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What They Didn't Know Hurt Them: Disseminating Risk Information to Prevent Disaster

Dr. Carolyn K. Dunn

ABSTRACT

Aside from adhering to current occupational safety and health laws, effective dissemination of safety information intended to prevent incidents is one of the keys to ensuring the health and well-being of any economic endeavor. This study investigates a plant explosion that killed six people, injured 38 more and completely destroyed a manufacturing facility that employed several hundred people and was an important part of the supply chain for a global corporation. The findings suggest that there were tangible opportunities to virtually eliminate the risks that contributed to the disaster.

INTRODUCTION

In January of 2003, the West Pharmaceutical Services manufacturing plant in Kinston, North Carolina suddenly and unexpectedly exploded, killing six workers and injuring 38 more. The plant itself was leveled, putting several hundred people out of work and shutting down a vital link in the company's supply chain. The United States Chemical Safety and Hazard Investigation Board (CSB) determined that a buildup of polyethylene dust above the plant's false ceiling ignited, causing the explosion. The CSB also determined that one of the key factors in failing to prevent the explosion was the failure to recognize the polyethylene dust as a combustible dust hazard, and the failure to communicate the hazard to the Kinston plant's more than 200 employees. This study examines the communication failures in this case and suggests ways in which manufacturing practitioners and plant managers can use these failures, along with common technical communication audience analysis techniques, to better inform risk communication procedures in their own facilities.

In the discipline of technical writing, students are taught to craft communication that is geared completely toward the audience using the information. Industrial managers and practitioners can also use this approach in crafting risk information for their employees. Audience analysis is certainly an integral part of technical writing. The idea of audience analysis in technical writing can be traced back to the 1950's (Johnson, 2004) and is a fundamental part of texts used to teach technical writing (Markel, 2010; Tebeaux & Dragga, 2010; Rubens, 2001; Robbins, 1996). Risk communication also

emphasizes the importance of understanding the audience. There are a variety of risk communication models: the risk perception model, the mental noise model, the negative dominance model and the trust determination model; all of them emphasize the importance of understanding the audience (Ferrante, 2010). However, the emphasis of risk communication seems to be geared toward communicating to a large, public audience and involves speaking as a delivery method (Ferrante, 2010). Technical writing, on the other hand, focuses on written communication, and the audience analysis involves identifying as many individual characteristics of the audience as possible.

The 'audience' for a technical document is the person or group of people that have to read, understand and use the document to learn or do something. Analyzing an audience means thinking about various characteristics of that audience, such as technical background and expertise, education level, and the way in which the audience will use the document. Those characteristics dictate the document's content and design. For instance, if engineers were the primary audience, the language might include technical jargon and references to theory without explaining either. Likewise, it could include detailed schematics or flowcharts that might be confusing to someone without an engineering background. Where the document is being used is also a factor. If it needed to be visible across a manufacturing floor, obviously the text and graphics would have to be large enough to be seen from a distance, and it likely would be made of a durable material such as metal or coated paper to withstand the environment in which it is being used.

Industrial managers and practitioners can use this type of analysis to augment a very common form of risk communication in manufacturing and industry – the Material Safety Data Sheet or MSDS. Occupational Safety and Health Administration regulation requires the chemical manufacturer to craft the MSDS to document the makeup and hazards of a particular chemical or product. That chemical or product then arrives at an industrial facility with the accompanying MSDS. The problem with some of these MSDS's are that they are written to satisfy Occupational Safety and Health Administration requirements, and thus the focus is on satisfying OSHA regulation, not necessarily creating a

user-centered form of communication. This study will also examine the gaps that MSDSs can leave in terms of communicating risk, especially in terms of combustible dust hazards. As this study suggests, it often becomes the industrial manager or professional that is responsible for making sure workers understand hazards in the workplace which means bridging the communication gap between the MSDS and the end user – the worker. Think about it in terms of a recipe. A recipe includes not only a list of ingredients, but also explicit instructions on how to mix those ingredients and cook that item. A recipe is a document specifically written with users in mind – not only do we need to know what is in that recipe, but how to put it together and cook it to make an end product we want to eat. What if industrial practitioners viewed their safety communication training in the same way? An MSDS may list certain ingredients and hazards, but unless these precautions are written in a way to communicate to the actual people who use these materials, are these workers protected from potential risk? Using audience analysis techniques, a knowledgeable practitioner could take the MSDS and craft risk communication that would help workers understand how those ingredients work and what risks they pose. This study examines two CSB investigation reports and synthesizes those reports to form an analysis of risk communication failures. The manuscript also introduces the concept of audience analysis and how it can be deployed to craft clear, user-centered hazard communication. It ends with a discussion of the implications of Occupational Safety and Health Administration Hazard Communication rules, and how utilizing audience analysis can help industrial practitioners satisfy both the current Hazard Communication Standard, and the version that will take effect in 2016. The goal is to examine the communication failures in this case and suggests ways in which manufacturing practitioners and plant managers can better tailor the information in a standard MSDS so that the workers in an individual facility better understand the hazards a material poses. As the manuscript will detail, the responsibility for informing workers of hazards often falls to the facility's managers. Understanding the audience will give practitioners and managers a tool to craft hazard communication that helps meet that responsibility.

BACKGROUND LITERATURE

In the wake of the West Pharmaceutical Services explosion in 2003, the CSB compiled a detailed report on the incident. Three years later, the CSB concluded an investigation on combustible dust incidents in the United States. Both reports are available on the CSB website, www.csb.gov. The reports were carefully examined and analyzed to assess what, if any, similarities exist between the West incident and other combustible dust incidents. The

analysis indicates that poor risk communication is cited as a factor across both reports. Given that, the concept of audience analysis in creating risk communication will be posed as one potential solution for what were deemed the failures in the West Pharmaceutical Services incident, and the underlying problems identified in the CSB's investigation of combustible dust incidents.

It's tempting to dismiss what happened in Kinston in 2003 as an anomaly or unimportant to the majority of manufacturing facilities, but neither claim would accurately portray the incident. The fact is that the West facility in Kinston did not store or work with any kind of dust per se; instead the dust was a by-product of the manufacturing process (United States Chemical Safety Board, 2004). The plant produced rubber components for medical implements, and the dust that fueled the explosion came from an 'anti-tack' agent used to ensure the rubber sheets the plant created did not stick together. Neither the workers nor the management understood that the dust created by the anti-tack agent was combustible. Furthermore, the dust explosion at the West facility was one of three dust explosions at U.S. manufacturing facilities in 2003 alone (United States Chemical Safety Board, 2006). The three incidents prompted the CSB to launch an investigation into combustible dust incidents in general and that investigation report was issued in 2006. The 2006 CSB report on combustible dust incidents indicated that combustible dust is not isolated to one particular industry or process (CSB, 2006). In the report, the CSB "identified 281 combustible dust incidents between 1980 and 2005 that killed 119 workers and injured 718, and extensively damaged industrial facilities. The incidents occurred in 44 states, in many different industries, and involved a variety of different materials" (CSB, 2006, p. 1). Food, wood metal and plastic were among the most common materials involved in the combustible dust incidents. In terms of property damage to the facilities where these explosions occurred, it is difficult to assign an overall number. The 2006 CSB report indicated that one insurance company responsible for insuring 22 facilities where dust related incidents occurred claimed each incident cost 1 million dollars. That figure does not include the cost of secondary losses from factors such as lost wages or disruption to the overall business (CSB, 2006, p. 32).

The 2006 CSB investigation and report on combustible dust incidents was prompted by several combustible dust incidents in the United States that occurred in a relatively short period of time. The CSB felt that the issue of combustible dust explosions warranted a full investigation and report (CSB, 2006). The 2006 investigation and report established that the concern about combustible dust was not limited to one type of facility or one type of dust. But it also established that the most common

form of hazard communication document used in industrial facilities – the Material Safety Data Sheet – or MSDS, often did not adequately explain the potential for a dust explosion (CSB, 2006). That was the case in the West Pharmaceutical Services explosion of 2003. In that incident, the MSDS for the polyethylene based anti-tack agent did not contain any reference to combustion hazards. However, the CSB investigation noted that West had information that indicated the polyethylene dust was a combustion hazard, but failed to realize it. Years before the 2003 explosion, West used a polyethylene powder in small amounts as an experimental anti-tack agent at another manufacturing facility. The MSDS for the *powder* noted that it was a dust explosion hazard, and that MSDS was passed to the Kinston plant in 1992. However, when West began widely using the polyethylene based anti-tack agent, it was not in powder form – it was in *paste* form, and the MSDS that arrived with the paste form said nothing about the possibility of a combustion hazard. The CSB criticized the review process that led to the paste form being used because it did not include reviewing the material on the powder form of the anti-tack agent. The CSB contended that a thorough review by West engineers could have potentially alerted West officials that the dust was a combustion hazard (CSB, 2004).

The CSB also found that West's hazard training did not inform the workers at the plant that the polyethylene dust was a combustion hazard. It is one of the tragedies of this incident that some workers knew the dust was building up above the plant's ceiling tiles, but they did not know that it was cause for concern. In the aftermath of the explosion, several workers reported seeing a layer of dust sitting on the tiles in the suspended ceiling; this dust was not visible unless the ceiling tiles were lifted and an employee looked above them, which a number of employees had done. The CSB noted in its 2004 report of the West incident that "The system of safety is best served by well-informed workers, who are more likely to identify accumulations of combustible dust in less traveled plant areas and to raise their concerns to management" (CSB, 2004, p. 51).

In the West incident, the CSB concluded that there were four *root* or primary causes of the explosion. They were: an inadequate engineering review of the anti-tack agent, a failure to consult relevant fire standards, a review system of MSDS that failed to identify combustible dust hazards and a hazard communication program that failed to both identify combustible dust hazards and communicate those hazards to employees (CSB, 2004, p. 59). Two of these four root causes dealt with a lack of risk awareness and communication.

There is one factor amidst the CSB's findings on the West incident that industrial practitioners should perhaps note. The CSB found that the MSDS supplied by the vendor of the paste based anti-tack

agent did not address the "end use hazard" of the material. In other words, the potential for dust combustion. But this omission was deemed a *contributing* cause of the explosion, not a root cause. The CSB placed the preponderance of the responsibility squarely on West Pharmaceuticals. This has implications for all industrial managers. What the CSB report infers is that the final responsibility for both recognizing hazards and informing the workforce of those hazards lies with the personnel at the facility itself. This means industrial managers cannot take the MSDS provided by the chemical manufacturer at face value; they need to be proactive in both recognizing and communicating hazards. Accomplishing this means understanding the elements of good risk communication, and blending those elements with technical writing concepts to form a user centered hazard communication process.

Both risk communication and technical writing emphasize the importance of understanding the audience. Risk communication theory and technical writing also align in a number of areas connected to this idea. 'Good' risk communication messages, like 'good' technical writing, avoid jargon and technical terms an audience may not understand and make use of graphics to augment understanding (Ferrante, 2010). Both also stress the importance of including stakeholders in crafting the message. In risk communication, this translates into locating groups of stakeholders and including them in the process (Ferrante, 2010). In technical writing, this often translates into using focus groups to test the usability of the written documentation to see if it 'works' (Markel, 2010).

FINDINGS

The implication of the West incident in particular and the CSB's overall study of combustible dust incidents in general highlight the importance of two things: complete, correct and clear MSDS, and adequate hazard communication and training for workers that deal with combustible dust. This means that the MSDS must contain all of the relevant information on the chemical agent and communicate it in a way users can easily understand. When that MSDS reaches a facility, managers then have to make sure workers understand what it contains and can safely use the chemical it addresses. Both of these issues can be problematic.

The Occupational Safety and Health Administration requires that manufacturers identify the risks of using particular chemicals. This is done through the use of a MSDS, which the manufacturer passes to the user. It is then the user's responsibility – a facility manager, for instance – to interpret the data in the MSDS and adequately inform and train workers regarding the risks of that chemical. It is a chain, more or less, beginning with the manufacturer of the chemical and ending with the well

informed user. But what occurs when one link in that chain is broken? The 2006 CSB investigation on combustible dust incidents highlights the fact that many times, the information in MSDS is inadequate or even confusing (CSB, 2006). In the 2006 report, the CSB reviewed 140 MSDS's for materials known to be combustion hazards to judge how well the MSDS communicated the explosion hazard (CSB, 2006). Forty one percent did not contain any warnings regarding the combustible dust hazard. Fifty nine percent contained some language that referred to the explosive capacity of the dust; however, in many cases the language was unclear and not easily accessible. The CSB noted that only seven of the 140 MSDS reviewed referenced the National Fire Prevention Association's (NFPA) standard for addressing dust hazards, which is widely seen as the benchmark for controlling combustible dust. Even those seven however, did not express the danger clearly, with the CSB indicating "the nature and placement of combustibility warnings did not clearly emphasize the explosion potential of these materials" (CSB, 2006, p. 38). The CSB's review indicated that only ten percent of the MSDS that contained a dust hazard warning put the warning itself in the MSDS's 'Hazard Identification' section where users could most easily access it (CSB, 2006). Finally, the CSB report noted that none of the MSDS's reviewed listed the "physical properties necessary to determine the explosion potential of the material" (CSB, 2006, p. 38) and that even those that recommended controlling dust accumulation did not explain how doing so would lessen the chance of an explosion.

Even a perfectly crafted MSDS can present problems. Depending upon the workforce, relying on a technical document such as an MSDS to fully communicate risk may be problematic, and the subsequent training and communication from an employer needs to take the audience's needs into account. At the West plant in Kinston, for instance, the majority of the workers were what would be considered working class, blue collar employees with a high school education or less. Therefore, industrial managers employing workers with a similar background should consider the technical background and literacy level of workers and whether or not those workers can interpret the technical language in an MSDS. Attitude can be a factor as well. Risk communication is a technical enterprise, and sometimes viewed by employees with "suspicion, confusion, ignorance and disagreement" (Caccia, 2007, p. 166). A disparity can also exist between the perception of risk among employers and employees that can cause tension, with employers assessing a lower level of risk than the employees themselves do (Caccia, 2007). Similar concepts are documented in risk communication literature. Risk communication theory emphasizes understanding the difference between the perception of risk and the actual risk (Ferrante, 2010).

Risk communication also emphasizes the importance of gaining and keeping an audience's trust. Cole and Fellows (2008) documented the failure of risk communication messages during and after Hurricane Katrina; failures blamed at least in part on the audience's mistrust and suspicion of those delivering the messages. Fast-paced or high stress work environments can also lead to less communication in the sense that workers may adopt a 'collective mind' with each person focusing on his or her task to get the overall job done (Cyphert, 2007). In this type of environment, having to stop and communicate or articulate commands is viewed as dysfunctional (Cyphert, 2007). And finally, in many facilities, blue collar, working class employees are not encouraged to question policies or procedures established by their bosses (Caccia, 2007), which means questions about safety or hazards may go unasked. In essence, the power imbalance between worker and employer can act as an impediment to communicating risk.

ANALYSIS AND DISCUSSION

As Goldworthy et al (2010) noted, hazard mitigation is often part of the product design process, with the hazard first being 'designed out' of the product. When the hazard cannot be removed through better design, organizations create procedures to lessen the risk, and those procedures involve educating workers regarding the risk (Goldworthy et al, 2010). Training and education involve analyzing the audience, because "if we do not fully understand whom we are safeguarding, our efforts to reduce risk and mitigate adverse outcomes will be less effective than they otherwise could be" (Goldworthy et al, 2010). Audience analysis essentially begins by first defining the primary audience. The primary audience in this case is the group of people who will actually be *using* that document. Once the primary audience is identified, the analysis then focuses on the characteristics of that audience. What kind of professional experience does this audience have? Would they be considered subject matter experts? Do they have advanced degrees and/or a high knowledge of theory and application? Or is their knowledge more practical, focusing on items such as maintenance and use of equipment? A person with an engineering degree, for instance, and/or a wealth of professional experience would more than likely understand complex writing using technical jargon and long, compound sentences. Someone with less expertise might not. One can see how analyzing professional experience might dictate word choice in a document. Another characteristic to consider is the audience's attitude toward the material. How does your audience view risk communication and safety training in general? As helpful and enlightening, or as a waste of time that interferes with the 'real work' of the facility? As noted, working class employees can view risk com-

munication with suspicion (Caccia, 2007). Giving it to them in a clear format designed specifically for them may indicate that ‘the bosses’ understand their needs, which may help reduce the tension surrounding the communication. It may also be helpful to include some of these employees in the actual production of the documentation. Understanding workers’ needs, how they use the document, and what they feel is important to include can definitely make the document more useful, making the employees feel more engaged. Other individual characteristics to consider are the literacy levels of the audience. Can the audience not only read, but understand the words in the document? Does that audience speak English as a second language? If literacy is an issue, the document should contain short sentences, very clear, fairly simple language, and graphics that augment the text (Markel, 2010). Once the individual characteristics of the audience are taken into consideration, the final step in audience analysis is to consider how the audience will be using the document. Do they need to refer to the document before completing each step in a process? If so, make sure the document has a spiral binding so it will lie flat, or that it is permanently affixed to the piece of equipment the worker is using. Will the document need to be seen from a distance away? Then consider printing it in larger font. Are weather or humidity a factor? Those considerations may dictate how the document is displayed, and on what kind of media.

Employing audience analysis to craft more effective risk communication is a fairly simple and inexpensive process. Yet it can help manufacturers and industrial managers better meet their responsibility in the aforementioned ‘chain’ of communication dictated by OSHA. The CSB placed the bulk of responsibility for what happened in Kinston in 2003 on West Pharmaceuticals, even though the MSDS for the anti-tack agent was deemed faulty (CSB, 2004). The implication is that the industrial manager cannot take the MSDS at face value. He or she has to identify problems with the MSDS and address those problems with communication and training suitable to the end users. This diligence may be even more critical when combustible dusts are involved. In the wake of its 2006 report on combustible dust incidents, the CSB requested that the Occupational Safety and Health Administration adopt a combustible dust standard for general industry. OSHA has yet to adopt such a standard.

However, OSHA has recently altered its hazard communication standard (HCS), which was originally implemented in 1983, and this change has implications for all chemical hazards – not just combustible dust hazards. On March 20, 2012, OSHA announced a change to the HCS that may strengthen the argument for implementing audience analysis in crafting risk and hazard communication. The changed HCS requires improved

labeling and identification of hazards in an effort to make them better *understood* by workers – especially low literacy workers. As OSHA officials noted, the emphasis of the old version of the HCS was the worker’s right to know while the emphasis of the new version is the worker’s right to understand (OSHA, 2012). The change in the HCS takes effect in 2016 and is better aligned with the United Nations’ Globally Harmonized System of Classification and Labeling of Chemicals. The new version of the HCS will classify chemicals based on physical and health risks and standardize labeling and MSDS for chemicals made in the United States and those that are imported from abroad.

If the emphasis in this new version of the HCS is on providing clear risk information workers (especially those with low literacy levels) understand, and the goal of audience analysis is to help writers craft clear, user-centered risk communication, then audience analysis techniques could be a useful tool in helping manufacturers and other industrial managers comply with this new standard. Creating communication that workers understand means analyzing who those workers are and applying that knowledge in writing documentation that caters to the user is the goal of audience analysis.

In the case of the 2003 West Pharmaceutical Services explosion, the company did adopt the recommendations made by the CSB. The CSB made a number of recommendations to not only West Pharmaceuticals, but to the state of North Carolina as well. Of the five recommendations made to West Pharmaceuticals, three dealt with identifying hazards and two dealt specifically with communicating those hazards to the workforce, which again highlights the importance of both recognizing and communicating hazards for facility managers. The CSB also urged the North Carolina Department of Labor, Occupational Safety and Health Division to identify other companies in the state that may be at risk for dust explosions, and develop an outreach program to make those companies aware of the dangers. The CSB finally recommended that the North Carolina Building Code be amended to address dust explosions in manufacturing, and that building and fire code officials be trained on how to identify the hazards of dust. According to the CSB, these recommendations were adopted, and the investigation into the West Pharmaceutical Services explosion has been closed, with the action taken by West and the various state entities deemed “acceptable” (CSB, 2004).

As for the recommendation to OSHA that a national dust combustion standard be adopted, there is no official timeline for when (or if, given the recent change in OSHA’s Hazard Communication Standard) that might occur. As recently as February, 2012 the CSB commented: “Our 2006 report revealed there is no national regulation that adequately addresses combustible dust explo-

sion hazards in general industry. Although many states and localities have adopted fire codes that have provisions related to combustible dust, a CSB survey found that fire code officials rarely inspect industrial facilities to enforce the codes. The board clearly stated that American industry needs a comprehensive federal combustible dust regulation” (Moure-Eraso, 2012). This statement makes

clear that the gap in understanding and enforcement of combustible dust hazards in the workplace is widespread. Without adequate direction from an MSDS or oversight by fire and code inspectors, making sure risk communication in the workplace is easily understood and accessed by the workers facing those risks is even more critical.

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