

AN INCIDENT INVESTIGATION PROCEDURE FOR USE IN INDUSTRY

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A Research Paper
Submitted in Partial Fulfillment of the
Requirements for the
Masters of Science Degree in
Risk Control

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Abstract

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An Incident Investigation Procedure for Use In Industry			
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Risk Control	Dr. Elbert Sorrell	May 2002	48
(Graduate Major)	(Research Advisor)	(Month/Year)	(No. of Pages)
<hr/>			
American Psychological Association Manual			
(Name of Style Manual Used in this Study)			

The purpose of the study is to develop an effective incident investigation procedure that may be utilized by Company XYZ as a valuable tool to reduce and prevent losses from occurring. In order to accomplish this, a review of pertinent literature was conducted along with first hand participation in incident investigations at a Minnesota manufacturing facility. By reviewing the literature related to incident investigations and identifying shortcomings in the existing procedure, recommendations were provided to ensure the incident investigation procedure will be a valuable tool to reduce and prevent losses.

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Chapter 1

Statement of the Problem

Introduction

The Location

The location for this study was Company XYZ in Minnesota (at the request of the corporation, the company will remain anonymous). Company XYZ is a heavy manufacturing facility with approximately 1600 employees that operates 24 hours a day, 7 days a week.

Costs of Losses in Industry in the United States

In the United States in 2000, there were 5200 workplace fatalities. This calculates to 3.8 deaths per 100,000 workers for the year 2000 alone. Also in 2000, 3.9 million American workers suffered disabling injuries. Work injuries cost Americans \$131.2 billion in 2000, a figure that exceeds the combined profits of the top 13 Fortune 500 companies (National Safety Council, 2000). In addition to the losses mentioned previously, tens of billions of dollars are also lost in destroyed equipment and material where no injury was involved (Ferry, 1988).

Role of Incident Investigation

Injuries that occur in the workplace have many negative effects on a company. Insurance costs increase, productivity may decrease and training costs increase as employees are moved into unfamiliar jobs as well as other potential drains on company resources. To preserve both the human and financial assets of a company, it is vital to have tools in place that focus on reducing losses.

A common tool to guide the loss reduction efforts of a company is the accident/incident investigation. Accident/incident investigations most often occur post-loss. The function of the investigation is to identify the root causes of accidents and determine what corrective action needs to occur to prevent future losses. The root cause is defined by Ted Ferry, an author of several books on incident investigation, as, “The management system that allows the substandard practice to be committed or the substandard condition to exist.” Incident investigations may also be performed in situations where loss has not occurred, but has the potential to occur. Larry W. Sorrell, a CSP with significant experience in accident analysis, supports the investigation of all hazards, even concerns, to prevent an accident from happening or happening again (Sorrell, 1998). Whether an investigation occurs post-lost or to prevent a loss, the goal remains the same: identify the root cause and determine corrective action.

In addition to identifying the root cause of a loss, accident/incident investigations also serve other purposes. One purpose is to ensure that the injured employee receive the workers compensation benefits they are entitled to. A poorly written investigation report may result in an injured employee’s claim being denied. As well as protecting employees following an injury, the incident investigation process also functions to protect the company from false claims (Sorrell, 1998).

Carter and Menckel (1990) expressed the importance of accident/incident investigation procedures by writing, “Most accident prevention efforts are based on knowledge gained from accidents and, consequently, it is important to learn as much as possible from each accident.” By identifying the root causes of a loss producing event

and implementing corrective action, the potential for reoccurrence and associated losses is reduced. This is the value of the accident/incident investigation process.

Company XYZ has an investigation procedure in place, but it has a lot of room for improvement. The general flow of an investigation begins with a loss producing event, either injury or damage to product/equipment. The department manager will print off the generic form from their computer, and write the basic facts of the accident/incident. Next, the investigation will have to be scheduled which requires a significant amount of communication to ensure that all members of the team are informed of the date and time the investigation will take place. The location is always the same, the plant manager's office. When the team gathers for the meeting, the accident/incident is recounted and details provided by the employee, the department manager, witnesses, engineers (if necessary), and the department safety leader. Others in attendance include the plant manager, members of Health Services, and members of the Environmental, Health, & Safety department. If necessary, the team may go to the incident location. Finally, corrective action is determined, the action is written down in the appropriate section on the printed form, and the meeting is adjourned.

The inefficiencies of this process are many and include: near-misses are ignored, too much time is spent to communicate basic information to team members, the current form is inadequate to meet the needs of the investigation, lack of an accessible database of past accident/incidents with corrective actions to allow follow-up of current reports and to review past action, and the meeting location is inappropriate. From this list of inefficiencies, it is clear that the process at Company XYZ needs to be revamped from the ground up to be a valuable tool to prevent the occurrence of loss.

When properly done, Company XYZ and its employees will realize the benefits of a thorough accident/incident investigation. However, when these investigations are not efficiently performed, the result is a waste of time and effort for all parties involved.

Statement of the Problem

The incident investigation procedure at Company XYZ in Minnesota is not an effective tool to address the need of the company to investigate loss producing events or conditions. As a result, incidents were either not being investigated at all, or if they were, the investigation was incomplete. By neglecting to investigate loss producing incidents, or even near-miss activity, an opportunity to prevent/reduce future losses is not realized.

Purpose of the Study

The purpose of the study was to develop an effective incident investigation procedure that may be utilized by Company XYZ as a valuable tool to reduce and prevent losses from occurring.

Goals of the Study

- 1.0 Analyze the current incident investigation process in place at Company XYZ.
- 2.0 Identify the elements of an effective incident investigation procedure.
- 3.0 Develop a process to guide investigations at Company XYZ that ensures investigations are a useful loss prevention tool.

Background and Significance

Incident investigations have the potential to be a valuable tool when they are effectively used in industrial settings. When properly used, they serve as an efficient means to identify the root problem that resulted in the incident as well as determine

effective corrective action. Incident investigations function to continuously improve operations at a facility to reduce human losses, financial losses, and material losses.

Conversely, they also have the potential to be exercises in frustration if they are improperly implemented and used. The current system in place at Company XYZ has been identified as an area of improvement due to the determination that the accident/incident investigation procedure does not provide an effective, efficient means to track past accident/incidents, report new ones, and refer to past corrective action to determine the effectiveness of recommended corrective actions.

Profits and losses at Company XYZ are provided in percentages at the request of the company. In 2001, profits before interest and taxes were 5.6% of sales while workers compensation costs consumed 4.2% of profits. By reducing workers compensation losses, these dollars will be added directly to profits, increasing the profit margin of Company XYZ.

Limitations

This study was limited to the needs of a single manufacturing facility. While the process fit in well with work practices at Company XYZ, the process may need further modification for use in other locations.

Definition of Terms

Accident – An undesired event that results in harm to people, damage to property or loss to process (Bird & Germain, 1985).

Accident/incident – An undesired event that, under slightly different circumstances, could have resulted in harm to people, damage to property or loss to process (Bird & Germain, 1985).

Immediate Cause – The circumstances that immediately precede the accident.

Immediate causes may be broken down into two categories, substandard practices and substandard conditions (Bird & Germain, 1985).

Basic Cause/Root Cause – The management system that allows the substandard practice to be committed or the substandard condition to exist (Bird & Germain, 1985).

Corrective Action – Activity that is conducted to prevent the existence of a substandard condition or prevent the substandard act from being committed.

Chapter 2

Review of Literature

Introduction

The purpose of the literature review is to provide an examination of the financial impact of loss to organizations across the United States, in the state of Minnesota, and at Company XYZ. After that, two models of loss causation will be reviewed to gain a better understanding of the loss process. Further, the literature review will define the incident investigation process and describe its value as an effective tool to prevent loss by interrupting the loss process. Next, a discussion of root cause analysis and cause and effect diagramming is provided to review their relationship with incident investigations. Finally, a review of the incident investigation procedure that is currently utilized by company XYZ in Minnesota will be provided.

Cost of Injuries

In the United States in 2000, there were 5200 workplace fatalities. This calculates to 3.8 deaths per 100,000 workers for the year 2000 alone. Also in 2000, 3.9 million American workers suffered disabling injuries. Work injuries cost Americans \$131.2 billion in 2000, a figure that exceeds the combined profits of the top 13 Fortune 500 companies (National Safety Council, 2000).

In 1998, work injuries killed 84 Minnesota workers and approximately 164,000 Minnesotans were hurt or became ill from job related causes. Also in 1998, the total cost of workers compensation for Minnesota companies was estimated at 1 billion dollars (U.S. Bureau of Labor Statistics, 2002). Costs not included in the worker's compensation figure are indirect costs such as delays in production, administrative costs

of hiring and training new workers, pain and suffering, and economic costs to injured workers and their families not covered by workers compensation (Minnesota Safety Council, 1999). From 1994-1996, traumatic injuries and disorders accounted for 89.6% of the total days away from work with about half of these (46.1%) due to strains and sprains (U.S. Bureau of Labor Statistics, 2002).

Profits and losses at Company XYZ are provided in percentages at the request of the company. In 2001, profits before interest and taxes were 5.6% of sales while worker's compensation costs consumed 4.2% of profits. By reducing worker's compensation losses, these dollars will be added directly to profits, increasing the profit margin of Company XYZ.

The drains on a company when an employee is injured may be significant, especially when considering the direct and indirect costs of the injury. Direct costs of an injury include medical costs and worker's compensation costs while indirect costs may be far in excess of the direct costs after considering the costs of replacement employees, extra training, legal costs, overtime, lost product, decreased productivity, and so on. Companies have a financial interest in preventing injuries to their employees. The employee also has an interest preventing his or her own injury. Temporary or permanent loss of abilities, disfigurement, and pain that are a result of an on the job injury are just a few of the burdens that the employee will have to bear, potentially for the balance of their life. When actions are taken to reduce injuries, both the company and the employee enjoy the benefits of the effort. The causes of loss in an organization can prove to be elusive if the source is not methodically investigated. To

provide a model to guide investigation procedures, several loss causation models exist, two of which are detailed in the following section.

Loss Causation Models

There are numerous accident and loss causation models in existence. The two that will be detailed in this section will be H.W. Heinrich's Domino Theory and the ILCI Loss Causation Model. Loss causation models are used as models for safety and accident prevention theory. Loss causation models provide a direction of focus for the individual interested in reducing injuries in an organization. Heinrich's principles date back to 1932 and encourage focusing on near misses instead of injury-related incidents to prevent significant losses from occurring (Fulwiler, 2002). The International Loss Control Institute developed their own model in 1985, the ILCI Loss Causation model, to provide users a tool to control the vast majority of accidents and loss control problems (Bird & Germain, 1985). The ILCI model encourages focusing on development of standards, the measurement and evaluation of standards to ensure they are being followed through by members of the organization, and the continuous update of standards to provide a means to prevent injuries in an organization. A more detailed account of each of these loss causation models follows starting with Heinrich's theory.

H.W. Heinrich's Domino Theory of Loss Causation

In his 1932 book "Industrial Accident Prevention", H.W. Heinrich wrote that there are five factors in the accident sequence. The first factor is the social environment and ancestry. Traits such as recklessness, stubbornness, avariciousness, and other undesirable character traits may be passed along through inheritance. The second factor is the fault of the person. This factor states that inherited or acquired traits of the

person; such as violent temper, lack of consideration, ignorance of safe practice, etc., are responsible for the person committing unsafe acts or allowing the existence of mechanical or physical hazards. The third factor is the unsafe act and/or mechanical or physical hazard. Unsafe acts include standing under suspended loads, failure to adhere to lock-out/tag-out policy, horseplay, and removal of safeguards. Mechanical or physical hazards include such items as unguarded machinery, unguarded pinch points, and insufficient light. The fourth factor is the accident. The accident includes events such as slips and trips, being struck by flying objects, being caught in machinery, or coming into contact with high energy sources. Finally, the fifth and last factor is the injury. Injuries include fractures, lacerations, etc., that result directly from accidents (Heinrich, 1932).

Heinrich then arranges these five factors in a domino fashion such that the fall of the first domino results in the fall of the entire row. The domino arrangement illustrates Heinrich's notion that each factor leads to the next with the end result being the injury. It also illustrates that if one of the factors (dominos) is removed, the sequence is unable to progress and the injury will not occur. While it may be difficult or impossible to change a person's attitude (the first and second domino), proper supervision can guide the person's behavior so that they do not perform a substandard act or allow a substandard condition to exist (the third domino) which leads to an accident (the fourth domino) that leads to an injury (the fifth and final domino).

Heinrich also developed a pyramid shaped model to explain the relationship of near-miss accidents to minor injuries and major injuries. Heinrich's pyramid states that for every 300 near-miss incidents, there will be 29 minor injuries, and 1 major injury.

This pyramid summarizes Heinrich's belief that near miss incidents must be prevented in order to eliminate the possibility of reaching each successive level of the pyramid.

Figure 1 depicts Heinrich's pyramid.

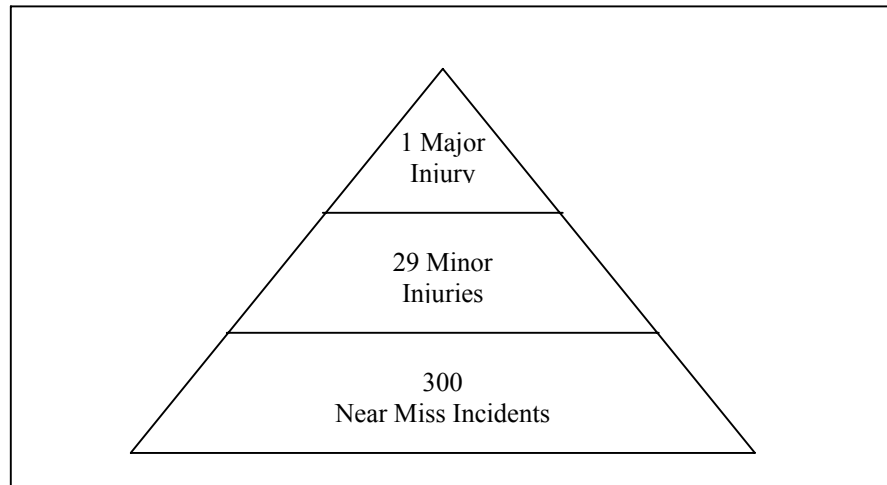


Figure 1

While the terminology and thinking found in Heinrich's Domino Theory of Accident Prevention are dated, the process remains worth review. Properly training employees and managers insures that the management system is working in concert with employees to reduce the occurrence of near misses that, in turn, reduces the opportunity for more severe injuries to occur. A major flaw with Heinrich's model is that it relies on a single cause that leads to an incident. Rarely is an incident the product of a single cause; more likely, an incident is the result of several factors that occurred simultaneously to produce the incident or loss. A more up to date and complete model of loss causation is the ILCI Loss Causation Model that dates to 1985. Where Heinrich focused on reducing the incidence of near misses, the ILCI model focuses on development of performance standards and enforcement of standards to ensure that employees are performing their work in a safe manner. With emphasis on performance

standards, the ILCI model takes a proactive approach to loss prevention and suggests that losses are due to a breakdown in these standards. A closer look at the ILCI model follows.

ILCI Loss Causation Model

The International Loss Control Institute has developed the ILCI Loss Causation Model. Like Heinrich's Domino Theory, the ILCI model is based on a sequence of events that leads up to an eventual loss. The events in sequential order are, Lack of Control, Basic Causes, Immediate Causes, Incident/Contact, and Loss (Bird & Germain, 1985).

Each event has a role in continuing the loss process to its conclusion, the Loss. To facilitate a better understanding of the ILCI model, the events will be reviewed in reverse, starting from the end with the Loss (injury or damage to property) and working back to Lack of Control (inadequate program or inadequate compliance to standards).

To begin, Loss is the result of an accident. Loss can be direct or indirect, both of which must be considered to fully appreciate the impact to a company. Direct loss includes some or all of the following; harm to people, damage to property, or a reduction/halt in productivity. Indirect costs may include, but are not limited to, increased training costs to replace injured employees, legal expenses, investigation time, and loss of business due to unfavorable press. The ILCI Loss Causation Model estimates that for every dollar of direct loss, the indirect costs may be six to fifty-three times as much. Both direct and indirect costs of injury and illness are deducted directly out of profit; conversely, when dollars are saved from accidents the organization realizes increased profits (Bird & Germain, 1985).

Prior to the Loss, the Incident occurs that may or may not result in injury to a person or damage to property. A person or object is able to absorb a given amount of energy without harm, however, when the amount of energy exceeds the amount that may be safely absorbed, injury or damage results. This not only applies to an objects kinetic energy that contacts the person or property, but also electrical energy, acoustic energy, thermal energy, radiant energy, and chemical energy (Bird & Germain, 1985). The American Standard Accident Classification code lists some of the more common types of energy transfers which include:

- Struck against (running or bumping into)
- Struck by (hit by moving object)
- Fall to lower level (either the body falls or the object falls and hits the body)
- Fall on same level (slip and fall, tip over)
- Caught in (pinch and nip points)
- Caught on (snagged, hung)
- Caught between (crushed or amputated)
- Contact with (electricity, heat cold, radiation, caustics, toxics, noise)
- Overstress/overexertion/overload

Continuing up the chain of the ILCI model, Immediate Causes precede the Incident. Immediate Causes are subdivided further into substandard practices and substandard conditions. While Heinrich used the term unsafe act or conditions to describe the direct cause of injuries, use of the term “unsafe” has fallen out of favor with current trends in accident prevention. The term “unsafe” calls the organization’s ability to identify obvious problems into question, a potential problem in today’s

litigious society. The term “substandard” acknowledges that organizations have standards of performance that are to be followed by all employees and is the accepted term used today.

When substandard conditions and/or practices are allowed to occur in a facility, there is always the potential for an energy transfer that is beyond the persons/objects ability to absorb without damage. To clarify substandard practices and substandard conditions, the following examples are provided:

Examples of substandard practices would include:

- Operating equipment without authority
- Improper loading
- Horseplay
- Under influence of alcohol and/or other drugs

Examples of substandard conditions would include:

- Inadequate guards or barriers
- Defective tools, equipment or materials
- Poor housekeeping; disorderly workplace
- Inadequate ventilation

Prior to the Immediate Cause of the loss are the Basic Causes. Basic Causes must be identified and addressed to allow a more effective control of losses. The Basic Causes help to explain why people perform substandard acts or allow substandard conditions to exist. The ILCI model divides the Basic Causes into two categories, personal factors and job factors. Personal factors include lack of knowledge, skill, or inability to handle pressures of the job while job factors include such items as

inadequate training, inappropriate equipment and tools, worn equipment and tools, or inadequate equipment and tools (Bird & Germain, 1985).

Lack of Control is the initial step that leads to Basic Causes and allows the sequence to proceed to the eventual loss. According to the ILCI model, there are three common reasons for lack of control; inadequate safety/loss program, inadequate safety/loss program standards, and inadequate compliance with standards. First, an inadequate program occurs when there are too few program activities to address the needs of an organization. Necessary programs will vary depending on the size of the organization, work performed at the organization, and the methods to perform the work. Common elements of an effective program according to the ILCI model include management and employee training, personal protective equipment, engineering controls, planned inspections, task analysis, emergency preparedness, and incident investigations. Second, inadequate program standards occur when organizations standards are not specific enough, not clear enough, or are not high enough. Program standards need to let people know what is expected of them as well as provide them with a tool to measure their performance against the standard. Third, inadequate compliance is a factor that leads to Lack of Control. Most managers agree that inadequate compliance is probably the single greatest reason for loss. Poor compliance with effective program standards is due to ineffective communication of standards to employees or a failure to enforce standards (Bird & Germain, 1985).

In summary, the ILCI Loss Causation Model indicates that losses begin with a lack of control. With a lack of control, basic causes such as lack of training or inadequate tools and equipment are allowed to occur/exist. These basic causes lead to

the immediate causes, which are the existence of a substandard condition or the performance of a substandard practice. Immediate causes lead to the incident itself, and conclude with the loss. The loss may be to people, property, product, the environment, or the organization's ability to provide its services.

It is important to note that it is not the intent of the ILCI model to place blame on individuals for committing substandard acts or for allowing substandard conditions to exist, but rather to encourage managers to evaluate the management system that influences human behavior (Bird & Germain, 1985). Richard Speir, a consultant with over two decades of safety experience, agrees that punishment should never be inflicted as the result of an accident investigation (Speir, 1998). By punishing the employee, attention is shifted away from the management system that allowed the loss to occur in the first place. The following questions may be asked to maintain focus on the management system to identify where the breakdown occurred that led to the loss:

- Why did that substandard practice occur?
- Why did that substandard condition exist?
- What failure in our supervisory/management system permitted that practice or condition?

The ILCI model starts with a lack of control. Control is within the four essential functions of management, which are to plan, lead, control, and organize. Taking this into consideration, it may be summarized that a loss is indicative of a failure on management's part to perform one of its essential functions. By asking the right questions, the lack of control in the management system may be identified and

addressed to prevent the sequence of events from occurring that leads to the eventual loss.

Summary of Loss Causation Models

As detailed in the ILCI model and H.W. Heinrich's model, loss is very rarely the result of random occurrences. Upon close examination, the steps that led to the loss may be identified and the cause of the loss defined. This knowledge may then be used to examine similar areas of the organization for shortcomings to ensure that the loss does not continue to occur. The process of examining past losses and applying the knowledge gained to prevent further losses is the heart of a process known as the incident investigation.

Incident Investigation

OSHA's Take on Incident Investigation

OSHA describes incident investigation as a procedure to determine how and why failures occur that result in personal injury or property damage. OSHA further breaks down the direct cause of an incident, the indirect cause, and the basic (root) cause of an incident. The direct cause is the energy or hazardous material that a person or object receives that cannot be absorbed safely. The direct cause is usually the result of one or more unsafe acts, unsafe conditions, or both. The indirect cause is the substandard acts and substandard conditions that allowed the direct cause to occur. Finally, an unsafe act or condition is usually traceable to a fault in the management system. This fault in the management system is the root cause (OSHA, 2002). The OSHA definitions of direct cause, indirect cause, and root cause follow the ILCI model quite closely. Where OSHA identifies a root cause, ILCI identifies a lack of control;

where OSHA identifies an indirect cause, ILCI identifies immediate causes; and where OSHA identifies a direct cause, ILCI identifies an incident.

While incident investigation is a tool frequently used in industry in an attempt to reduce losses, they are just one of the loss prevention tools used in an organization. Incident investigations are essential if management is to “profit” from errors that have resulted in loss (Ferry, 1988).

Proactive and Reactive Incident Investigation

At the most basic level, the function of an incident investigation is to determine the root cause of an incident and determine the necessary corrective action. Gene Ernest warns of taking a reactive approach to incident investigations. Too often, incident investigations focus on the direct cause of an incident and develop corrective action to address the direct cause. For example, an employee operating an industrial truck runs into another truck causing damage to both. Upon investigation, it is determined that the brakes on the truck the employee was operating failed. The reactive corrective action would be to check the brakes in all trucks to ensure they are working properly. The proactive approach to this problem would be to examine the management system that directs the operation and maintenance of all powered industrial trucks at the facility. Questions asked by the proactive incident investigation team may be: Are trucks being checked by maintenance regularly? Is there a maintenance schedule for each truck? Is there a process in place that requires the operator to perform a daily check and is the employee performing the check? Is the operator properly trained to operate this particular truck? To be proactive with incident investigations, the team needs to consider changing the management system to eliminate the direct cause of the

incident (Ernest, 1997). By addressing the system rather than the direct cause, unforeseen errors in the management system may be corrected even before an incident occurs. A proactive approach to incident investigation is built into the ILCI Loss Causation model by the fact that the first step of the ILCI loss sequence is Loss of Control. The ILCI model recognizes that losses can nearly always be traced back to a lack of standards, inappropriate standards, or inadequate compliance to standards. Rather than ceasing investigation efforts at the Basic Causes (lack of knowledge, or equipment, for example), the ILCI model acknowledges that the management system must be evaluated to ensure the incident investigation is thorough.

Incident Investigations for Near-Miss Events

Professor Kenneth R. Andrews of the Harvard Graduate School of Business Administration is quoted as saying, “Every accident, no matter how minor, is a failure of the organization.” This statement implies that accidents are a reflection of the management’s ability to manage and also that accident prevention is a management function (Ferry, 1988). In Great Britain, the Health and Safety Commission is proposing to introduce a compulsory duty for companies to investigate all reportable work-related accidents, illnesses, or near misses that could have resulted in serious injury. The Health and Safety Commission estimates that if every reportable incident not currently investigated by employers was investigated and acted upon, it would save up to 1.8 billion British pounds per year in preventable incidents (Kirby, 2001).

Jerome E. Spear, a senior consultant for ECS Risk Control Inc., also supports performing incident investigations after a near miss. Spear defines an incident as a deviation from an acceptable standard or work practice. In Spear’s view, such

deviations indicate organizational problems and require investigation by the proactive organization to determine their root cause (Spear, 2002).

Andrews acknowledges that management has the ability to manage accident prevention; the British Health & Safety Commission has recognized that employers' actions will positively affect incident rates; and Spear agrees that losses are indicative of organizational problems. H.W. Heinrich's research indicated that 300 near-misses will result in 29 minor injuries. It is clear that there is a far higher occurrence of near-misses than loss producing events. By investigating near-misses, breakdowns in the management system may be identified before a loss even occurs. It is clear that near-miss investigations are an essential component of a proactive management approach to incident and loss reduction and control.

Incident Investigations vs. Root Cause Analysis

A simple definition of root cause analysis is, "the most basic cause(s) that can reasonably be identified and that management has control to fix." After an employee falls and breaks an arm, one may determine that the root cause of the fall was gravity. However, management cannot affect gravity, thus an alternative root cause must be determined. The very definition of root cause analysis allows for multiple causes. Traditional incident investigation has emphasized finding the one true root cause of an incident, but it is rare that an incident can be traced to a single cause (Paradies, 2000). In stark contrast to Heinrich's model that attempts to locate the single cause of loss, the ILCI Model of Loss Causation follows the principles of root cause analysis in that a lack of control can occur in more than one area.

When analyzing a problem, the investigator must understand what exactly happened before they can tell why it happened. A tool to guide this understanding is the preliminary Events and Causal Factors chart (E&CF chart). In an E&CF chart, the steps leading up to the problem are arranged and the reasons for each step are listed (Paradies, 2000).

To use the forklift example again, the steps leading up to the collision of the two trucks may be: 1. Operator notices brakes operated differently at start of shift but did not report the change, 2. Operator notices truck takes longer to stop with full application of brakes and drives truck back to exchange it for a different one, 3. Brakes fail on truck and a collision occurs with a parked truck. The reasons for step 1 may be lack of training, lack of familiarity with equipment, or brakes are inconsistent from truck to truck and the operator has come to expect variation. The reasons for step 2 may include the operator is a distance from the alternate truck and wants to ride back rather than walk and/or production demands are such that the operator must work as quickly as possible and there is no time for walking back to get a different truck. The reasons for step 3 may include a lack of maintenance on all trucks, lack of maintenance to this truck, failure to properly complete daily check of equipment or lack of process to guide daily checks of equipment. Once these steps are charted, the investigation team will have a much easier time determining the true root cause that management has the ability to control. The root cause analysis may reveal that there is not a daily checklist procedure in place and the employee has only been working with in the department for 3 days and was not trained fully on the operation of the equipment. In this case there are two root causes, the lack of a daily checklist procedure and lack of training. Where

Heinrich would be trying to determine which of these two is the true root cause, the ILCI model acknowledges that any lack of controls need to be addressed to properly address the incident.

Cause and Effect Diagramming

Oftentimes, it is helpful to diagram the causes of a loss using a tool known as a Cause-and-Effect Diagram. Cause-and-Effect diagrams are best used early in the incident investigation process to organize ideas on possible causes (Spear, 2002). Cause-and-Effect diagrams are also known as fishbone diagrams because of their resemblance to the bones of a fish. The spine of the fish leads to the effect, in this case a loss. Each bone of the fish refers to a different contributing factor category. In this case, the contributing factors are divided into four categories: Materials, People, Machine, and Method. Branching off of each category are potential causes that led to the end result. The first step is to list as many potential causes as possible on the diagram. Next, as facts are gathered, causes are either analyzed further or eliminated from consideration. Finally, when a solid list of factors exists, the management system that is responsible for each factor is reviewed and corrective action determined to address the management error. Both cause and effect diagrams and the ILCI model function similarly, that is, to determine the root cause(s) of an incident so that corrective action can be implemented to prevent the reoccurrence of the loss. The forklift incident may be studied using a cause and effect diagram as shown in Figure 2.

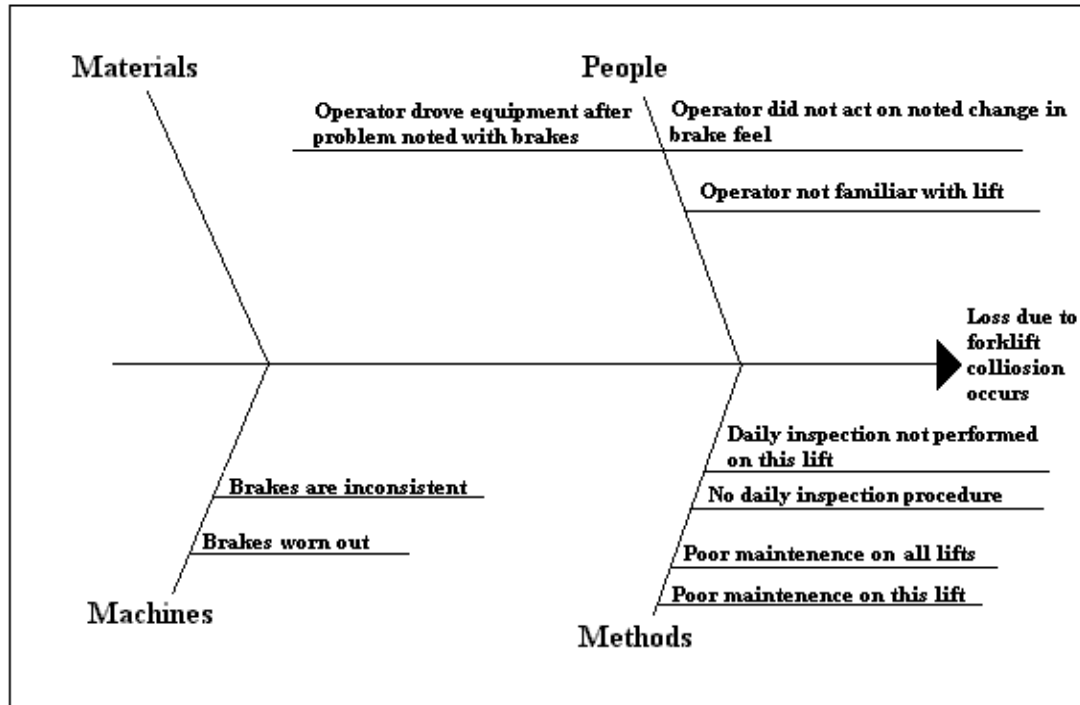


Figure 2

Incident Investigations at Company XYZ

Incident investigations at Company XYZ are currently only held post-loss; near miss activities are not investigated. Once a loss-producing event has occurred, the manager of the department that incurred the loss requests an electronic copy of the incident investigation form from the Safety Coordinator. The manager must go through the Safety Coordinator since the form is not accessible to managers directly. At this point, only the most basic facts are needed; who is involved, what happened, what injuries were sustained, the employees statement of what happened, and the date and time of the incident. From here, the form is returned to the Safety Coordinator who forwards the form to the plant manager's administrative assistant. The plant manager's assistant then schedules the investigation and notifies team members via Lotus Notes e-mail. The investigation team will include the affected employee or employees, the plant

manager, the department manager of the affected employee, members of the safety staff, members of the Health Services department, as well as any witnesses or other individuals with information that may be useful to understand how the loss occurred. The location of the meeting is always the same, the plant manager's office. When the team gathers for the meeting, the incident is recounted with details provided by the involved employee, the department manager, witnesses, engineers (if necessary), and the department safety leader. During the investigation, the team may go to the incident location to gain a full appreciation of the events that led up to the loss. One of the primary goals of the investigation is to determine what corrective action is needed to address issues discovered, and a section of the form is dedicated to corrective action that will be taken. Once the incident is understood and corrective action is determined, the meeting is adjourned. As far as record keeping of past incidents, the hard copy is the only record of past activity and is kept in the safety department's files.

Summary

Incident investigation is performed post-loss and attempts to gather the facts of an incident, identify the root cause(s), and suggest corrective action to ensure the incident does not repeat itself. To gather the facts of an incident, an investigation team is assembled. Personnel involved on the investigation team usually include members of the safety staff, department supervisors, employees directly involved in the incident, and witnesses. The investigation team may complete their task by taking photos, confiscating equipment, interviewing employees, reenacting the incident, and/or video recording the scene (Ferry, 1988).

Once the investigation is complete, the team determines what the root cause(s) of the incident was/were. It is important to identify the true root cause(s) of an incident rather than fix blame on an individual. Too often, investigators seem to focus on identifying an individual to blame rather than identifying the management system that allowed the loss to occur (Hoffman, 1998).

Finally, corrective action is identified to address each root cause of the incident. Corrective action may include administrative controls, such as training and use of personal protective equipment, or engineering controls that centers on modifying the work area to eliminate exposure to the hazard. It is important to not only identify what corrective action is needed, but to ensure that it has been implemented and continues to be utilized (Ferry, 1988).

The function of the incident investigation is to identify the root cause, or fault in the management system, that allowed the incident or near miss to occur in the first place. Root cause analysis defines the root cause as the most basic cause(s) that can reasonably be identified and that management has control to fix. To assist in identifying the root cause, a diagramming tool such as a cause and effect diagram may be used. Once the root cause is identified, corrective action is implemented to prevent the incident from repeating. By investigating all incidents as well as near misses, several benefits will be realized.

The first benefit of the incident investigation is that it provides the team with a tool to determine the true root cause and determine the needed corrective action. Rather than blindly asking questions and haphazardly making recommendations, an effective incident investigation procedure provides guidance to ensure that the investigation is

properly conducted, the true root cause is identified, and effective corrective action is recommended and implemented.

A second benefit of incident investigation is to provide a record of past incidents and their corrective actions. Incident investigation records function as a resource to management for implementing effective changes in processes to reduce losses. This is especially true in large organizations. An easily accessible database of past action can serve as an efficient resource when new processes are added. A second use of the record keeping is to monitor the corrective action that has yet to be implemented. By recording what action will be taken and ensuring that it is completed closes the loop of that particular investigation and also ensures that the effort was not wasted.

H.W. Heinrich recognized the value of keeping record of past injuries and dedicated a chapter to the practice in the 1959 edition of his book, "Industrial Accident Prevention." Heinrich wrote, "When an accident and its resultant injury have occurred, the event becomes a matter of history. If the work of investigation and record keeping has been done well, the facts of each past accident will already have been recorded in such manner that analysis covering a considerable period of wide exposure will require merely that facts already available be assembled and that conclusions be drawn."

For effective incident investigation record keeping, not only will the root cause of an incident be identified and corrective action recommended, but also an individual responsible for tracking the implementation of corrective action will be identified. Also, an effective incident investigation procedure will provide a record of effective practices to guide future action when changing processes, and serve as a check to ensure that past corrective actions are still being utilized.

Chapter 3

Methodology

Introduction

The purpose of this study was to evaluate the existing incident investigation procedure at Company XYZ, identify the inefficiencies of the procedure, and recommend solutions to make the incident investigation procedure a valuable tool for loss reduction and prevention. The purpose of this chapter is to discuss the sequence of events and procedures used to conduct the study. To accomplish the research objectives, the following method was followed.

Method of Study

The first goal of the study was to analyze the current incident investigation procedure in place at Company XYZ. It is necessary to have a full understanding of the existing process before recommendations for change can be made. To analyze the current incident investigation procedure, the author participated in five incident investigations at Company XYZ. During each investigation, the author took note of the steps required to initiate the investigation, schedule the investigation, complete the incident report, and to file and review the report, as well as other important observations during the investigation. The current procedure is only put into use following an injury or significant damage to property. To initiate the procedure, the manager of the department that experienced the loss requests an investigation form from the Safety Coordinator. The investigation team will include the involved employee(s) and their manager as well as the plant manager and members of the Environmental, Health, &

Safety department. The team works to determine corrective action and documents their findings on the investigation form. This form is then filed away in the Environmental, Health, & Safety department. A closer examination of the investigation process is detailed in the following chapter.

The second goal of the study was to identify the elements of an effective incident investigation procedure. To ensure that the recommendations to the existing process will truly result in a useful loss prevention/reduction tool, an understanding of those elements essential for a successful incident investigation procedure is required. This goal was accomplished through a review of pertinent literature related to loss causation and incident investigation. In addition to basic incident information (who, where, when, what happened, etc), examples of effective process elements may include the investigation of near-miss activity as well as losses, an easily accessed form that managers may quickly fill out when reporting a near-miss or loss, and a record keeping system that allows quick review of past investigation results.

The third goal of the study is to develop an incident investigation process that incorporates those elements of effective incident investigations and results in a valuable tool to reduce and prevent losses at Company XYZ. To complete this goal, the inefficiencies of the existing procedure previously identified will be updated to incorporate the elements of effective incident investigations. Further, a modified version of an existing database may be used to guide the incident investigation process. The existing database is a Lotus Notes-based database that is used to record the results of safety/housekeeping audits. The way this database is used is as follows. The Environmental, Health, & Safety department conducts quarterly safety/housekeeping

audits. These audits are entered into the database and include the departments overall score and scores in various categories (Housekeeping, Hazardous Materials, Emergency Equipment, Tools & Equipment, & Personal Protective Equipment). In addition, the database also provides a means to summarize corrective required and attachment of photos to document findings. The use and capabilities of this database will be detailed in the next section as well as modifications required to create an incident investigation database that will serve to guide the incident investigation process at Company XYZ.

Chapter 4

Results and Discussion

Introduction

This chapter will detail the results of the study. The topics discussed will begin with an analysis of the existing incident investigation at Company XYZ to provide background information on the procedure currently in place, then a discussion of elements of effective incident investigation procedures based on the results of the literature review will follow. To close this chapter, a discussion of a process to guide incident investigations at Company XYZ will be detailed.

Incident Investigations at Company XYZ

The first step of the study was to gain an understanding of the incident investigation process that is already in place at Company XYZ. This was accomplished through the authors' participation in five incident investigations. To begin the incident investigation process at Company XYZ, a loss had to occur. A loss that would trigger an incident investigation would involve either significant damage to equipment or an OSHA recordable injury to an employee. The managers of individual departments have been instructed that incident investigations must follow losses and they must contact the Safety Coordinator of Company XYZ to notify them of the loss and to obtain the incident investigation form. The Safety Coordinator sends the manager an electronic copy of the incident investigation form through the company's Lotus Notes mail system. The reason the Safety Coordinator must send the copy of the form to the manager is that the manager does not have access to the forms. Once the manager receives the form, s/he fills it out with only the most basic of information. Information

on the initial form will include items such as employee name, department number, date and time, and a statement by the employee of what happened. After entering data into the electronic form or handwriting the information on a printed blank form, the form is returned to the Safety Coordinator. The Safety Coordinator will then send the form to the plant manager's administrative assistant who will schedule the investigation date after looking at each team member's calendar via Lotus Notes. Team members that are included in each investigation are the involved employee, the employee's manager, the involved employee's department safety leader, members of the Environmental, Health & Safety department, the plant manager, and members of Health Services. Other people that may be involved include witnesses, engineers, or any other individual who may have information that may be used to determine the root cause(s) of the incident and determine appropriate corrective action. The meeting location is always the same, the plant manager's office. On the day of the investigation, team members will converge in the plant manager's office and a discussion of the events of the loss will occur as well as questions and answers from team members. Each member will be provided with a copy of the incident investigation form with the preliminary details filled in. If necessary, the team will relocate to the incident location to ensure that all team members have a thorough understanding of the loss and the loss is correctly documented on the investigation form. During the five incident investigations the author participated in, the meeting always relocated out to the incident location to provide details of the loss. The team discusses what corrective action is feasible to address the root cause(s) identified during the investigation and the department safety leader records the corrective actions recommended by the team on the incident

investigation form. Once corrective action is determined, the meeting is adjourned. The Environmental, Health & Safety department retains a copy of the completed incident investigation form that is filed away by the Safety Coordinator.

Currently, there is no process to review the past investigations to ensure that the corrective action was actually implemented. If a review is to be performed, it would require locating the hard copies of past investigations and reading through to find the corrective action, then going out to the department to observe if the actions are in place.

Elements of Effective Incident Investigation Procedures

To identify the elements of an effective incident investigation procedure, information gathered during the literature review was utilized. The basic elements of an incident investigation report are as follows:

- Who was involved?
- What injuries were sustained?
- What property damage was sustained?
- Date and Time of the incident
- Location of the incident
- Brief statement by the employee as to what happened
- A cause analysis of the loss
- Corrective action to address the root cause of the loss

Bird & Germain's book "Practical Loss Control Leadership" expands the list of basic components and recommends that the investigation report also include items such as cost of damaged property, the occupation and experience of the involved employee, and a checklist of immediate and basic causes (Bird & Germain, 1985). While this

information will result in a complete form, there are other elements beyond simply completing a form that need to be incorporated for the procedure to be a valuable tool for loss prevention and reduction. One element yet to be addressed is when to conduct incident investigations. Traditional incident investigations are only conducted after a loss. By limiting investigations to losses that have already taken place, many opportunities for improvement are being neglected.

Several resources recommended conducting incident investigations for near-miss activity as well as actual loss producing events. The justification for this is to obtain as much data as possible to proactively investigate potential sources of loss. Far more near misses occur than actual loss producing events and, as H.W. Heinrich's research indicated, there is approximately a 10:1 ratio of near misses to loss producing events. It is important to realize that both near misses and losses are equally indicative of breakdowns in the management system. By investigating near misses, these breakdowns can be identified prior to a loss. It is clear that near-miss investigation is an important element of an effective incident investigation procedure. Once a process is in place to investigate all near-miss activity and loss producing events and reports are being efficiently completed, it is important to keep record of past activity.

Record keeping is important enough to justify an entire chapter in the 4th edition of Heinrich's book "Industrial Accident Prevention." By recording the details of an incident investigation and the resulting corrective action, a resource is created to guide future actions as well as a means to determine if recommended corrective actions have been completed. To be a useful resource, past records must be easily accessible and updateable. To provide an easily accessed and updateable database for incident

investigations at Company XYZ, an existing database was evaluated for potential modification to record incident investigation results.

The existing database is based on a Lotus Notes document and was developed in-house at Company XYZ. The database records the results of safety/housekeeping audits that the Environmental, Health & Safety department has conducted throughout the facility. Not only are audit scores recorded in the database, but also the auditors' comments and corrective actions recommended to address identified hazards in each department. To ensure departments are accountable for completion of the corrective actions listed on the audit, the audited department must fill in a comment section for each corrective action after the corrective action is completed. When an audit is initially entered by the audit team and has corrective actions listed, its status is "open" in the database. Only after the department completes all corrective action and records this activity in the database does an audits status change to "closed." Finally, audits may be organized by status for review by members of the Environmental, Health & Safety department and reported on to ensure corrective actions are completed. By combining an organized list of corrective actions required and the means for a department to indicate that fixes are complete, an effective tool exists for departments to efficiently address areas of concern as well as provide a tool for the Environmental, Health & Safety department to monitor the progress of improvement.

A method to maintain confidentiality is built into the audit database as well. Each audit in the database has a section where department managers and team leaders names are entered by the audit team. By logging into the Lotus Notes system, the database is able to compare your identity to those listed on the audit. If your name is on

the audit, you are granted access to the form and may update the form after completing the required corrective actions listed on the audit. The access to the database has two levels, administrative and individual. Administrators include the EH&S department members, Health Services members, and the plant manager. Administrators may access any audit and modify them as needed. Individual access is limited to those people listed on individual audits. If an individual's name is not on the audit, that person is not able to open the audit and confidentiality between departments is maintained. A second feature of the database is notification of new activity. When a new audit is entered, each person listed on the audit, including the administrators, will receive a memo with the message that new audit results have been posted. Finally, the audit may have files attached to it, such as digital photos to record either positive or negative findings of the audit. This system has been useful and, with some modification, would meet the needs of an incident investigation database as well.

Modifications to the existing database would mainly be to reformat the electronic document to reflect incident investigation information rather than audit information. A customized administrators list would also be necessary to ensure each team member has unrestricted access to the database. The ability to list corrective actions required along with the status of each action would be maintained from the original database, as would the ability to attach files, such as digital photos, to the investigation document.

A Process to Guide Incident Investigations at Company XYZ

After reviewing the literature and observing the incident investigation process at Company XYZ, the following process has been developed to guide future incident investigations.

At the center of the incident investigation procedure is a modified version of the safety/housekeeping database. By making the modifications described in the previous section, an incident investigation database would be created with the following characteristics:

- A centralized location for all incident reports is created
- Department managers would have instant access to the reporting form to initiate the investigation
- Confidentiality is maintained
- Corrective action performance may be efficiently tracked by both department managers and EH&S department members to ensure follow through of recommended action(s)
- Notification capabilities allow team members to be aware of all incidents that are reported and streamlines scheduling
- By including the plant managers assistant in the notification loop, scheduling may start as soon as the incident is entered into the database

Further features of an improved incident investigation process would be the investigation of near misses as well as loss producing events and also relocate the investigations from the plant manager's office to the incident location. The flow of the incident investigations Company XYZ would be greatly improved by the flow of activity as depicted in Figure 3.

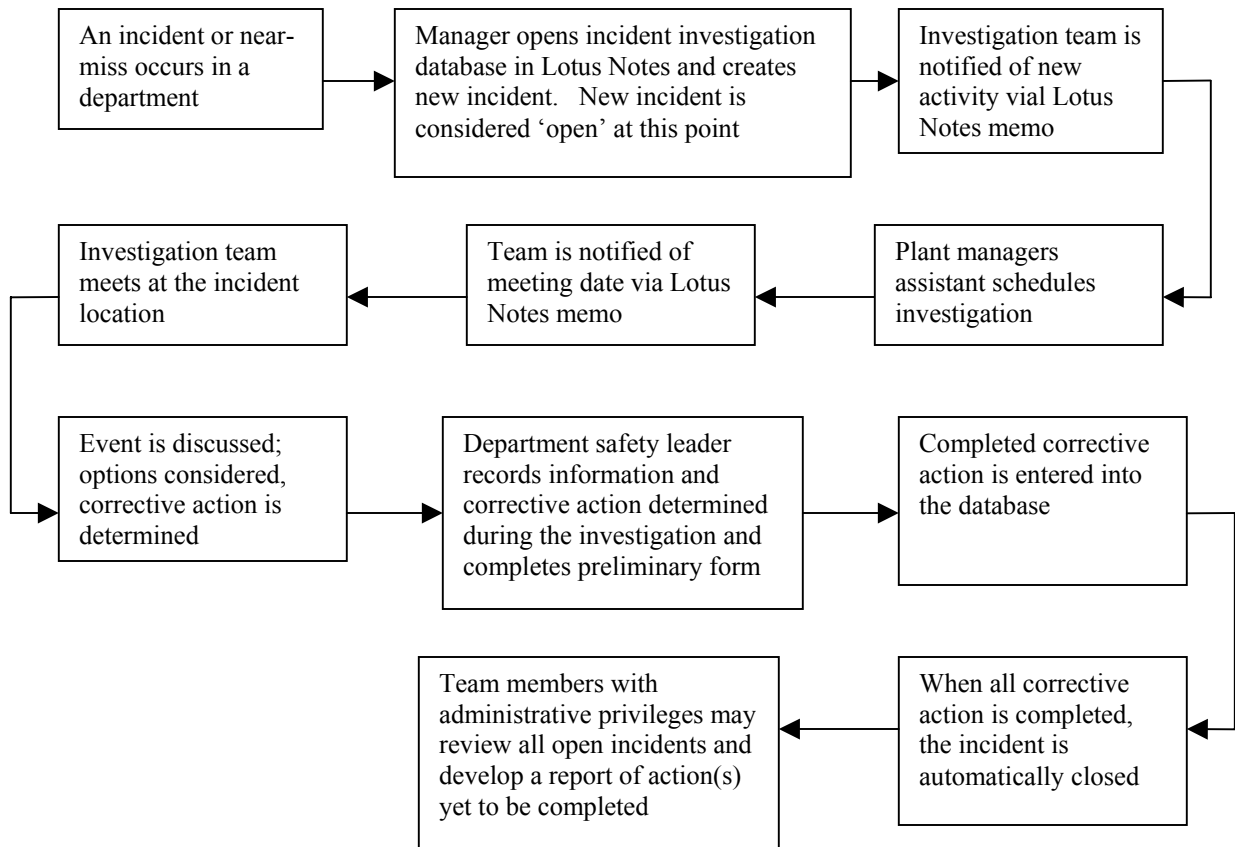


Figure 3

The collection of data reveals that although Company XYZ does have an incident investigation procedure in place, there are gaps that restrict its effectiveness in being a valuable loss prevention and reduction tool. The suggested process depicted in figure three utilizing a Lotus Notes based database ensures that gaps that exist in near-miss investigation, scheduling, recording, accountability, and review are filled.

Chapter 5

Summary, Conclusions & Recommendations

Introduction

This purpose of this study was to evaluate the current incident investigation procedure in place at Company XYZ, determine what vital elements of effective incident investigations are missing, and recommend modifications to the process to ensure that the incident investigation process is a valuable loss prevention and reduction tool.

Summary

To summarize the study, a restatement of the problem will follow as well as a review of the methods and procedures used to complete the study.

Restatement of the Problem

The incident investigation procedure at Company XYZ in Minnesota is not an effective tool to address the need of the company to investigate loss producing events or conditions. As a result, incidents were either not being investigated at all, or if they were, the investigation was incomplete. By neglecting to investigate loss producing incidents, or even near-miss activity, an opportunity to prevent/reduce future losses is not realized. The methods used in the study are detailed in the next paragraph.

Methods and Procedures

The study was performed by first analyzing the current incident investigation procedure at Company XYZ through participation in five incident investigations. Next incident investigation based literature was reviewed to identify essential elements that may be missing from Company XYZ's procedure. Finally, an improved incident

investigation procedure was developed that incorporates those essential elements identified in the literature review, addresses inefficiencies in the current system, and utilizes an existing database as a central element to guide investigation at Company XYZ.

Major Findings

Based on the analysis of the existing incident investigation procedure in place at Company XYZ, the following findings were significant:

- For an incident investigation to be initiated, an actual loss to property or OSHA recordable incident has to occur.
- Several steps that require a significant amount of paper shuffling must be completed before the investigation will be scheduled.
- The investigation team for every investigation always consists of the plant manager, members of Health Services, and members of the EH&S department. Additional team members will vary as different departments initiate investigations that require input from an assortment of people.
- The meeting is concluded after corrective action is determined. Currently, there is no means to efficiently review past corrective actions to ensure they have been completed.
- Although the investigation meetings are located in the plant manager's office, the meeting always relocates to the incident location to provide team members with a clearer understanding of the event.
- Record keeping is limited to the EH&S department Safety Coordinator filing a hard copy of the incident report away.

Based on literature review, the following elements were determined to be essential for effective incident investigations:

- Basic information for any incident report will include who was involved, what injuries were sustained, what property was damaged, date and time of the incident, location of the incident, a brief statement by the employee as to what happened, a cause analysis of the loss, and corrective action to address the root cause of the loss.
- The root cause of an incident is the most basic cause of an accident that management has the ability to control.
- Investigation of near-miss activity as well as loss producing events is mandatory to ensure that incident investigations take a proactive stance in preventing and reducing loss.
- Records need to be maintained for efficient review of past incidents and to track the implementation of proposed corrective action.

The following findings were determined to develop a process to guide incident investigations in the future at Company XYZ:

- Near-miss activity needs to be investigated to ensure that Company XYZ is proactive in reducing and preventing loss.
- By modifying an existing database in use at Company XYZ, an incident investigation database can be developed that will streamline reporting, scheduling, improve accountability, allow for confidentiality, create a centralized incident database, and allow for quick review of past corrective action and actions yet to be completed.

- Incident investigations should be held at the incident location for maximum ease in recounting the event.

Conclusions

Based on these findings, the following conclusions can be made:

- Near miss activity is being neglected in Company XYZ's incident investigation procedure. By neglecting to investigate near misses, Company XYZ is allowing management errors to produce loss before they will be addressed.
- The current investigation procedure involved too many steps to get an investigation even scheduled. By the time an incident occurs, the manager requests the incident form, receives the form, completes the report, returns the report to the Safety Coordinator, and the Safety Coordinator delivers the form to the plant manager's assistant for scheduling, a significant lapse of time will have passed. This is an inefficient process that is a detriment to the implementation of corrective action.
- Holding investigation meetings in the plant manager's office is inefficient. Team members do not have a clear picture of how the incident occurred. By relocating the incident investigations to the incident location, time can be better spent determining what corrective action will be required.
- A database currently in use at Company XYZ can be modified to fit the needs of an incident investigation database and will streamline the process as well as provide a method of record keeping and review to improve accountability.

Recommendations Related to This Study

The recommendations related to this study are as follows:

- The author of the existing safety/housekeeping database needs to be contacted to modify the safety/housekeeping database to create an incident investigation database with the characteristics described previously. By modifying an existing database with useful features already built-in, the new database may be more quickly developed.
- Managers need to be trained to complete incident investigation reports for near misses as well as loss producing events to take a proactive approach to loss reduction and prevention. To ensure the new incident investigation process is well received and is used properly, training of all users is necessary.
- A significant amount of training is going to be required to ensure the database system is effective. Managers and team members will need to be trained to use the new database, the plant manager's assistant will need to be trained to schedule the investigations a notification of new activity is received.
- The meeting location needs to be changed from the plant manager's office to the incident location to make the best use of investigation time.
- Potentially, information from past incidents needs to be entered into the new database.
- A regular review of open incident investigations needs to be worked into the schedule of the members of the EH&S department. This review may be monthly or bi-weekly and will serve to ensure that corrective action is being implemented. In addition, a review of closed investigations will ensure that past corrective action continues to be utilized.

- Further, a standard for incident investigation entry needs to be developed. The standard will detail what information is required for each field in the database and serve to ensure that incident investigations are properly reported.

Recommendations for Further Study

Topics for further study may include:

- Follow-through of departments to complete corrective action as a result of incident investigations. It would be interesting to determine the completion rate of corrective action and what factors were responsible for high follow through and what factors were responsible for low follow through.
- Affect of Incident Investigations on Incident Rate. It would be interesting to study the incident rates of companies before and after implementing an incident investigation procedure. Related to this study, it would be interesting to know the differences in the investigation procedure for companies that experienced a significant incident rate drop as compared to those that did not.

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