A Case Study for Improving Construction Project Management

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Every construction project generates an enormous amount of data. The need to be more competitive and to gain better control over construction processes is driving some organizations to change the conventional paper format and consider innovative ways to circulate information. Achieving a paperless environment on construction sites has been an elusive goal of construction managers for the past several years. By implementing digital document management softwares, construction companies can make information more easily accessible from anywhere, fueling faster project completion and a better flow of information. This paper presents Gilbane Building Company's approach for creating paperless processes for construction projects. They were able to achieve their goals, by taking advantage of true mobility in the field which has rapidly evolved to tablets and iPads loaded with drawings sets stored in the cloud. PDF and cloud storage have been combined together to create a viable way for the designer and field workers to view project content and collaborate in ways never seen before. The benefits of eliminating papers are multiple: reduced costs, streamlined communications and decision-making, and enhanced teamwork. Not to mention, it gives instant access to project updates among all constituents and eliminate waste that comes from information silos.

Keywords: Paperless Jobsite, Electronic Document Management, Project Management

Introduction

The construction industry is fragmented due to the many stakeholders and phases involved in construction projects. This has led to problems related to communication and information processing that created adversarial relationships between the different parties involved in a project (Ghanem, 2007). One of the most common complaints from construction managers is the difficulty in requesting information or relaying information to every member of the construction team (Ruikar et al. 2007). Current project management practices are often isolated and concerned with managing problems related to individual stages of the projects. As a result, problems of reworking occur due to conflicting information and information not received in time to the parties concerned (Fewings, 2005).

Lack of standard processes for project management is a weakness of the traditional management manner. Projects are normally managed according to the experience of the project managers who are specifically appointed for this task. Each project manager, even within the same organization, prefers to follow his or her own experience, which has been developed over a long period of time. These practices lead to large variations in management practices and thus can create a significant impact on the capability of coordinating and controlling project information (Alshawi & Ingirige, 2003).

Construction project management best practices require certain documents to be generated and updated regularly throughout the project. These documents mainly include request for information (RFIs), request for proposal (RFP)/request for quotations (RFQs), schedule, budget, and estimates. Software developers and practitioners within the construction industry have realized the achieved benefits by the means of electronic communication and storage

to help project management best practices accomplish their goals. Declining costs of end-user computing and network communication have further fueled the development of such technologies.
As building projects become more complex with shorter schedules, driven by more dramatic building forms, new project delivery standards, and regulatory restrictions, different team participants diversify into areas of special expertise to deliver the end product. This diversification in turn requires communication, collaboration, and coordination between the different trades to facilitate the network between different parties involved in the construction project (Nuntasunti et al. 2006).

Background

Traditionally, all documents have been printed on paper but it has been changing. The current situation in the construction industry is that a mixture of different generation methods is used to manage documents. A lot of the documents today are still transferred by printing them out and sending them to the other parties by mail or couriers. A slightly more sophisticated method is that documents are both produced digitally and transferred digitally as email attachments. This speeds up the document transfer, but in terms of document management, this hardly offers any improvement over the current situation since finding a document in another person's personal computer may be even more difficult than on his/her shelves (Vileneuve and Robinson 2003). Construction project management requires effective collaboration and coordination among all the stakeholders which is believed to be crucial for a successful project. As many researchers have mentioned, the traditional project management have not fulfilled project duties so that a better management manner need to be developed. In terms of project team organizations are geographically separated and project team structures are becoming increasingly complex, the use of web-based management can provide more effective communication (Yang et al. 2007).

Finding a way for owners, architects, engineers, consultants, contractors, and subcontractors to communicate, interact, and share information is the best way to reduce the inherent risks associated with complex construction projects (Weippert et al. 2003). To speed ideas to reality, project teams need collaborative technology that enables anytime, anywhere access to accurate, reliable project information, and participants need to follow standardized processes that maximize their efficiency and productivity (Lam and Chang 2002). Below is a brief description of some of the software systems Gilbane Building Company decided to adopt on their way to paperless jobsite.

Software Options

iBuild

Gilbane developed a fully web-based project management application that offers modules that pertain to construction administration activities. iBuild offers numerous modules, however, submittals, RFI's, Daily Reports, and Meeting Minutes are most commonly used on the jobsites. Each module has workflow associated with it that has been tailored to the company's processes, yet it is also customizable (Figure 1). Project data can be communicated through one global, web-based secure platform enabling all users to see activity reports, action items, issues, dates and pertinent job information on one screen. With customizable dashboards, users are able to see only the information they want to see (Figure 2). iBuild also provides total transparency of items to the entire project team which means everyone can see which individual is responsible for taking action. With iBuild, project teams have been able to provide many of their daily tasks electronically leading to jobsite efficiency and time savings.
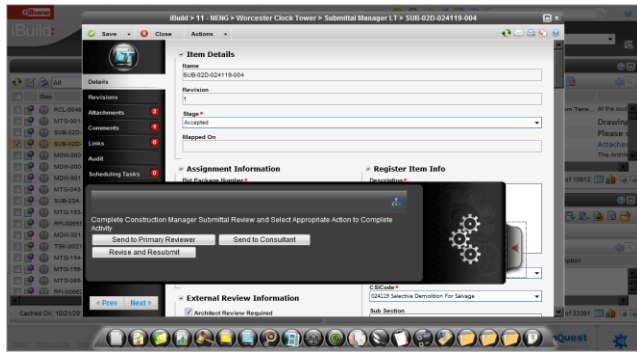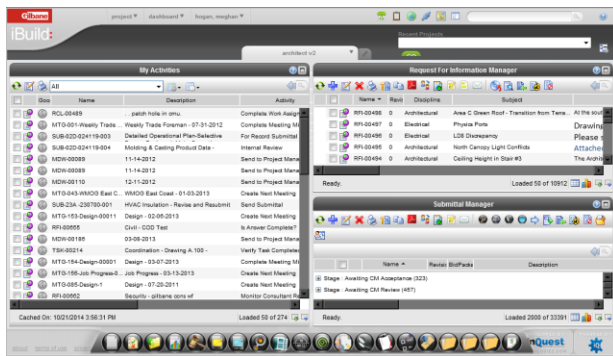
Figure 1: Sample of iBuild workflow options

Figure 2: Sample of typical dashboard view

Bluebeam

Bluebeam has become a widely used tool throughout the construction and design industry. Construction managers, architects, engineers, and trade contractors are benefiting from the different options offered to them. The functions it provides are not limited only to marking up PDF's. Bluebeam can also be used to electronically manage and share contract documents, share other project-related documents such as photos and schedules, perform quantity take-offs, compare drawings, as well as many other features (Figure 3).
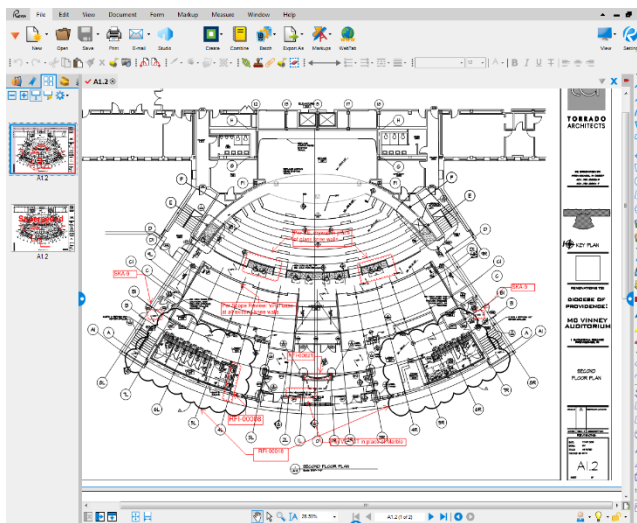

Figure 3: A posted drawing in Bluebeam

Figure 4: BIM 360 Field report sample

BIM 360

BIM 360 Field is a cloud-based mobile application which enhances quality in construction, equipment and systems tracking, and startup and commissioning. This software is used in the field for inspections, checklists, rolling completion lists, punchlists, equipment tracking and turnover documentation. BIM 360 Field eliminates the need for paper on the jobsite while increasing efficiency and collaboration (Figure 4).

Case Study

The main purpose of this paper is to present the application of current project management software systems into a company's processes to help with the paperless jobsite. A comparison of the company's processes before and after implementation of the project management software systems is presented and analyzed.

iBuild Impact

Before iBuild was rolled out on to jobsites, the project teams were using a window-based construction project management application to manage their daily construction administration activities. The most common applications that were used were submittals, RFI's, daily reports and meeting minutes. At the time, the software worked well for the project teams, however it was very expensive. Gilbane knew that they could save time and money by finding an alternative solution. They wanted a solution that no longer entailed printing out numerous copies of submittals and then mailing them to the appropriate reviewer(s). If they could change these processes to become electronic, then they could save a lot of time and money.

Not only was Gilbane looking for another solution, Owners and Architects were too. Through Gilbane's Client Satisfaction Program, negative feedback was received regarding the current use of the construction management application. Owners and Architects were telling Gilbane that the software was not collaborative, could not be easily tailored to project needs, and was expensive due to proprietary software licensing fees. As a result, a full market analysis was conducted to review all available project management applications. Each product was lacking in functionality and available features. So, the business decided it was worthwhile to make a financial and time investment to create a tool that fully meets the needs of the company and its Clients.

In 2008, Gilbane started rolling out iBuild on all new projects. Six years later iBuild has been rolled out on all jobsites. The most common, as well as the most powerful modules that are being used: submittal, RFI and daily report modules.

iBuild had the biggest impact on the submittal process. With iBuild, subcontractors are responsible for uploading their own documents then sending them to Gilbane through the system. Once the submittal is sent, a project team member automatically gets an email informing him/her that they have an activity (also known as "Workflow"). At that time, the member will review that particular item, electronically stamp it with company's stamp, make any comments on the document if needed, and then send it to the appropriate reviewer, or reviewers through iBuild as shown in Figure 1. Once the reviewers complete their review, they will send it back to Gilbane, who will then send it back to the subcontractor through iBuild. This process is now entirely paperless and much more efficient. Project teams no longer waste days by mailing the documents from one party to another.

The RFI process is least effected by iBuild, as the routing in the previous software is similar to the routing in iBuild. In both programs the subcontractor will write an RFI in that particular program and then forward it along to Gilbane. Gilbane will then review the RFI and forward it along to the appropriate reviewer(s). Once the reviewer(s) have answered the RFI, then they will send it back to Gilbane. At this point the routing between programs is a bit different. With the previous software, the project engineers would need to download a copy of the RFI and its attachments to a local drive on their computers. Then they would need to send a copy of the answered RFI to the subcontractor via email, as well as printout of a specific number of copies to distribute to the subcontractors foreman, superintendent, and other trades that may have been affected. With iBuild, as soon as Gilbane reviews the answered RFI, they have the option to forward the RFI through iBuild to the subcontractor, subcontractor's foreman, superintendent and any other trades that were affected. iBuild not only saves the Gilbane engineers time by distributing the RFI automatically, but it also gets the response to all affected parties quicker than the previous software did.

Also iBuild had a big impact on the way daily reports were processed. Subcontractors can no longer submit hand written daily reports, instead they need to log into iBuild to fill out a daily report for each day. Once they have filled out the report for that particular day, it is sent to the Gilbane superintendent through iBuild for approval. Since this process is now completely electronic, Gilbane sets up a mobile kiosk on each job which allows the foreman to get their dailies submitted (Figure 5). This process not only saves paper, it also eliminates the need to manually calculate monthly manpower reports with automatic reports that you can run at any time.

Figure 5: Mobile Kiosk on left and Mondopad on right

Bluebeam Impact

Before Bluebeam was rolled out, project teams were spending an enormous amount of time managing the contract documents. On a typical project, there would be at least two sets of drawings and specifications. The Gilbane engineers would have a copy, and the superintendent would have a separate copy, both of which needed to be maintained and updated to reflect the most up-to-date information. On most jobsites you would see that the engineers copy was up-to-date, but the superintendent's set were typically missing current information. Not only was this risky due to the fact that they were potentially building off an old out dated drawings, but project teams were also duplicating their work.

A group of Business Consultants around the country reached out to various jobsites to see if they were doing anything different to make their jobsite more efficient. They found out that a couple jobs were using Bluebeam to manage their contract documents and the process worked well. The Business Consultants started exploring potentials of Bluebeam to make sure the system was capable of meeting Gilbane's policies without having to change too much, or take on any risk. After a couple weeks of testing and rolling Bluebeam out on a couple smaller jobs Bluebeam was the answer.

Gilbane decided to roll out Bluebeam as the new standard PDF tool and immediately installed the program on all employees' computers. Gilbane knew that not all projects would use the software to manage their contract drawings right away. They didn't want this change to effect jobs that were already setup which meant that the rollout would take a couple years to get all jobs on board. The purpose of rolling out Bluebeam to all users immediately was so that they could at least take advantage of the other features of Bluebeam. Project teams were able to immediately benefit from the PDF mark-up, quantity take-off and photo management tools. Personnel on all new jobs starting up were then trained and guided on how to manage their contract drawings through Bluebeam. It has been a year since Gilbane first rolled out Bluebeam and there are now more than 100 jobs managing their contract documents electronically and sharing them with the entire project team.

With Bluebeam, project teams are now able to add all contract drawings, specifications, RFI's, sketches and any other documents that can be shared out with all project team members to a Bluebeam Studio Project. In this Studio Project, all drawing sheets and specifications are hyperlinked to either the drawing index, or the specification table of contents. Not only are the sheets hyperlinked, but the detail callouts are also hyperlinked to the individual detail. This provides users a much quicker, more efficient way to navigate through the drawings. The project teams no longer need to search through different volumes of drawings to find a floor plan and compare it against the detail. In the Studio Project the project teams are also posting any RFI's and sketches electronically to the documents as shown in Figure 3. They simply cloud any area on the contract documents that an RFI or sketch has effects on and then add a callout to reference that particular document. Then with Bluebeam, they are able to hyperlink those RFI, or sketch callouts to the actual document it is referring to. This eliminates the need to go searching for that particular document. Users can simply click on the callout and the document will open up. The screen can also be customized so users can pull up both the drawing and the RFI/sketch it is referring to side by side.

Once a project has setup a Bluebeam Studio Project, the project is then shared with all project team members including the owner, architect, consultant and subcontractors. Users do not need to have a license of Bluebeam to view all documents within this Studio Project; however, they do need to download the free version. The free version allows all users access to the most up-to-date drawings and enables them to take advantage of the hyperlinks that were created. Users can then view the Studio Project by using their personal computer, iPad, or a mobile kiosk that Gilbane has set up in the field for any project team members that may not have an iPad. One of the major benefits of the program is the ability for all users to immediately access the most-up-to-date documents in the field. This eliminates the need for multiple trips back to the trailer in order to view an RFI, submittal, or drawing that project team members didn't have with them. Everything is now at their fingertips.

BIM 360 Field Impact

Before BIM 360 Field was rolled out, project teams were spending more than double the amount of time on rolling completion and punchlist activities. The project teams were using all different methods from hand writing the issues in the field and then typing them up when they got back to the office, to bringing a laptop outside and typing everything into excel. These methods created a lot of work for the project teams. Not only did the teams need to

create these lists, but they needed to distribute the lists to the appropriate subcontractor and only include those specific subcontractors' items. This meant that the data needed to be updated constantly and filtered in order to send out weekly reports to each subcontractor.

Another inefficient task was performing a quality inspection. The superintendent would need to print out an inspection report, gather all of the required submittals, details, RFI's, etc. and then go out to the field for the inspection. Once the inspection was completed the superintendent would then go back into the office, file the inspection into a binder and then send out any emails to the subcontractors regarding deficient items. Not only was this way inefficient, but the inspections were extremely difficult to find once they had been filed away.

After exploring a couple different products it was evident that BIM 360 Field was what Gilbane was looking for. BIM 360 Field was rolled out to various jobsites a little less than a year ago. Within the past year, Gilbane has set up more than 120 jobs and the number is quickly rising. The most beneficial features of BIM 360 Field are the issue tracking module and quality inspection module.

The issues tracking module within BIM 360 Field has substantially decreased the amount of time it takes to manage the rolling completion list and punchlist activities. Project teams are able to bring their iPad out in the field and create deficient items within a matter of seconds. The system works without an internet connections which is why the program is so quick. Once the project team member is done creating items for the day they simply go into the office and sync their iPad. One of the most beneficial features of this program is the reporting module. As soon as the project team member syncs their iPad, an automatic report will be sent out to the responsible subcontractor including only their deficient items that need to be addressed. The Gilbane project team no longer needs to manipulate the data and send out new reports each week. A sample report has been included in Figure 4.

BIM 360 Fields inspection module also has a big impact on the way quality inspections are performed. All of Gilbane's quality inspections are now electronic and available within the program. A sample inspection is shown in Figure 6. When a superintendent is ready to perform an inspection all that is needed is an iPad. If the superintendent notes an item as deficient within BIM 360 Field, the system will automatically send the responsible subcontractor an email stating they have an item to address. This program has allowed the superintendents to spend more time in the field rather than typing up an email to document any issues that are found, or gathering the right paperwork to perform the inspection.
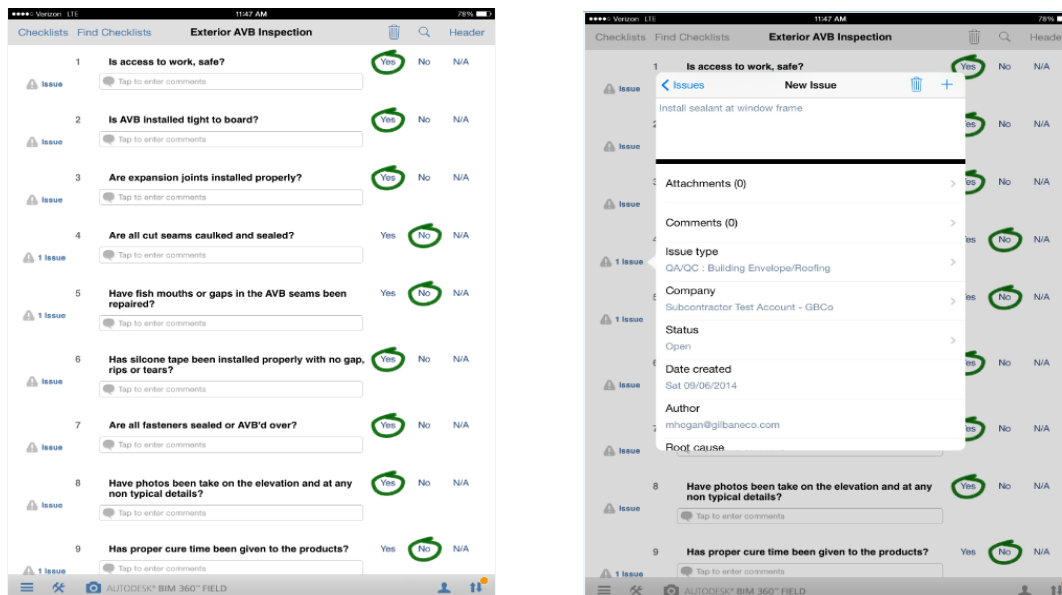

Figure 6: Sample inspection on left and automatic issue creation for deficient item on right

Findings & Analysis

Rolling out new software always has its challenges. Trying to change processes and procedures that have been in place for years is not an easy task. With all three programs there were similar challenges.

One of the major struggles Gilbane had to face was how to get all project team members trained quickly on all three programs. Not only did they have to worry about getting everyone trained, but they also had to try and change the mentality that some people had regarding the new program. Another reoccurring obstacle was getting users to eliminate paper copies completely and rely on an electronic version. For the older generation, a big worry was how to review submittals, or drawings on a computer. To some people, reviewing drawings electronically is extremely difficult to get used to. The last major challenge Gilbane faced was getting the subcontractors on board to use the programs. This was extremely difficult, not only because the subcontractors typically don't have iPads, but some of them have a difficult time using computers.

In order to mitigate these challenges, Gilbane put together a group of six Business Consultants. One of their jobs was to train all users with the project management software systems. When a project was just starting off the Business consultant would train all parties and he/she was always available to answer questions. The Business Consultant would work closely with anyone that struggled and showed all users the quickest and easiest way to use the systems. They also shared tips and tricks on how to use the system as effectively as possible in hopes to eliminate any concerns related to reviewing documents electronically. The Business Consultant also helped the jobsites get set up with the most useful hardware. A typical jobsite would have a mobile kiosk on site for the subcontractors to use, as well as a large flat screen TV, or a Mondopad in the trailer for easy review of the drawings. Some of the jobsites even had iPads that users could check out and use in the field. With the help of the Business Consultants, Gilbane was able to mitigate their biggest challenges to make the rollout of these programs a success.

Even though rolling out iBuild, Bluebeam and BIM 360 Field has had its challenges, there are many benefits that make it worth it. Each program is unique in its own way, but the one common goal with all is to create a paperless jobsite. The major benefit we have seen with iBuild is the ability to share data instantly between all stakeholders. Project teams no longer waste time mailing submittals back and forth. With iBuild they can send items instantly for immediate review. Also, with this system all users are able to see exactly who is handling an item and figure out why it may be held up. This eliminates any confusion on the status of a particular document.

Rolling out Bluebeam has allowed project teams to take a really inefficient process and make it much more efficient. Enabling the project teams to only post one set of drawings rather than multiple copies has enormous time savings. Not only have the project teams been able to save time from posting, but they have been able to save time and money by reducing the amount of rework that needs to be done with one updated set of drawings that everyone can access. Another major benefit of Bluebeam is the ability for all users to access documents out in the field on their iPad. Project teams no longer need to carry sets of drawings out to the field, or run back into the trailer when they don't have a document.

With BIM 360 Field superintendents are able to spend more time in the field solving problems and focusing on quality and less time in the office performing administrative duties. When creating rolling completion or punchlist items, the automatic reporting features have proven to be extremely beneficial. Another major benefit of the system is the quality inspection module. Superintendents can now access all required inspections and associated documents electronically on their iPads. If there are any deficient items on the inspection, the responsible subcontractor will get an automatic notification explaining what needs to be corrected. These automatic notifications have allowed the superintendents to spend more time out in the field rather than going back into the office and typing up emails. Lastly, BIM 360 Field has provided a way for better collaboration between all project team members in regards to punchlist activities. On most jobs, owner, architect and consultant use the software to create their own punchlist items. With this software users are able to filter information multiple ways which reduces the amount of duplicate entries created.

Conclusion

Technology is constantly changing and applications that were the most advanced at the time are easily replaced by something better and more innovative. Currently, all three project management software systems have proven that it is possible to go from a mainly paper based jobsite to an electronic jobsite. These programs have helped the project teams reduce cost, streamline communication and decision-making which has increased efficiency, enhanced teamwork and reduces rework. In a very short span, an evolution has occurred in the mobilization of jobsites. Gilbane has gone from paper-filled trailers to large screen monitors, creating paperless plan rooms. True mobility in the field has rapidly evolved from lock-box kiosks with a hard set of drawings on each floor to laptops on rolling carts to tablets and iPads loaded with drawings sets stored in the cloud. PDF and cloud storage have been combined together to create a viable way for the designer and the field worker to view project content and collaborate in ways never before seen. Centralized data is very powerful, and it makes the information more valuable to the different constituents. By building leaner practices and allowing the project management process to become more transparent, a lot of the waste that comes from information silos and rework can be eliminated. Some of the benefits achieved could not be quantified like owner's satisfaction of the project management process and attracting new businesses as a result. Authors' future work will be focusing on performing cost/benefit analysis of the project management software systems used and try to quantify the total saving of the company

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