Integration of Digital Forms for Improved Safety Tracking and Quality Control: A Case Study

Andrew Cisterman
California Polytechnic State University
San Luis Obispo, California

The integration of new technology into the construction industry is commonly practiced in an attempt to improve standards and quality. iAuditor is an inspection checklist app which provides clients with the tools to build custom and dynamic forms to fit the needs of its client base. This paper examines the effectiveness of integrating this new software and observe the difficulties of integrating such new practices into a company's safety and quality control programs. Additionally, this paper evaluates ways the aforementioned software could be improved to better meet the needs of its users as well as assess ways it could be better utilized by companies. In addition to an extensive literature review, research was conducted through a series of interviews with the initiator of this change in practice, the head of safety, and a pilot group of personnel who use the new program on a daily basis on a job site using exclusively paperless forms created through iAuditor. The conversion to paperless forms was found to have numerous benefits in the case of this company; improving safety, quality, productivity, and efficiency.

Keywords: Paperless Documents, Safety Tracking, Quality Control, Behavior-Based Safety, Safety Culture

Introduction

This paper is a case study observing the integration process of the iAuditor system into the safety program of a construction company and explore its potential application to the company's quality control program. Additionally, this case study will examine ways the use of iAuditor improves overall safety, quality, productivity, and efficiency with its various features and paperless format.

iAuditor is an inspection application made by creators SafetyCulture, is used in over 80 countries, and has been used for more than 50 million inspections. iAuditor gives its users the capability to build inspection forms in a matter of minutes by using their prebuilt checklists, converting your existing checklists, or creating brand new ones. Through the use of various field types and advanced conditional logic, iAuditor provides its users with all of the tools needed to build any form desired (IAuditor).

In combination with the web platform, iAuditor provides insight to help raise safety and quality standards by collecting consistent data, standardizing operations, sending reports. The program produces key metrics and tracks performance, uncovering areas for improvement. iAuditor can produce reports at set intervals and log historical reports that can easily be accessed any time (IAuditor).

iAuditor also provides users with the ability to share documents and inspection reports quickly through email and other third-party programs and has the capability to automatically upload documents to document organization apps like Box and Google Drive (IAuditor).

This paper will study a specific case, observing the integration of iAuditor into the safety program of Cahill Contractors LLC, a general contractor operating in the San Francisco Bay Area, hereafter referred to as The Company. The Company has been using iAuditor for one year and is hoping to roll out iAuditor across the company in the future. At the moment, iAuditor is being used on all sites to perform what the company refers to as "near-

miss" reports. These near-miss reports are generated by The Company's project management teams to stand back and observe jobsite operation and log potentially dangerous behaviors that could lead to injury. Some examples of near-misses that are recorded would be things such as uncapped rebar, potential fall hazards, obstructions to path of travel etc.

In addition to near-miss reports, The Company has selected a project, Camino 23, to pilot its use for all safety documents, inspections, and checklists. With the Camino 23 project, the company hopes to observe positive improvements as a result of the accessibility and organization the iAuditor app provides with its paperless format.

Research was conducted through an interview with the individuals who lead the company's initiative to utilize technology to improve the safety culture of the company. Those individuals being Senior Project Manager, Jason Sommers, and Senior Safety Engineer, Steve Archuleta. This interview hoped to understand the motivation to review the company's safety program, understand the criteria used to select a new technology, and the goals they hoped to achieve with the integration of this new technology. A second interview was conducted with Superintendent, Casey Hudson, and Assistant Superintendent, John Daly, on the Camino 23 project piloting the iAuditor application, to see if the goals set by Sommers and Archuleta were being met. In addition to observing the positive aspects brought on by a revision of the company's safety program, another objective of this study is to observe some of the difficulties of integrating a new technology into the culture of a company. Furthermore, a literature review was performed to understand the history of safety in construction and understand some of the ways companies in the industry are attempting to improve safety culture, as well as ways paperless documents are improving standards in the construction industry.

Construction Safety

The construction industry is well-known for the dangers associated with the work. According to the Bureau of Labor Statistics the rate of injury and illness cases in 2017 was 3.1 recordable cases per 100 workers and 1013 fatalities were recorded (Industries). The work by nature is dangerous. The Occupational Safety and Health Administration (OSHA) categorizes injuries and safety violation into several categories. Of the 4,674 worker fatalities in private industry in the calendar year 2017, 971 or 20.7% were in construction (Commonly). Of the 971 total deaths recorded in the construction industry in 2017, 59.9% can be attributed to what OSHA refers to as "Fatal Four." The Fatal Four are the leading causes of private sector worker deaths, including falls, struck by object, electrocution, and caught in/between accidents (Commonly). Eliminating the Fatal Four would save approximately 582 workers' lives every year (Commonly).

The construction industry has come a long way in terms of the improvements that have been made to the safety of workers. From historical data held by the Bureau of Labor Statistics, the construction industry reported 14.3 injury and illness cases per every 100 workers in 1989. Safety standards improve as a result of increased regulation, integration of technology, awareness, and a combine effort made by industry members to be better. By changing the habits of people, their attitudes about safety will follow, especially as their collogues adopt better safety habits (Choudhry 2014). When groups of people with similar habits and attitudes about safety form, we begin to talk about people having a common safety culture. To talk about changing safety culture, we must talk about changing the behaviors of the people within that culture (Choudry 2014).

Behavior-Based Safety

Behavior-based safety management is the systematic application of psychological research on human behavior to the problems of safety. Reducing accidents and improving safety in construction can be achieved by systematically focusing upon unsafe behaviors and learning to recognize the triggers of those behaviors as a means of preventing them. Some of these triggers include pressure to get the job done quickly, pressure to meet excessive production targets, competing priorities, tight construction schedules, lack of training, and lack of availability to adequate equipment or materials. Other triggers are often in the control of front-line management and or employees such as poor housekeeping and the improper use or application of personal protective equipment (PPE) (Choudry 2014).

Movement Towards a Paperless Industry

Though prime contractors are primarily not responsible for the physical completion of work on a project, they are responsible for the safety of the numerous subcontractors and workers who are. The means and methods by which prime contractors choose to regulate and improve safety vary across companies. Whatever the method of choice is, it can only work optimally if used throughout an organization (Coddington 2012). Getting employees to "buy-in" to a new program or culture change is not always an easy process and can be met with resistance. Some workers can be very enthusiastic about changes and others may not be comfortable with proposed change (Depasquale 2013).

With more and more available technologies like computers, tablets, and smartphones, the construction industry is eliminating the need for many paper documents. Bulky paper plans are being replaced by digital sets that make revisions and collaboration a quick and efficient process. A trend towards construction becoming a fully paperless industry is being observed. Though the process may be slow and still gaining ground, the movement away from construction being a paper dependent industry is beginning to show its many benefits.

Research Methodology

This paper documents data collected through several interviews and research conducted to analyze the effectiveness of the iAuditor program in the case of this company. The phases of research conducted are as follows:
- Phase I – Interview with Senior Project Manager, Jason Sommers, and Senior Safety Engineer, Steve Archuleta
- Phase II – Interview with Camino 23 Project Team Superintendent, Casey Hudson, and Assistant Superintendent, John Daly

Phase I

The first phase of research conducted was a phone interview conducted on 5/3/2019 in a semi-structured format with two interviewees, Senior Project Manager, Jason Sommers, and Senior Safety Engineer, Steve Archuleta. These two individuals were instrumental in the initiation of the changes that resulted in the integration of the iAuditor application into the company's safety culture. The goal of this interview was to understand the motivations to review the system that was in place and the goals hoped to be achieved by the integration of a new system. Additionally, this interview hoped to understand the criteria that was used to select a new program and the currently held thoughts on the integration process thus far.

Phase II

The second phase of research conducted was a second phone interview conducted on 5/23/2019 in a semi-structured format with some of the project management team on the Camino 23 Project. The interviewees included Superintendent, Casey Hudson, and Assistant Superintendent, John Daly. The Camino 23 project has acted as a pilot group for the company, being the first project to use the iAuditor application for all safety reports and inspection checklists. Their opinions on the integration of iAuditor were vital to understanding if the initial goals set by Sommer and Archuleta were being met and comprehending the success of the integration process by the individuals using the iAuditor application.

Research Results

Phase I

This section of this paper will show the questions asked and the following responses provided by the interviewees, Jason Sommers and Steve Archuleta, who lead the company's initiative to utilize technology to improve the safety culture. The interview was conducted on 5/3/2019, in a semi-structured format. The following responses do not represent the exact words used by the interviewees in their response, but rather capture the main ideas of their responses. The questions and their associated responses are as follows:

What prompted you to review your safety program?

Sommers was frustrated with the tedious time-consuming processes of the safety program. Instead of focusing energy on improving jobsite safety and awareness, much of their time was spent on safety documentation. One of their company values is continual improvement so he and Archuleta examined the existing safety procedures for documentation, inspection, and checklists. The process to print, populate, scan, and file completed forms was outdated and didn't utilize technology. A main objective they hoped to accomplish was to find a software to help improve efficiencies, streamline operations, and allow the team to focus more on jobsite safety rather than paperwork. By making safety processes more convenient for individuals, both Sommers and Archuleta hoped to see overall safety awareness improved on jobsites. They acknowledged that changing a safety culture in a company can be challenging, and a slow process, but the investment would improve safety, quality, and productivity.

What criteria did you use to select the software application?

The criteria they prioritized for selecting the software was ease of use and user interface, form flexibility, backend data collection, and cost. Once selected, the new software would be used to convert all safety forms and checklists from the company's safety manual, their IIPP (Injury & Illness Prevention Plan), to a digital format. The platform needed to be simple enough for all employees, including technology challenged Craft Foreman and Superintendents, to use on a tablet or smart phone, but also thorough enough to capture the same information documented on the existing paper safety forms. Flexibility with digital form creation was critical to allow technology implantation without impacting the basis of the safety program. Another important feature was automatic storage and retention of documentation, which would greatly streamline the existing procedure. Additionally, they wanted the software to produce easy to read, organized, and sortable backend data, which would identify safety trends and help improve the safety program. And, as with any business decision, cost is a driving factor and making sure the value is worth the investment.

How did the selected software (iAuditor) meet your expectations?

iAuditor met all of criteria set forth by their selection committee. Through the use of customizable forms, incorporating conditional "if-then" logic, dynamic fields, and various question and checklist formats, the conversion process from paper to digital forms was seamless. The digital forms functioned as well as the paper forms with some added functionality as a result of the conditional logic and dynamic field options. iAuditor's ability to automatically upload completed forms to Box, and instantly share reports via email through the app saves time and is more organized than the traditional method of scanning and filing paper documents. The sorting and organization provided by the automatic-upload process makes accessing historical documents much easier and a quicker process. The data output and analytics on the backend allows users and administrators to view performance and trends. This feature as well as automatically generated reports make identifying areas for improvement easy.

In addition to meeting all of the criteria set prior to its selection, iAuditor proved to exceed expectations in the customer service department. The iAuditor developers are constantly working to improve their software to meet the needs of its clients and are available to answer questions and assist in any way they can.

How did the selected software (iAuditor) fall short of your expectations?

The subscription method for the software is a short-term annual contract based on a pay by user model. After using the software for a year and getting everyone used to using the platform, the software increased its monthly user rate 66% ($15→$25/user/month). It's still a very economical option for a company their size, but they were left with little leverage or ability to negotiate better terms.

How could your company better apply the software?

iAuditor is currently only being used for safety, but they hope to explore its potential application to the company's quality control program. Pending its anticipative success as its in its trial period, they hope to roll out the iAuditor app company wide, then eventually get subcontractors using it, possibly writing its use into their subcontracts.

What resistance have you met that has made the integration of the software (iAuditor) difficult?

They acknowledged that the construction industry in general is resistant to change. Some more traditional industry personnel may be hesitant to the continued integration of technology into the industry. Sommers and Archuleta both agreed that they experienced difficultly getting users of iAuditor to be diligent in their population of the forms. They referred to this problem as "check-the-box safety" as some users may be checking off the boxes quickly in an attempt to complete the task quickly rather than considering the importance of the task at hand. The roll-out process is still in the beginning stages, but Sommers anticipates some initial resistance by subcontractors when writing the use of iAuditor into their contracts but hopes it becomes common practice and that subcontractors will realize the benefits.

Phase II

This section of this paper will show the question asked and the following response provided by the interviewees, Casey Hudson and John Daly. The interview was conducted on 5/23/2019 by phone in a semi-structured format. Below are the questions asked and the responses. The responses shown here capture the main ideas of the interviewees' responses in a summarized format. The following responses do not represent the exact phrasing of the interviewees.

How long has your project team been using iAuditor?

Hudson and Daly explained that their project team has been using the iAuditor app since the beginning of the project in September. The project itself is a 37-unit affordable housing project that broke ground in July.

How is iAuditor used on your project?

iAuditor is actively being used on the Camino 23 project for all safety forms and checklists such as Job Hazard Analysis (JHA) forms, inspections such as pre-work scaffold safety inspections, hot work permits and nearly 50 other forms. In addition to safety forms iAuditor is used to track and log jobsite safety orientations of new workers on sight. Hudson and Daly explained how their site was unique in how heavily they rely on iAuditor in comparison to other projects who use it exclusively for "near-miss reporting."

Who uses iAuditor on your project?

iAuditor is installed on the tablets and phones of the whole project team. It is used by the Project Executive, Project Manager, Project Engineer, and by Hudson and Daly who are Superintendent and Assistant Superintendent respectively. In addition to the project team who have access to iAuditor on their devices, often times subcontractors' workers will borrow devices to fill out reports in the field if needed.

Is iAuditor meeting the objectives of (1) streamlining procedures by eliminating tedious paperwork and (2) improving safety?

Hudson and Daly both verify that the use of iAuditor greatly improves the efficiency of the jobsite and streamlines operations saving mass amounts of time. Being able to address issues in the field with the devices rather than walk back to the job trailer, print out a form, fill it out, scan, then file it is a much more efficient process. Additionally, the ease of this process in comparison to the old process makes workers on site less inclined to take shortcuts. Hudson

used the completion of hot work permits as an example saying workers are more inclined to take time to fill one out if they can request it in the field and fill out the work permit in seconds. Both Hudson and Daly also commented that the act of scrolling through the list of forms while searching for others acts as constant reminds of some forms they may otherwise neglect. In conclusion, Hudson and Daly both agree that iAuditor is meeting and exceeding the goals set by Sommers and strongly endorse its use on future projects.

Do users of iAuditor view using the application as a burden in anyway?

iAuditor has been well received by most who use it on the project team. They added that some of the forms could be improved to function better, but this was more of a user error than a programming flaw on the iAuditor developers end of business.

What ways could iAuditor be improved to better fit the needs of your team?

Both interviewees agreed that the format in which the jobsite orientation form was set up was difficult to use in group settings, but this can be attributed to user error in the form creation process rather than a design flaw in the iAuditor programming. Another improvement that could be made is to the Job Site Safety Walk form. Hudson and Daly explained how the criteria used to evaluate overall jobsite safety rates the categories in a "pass-fail" manor that isn't reflective of the actual safety of the jobsite, skewing backend data output. Together, we came to the conclusion that a scoring in a scaled format rather than a "pass-fail" manor would be more reflective and provide better information.

Do you think iAuditor would be beneficial to integrate into your company's quality control program?

Both Hudson and Daly agreed that the current application being used for quality control, PlanGrid, worked well. PlanGrid's ability to markup sets of plans that can be seen by all parties on the job makes it invaluable. They didn't see any ways that iAuditor would be superior to PlanGrid.

Conclusions and Future Research

The integration of new technology aiming to change a company's culture is a process that takes time to observe its effectiveness. This case study observed the beginning stages of this process with Cahill Contractors LLC from the point of its first conception into its trial period. Though this study was unable to see through the full integration process, having the opportunity to observe some of the initial successes and challenges will provide the industry with the knowledge of what can be expected with similar integrations in the future.

Understanding the goals set by the initiators of the revision to the company's safety program was critical to assessing the current effectiveness of the integration process. Sommers and Archuleta provided valuable insight into ways future industry personnel can assess the need for new technologies and ways to select programs that cater to the needs of one's company. In this case, it was observed that in addition to improving overall safety, improved efficiency was a motivator in the search for improvement and was a key factor that was considered in the selection of iAuditor. The features of iAuditor aligned with the goals set by Sommers and Archuleta and the paperless format proved to show numerous benefits over the traditional paper-based process. The Camino 23 project team confirmed iAuditor's success, proving that it functioned well in the field and produced the benefits Sommers and Archuleta had hoped. Though iAuditor's future application to the company's quality control program was found to be insignificant at this point in time for the company, with the continued progression and improvement of the iAuditor application it may one day be an integral part of the company's program.

The discoveries made through this case study would not have been made possible without the continued cooperation of the Cahill Contractors team. The insights provided by Sommers, Archuleta, Hudson, and Daly, will prove to further improve the safety culture within the construction industry and create a safer working environment for the hard workers of the construction industry.

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