Student Response to Traditional Fire Alarm Systems in the Cal Poly Yosemite Dorms

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What would you do if you were a student living on campus and you were burdened by an annoying fire alarm late at night? Though evacuating the building seems like the most logical and safe course of action, sleeping or studying for a big midterm may be a risk you are willing to take. Going back to grade school and up to your freshman year of college, we have been exposed to countless fire drills and false alarms. It is important to know the real facts on how students respond to fire alarms, the reason why they would respond, and their overall interpretation of them. In this paper is one in person survey of 50 students in the Yosemite dorms, three phone interviews with two fire alarm contractors and a Cal Poly fire and life safety specialist. Most of the student responses were the right thing to do in terms of response, but their thought process on whether an alarm would be a real fire, or a drill was exactly what was expected. By collecting the qualitative data in the three phone interviews, a general overview of fire alarm systems and the sequence of operation of those systems could be better understood. The results of this survey bring up some concerning evidence on whether students take fire alarms seriously.

Keywords: evacuating, course of action, risk, fire drills, false alarms, saving lives, response, thought process, fire alarm systems, sequence of operation,

Introduction

The hypothesis taken in this survey is that if a fire alarm sounded off, then students living in the Yosemite dorms would wait for a secondary form of notification rather than evacuating right away. Students for years have been exposed to fire alarm drills from kindergarten all the way to their freshman year in college. In their first few months in the dorms, students are exposed to so many false alarms from someone setting off the smoke alarm that it is engrained in heads that a fire alarm is probably a drill. Actual fire's in buildings are so uncommon but could be so dangerous if they happened. The students in the Yosemite dorms are exposed to one fire drill before every quarter, having coordinated spots where to meet if a fire alarm went off. The most important time to know the evacuation process is during the night when students are half asleep and all trying to evacuate the dorm at the same time. With the unlikeliness that a fire alarm presents a real fire makes this survey important to know if it's ever possible to change the way students think about fire alarms. It is also important to know if new technology is possible to boost student response. Fire alarm systems have been traditional for years, having the same sequence of operation.

The behavioral response to fire alarms is considered to be a cognitive process. According to (Bryan, 2002.) in the SFPE Handbook of Fire Protection Engineering, there are six important factors that should go through your head when a fire alarm sounds off. These six factors include recognition, validation, definition, reassessment, commitment, and evaluation. All these factors surround one main factor which is the individual. The uneducated occupants take a while to actually perceive a real fire. First validation is important because individuals are unclear about the cues that define the event. Sometimes individuals will adapt to a certain mode of behavior that is directly related to a perception of the reward structure of the situation. If there is a competitive escaping behavior observed between occupants, then this response will become the norm for the group. The reward is to obtain the means of egress. The individual's evaluation process, cultural, or sociological or economic influences, or the assumption of a particular individual psychological role is critical in the formation of behavioral response strategies. The occupants with experience or familiar surroundings may experience less anxiety and will select more efficient behavior

responses. If the students in the dorms have an unserious approach to behavior responses, they may not be efficient when picking the right approach to evacuating and will affect them in a real fire occurrence.

Partying and drinking is an often occurrence in the dorms. If students are intoxicated, it is important to know if they would respond to a fire alarm. In a study done by Michelle Ball and Dorothy Bruck at Victoria University in Melbourne Australia on residential fires in Japan, 53.1% of fatalities were asleep and or/drunk, and that over 65% of victims aged 6 and 64 were under the influence of alcohol (Ball & Bruck, 2004). The presence of alcohol in occupants systems hinder there performance to respond fast and efficiently. If the less vulnerable age groups are intoxicated by alcohol, matches the risk factor for death equal to the most vulnerable age groups. Alcohol has become the number one risk factor in fire related deaths. First year freshman are also new to drinking so there coordination, motor skills, and the ability to hear the alarm when they are drunk are all important factors.

After an interview with Curtis Streeter, the CEO of the local Deep Blue Integration, it is possible to use systems that implement cell phone notification, but the fire alarm contractors must follow what is code mandated. There is a national recognized testing laboratory that approves fire alarm systems and puts them out as a specific standard. If the codes and standards are for traditional fire alarm systems, then that is what should be implemented. The codes written by a committee are playing catch up with new technology. According to Curtis, new language for fire alarm codes in California is something that is coming up. That said, the fire alarm system set up in the dorms are very traditional. Deep Blue Integration had to follow different code requirements to suit the correct level of protection for the occupants. The Yosemite dorms uses a full coverage smoke detector and sprinkler system. According to (Szymanski, 2013), there two main types of smoke alarms: ionization and photoelectric. Photoelectric smoke alarms contain a light chamber, that allows for smoke to interrupt a beam light which sets off the smoke alarm. These smoke alarms are better at picking up smoldering fires than ionization smoke alarms, which makes them better for a dormitory. Ionization smoke alarms are the most common smoke detector system that has been used longest. These smoke detectors not only just identify smoke, but they attract the ions from a fire when combustion occurs. These ions enter a chamber in the detector, which contains a small radioactive particle. The combination of the ions and the radioactive particle causes an electronic reaction, which sets off the alarm.

The purpose of this paper is to find out how students respond to fire alarms. I want to find out if there is a way to boost student response utilizing cell phone notification, which would help students evacuate faster knowing the reality of the fire. By conducting face to face surveys, I can find out not only what their response is but why students respond the way they do. There are so many factors why students do not evacuate right away or even at all. The first factor is that students right away think it's an annoying sound that is disrupting their sleep or studying. Secondly, students automatically think the fire alarm is a false alarm. Fire alarm evacuation is more of a necessity to students rather than a priority. This means that students will always feel they need fire alarms to let them know of any danger but never feel like the evacuation process is ever a serious matter. A new fire alarm system technology would benefit students by letting the students know if the fire is active or not, and where the detection is coming from. When students are left curious, they rely on what they know, and that is been countless false alarms.

Fire Alarm Systems Overview

During an interview with Jayme Doyle, director of engineering at Tri-Signal, he explains the fire alarm system installed in student housing south on Cal Poly's campus. The fire alarm system in student housing south is a full coverage photelectric smoke detector and sprinkler system. In every room is a photoelectric detector and carbon monoxide (CO) detector. The photoelectric detector is also called a sounder base detector or photoelectric detector with sounder base. This photoelectric detector is early warning which will go off even if it senses smoke from burnt toast. There is a photobeam in the detector that shoots out and hits a prism and shoots back the beam. Smoke or dust obscuration is detected during this process, which will set off the alarm. The alarm from the sounder base detector will only go off in that room but will send a signal to the Fire Control Panel (FACP). If the smoke travels to a different room, then there is cross verification, which will alert the FACP to sound off all the alarms in the building. Both the Yosemite dorms and student housing south have an all automatic system which means that when a fire is happening and a smoke detector goes off, then there is a sequence of operation that controls all other aspects of the building. If someone is in the elevator, the elevator will automatically bring them down to the first floor. If the fire is on the first floor, the elevator will bring the occupants to an alternate level or recall like the second floor. In rooms where there are fire rated walls and doors, there are smoke fire dampers that keep air movement from passing on because the air movement is what feeds the fire. There is a HVAC shut down when the air flow gets above 2,000 cfm, which will shut off air in certain spaces.

All this sequence of operation comes from the Fire Alarm Control Panel (FACP). Each detector has a certain address that is linked to the FACP. The power supply comes from the FACP to continue the sequence of operation. The horns and strobes are all on the power supply including a sequence of operation that shuts down the 24V door holder. Every door room contains 24V of power that will automatically hold the door open if you push it all the way back. When there is fire, the FACP will automatically kill the 24V of power and keep it closed. The fire marshal does not want occupants to use trash cans to hold open doors because it is a safety hazard when a real fire occurs. In every room are voice speakers that say prerecorded messages along with the alarm. This is the main difference between the Yosemite dorms and student housing south. The alarm will sound three tones, then a message will sound which will say something to the extent of please evacuate. This will be followed by another three tones and the whole notification repeated. This is what is called an emergency communication system (ECS), which is not required but is an enhancement that will boost student response and safety.

In the lobby of the dorms, there is an annunciator that mimics an LCD display. This annunciator will identify the locations of a fire, so when first responders show up, they know exactly where the fire is. The annunciator has an acknowledge button that is pressed and sent to the FACP to let UPD and the fire department know that someone has responded. There is also a button that silences the alarm horn but keeps the strobes flashing until all the fire is put out. After the fire has been cleared, then the reset button is pressed. Also, in the lobby there is a remote paging unit (RPU), which has a microphone and a bunch of buttons that control the system. After the FACP is sent a signal from the fire alarms going off, the panel will send a signal to University Police Department (UPD) by Internet Protocol. The UPD will then send a signal to the fire department. The fire department can then diagnose the seriousness and only show if need be. In the panel is a digital alarm communicator transmitter (DACT), which will allow communication from the panel to the data system. The UPD has a receiver to take the signal and diagnose the severity of alarm. All this data is hard wired with a new Internet Protocol network that allows data to the FACP and out. In an older building like the Yosemite dorms, they use hard wire POTS, plane old telephone line, which is an older system that most codes still require. In the student housing south project, the fire marshal wanted new Internet Protocol network instead of POTS. The campus standard is a two-telephone system because of specific codes, but this might be changed totally soon because of new Internet Protocol networks. Another option for data travel includes a cellular path which will go through the cellular tower, utilizing cell phones. According to Jayme, codes are constantly changing, and new technology is constantly on the rise. When asked about possible utilization of student cell phones when the alarm goes off, he said he foresees it in the future.

New Technology for Mass Notification

The most important aspect of a fire alarm system is the notification. When a fire is present somewhere on campus, students need to be warned on where the fire is and the seriousness of the matter. In a NFPA Journal article, (Corich, 2008), Messa Community College (MCC) installed mass notification system (MNF) on their campus. MCC installed a system called Cisco System Internet Protocol (IP), utilizing phones, strobe, siren, and text notifications. They placed the phone alert system on the uninterruptible power supply so these critical systems can be reliable. MCC's Information Technology Services (ITS) worked with the Public Safety Department to update the outdated telephone system on campus. These telephone systems were installed in every classroom, office, and meeting room on campus. The two aspects of this notification system that were implemented included a 911 integration and an emergency broadcast. For the 911 integration, the MCC data center has a server that is programmed to catch certain numeric patterns when someone is dialing the phone. One of these patterns is 911, which when dialed, triggers an alert sound that goes off in all the first responders' offices. If the first responder is on an active telephone call, the system automatically mutes the other call and allows the first responder to hear the notification. The emergency broadcast system is an application that can alert all phones at the same time. This application can be used for a certain amount of buildings to provide the tactic for notification. Messages can be repeatedly sounded off on the phone speakers at high volume.

After interviewing Jensen Aquino, the fire and life safety specialist at Cal Poly, I found out that Cal Poly does not use a mass notification that alerts multiple classrooms at the same time. The first responders do get an alert after call gets through dispatch. Once the alarm sounds off in the dorms, an alert is sent to the San Luis Obispo Fire Department, Campus PD, and then to the Emergency management office (EMO) shortly after. The EMO sends out a poly alert to the whole campus. The alert must go through a fire department verification process, which allows the fire department to only respond if need be. The campus PD will always respond no matter what, checking to see

how serious the matter is. The fire could be just smoke from cooking or someone maybe smoking, so it is important for Campus PD to get there as soon as they can to decipher the situation. If the police or fire department are getting a lot of calls, this is a self-explanatory situation that could let the first responders know how serious the fire is before showing up. According to Aquino, the fire life and life safety department has gotten reports of one or two fires a day this past year from all the on campus living at Cal Poly combined. This could be anything from students cooking to students smoking inside. Students that are living on campus are exposed to one fire alarm every quarter to assure that students know that the right plan of action when these false alarms turn into real fires. According to Aquino, he notices that the evacuation process simmers down as the year goes on. It is an ongoing battle that he says will need continued fire safety prevention measures from Cal Poly. Jensen is part of the group that coordinates the quarterly fire drills for on campus living. He is also in charge of inspecting and testing the fire alarms annually. He is frequently checking the California fire codes and the title 19 requirements. With student's response to fire alarms decreasing as the year goes on, I wanted to know if Jensen thought any newer technology would help. He has noticed in other buildings that message boards are used in rooms and corridors to help with notification. He believes the post fire alarm sequence of operation set in place at Cal Poly is great because the police respond quick, allowing for quality response from the fire department.

Methodology

One survey of the Yosemite dorms was used to receive information on student's response to fire alarms and why they respond the way they do. I had short face to face conversations with 50 students of the Yosemite dorms, asking them three questions. I wanted to know what their response is, why they respond the way they do, and if they have been exposed to a fire drill this year. The face to face conversation allowed to me to see their facial expression on the topic and if this was even a serious matter to them. I focused on the Yosemite dorms because on campus housing is where most of the false alarms happen. It is also important to know how students would respond in on campus housing because of the amount of people living in the dorms and the possibility of a fire in the middle of the night. The survey questions were phrased in a way that made me think they have been exposed to false alarms in the dorms and they would react with no urgency. This made students expect my hypotheses slightly, but still gave them the chance to answer the survey with their own opinion. The questions I asked in the survey are listed below

- What would you do if you were in your dorm room and a fire alarm went off?
- If you were to evacuate during a fire alarm, what would be the reason for your evacuation?
- If a fire alarm goes off, do you think it is a false alarm or an actual fire?
- Have you been exposed to a fire drill at least once this year?

Results

Figures 1-4 represent 50 students surveyed living in the Yosemite dorms. See Figure 1 to see if students were exposed to a fire drill this quarter. Figure 2 will show the actual response rate of the students, with Figure 3 showing why students would respond if they evacuated. Finally, Figure 4 shows how serious the 50 students take fire alarms and if they would think it is false alarm or real fire if a fire alarm sounded off.
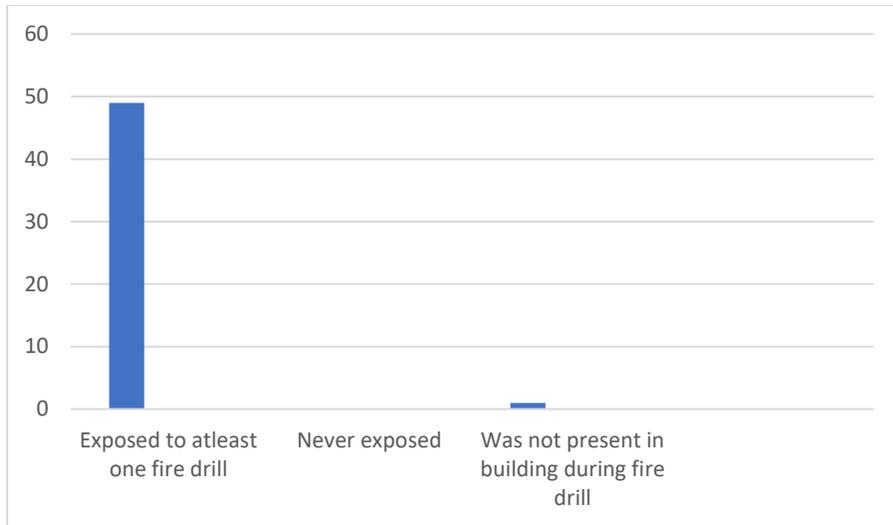
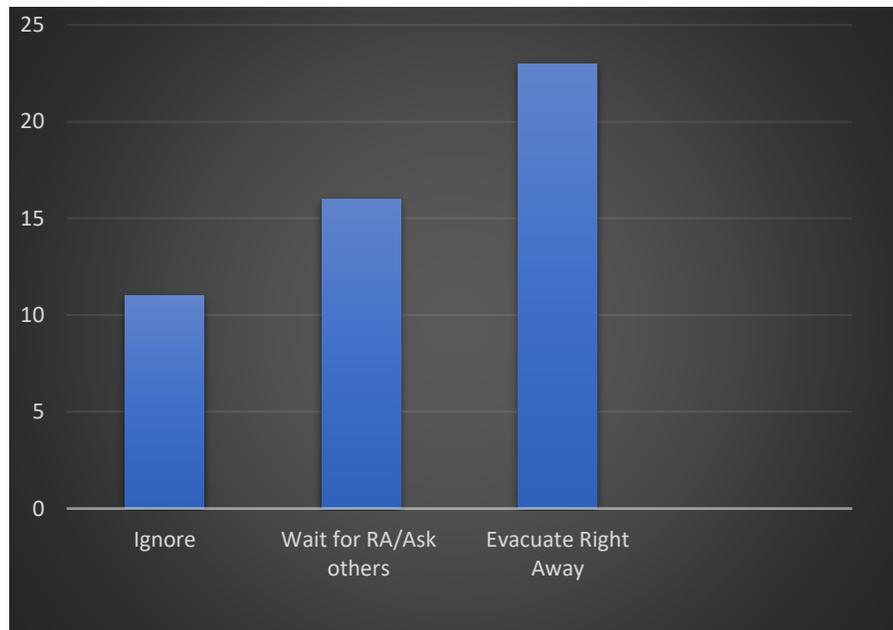*Figure 1- Fire Drills in the Yosemite Dorms*
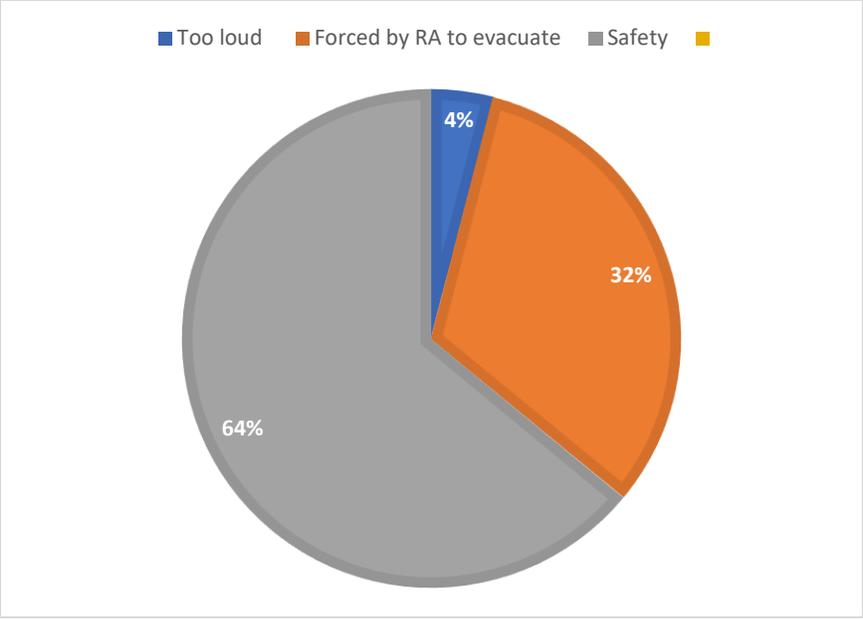

Figure 2- Student Response to Fire Alarms

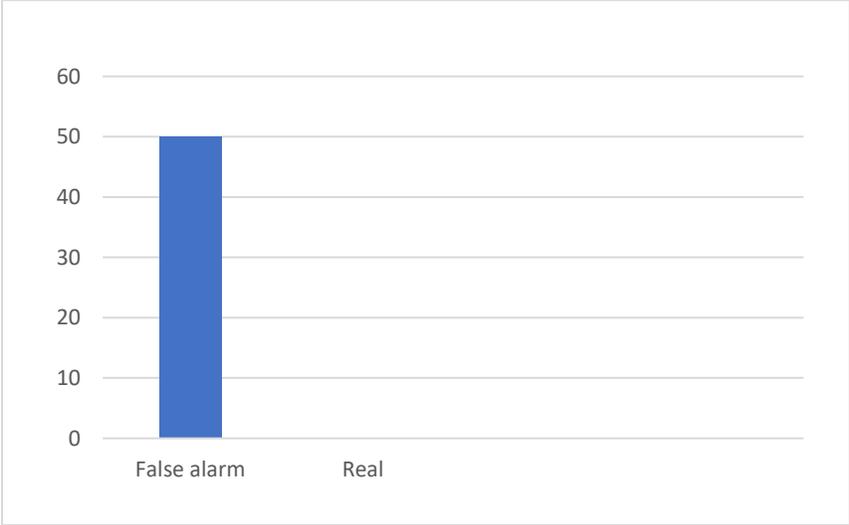*Figure 3- Reasons Why Students Evacuated in the Past*

Figure 4- False Alarm or Real

Discussion

The first graph showed me that all 49 students were exposed to at least one fire drill this year, with one outlier not being present during the drills. Cal Poly's fire prevention plan makes sure that students are exposed to at least 1 fire drill every quarter. Knowing this information, I could better understand the other results. The drills are facilitated by the RA's, which makes students put a lot of their sense of direction and urgency in the hands of the RA. Students do not practice as they would play because the RA's are getting the students together to meet down outside the dorms.

The second graph shows that 23 students would evacuate right away, 16 students would wait for others to decide a plan of action, and 11 students would ignore the alarm all together. Even though most students would evacuate right away, 27 students would not have a sense of urgency, which is the majority at 54%. Urgency is the most important factor in determining if students are going to make it out of the building if there is an actual fire. These results show that over years of being exposed to fire drills and false alarms, that students are more willing take the extra minutes to think twice about the alarm, rather than evacuate right away. The 16 students who would wait for others to decide a plan of action would most likely want a secondary form of notification. That is 32% of students who care about their safety but would rather take the risk to know for sure if the fire alarm is real or a false alarm.

The third graph shows the reasoning behind their responses. 64% of the students told me that evacuating is just the safest thing to do. They are not willing to take any risk waiting for others or hoping the fire alarm is a drill. Next, 34% of students said they would evacuate because the RA would force them too. During drills in the past, these students also said that the RA's would come door to door making sure that everyone that is in the dorm would evacuate. Lastly, 4% of students responded saying that they would get tired of the noise and evacuate until it's over.

Finally, the last graph shows if students would think the fire alarm is real or a false alarm. All 50 students responded saying that they would think the fire alarm is a false alarm or a drill. Fires have been so unlikely in the past that have never been exposed to a serious matter where their life was on the line. With this mindset, students will always think of fire alarms as something that is annoying and a burden to their everyday life.

From these results, it is easy to see that students are not taking fire alarms seriously. The third and fourth graph show that students might respond for a certain reason, but at the end of the day the fire alarms are always going to be an annoying burden. Students are not taking fire alarms seriously because of the countless drills and fire alarms they have been exposed to. From the face to face interactions, jocularity was seen on most of the students faces. Unfortunately, no one can force how students think about fire alarms, it is up themselves. Students living in the dorms, compared to people working in an office building, might have different mindsets when it comes to fire alarms. The students living in Yosemite think that they can easily get out of a three-floor small dormitory by acting with no urgency. But a person working in a big 20-floor office building might have different thoughts on the severity of getting out of a 20-floor building.

 Nothing about the traditional aspect of the fire alarms is preventing students from responding. Cal Poly's fire alarm and notification system put in place allows students every opportunity to evacuate and reach safety. They are alarmed by inspected and working fire alarms, which will never fail alerting you with a loud sound. The first responders will always act quick and get there to assess the situation. The one thing that is missing is fast secondary form of notification minutes after the fire alarm goes off to let students know if they can stay put or if they must evacuate. Students could benefit from this, but it is the safest bet to always evacuate when an alarm goes off. Once the students rely on themselves, then they can rely on the emergency management office to send out a poly alert or their RA's to let them know when it is okay to go back into the dormitory.

Conclusion

With 22% of students ignoring the fire alarm all together, that is 1,870 students out of an estimated freshman student population that would risk there lives when a fire alarm goes off. Fires will always be a rare occurrence, but that should never change the way you respond to fire alarms. Evacuation should be the only course of action when a fire alarm sounds off. No second thoughts and no relying on others or other aspects of notification, because your safety should be your number priority. As I continued to work on this project, I realized that newer technology for mass notification is not necessarily needed. Students need to first change the way they think about fire alarms, which will allow them to appreciate all they do to save people's lives. Once the alarm sounds off, it is up to your brain to be your secondary form of notification, which is to evacuate no matter what. For future research, I would like someone to survey the dorms once newer technology has been implemented to see if that makes a difference on student response to fire alarms. If I had time, I would have liked to implement newer technology utilizing text message notification into the dorms and see what students thought.

References

Ball, M. & Bruck, D. (2004). *The effect of alcohol upon response to fire alarm signals in sleeping young adults*, Melbourne, Australia: School of Psychology, Victoria University.

Bryan, J. (2002). *Behavioral Response to Fire and Smoke*. Fredrick, Maryland: Department of Fire Protection Engineering, University of Maryland.

Corich, S. (2008*). Campus Mass Notification: Is Your Campus Prepared for A Crisis*. MA. National Fire Protection Association Journal (NFPA).

Szymanski, T. (2013). *The Technical Aspect of Smoke Alarms*. Fort Atkinson, WI: SouthComm Business Media LLC.