**Session No. 626**

# Streamlining Safety Operations through the Widespread Use of Mobility Tablets

**Richard Baldwin, M.S., CSP**
**US Director, HSE**
**PCL Construction Enterprises**
**Denver, Colorado**

**Jim Barry**
**Vice President, HSE**
**PCL Constructors, Inc.**
**Edmonton, Alberta**

## Introduction

Since the use of computers to record and assess safety data began over 30 years ago, a common complaint by managers is that safety professionals' time is inordinately devoted to office work and their absence in the field, no matter in which industry, is a detriment to injury prevention. To correct the problem, rules were occasionally established mandating that for a certain percentage of the day the safety professional was required to be in the field, all because of the perception that too much time was spent in front of a computer screen. And in most instances, that perception was true, but only because of the increasing use of safety, health and environmental computer applications.

Initially, in the early 1980s, computers were used only a few minutes each week to prepare very simplistic incident rate charts, then to fill out inspection and incident reports. Over the years, more and more data was collected and assessed as we strived to find more and ever more effective leading indicators. There is little that we in safety do today that does not involve the use of a computer.

The use of tablets for construction operations is not a new concept, but its use in safety is just beginning. From the time the iPad was introduced in 2010, the available number of construction applications has been increasing steadily. These applications help to speed communications, obtain client approvals, facilitate inspections, track project logistics, and manage drawings and Building Information Modeling (BIM), among other functions. They are becoming indispensable.

This paper will identify the process that a leading construction company used to develop applications for a mobility tablet to enable safety professionals to work in the field rather than the

office. The selection of the type of tablet and the various applications employed will be explained with emphasis on the choices that any company could make to establish or increase the use of mobility tablets. Additionally, the pitfalls that were encountered will be discussed, and the resolution to the difficulties fully explained.

## Recognizing the Need

Our company's Health Safety and Environment (HSE) processes and systems are complex and require extensive resources to implement; yet without question they are very similar in that regard to those of other large firms. Because of this complexity, namely in the inspection and incident investigation systems that enable frequent and comprehensive trend analyses, the time needed to record data in the computer is extensive. And unless an administrator is hired to input the information, the safety professional must devote considerable time each day to the task; time that would be more productive spent interfacing with workers on the job.

In a quest for zero incidents, highly trained and effective safety professionals are best utilized in the field, not engaged in administrative duties. Most companies clearly understand that fact and are aggressively seeking alternatives, such as mobility tablets to improve the productivity of their safety professionals.

## Overview of Safety Systems

The PCL Safety Management Center (SMC) is a data-gathering and reporting system that is designed to

- Reduce the time spent creating safety reports
- Improve the accuracy of safety statistics
- Provide safety trend analysis data and graphs
- Enable accurate review of safety data and trends

The PCL SMC is used to collect HSE information on

- Behavioral Safety Observations
- Pre-Job Safety Instructions
- Audits of Pre-Job Safety Instructions
- Incidents (Recordable Injuries, First Aids, Near Misses, and Property Damage)
- HSE Inspections
- Field Safety Meetings
- District Safety Committee Meetings
- Project Safety Committee Meetings
- Subcontractor Hours
- Monthly Safe Action Plans

From these elements we are able to develop trends from inspections and incidents: incident causes, incident types, body parts injured, and a variety of other parameters, including updating of OSHA Logs. However, as valuable as the system is, the current process to input information can be cumbersome. For instance, when completing an inspection, our requirement is to fill out the printed form contained in the manual while the inspection is completed in the field. But to enter

the information in the SMC, in the past we had to sit at a computer in an office. This duplicates the effort required to complete the inspection.

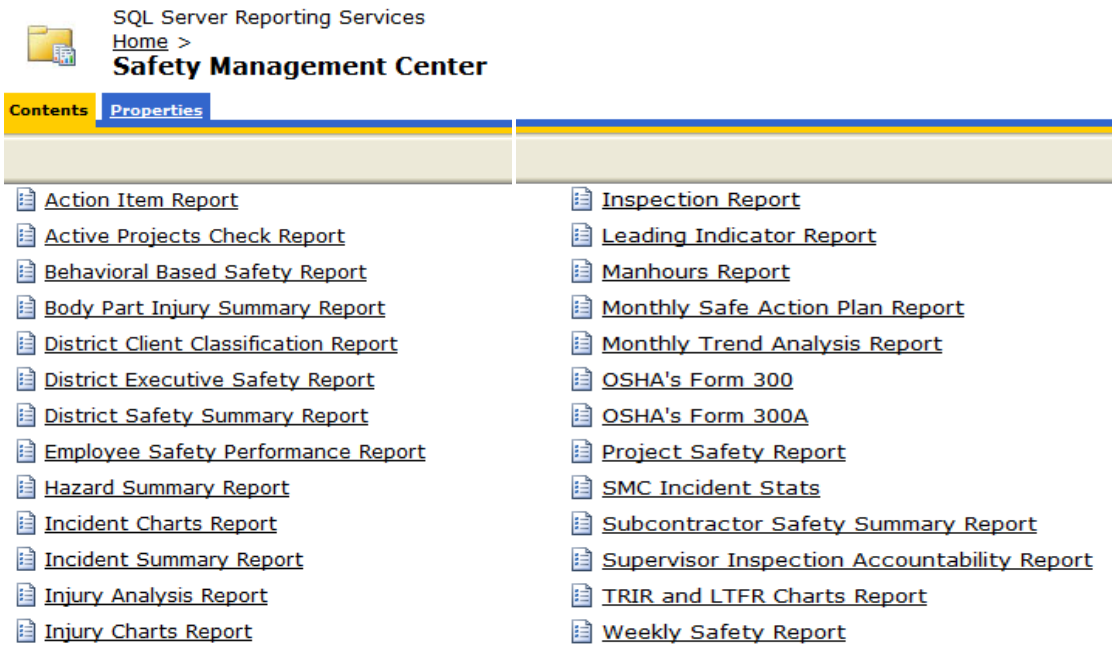



**Exhibit 1: The PCL SMC report menu displays the various report selections.**

## PCL SMC Evolution

Considerable research and trial and error were involved in the original development of the SMC in 2005. The system was entirely developed within PCL by the Corporate HSE and Information Technology departments. At that time, computer use was widespread even on the smallest construction projects and of course, there were no iPads to enable mobility on a project. The forms in the SMC were modeled after those in our HSE manual, and Infopath™ was used for the inspection and incident investigation forms. Reliance on Infopath necessitates that PCL maintain Windows SharePoint Services 3.0, which enables us to publish form templates that we design. InfoPath Forms Services allows storage and management of forms and form templates in the SMC. The InfoPath Forms Services technology is available in the Microsoft Office SharePoint Server 2007 Enterprise CAL and also, separately, in Microsoft Office Forms Server 2007.

Since 2005, many additional forms and capabilities have been added to the SMC. Continual modifications have enabled ever more reports, as shown in Exhibit 1. But to enable use of mobility tablets, completely different systems are to be used, thus the massive effort to redesign the system. Users with access to a web browser do not need to have InfoPath installed on their computer to fill out a web form. All they need is access to a browser, which greatly simplifies the system and allows others who are granted access, such as subcontractors and joint venture partners, to access project data. Windows 8 and iPad users can use the web forms if there is Internet connection. To be able to run offline, they would have to use the Windows 8 or iPad SMC App.

A common question asked by persons outside PCL is "Why didn't you simply buy off-the-shelf applications?" Our information technology department has responded by explaining that the complexity of our forms caused the development of unique applications. If PCL had been willing to modify our forms to a simple format and adopt those that were off-the-shelf, the time to develop the applications for the mobility tablet would have been abbreviated and the costs of the conversion much lower. Companies that are willing to use off-the-shelf forms will save time and money in developing their mobility tablet applications.

## Development of the SMC for the Mobility Tablet

The project to develop a PCL mobility tablet for HSE was initiated in December 2011. The first step was the publication of a business requirements document. This was authored by business analysts and safety professionals who dictated the features of the software; details were refined by the information technologists in PCL who were already familiar with the SMC. Every specification and capability for the mobility tablet was mandated in this road map and the information technology specialists knew each area on every form that required entries.

The charter was to move from Infopath that requires Microsoft Office to web-based forms, in part to enable PCL's trade contractors and joint venture partners to access our system. Anyone who can access the Internet with a web browser that supports HTML 5 and CSS 5 can use the SMC and access data for their project or, if granted approval, for an entire district or the corporation. Since the system is built for the web, we can use any device: Windows 8 or iPad.

User requirements were continually updated during the development process. Several projects and HSE professionals were selected to conduct beta testing of the tablets. With training by an information technology and an HSE professional, they quickly learned how to enter data in the applications developed by our in-house information technology professionals. However, there were some difficulties:

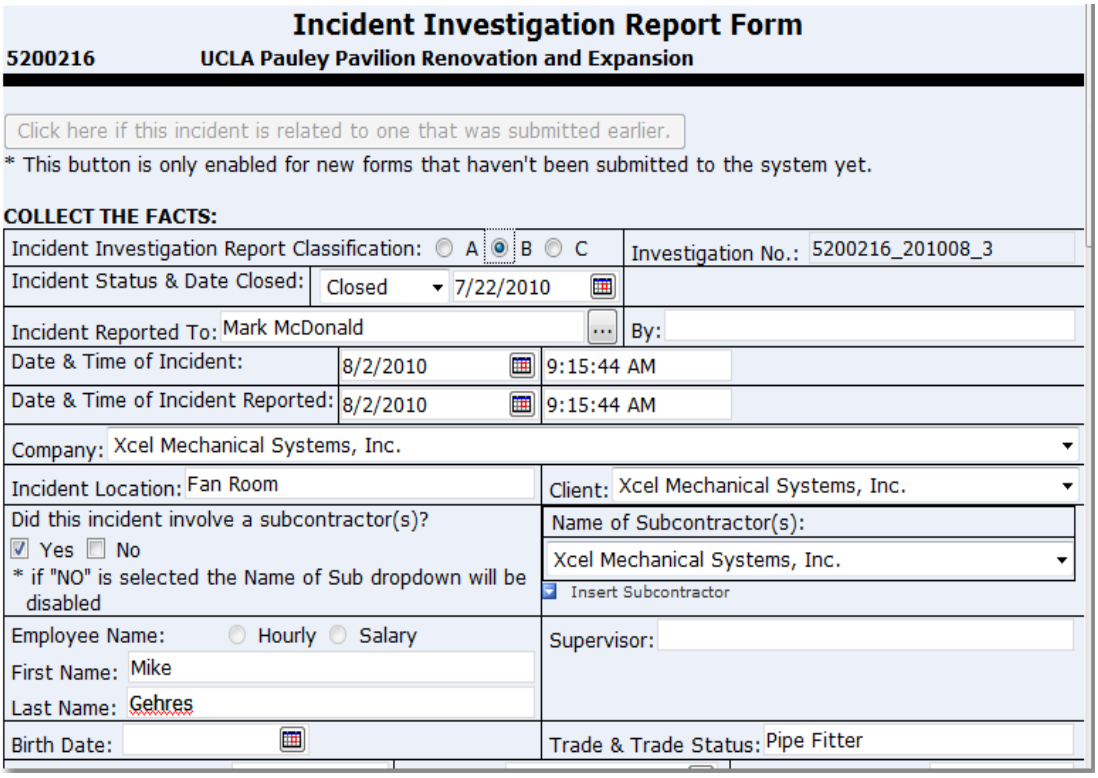
- To help control costs, overseas technical assistance was contracted; but over a three-month period, the help proved to be incapable of fulfilling the specifications. This slowed the development.
- Further delays were encountered because the developers found that one of the systems, Windows 8, was not ready for full implementation and could not be fully utilized because Samsung stopped shipment of their tablets. However, development for Windows 8 continued because some PCL districts rely solely on that system.
- Some design features, such as the menus and overall appearance of the applications, required improvement.
- The developers elected to establish forensic nets.

## Benefits of a Mobility Tablet

One of the primary benefits is the timeliness of data availability because data is entered and downloaded into the SMC. Manual data entries were often delayed because the personnel needed to enter the data have many other responsibilities on a construction project. And further, the current Infopath system employed in SMC is sometimes slow and frustrating as persons entering SMC data are forced to wait for entries and reports to generate.

Since inspection and investigation information are completed on a mobility tablet in the field and then downloaded to the SMC in real time or upon return to the safety office where connectivity is available, the information is instantly available for trending. This enables timely use of the information in safety committee and field safety meetings. Trends from a week before can be presented, which was not possible when stacks of behavioral safety observation cards and inspection reports were waiting for an administrative specialist to enter them into the SMC.

Incident investigations are completed in a more efficient manner when mobility tablets are employed. Witnesses can be interviewed in the field and recorded, and technical documents checked in the field. The capability to take pictures and download them immediately to the draft report, employ voice-to-text and complete the complex SMC incident report online in the field saves time and speeds the investigation.



**Incident Investigation Report Form**

5200216 UCLA Pauley Pavilion Renovation and Expansion

Click here if this incident is related to one that was submitted earlier.

* This button is only enabled for new forms that haven't been submitted to the system yet.

**COLLECT THE FACTS:**

| | | | |
|---|---|---|---|
| Incident Investigation Report Classification: A B C | | Investigation No.: | 5200216_201008_3 |
| Incident Status & Date Closed: | Closed 7/22/2010 | | |
| Incident Reported To: | Mark McDonald | By: | |
| Date & Time of Incident: | 8/2/2010 | 9:15:44 AM | |
| Date & Time of Incident Reported: | 8/2/2010 | 9:15:44 AM | |
| Company: | Xcel Mechanical Systems, Inc. | | |
| Incident Location: | Fan Room | Client: | Xcel Mechanical Systems, Inc. |
| Did this incident involve a subcontractor(s)? Yes No * if "NO" is selected the Name of Sub dropdown will be disabled | | Name of Subcontractor(s): Xcel Mechanical Systems, Inc. Insert Subcontractor | |
| Employee Name: Hourly Salary First Name: Mike Last Name: Gehres | | Supervisor: | |
| Birth Date: | | Trade & Trade Status: | Pipe Fitter |

**Exhibit 2: This is a portion of the PCL SMC incident investigation form.**

The PCL HSE inspection reports have options for entering 525 hazards into the SMC. This greatly enhances the accuracy of trend analysis, but it makes data entry more difficult and time consuming. In the field, the mobility tablet contains listings of those hazards as well as OSHA standards and PCL HSE manual requirements for reference as the inspection is ongoing. This is valuable when explaining requirements to workers, supervisors, and managers. Further, digital pictures of deficiencies and noteworthy aspects can be taken and immediately downloaded to the report. A significant advantage is that the inspection can be immediately downloaded to the SMC, and the persons responsible for corrective actions and senior project, district and

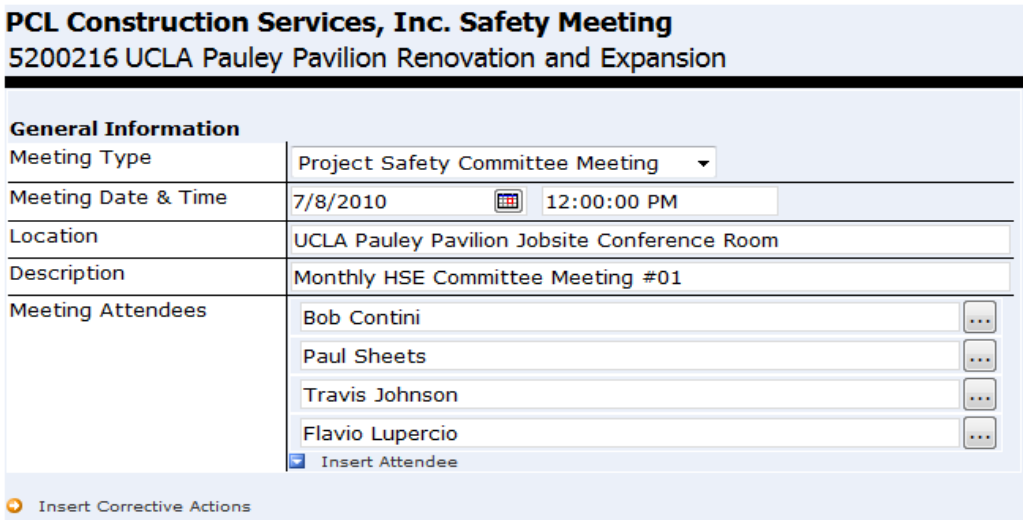
corporate officials are instantaneously notified via e-mail. This is very important when a serious hazard is detected and requires immediate attention.


**Exhibit 3: While in the field, inspectors can select the active hazard categories.**

An additional application is the compilation of Behavioral Observation data. Behavioral Safety Observations are completed by trained observers who check out a mobility tablet and record the observation as it is being accomplished. Checklist blocks are marked and comments entered as appropriate. As with the incident investigations, voice-to-text can be used to minimize the need to write notes; however, the mobility tablet can convert writing to printed entries on the form. During the observation, we discourage the observer from making tablet entries, not only because he could be distracted from making a good observation and being exposed to a hazard, but because of the impression that is evident to the person or persons being observed.

Yet another application that is contained on the mobility tablet is documentation of safety meetings. District HSE, Project HSE, and special HSE committee meetings, as well as each weekly project HSE meeting, are documented in the SMC and shown in Exhibit 4 on the next page.

Names of attendees, meeting dates, persons conducting the meeting, meeting content, and project locations are recorded. This mobility tablet application can be used in the field as the meeting is conducted, thus the safety professional need not return to the office. Once submitted, the meeting data is recorded in the SMC and is available to all on the project, in the district and at the corporate HSE office. Project officials can easily assess the attendance at HSE meetings and follow up to make sure that regulatory compliance is achieved. This is especially useful during corporate audits.



**PCL Construction Services, Inc. Safety Meeting**
5200216 UCLA Pauley Pavilion Renovation and Expansion

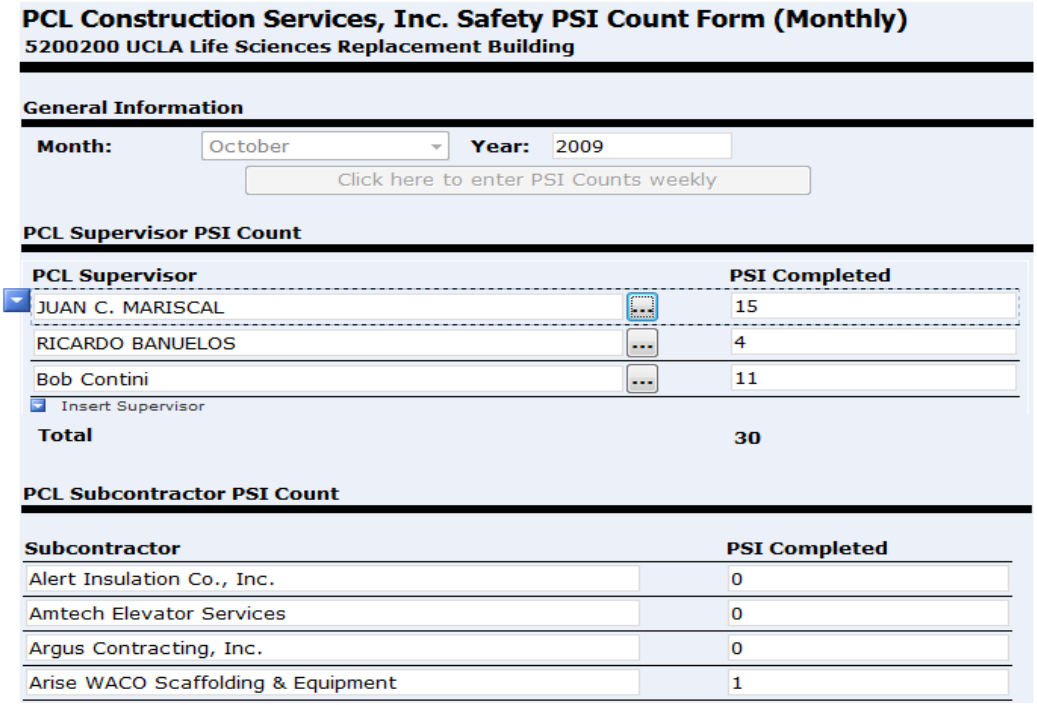
**General Information**

| | |
|---|---|
| Meeting Type | Project Safety Committee Meeting |
| Meeting Date & Time | 7/8/2010 12:00:00 PM |
| Location | UCLA Pauley Pavilion Jobsite Conference Room |
| Description | Monthly HSE Committee Meeting #01 |
| Meeting Attendees | Bob Contini<br>Paul Sheets<br>Travis Johnson<br>Flavio Lupercio<br>Insert Attendee |

Insert Corrective Actions

**Exhibit 4: The HSE committee meeting attendance and description are recorded.**

The last application of the SMC mobility tablet in this paper is the method used to document the accomplishment and measurement of Pre-Task Safety Instructions (PSIs).



**PCL Construction Services, Inc. Safety PSI Count Form (Monthly)**
**5200200 UCLA Life Sciences Replacement Building**

**General Information**

**Month:** October **Year:** 2009

Click here to enter PSI Counts weekly

**PCL Supervisor PSI Count**

| PCL Supervisor | PSI Completed |
|---|---|
| JUAN C. MARISCAL | 15 |
| RICARDO BANUELOS | 4 |
| Bob Contini | 11 |
| Insert Supervisor | |
| **Total** | **30** |

**PCL Subcontractor PSI Count**

| Subcontractor | PSI Completed |
|---|---|
| Alert Insulation Co., Inc. | 0 |
| Amtech Elevator Services | 0 |
| Argus Contracting, Inc. | 0 |
| Arise WACO Scaffolding & Equipment | 1 |

**Exhibit 5: Records of PCL SMC PSI counts and audits are maintained.**

Assessment of the number of PSIs completed on a project is important to determine compliance with the PSI system. It is particularly crucial that if subcontractors are participating.

As with other systems, anyone from the district or the corporate office can access a report showing the status of PSI use and audits on any project.

## Negative Aspects of Mobility Tablet Use

Although there are many advantages to the use of mobility tablets as opposed to desktop computers, there are a few negative aspects that must be identified:

- When using a mobility tablet in the field, the supervisor or HSE professional is distracted and could be at risk from nearby construction operations.
- There is some evidence that SMC entries are more expeditious on a desktop computer.
- Tablets and applications add cost to the project.
- The perception among craft workers upon seeing supervisors and HSE professionals using a tablet in the field could be negative.
- Training is required.

## Mobility Tablet Training

Face-to-face training is conducted in PCL on each site to ensure that users understand the functions of the tablet and the various applications. A two-person team comprising an information technologist and an HSE professional was involved in the development of the business requirements document and the applications conduct training on each site. The training is planned for two days, with classroom and onsite portions supported by power point presentations.

In another vein, the mobility tablet can be used to do short training sessions for a small group of craft workers. For instance, if minor deficiencies are observed in the conduct of a confined space entry, the mobility tablet can be used to show a brief training segment on proper air monitoring techniques.

## Summary

Although more experience with the mobility tablet is needed before any quantitative assessment of increased efficiency can be made, there is already evidence that during beta testing, safety professionals are able to devote far more time to field activities than when reliance on desktop computers was the norm. HSE supervisors in the beta test also report that they have considerably more contact with craft workers and that the applications, especially the incident investigation module, help to ensure a much more comprehensive and expeditious report. As the applications mature, all construction supervisors who have an iPad or Windows 8 tablet will have access to the software for HSE inspections. The forecast is for every supervisor above foreman level to have a mobility tablet.

## Bibliography


The Construction Industry Institute Zero Accidents Task Force, "Safety Plus: Making Zero Accidents A Reality," Publication RS160-1, 2002.

"Mobility Matters in Construction." CONSTRUCTECH Magazine, August 2, 2011.

"The Galaxy Tab for Construction." CONSTRUCTECH Magazine, July 28, 2011.

Lofgren, Alexander. "Mobility in-site: Implementing mobile computing in a construction enterprise," Project Communication, Department of Industrial Economics and Management (INDEK), School of Industrial Engineering and Management, Royal Institute of Technology, Stockholm, Sweden, 2006.

Tech Crunch. 2012. *How Tablets Will Transform Construction (retrieved January 29, 2013.*

Van Hampton, Tudor. "Tablets Take Off in Construction," Engineering News Record, September 12, 2011.

Delude, Galina, PCL Business Systems Analyst. Personal interview, January 31, 2013.

Phungtham, Somsong, PCL Systems Analyst. Personal interview, January 31, 2013.

Zimmerman, Jeremy, PCL HSE Manager. Personal interview, January 30, 2013.