ELECTRONIC DATA COLLECTION AND RECORD KEEPING OF FRA TESTS AND INSPECTIONS FOR THE SIGNAL DEPARTMENT

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ABSTRACT

CSX Transportation identified a need to improve its compliance with the requirements of federally mandated, routine tests and inspections. Our goals were to provide superior management and oversight of FRA compliance across our entire infrastructure, while eliminating paperwork at all levels. Our approach integrates four key components to deliver a complete solution: Handheld computers for field use, Secure Digital™ memory cards for each handheld computer user, a cost effective and reliable communications infrastructure, and a central computer system to manage assets and test records as well as to support the handheld computers. CSXT has deployed over 300 handheld computers to signal supervisors, maintainers, and inspectors on its Southern Region, and we have processed tens of thousands of test forms, representing many hundreds of thousands of FRA inspections, thus far.

Key Words: FRA inspections, electronic record keeping

INTRODUCTION

This paper describes the recent project at CSX Transportation to provide and support electronic FRA test and inspection records. Test and inspection records are now fully electronic, end-to-end, originating on handheld computers utilized by field forces and culminating in on-screen viewable and printable test records. A central computer system manages inspectable assets and test records and provides work planning and scheduling.

CSXT embarked upon this project for three primary reasons: 1) The FRA Safety Assurance and Compliance Program (SACP) at CSXT identified a need to improve compliance with the testing requirements of 49 CFR 234 and 236; 2) existing processes placed all management of test and inspection records at the local level (paper in file cabinets at supervisor offices) which was burdensome, inefficient, and error-prone; and 3) in the past CSXT has proven that the reliability of its signal system improves directly with increased focus on proper and timely performance of the federally mandated tests and inspections.

CSXT wanted to apply new technology to the testing and inspection processes to facilitate improvements and to gain efficiencies. Representatives from both the Brotherhood of Railroad Signalmen (BRS) and the Federal Railroad Administration (FRA) were invited to planning meetings in the very early stages of the project. Both the BRS and the FRA have supported this project from the beginning, and both were heavily involved from the planning stages through the initial rollout of the project. This project has truly been a joint effort by CSXT, the FRA, the BRS, and the technology vendor, 10East Corp.

INITIAL GOALS OF THIS PROJECT

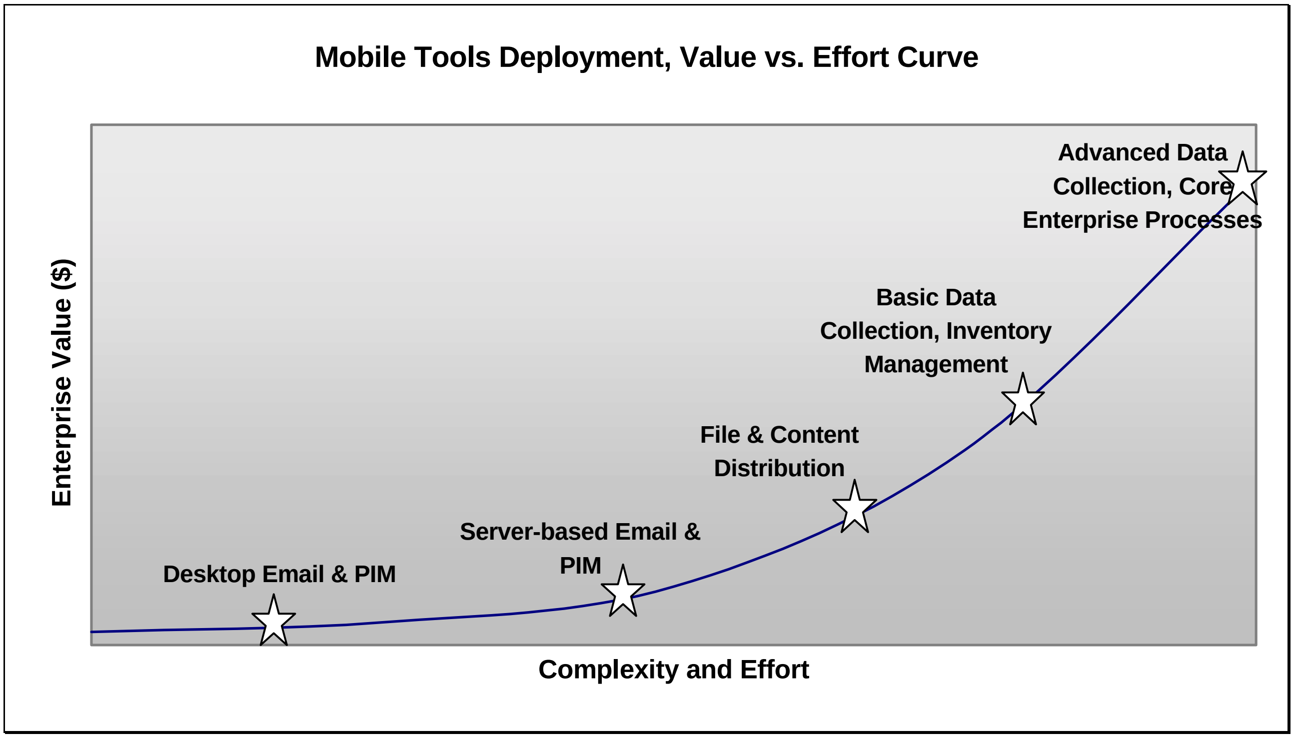
The primary goal of this project, initially, was to improve compliance with federal testing requirements by providing tools for work planning and management oversight. Providing consistency in record keeping across the entire system, while dramatically reducing or eliminating the paperwork and filing burden from field supervisors, was another important goal. CSXT also feels confident that it will benefit from improved signal system reliability as a result of improving its testing and inspection processes.

Other project goals included the ability to accurately know what signal assets are in the field that need inspecting, who is responsible for inspecting them, and when. Of utmost importance is the additional requirement to maintain correct and current data regarding those assets that require inspections. Not only does this improve accountability and limit the chance of required tests being overlooked, but it also allows us to better balance assigned territories based on testing loads, and importantly, to rebalance territories as the equipment configuration on the CSXT infrastructure changes.

Keeping up-front and recurring costs to a minimum was another strategic goal. This led to two important design decisions: First, the handheld computers had to be self sufficient, not reliant upon a personal computer or laptop to accomplish their assigned tasks. Second, communications costs had to be kept low due to the sheer numbers of users, and the associated volumes of tests being performed and transmitted to the central computer system.

PROJECT COMPLEXITIES VERSUS BENEFITS

In the executive white paper entitled *The Future of Enterprise Mobile Computing*, Synchrologic, Inc. has observed two patterns to the typical evolution of mobile computing deployments within different corporations. The following graphic depicts a range of mobile computing initiatives available. It highlights that the greatest potential “value add” and ROI (return on investment) is with mobilizing the core enterprise application set.



Companies tend to start at one end of this curve and move toward the other. Some focus first on the big wins of mobilizing core enterprise applications before pursuing other initiatives. Others start small and inexpensively, providing only basic tools first, and then move up the curve as they gain confidence.[i]

Mr. Phil Redman, research director for the Gartner Group, was recently quoted as saying "ROI is possible for many mobile applications, but enterprises that proactively link mobile technology investments to job functions and bottom-line productivity indicators, such as sales revenue, customer support and internal operations goals, will be successful at defining a mobile ROI, as long as TCO (total cost of ownership) is also understood." [ii]

In a recent article highlighting the results of a META Group study titled "Wireless Adoption, Trends, and Issues" CyberAtlas notes the following: "Several studies have found that the first priority of implementation is for business-to-employee (B2E) applications, because these applications deliver the most immediate productivity return for organizations." [iii]

In the case of the CSXT signal department, we have started by focusing on the big win areas first. The complexity and effort of electronic FRA inspections and record keeping using mobile computers is great, but the ROI is greatest as well. Making a “B2E” connection to our field forces is also important due to all of the future value that can be derived from having those connections in place.

HOW THE PROJECT WAS EXECUTED

In 2001, CSXT asked 10East Corp. to investigate options for this project. 10East is an applications services provider (ASP) specialized in delivering technology solutions to large railroads. 10East has been providing technology services to CSXT's signal department for many years.

Several months of research went into various data collection technologies. Every brand of handheld computer imaginable, Interactive Voice Response (IVR) systems, and even Image Character Recognition (ICR) systems (characters written in blocks, like many IRS and bank forms use) were investigated. A similar myriad of both wired and wireless communications options were researched.

In the end, these four key components were chosen:

1) Handheld computer for field data collection:

   Sharp Electronics Zaurus SL-5500, Personal Mobile Tool (PMT)

2) Handheld user identification, authentication, and data storage:

   Secure Digital™ Memory Cards

3) Communications Infrastructure:

   Encrypted and digitally signed communications over the Internet

4) Central computer to manage records and support the field devices:

   10East's RailDOCS - **Rail**way **D**aily **O**perations **C**ontrol **S**ystems

10East built and demonstrated a fully working model of the system in early 2002. The success of the fully working model, years of good experience with this vendor, and CSXT's desire to quickly improve these processes were reflected in the unusually large pilot project. CSXT's entire Southern Region was chosen to pilot this program. The Southern Region is CSXT's largest region, and required over 300 handheld computers for deployment to signal supervisors, maintainers, and inspectors.

CSXT chose to use "train the trainer" and “peer training” methods to deploy this project. In early October of 2002 the initial trainers were chosen from CSXT's Jacksonville Division and given the very first handheld computers in this project. Those trainers, with support from 10East Corp, began rolling out the system to the entire Jacksonville Division on November 11, 2002. Peer trainers were then chosen for the other divisions in the Southern Region. Training on the entire Southern Region was completed in mid-February 2003.

DETAILED DESCRIPTION OF THE SOLUTION

The Handheld Computers

As mentioned earlier, the Sharp Electronics Zaurus SL-5500 was chosen as the handheld computer for this project. Many factors played into that decision. One important factor was the power and flexibility of the Zaurus that allowed 10East Corp to turn it into a stand-alone tool, with no dependency upon a more powerful personal computer or laptop. A goal of this project was to keep the field users' component as simple as possible; to add a tool to the signalman's toolbox that he could view in a similar fashion as his Fluke meter.

The "Fluke meter" approach kept initial capital costs low, and recurring support costs are dramatically lower than comparable laptop computer support costs. Small, embedded computers like the SL-5500 do not suffer many of the reliability issues associated with laptops. If an SL-5500 does fail, a replacement unit is shipped over-night to the user, and when he "restores" his last backup from his assigned memory card, that new device is identical to the lost or damaged one.

The Zaurus runs custom RailDOCS-offline software to provide disconnected field worker functionality. The device functions as a stand-alone unit giving the user the ability to work offline, and later "synchronize" his data with the central computer system’s data.

The RailDOCS-offline software provides the user with a "To-Do" list showing all of the assets he is responsible for testing, along with the types of tests required and their next due dates. This to-do list can be sorted many different ways, including milepost, but the most common method is to sort by "due date" and work on what is due soonest. Part of our user training sessions focused on helping workers understand the importance of testing assets on their jobs in geographic succession, from one end to the other, maximizing testing efficiency.

The FRA Test and Inspection software on the PMTs is highly customized, designed specifically for that task. The software knows the "business logic" associated with each inspection type, and prompts users appropriately. For example, if a user tries to indicate a grade crossing warning time of 18 seconds without repairing that issue, the Zaurus prompts the user stating that the FRA minimum warning time is 20 seconds and that the input he is trying to give is not valid. These "business logic" prompts are invaluable tools for data correctness and self-service training, while enhancing railroad safety.

User Identification and Authentication

When deploying handheld tools to hundreds or thousands of workers, of paramount concern is user identification and authentication, particularly when handling federally mandated inspections. The traditional method for identification and authentication is the username and password. Forgotten usernames and passwords are the most common end-user support issue and are very costly to administer. This burden is exacerbated when spread across thousands of users, dispersed across tens of thousands of miles of track, using devices that are not connected to a computer network.

This project took advantage of some recent technological advances in the area of small, secure, memory storage cards. Specifically, Secure Digital™ (SD) cards were used. SD cards are slightly larger than a typical US postage stamp and about two millimeters thick. SD cards are manufactured in such a way that each card is encoded with a unique and unalterable card identifier.[iv] SD cards are available today in capacities ranging from 8 megabytes up to 512 megabytes. For this project, 128-megabyte SD cards were used.

SD cards were used in this project for handheld user identification and authentication. Think of the handheld computers as tools assigned to the employees’ trucks (like wrenches and meters), and the SD cards as assigned to individuals (like credit and gas cards). The unalterable card ID of each SD card is associated with a RailDOCS user account, and with the assistance of some encryption and digital signature technology, identifies and authenticates the user without the need for usernames and passwords. Users are responsible for securing their assigned, postage-stamp sized, SD card. Many users keep their SD cards inserted into their handheld computers most of the time, choosing to secure the entire unit, and removing and securing the SD card separately only when going on vacation, or on weekends, etc.

In addition to user identification and authentication, the SD cards store all of the inspections software, the inspections themselves, and a series of device backups. RailDOCS-offline software installed on the devices automatically manages a once-per-week full device backup onto users' assigned SD cards. These device backups protect users from device damage. Restoring one of the backups from a user’s card onto a brand new device makes that new device identical to the one the user had at the time of that backup. This backup and restore capability is a very compelling feature for field deployments, and another large advantage of customized, embedded handheld units over laptop computers.

The Communications Infrastructure

An average of over 7,500 test forms, representing over 37,500 FRA mandated tests, have been coming in each month from the handheld computers deployed on CSXT's Southern Region. At these volumes, long distance or toll free modem dialup was not an option. With over 300 users today, and over 1,000 users predicted at full deployment, per-user pricing for Internet services proved very expensive as well. 10East provided a low cost solution of per-minute pricing for Internet access, which has no regard to the number of users, and through a nationwide network of over 5,000 local phone numbers. Communication costs are very manageable with this novel approach.

The Central Computer System

RailDOCS does all of the “heavy lifting” in this project. It stores all of the assets, responsibility, inspections, and scheduling of tests. RailDOCS communicates with each handheld computer during the "synchronization" process, validating and accepting tests, calculating the "next due" data for every asset on the handheld, adding any new assets to the handheld that a supervisor has requested RailDOCS to “push” to the handheld, etc.

RailDOCS provides management reporting and data views in several different ways. The most common method used by management is to browse inspection compliance by organizational chart. This view starts with the regional engineers of signals, and drills right down to individual test records on specific assets assigned to a given maintainer. Identifying problem areas is as simple as following the red indicators (green is good, red needs attention) right down to the exact area needing improvement. Other data views include the ability to browse compliance by railroad divisions, or to search for inspections by a wide array of criteria.

RailDOCS additionally allows managers to reorganize territory boundaries, view on-line documentation and instructions, “push” assets to handheld computers, and many other functions.

RailDOCS is normally accessed over the Internet, by using a web-browser pointed to https://www.raildocs.net/. The Internet nature of RailDOCS makes it available to anyone with Internet access, anytime, anywhere. This includes field workers with home computers, or from local libraries, and management workers from home, office, or on the road.

Documentation

All RailDOCS-offline software applications running on the Sharp Zaurus PMTs in support of this project have on-line help. Every program has a small question mark icon in the upper right of the title bar that, when clicked by the user's stylus, provides documentation for that application.

In addition, a comprehensive user manual was produced for this project. That user manual, useful hints and FAQ documents, summary documents that give new users a "big-picture" overview of the complete system, as well as CSXT TCI (Train Control Instructions) for things like the proper way to apply "Inspectable Asset ID Tags" and to handle Secure Digital™ Cards are available for all users in Adobe PDF format, around the clock, from RailDOCS.

Computer-animated movies, that show users exactly how to use the Sharp Zaurus PMT and its testing software, are available to users through RailDOCS as well. These animations are delivered as Macromedia Flash documents, and are viewable in any modern web browser.

WIRELESS VS WIRED COMMUNICATIONS

When evaluating mobile work force automation tools, many staffers and vendors will recommend wireless communications. Wireless communications should be closely scrutinized today, particularly in the highly dispersed, and often rural, environments found on most railroads. Over time, wireless communications for field deployed handheld computers will become more cost effective and widely available. Today, however, costs and availability are both poor, and available bandwidth is extremely limited.

The technical difficulties of “fully disconnected” field device operation are far greater than devices having wireless communications available. In today’s wireless communications environment, however, fully disconnected operation borders on imperative in a railroad environment. Fully disconnected operation coupled with routine (daily in our project) synchronization from home or office appears to be the correct model for the near-term.

It is vitally important, however, that the synchronization technologies deployed be indifferent to the underlying means of communication. Using the Internet and its TCP/IP foundation as the conduit for synchronization in this project provides that flexibility. In fact, in addition to the standard Compact Flash (CF) modems deployed to all users in our project, roughly a dozen users have been identified who have high speed Internet connectivity in their homes by way of cable modems or DSL circuits. Those users have been provided a “broadband connection” option to allow synchronization through their home broadband connections. This option trades a small one-time capital expense for zero future communications costs for that user. The users benefit from dramatically faster and more convenient syncs.

10East Corp has demonstrated handheld synchronization through digital cellular data services like SprintPCS Connection and Verizon Wireless. Future advances in our project may include deploying cellular modem cards to select users for wireless device connectivity.

ADVANTAGES OF AN APPLICATION SERVICES PROVIDER (ASP)

10East Corp. delivered a turnkey solution, isolating CSXT from the work and risk of integrating many complicated, disparate, and cutting edge technologies, as well as the on-going support burdens associated with supporting the field deployed devices. The pay as you go business model, indicative of most vertical market ASPs, dramatically reduces up-front costs as well as financial risks for a pilot project, and for a full deployment.

Aggregation of resources across several similar customers allows the vertical market ASP to offer access to applications at a lower cost than companies can deliver internally. This includes reducing the cost of hardware through volume discounts, as well as reducing the substantial costs to fund user support. These benefits drive cost effectiveness and cost control.

KEYS TO SUCCESS IN OUR PROJECT

META Group analyst Peter Firstbrook offers some solid advice, "Above all else, keep applications simple and avoid feature creep at all cost. Focus on the two or three top functions that mobile users really need to get the job done."[v]

META Group analysts have also been quoted as stating, "...projects have a much higher success rate when the goal is to drive a particular value proposition for a specific audience and not general functionality relevant to everyone. In particular, many projects become derailed when too many applications are piled onto the initial design, leading to few things working well." [vi]

When involved in a project like ours, one's mind can run wild with ideas and possibilities for the new tools, and the capabilities that they bring. There is a high degree of temptation to introduce extraneous endeavors into a project such as this, even in the early stages. We strongly resisted these temptations, choosing instead to focus all efforts on the core issues, and choosing to ensure success in those fundamental areas, deferring other initiatives, which will have high value as well, until a later date.

Another large key to the success of this project has been to involve all affected parties early and often. The Brotherhood of Railroad Signalmen and the Federal Railroad Administration were both key participants in the project from the very early stages, and remain highly involved even today.

POSITIVE SIDE EFFECTS OF THE PROJECT

Some positive side effects of our project have included improved accident and incident response times, by having all inspection records always available, to all appropriate levels of management.

The handheld computers, and the “B2E” connection that they provide, give CSXT a clear path to compliance with the upcoming 49 CFR 236(h) rules regarding configuration management.

Field forces can now interact with RS-232 capable field electronics equipment with their handheld computer without the need of a laptop, providing that access to a larger set of the field force and at a lower cost to CSXT.

Most importantly, the handheld computers, and their communication back to the central computer system that manages them, facilitates improved communication with the field work force. We will continue to expand upon and leverage that to our advantage through time.

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FOOTNOTES

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