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Project & Report

Improving Sustainability in Construction with Focus on Subcontractors

Introduction

Sustainability, being more "green" and making efforts to have less of a carbon footprint left on the environment are becoming very important issues in many different industries today, including the construction industry. The move to more sustainable actions and methods has been occurring slowly over the past couple of decades, but relatively recently the focus on them has increased substantially. Because of this, it is important for the construction industry to continue to increase its sustainable efforts and to influence societal acceptance of sustainability and "green" building methods.

In 2000, there was an estimated three hundred billion total square feet of built space in the United States (Nelson 2004). Then, looking ahead to 2030 the estimate for total square feet of built space rises to four hundred and twenty-seven billion in our country alone (Nelson 2004). Based on this large amount of projected construction needed in the future, it appears that there will be continuously large amounts of construction activity all over the country. Also because of this projection, there should be many opportunities for improvement of the building methods and materials to make them more environmentally friendly. In order for the industry to meet this projected amount of necessary built space, all people in construction should start looking at ways to minimize their impact on the environment by using sustainable methods whenever logically possible.

Background

As awareness of sustainability has grown, the construction industry has begun to get involved. Presently most of the information and education has been focused on office management personnel and students at universities and institutions. Unfortunately, the career path most of these students take after graduation leads into the office of a contractor, which greatly lessens the chance that they will work in the field. So, now most of the knowledge about sustainability is in the offices of contractors with the middle and upper management. The people in these positions are then able to have an influence on the project during its design phase by trying to implement as many sustainable systems and products as possible.

The industry has begun to change with mainly middle and upper management having the knowledge of sustainability. The problem arises in that information and knowledge of sustainability at these levels of management do not have a way of reaching out to the onsite employees and trade laborers. If all levels of the construction industry are not included, then the message and purpose of sustainability gets lost before it reaches the hands-on trades level. Therefore it leaves the industry with a situation where sustainable systems and products are possibly being installed using unsustainable methods. This contradiction provides further opportunity for the construction industry to improve its sustainable efforts.

Problem Statement and Objective

The goal is to create a protocol, which can be followed in the future, that gives an effective and unobtrusive method of observing and learning what installation methods the

trades use onsite. This protocol is basically a sustainability process audit that third party auditors, such as students and consultants, can take and utilize when looking for an effective method for observation of the trades. The protocol could also be taken and replicated many times with many different trades or jobsites to begin to understand what current methods are being utilized by the trades and whether those methods are promoting sustainability in construction.

State of the Art

Documenting the onsite work processes and methods with enough detail usually proves to be a difficult task. Because of the detail involved in many work methods, the main goal for the observation and documentation is to capture as accurately as possible what is happening in the field (Kuprenas and Fakhouri 2001). Various methods of well-known data collection and documentation have previously been utilized in construction data collection, including: questionnaires and surveys (Chang and Borcherding 1985), delay surveys (Heinze 1996, Tucker et al 1982), activity sampling (Thomas and Daily 1983), and recording of work face practices. All of these methods have been used many times previously. However, some of them are better in certain situations than others and vice-versa based on variations in work characteristics, performance methods, or the nature of the project (Kuprenas and Fakhouri 2001). For application to sustainability, the focus of the data collection will be based on the nature and type of actions taken and what potential effects those actions have on the environment.

Methodology

The first thing to establish for the protocol is finding the best way to approach getting onsite and observing the trades. After settling that issue, the next thing to do is figure out what type of actions or installation methods to focus on and observe. Once these are decided, the method of documentation, such as notes or videotape, must be determined because it can be used for future analysis and it allows others the opportunity to review the material as well. The trades should not be aware that they are being observed, so an unobtrusive method of observation must be found. After documenting what was found onsite, a system of labeling and organization should be created to keep the information well organized and easily found. Upon completion of this protocol, it will then be possible to begin coming up with solutions for how to improve on the current methods and begin acting and working in more sustainable ways.

Expected Outcomes and Impacts

The main result or outcome for this project is an efficient and useful protocol that others may use in the future to study the trades. Also, if this protocol is used often, then the information found through using the protocol could be compiled into a report that provides information on the current status of trades and their working methods.

The protocol could provide a significant impact from this point of view because it focuses on some of the onsite sustainability issues that still need to be addressed. It could also create more of a dialogue about getting the trades involved in the education of sustainability in construction that is occurring right now, but primarily in the office.

Observation Results

Throughout the video observation process, I came back from every effort and wrote down the details pertaining to each one. Below are the general synopses of my video observation experiences and findings. Each observation effort explained below represents a visit made to a jobsite to try and obtain video footage. Some of the efforts proved more beneficial than others, but all of them ended up contributing much to the research for the protocol.

First Observation Effort

On this attempt, I went out to a site where I had asked permission from the owner of the contracting company before heading out to the site. This process of obtaining permission to access the site took a greater amount of effort, but it still proved to be very effective. The initial plan when heading out to the jobsite was to observe the trades in a regular work setting using video. To accomplish this on the first time out, I decided to try the method of observing with video the trades when they were not aware of it to capture their typical working methods. Also, I dressed in a similar fashion as the trade workers to attempt to blend in with the crews a little more.

On this effort all of the attempts to blend in proved moot because I was constantly located close to the trades when trying to make observations and there were a small number of crews and workers on the site. Only interior work was being done during the time I was onsite, so all of the observations had to occur within relatively confined quarters. Anytime I was around the trades, most of the workers in the crews were watching what I was doing, so I could not use the camera or they would be completely aware of it and therefore would not continue to work as they usually would. There were

times that I would leave an area for a few minutes, come back, and the work that I was waiting to observe before had been completed during the time I was gone. During the times I was back around the crews, they would talk to each other and move things around but not actually perform any work. In the end during this first attempt, there proved to be a small number of crews on a smaller site.

So, the workers proved to recognize me as an outsider and ended up more focused on me than the actual work needing completion. The method of observation that proved to be relatively successful was watching and taking notes, whereas the video observation proved completely unsuccessful and I was not able to get any footage.

Second Observation Effort

For this effort, I visited a superintendent I know and received permission from him to enter his site, after explaining to him what I would be doing. This proved to be one of the easier methods to use because I already had an established relationship with the person in charge. This time the plan heading out to the site was to video observe the trades without their knowledge. I managed to get video of the grading subcontractor workers installing the curb and gutter systems and also doing some rough grading in the parking lot area. In order to make sure the trades were not aware of being observed, I went into the building and took video from inside. This method proved very effective because I caught the trades working as they typically do.

Also, I chose to try blending in again with the trade crews again by dressing in a similar fashion and finished with better results. I captured the insulation installers working on one of the floors of the building due to the fact that the building is large

enough and still has enough open spaces to allow me to observe them from the other end of the building without being noticed as anyone out of the ordinary.

Third Observation Effort

I decided to try visiting a site where I did not know anyone involved with the project. An obstacle from the start with this method is I could not enter the site. Unfortunately during the time I was out observing, none of the crews who work on the building of the framing and exterior were there, and the rest of the trades were inside the other units. Because I did not have permission to be onsite, I did not have the opportunity to catch any of the work going on inside. This method did not work out as well as the last couple of methods mainly because I was not able to be in the areas that were being worked on at the time. All observations were based on what was lying around the jobsite at the time. From certain things observed at the jobsite, some inferences can be made about the methods the crews are using on these projects.

Fourth Observation Effort

The site for this observation period stayed the same from the previous effort. I tried it another time because none of the trades were outside working for me to observe on the last effort. This proved to be a good idea because there were a few trades working outside in different areas of the project, so I was able to capture some video observations of them working. Due to the distance between myself and the workers, I was able to get video of one crew spreading stone to prepare for a slab pour and another crew working on the windows.

Everything turned out much better than the previous visit due to most of the crews and trades being onsite this time. This method proved to be fairly effective for observing

the general work of different trades on the jobsite. It still posed some problems because I could not get to certain areas or angles to capture much of the work going on, especially for the trades installing the light wood framing for the buildings.

Fifth Observation Effort

For this site observation period, I chose a larger apartment complex site that had many different crews onsite executing various tasks. Again I did not know the contractor and had not previously contacted anyone with the contractor, so all observations were limited to what I could capture from the edges of the site. During this visit, I managed to get some video observations done of some of the trades working on different aspects of the project. Some of the roofers were installing the base sheathing for the roof. Another worker went around and picked up all of the large trash scraps at the edge of the site. Also, a site crew sorted stone on one end of the site, while another crew loaded and hauled dirt offsite.

Due to the large size of the project, there were more activities going on to be observed. As before in my fourth effort, this method of observation is effective but only to a certain extent. It does not allow me to get observations in the areas behind the exterior sheathing that is already up on some of the buildings. However, capturing the crews while they were working in their usual manner proved much easier because of the large project site size.

Sixth Observation Effort

The last observation period happened at a school site and mainly focused on the site crew. Due to having worked with the majority of the crew previously, the footage turned out much better than some of the previous undertakings. The workers continued

to work as they normally would and it provided me clearer observations, which allow for better analysis later when looking back over the video. The dozer operator milled the topsoil pile to dry out the top layer, while the track hoe operator fed the topsoil sorting machine. From there the topsoil was being spread out in a future playground area for the project. The site crew also had a water truck being filled with the water from the retention pond, which they use to wet down the areas where the trucks often drive. For all of the methods tried up to this point, this method proved much more effective because I did not have to worry about being noticed and possibly interrupt the regular working patterns and methods.

Support of the Protocol

The formation of the protocol and the suggestions included in it were based on the research and results performed for this project. The purpose of these suggestions and the protocol in general is to provide a third party researcher with an effective method to use from start to finish for video observation of the trades. All of the recommendations were made with the observation efforts and the lessons learned from those in mind. So now someone else does not have to go through the problems and complications that can occur when using just a trial and error method of observation.

From the start, the first step I mention deals with the preparation and brainstorming that is necessary before doing anything else. The basis for this being so early in the protocol is from the third observation effort mentioned before, when I went out to a jobsite where I did not have a specific goal in mind for the observations and ended up not actually having any activity at all to video.

In the protocol, the next step explains that better observation results can come from bigger jobsites mainly because of the space those size projects provide. The first site I visited for my observations turned out to be a smaller jobsite and only had interior work going on at the time. The result from that effort proved to be only hand-written notes taken after I left the construction site. Whenever I had a good view for the video observations, it turned out I was too close to the crews so they paid more attention to me than their work. Due to this experience and similar experiences in some of the other efforts, I felt that the bigger site would yield the best results for others when attempting these observations.

Getting permission before entering any construction site is very important for these research attempts because it is important to keep a good relationship with local contractors so they can be utilized in the future as well. By entering a construction site without permission, students have in the past upset the onsite superintendent, which leads to bad relations with the general contractor. Of the methods mentioned for requesting permission, the two quickest and easiest options were to visit construction sites where I knew the superintendent or a foreman. With that being said, all of the options provided in the protocol were attempted and proved to be very effective for obtaining access to the jobsites.

The observation methods mentioned in the protocol were the styles that I used in my observation efforts. There were multiple efforts where I chose to try blending in with the rest of the crews around the sites. Overall, this method worked well when on construction sites where there were more than only a couple of crews working. The trouble arises when on a site where there are not many workers overall or when on a

smaller type of project. The only time blending in did not work out well occurred on my first observation effort where all of the work occurring at the time was inside in relatively close quarters.

As for the idea of speaking with a foreman, I went to the foreman of a crew that I had worked with before, so it proved to be a great way to obtain closer observations that had a little more variety. The process of obtaining the video observations seems to have been made easier when working with people or contractors where there is a preexisting relationship. So I recommend in the protocol for other researchers to use this method as well because it seems that better results can come from utilizing personal connections one might have with certain construction personnel.

The duration of each video observation is better when shorter, if it is possible. The length of the video does not need to be very long if the activity you are observing is not going on consistently. For most of the actions I observed in my efforts, shorter video clips under a minute were all that was needed to capture specific sustainable or unsustainable actions. This is a recommendation made for the benefit of those who do future analysis with the video observations because having to weed through hours of video to find the pertinent information takes much time and effort.

The next section deals with writing up synopses of the observations and their results soon after completing the observation period. By writing down the details of what was observed as soon as possible, there is a much lower chance of any important information being left out of the research. Also, recording this information as accurately as possible will help keep other subsequent projects that use this information accurate as well. Another benefit to keeping a written log of the observations is that it serves as a

backup to the video and helps put the videos into context for others who were not involved in collecting the raw data.

When it comes to taking care of the video files, the method of labeling and organization is rather important. The main thing to remember is to remain consistent with the format for both. By having a folder for each different site visit made, it is then easier for other people who are looking over the data to use the observations and results synopses and refer back to the correct videos because both are organized in a similar manner.

The lessons learned analysis provides a way for those using the protocol to comment on what worked well in the whole process and what needs improvement. This type of feedback from other following the protocol will prove to be important in the future by helping to smooth out any issues other researchers find. It also provides others a way to review how they gathered the data and recognize what they learned about the process of observation to help them in the future.

The protocol is capable of being used by any third party researcher interested in making video observations of the trade workers on a construction site. The recommendations in the protocol were based off of the research and results found previously when trying out various methods. The best of all of the methods attempted through my research is what is included in the protocol, which allows other researchers quicker and more useful results.

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Video Observation Process

The purpose of this assignment is to guide you through the process of observing the trades. You will be using video footage as the method of documentation for these observations. The goal is to capture trade laborers using their normal methods of work in a regular construction work environment. The information gathered from the observations can then be used to analyze whether current practices used by the trades are sustainable or not. Also, after many observations have taken place, the videos and their analyses can be compiled, analyzed, and then used to help understand whether the trades and their methods of work are a part of the solution to increased sustainability in construction.

Execution of Observations

Instead of heading out onto a jobsite and making random observations, there are general steps that you should follow to make your observation periods more productive and successful.

Before starting any of the actual observation process, there are some things that need to be considered or completed.

- Make sure you either have a camera that can take good quality video or have access to one
- Know what kind of information you are looking to find and how to find it. You do not want to head out to a construction site that does not have activities involving potential sustainable practices because there will be no valuable observation opportunities. So, make sure the site you intend to visit has the appropriate crews and activities out working onsite during the time you are around.

When choosing a construction site for the observations, there are some important characteristics or factors to consider that can allow for better opportunities to get your video. Bigger projects allow for better opportunities because there can be more distance between you and the crew of interest. The more space you have to work with the better the video observations will turn out to be because you are not sitting on top of any of the crews.

Getting permission to enter a construction site prior to heading out for observations is an integral part to producing useful video data. You should plan on using one of the following methods to get in touch with a contractor.

- Find contact information for the president of the company whose site you are interested in and either email or call to request permission to enter the site of interest. When doing so, make sure to explain:

    - who you are
    - why you are contacting them
    - the nature of your visit onsite
    - whether your methods will be disruptive to the ongoing work
    - what your observations will be used for
    - what potential benefits they could get out of the observations made on their jobsite

- Also, you will want to include the potential dates you intend to be onsite, when during the day you will be there, how many people will be out there with you (try to keep this number to no more than 2 or 3), and the contact information for the superintendent of the site.
- Another option available to those who have already worked on a jobsite is to contact a superintendent you know and receive permission through those channels. Typically, this method will prove to be an easier solution to the objective of receiving permission to enter a jobsite. Make sure to still explain the details of your observation methods and techniques.
- A similar viable option is to get in touch with a foreman who is in charge of a trade crew, follow that crew around, and make video observations during that time. This method provides a fairly easy way to get permission to observe the trades. Once again, you want to explain the details of everything you will be doing regarding the video observations.

After receiving permission to head onto a jobsite, the actual video observation activities can start taking place. The main goal with your observations is to capture the workers using their typical working methods. This can prove to be a difficult task because there is a tendency for the trades to either not work or work in a different manner than usual if they know they are being observed. The following bullets are some different methods to use to observe the trades effectively.

- One method is to attempt to blend in with the rest of the working crews out on the construction site. By dressing similar to all of the workers, the chances of your blending in without being noticed are much greater. Try not to hold the camera out in the open to get the video unless there is enough distance or obstructions in the way so the workers will not notice you making the observations.
- Another effective method that can be tried is to talk to the foreman of the trade crew that you want to observe and see if there would not be a problem with you making video observations of his or her crew. This may allow you to obtain better video because you will be allowed to get closer to the trade laborers while they continue on with their work.

- One recommendation would be to try not to be completely out in the open and obvious with your video observations, unless there is a large distance between you and the trades of interest. Sometimes there is a tendency for the trade laborers to not do much, if any, work if they know they are being watched or taped by visitors to the site.

The purpose of these video observations is to capture clips of trade crews working while using sustainable or unsustainable practices. Therefore, the length of video observations need not be extremely long. Instead, smaller clips under a minute should typically prove to be enough time to make your video observations of the practice you are choosing to focus on for that observation.

After making your video observations, you will need to sit down and make notes of the contextual information (date, time of day, site info, etc.), your observations, and their results. This section is where you describe how the whole process went and what you observed. It is important to complete this step because it will put your videos into better context when they are looked at in the future without you around to explain the setting and background information.

When saving and organizing your videos, it is best to keep a different folder for each different site visit made for observations. Keep the labeling of the folders and the videos consistent so everything can remain as organized as possible.

(Provide a file-naming format for them to follow?)

After you are finished with labeling and organizing video, write a lessons learned analysis on the entire process used to do the video observations. Be sure to point out where things went smoothly, any problems that occurred, and how things could be improved so as to not have those problems in the future.

Once finished with everything, put all of the video files and other documents pertaining to this observation research, such as your observations and results notes, onto a CD to turn in.

When you have finished all of the necessary site visits to get your observations, remember to write a Thank You email or letter to the person(s) who allowed you access to their jobsite for the purpose of these observations. DO NOT forget to do this step. It is important to keep a good working relationship with the local contractors because we may need to ask for more help with research for future projects.

List of Deliverables and Format

- Video files – Named and organized in a logical manner.
- Observations and Results document – For each video observation effort, have one part that describes the general information about the jobsite and the observation

methods used, then another part describing the results of your effort. These parts should be written in narrative format.

- Lessons Learned Analysis – Give your analysis of how everything went, what worked, what didn't work, any new things learned or found out, and recommendations for improvement for the video observation process. Remember to write this part in narrative format as well.
- CD – Containing all of the video files and documents pertaining to this observation project.