucking industry. As part of the training courses we offer, we collect data so we can track our programs and the students who use them. All data are maintained on secured computers, password-protected, and accessible only to MCTS staff. We use the data to properly credit students with the courses they have taken, document the utilization of MCTS training courses, and evaluate and improve the training that MCTS offers. The privacy of all individuals is protected. Only aggregate and summary statistics are ever reported.