Job Hazard Analysis

A primer on identifying and controlling hazards

By George Swartz

SH&E PROFESSIONALS LOOKING for a program to reduce and eliminate workplace injuries, improve ergonomics and lower injury costs can find the solutions in job hazard analysis (JHA). JHA can serve many objectives—from the need to develop safe working procedures or create uniform safety standards (Smith), to a desire to participate in OSHA's Voluntary Protection Programs (VPP) or the need to reduce costs associated with product and property damage. Simply put, JHA can have a major impact on safety performance.

Unfortunately, many organizations do not take advantage of the special benefits that JHA can provide (Manuele). JHA requires supervisors to devote time to observing work areas and to watching employees work. Many programs do not have provisions for ongoing employee safety observations. Becoming skilled in JHA requires classroom sessions, focused observations and the recording of detailed information of a task being performed—a process not seen outside a JHA program.

A JHA program features several key components. This article provides an overview of JHA and offers a definition for the term "job." It also outlines the keys to success: management support, a written program, training and the need for management oversight; describes the process needed for JHA (job selection, the four methods for producing JHAs and necessary forms); and suggests hazards to look for in the workplace as well as the causes of injuries, unsafe conditions and unsafe behaviors.

Job Hazard Analysis Overview

JHA is a multistep process designed to study and analyze a task—or job—then break down that task into steps which provide a means of eliminating associated hazards. JHA results in a detailed written procedure for safely completing many tasks within a facility.

Job safety analysis likely had its start many years ago in the steel industry. Safety has been a part of that industry since its inception (U.S. Steel); for example, Chicago Bridge & Iron was a founding member of the National Safety Council in 1914 (CBI). While working in the Pittsburgh steel mills, the author was introduced to job safety analysis. Seasoned steel workers and the safety staff indicated that big steel was the first to utilize JHA to identify serious and dangerous jobs in the plant. Veteran steel workers reported that the process was initiated during the 1930s. The original system concentrated on only the most hazardous jobs and usually did not address ergonomic issues.

Defining the Term "Job"

Typically, one thinks of a job as an occupation, such as a welder, punch press operator, auto mechanic or electrician. In JHA, the word "job" refers to a given task that contains several steps. In this context, a job can be changing compressed gas cylinders on a welding cart; feeding a coil of steel into a punch press; installing a new muffler on a car; or changing a defective ballast in a fluorescent light. Each occupation listed performs multiple tasks or jobs. The purpose of the JHA program is to analyze each job in each occupation within a facility in order to develop safe working procedures (Eninger 2).

Keys to Success

A successful JHA program features several key components.

1) **Management Support.** An initial challenge is convincing management that JHA will be successful if given the proper support (Swartz). Support means that time will be allocated for classroom sessions to explain program components and function as well as for supervisors to complete and record the observations.

2) **Supervisor and Employee Training.** JHA requires complete, detailed training of supervisors and employees

George Swartz, CSP, *is a safety consultant residing in Davenport, FL. A Fellow of the Society, Swartz is a former chair of ASSE's Editorial Review Board and has served on many ASSE and National Safety Council committees. With more than 31 years' experience in the safety field, he was safety director for Midas International for 23 years. Swartz has authored five books and more than 100 articles on various safety topics. A member of ASSE's West Florida Chapter, Swartz is a 2002 inductee into the Safety and Health Hall of Fame International.*

Figure 1

Job Hazard Analysis Master Listing of Jobs

JHA NUMBER	TITLE OF JOB HAZARD ANALYSIS	JOB ASSIGNED TO:	DATE ASSIGNED:	COMPLETION DATE:	REVIEW DATE:

(Kapp). Employees will be asked to provide feedback and on-the-job information regarding tasks that they perform regularly. All workers should be knowledgeable about how JHA works and how they will assist in the process. Management must stress quality over quantity when it comes to completed JHAs.

3) **Written Program.** The written program should define the scope and methods to be used. It should include basic JHA information, benefits, program assignments, necessary forms and guidance on how to use them, methods for completing forms, employee involvement, recommended job selections, and management control and monitoring.

4) **Management Oversight.** At least one individual should be well-trained in the JHA process so s/he can be designated to oversee the program. In addition to determining JHA assignments, this person must strive to prevent duplication of effort in various departments or shifts. S/he must also track the process, and review rough drafts and completed copies of all JHAs for accuracy as well as quality.

As noted, supervisors and employees must receive comprehensive training (Spence). Without training, the program will likely fail. Management must also agree to ensure that assigned JHAs are completed in each department on a regular basis. In most cases, a facility will agree to have one JHA completed per quarter by each supervisor. A company may also consider making the assignment and completion of JHAs part of a supervisor's annual salary review.

The JHA Process

Step 1: Selecting the Job

Once training is complete, the first step is to select a job for analysis (Eninger 1). To determine priorities, a comprehensive job list should be developed (Figure 1); it should contain all jobs within a facility. Management must then use a priority system to select jobs for analysis. This process should be based on past injury reports and employee feedback as well as factors such as:

- jobs that have the potential for serious injury or a fatality;
- jobs that have consistently produced injuries, illnesses and ergonomic claims;
- jobs that have resulted in injuries with cases of high severity;
- jobs that have the potential to cause a high number of injuries or illnesses as well as ergonomic claims;
- jobs that involve new machines, processes or are new to the facility;
- jobs that have produced incidents of property and product damage as well as near-hits among workers.

Identifying these jobs requires those involved to answer many questions. What jobs have caused the most serious injuries or fatalities? What jobs have resulted in the largest numbers of injuries? What jobs have produced the most lost-workday injuries? Have any jobs caused property damage and narrowly missed injuring a worker? Have new machines or processes that have the potential for causing injury been analyzed?

In large facilities, development of job lists can be a huge undertaking. Depending on facility size and work performed, the list could easily contain 100 or more jobs. When supervisors, safety committee representatives and employees are involved, the project becomes more manageable. Lists can be created for specific departments, operations or job classifications to allow for an easier focus.

To illustrate what a job list should contain, following is part of a short job list from a hypothetical sheet metal forming plant:

a) operating a punch press;
b) changing dies in a punch press;
c) placing a coil of steel on a spindle;
d) operating a pendant-controlled overhead crane;
e) inspecting a punch press;
f) operating a press brake;
g) changing dies in a press brake;
h) hand stacking formed metal sheets;
i) wrapping and banding completed metal sheets for shipment;
j) operating a portable hand drill.

Step 2: Methods to Accomplish JHA

So what is the best method of completing a JHA? Four methods are available, discussed here in recommended preference.

One-on-one observation is the best choice (U.S. Steel). A supervisor selects a worker to participate in the process. This worker should have knowledge of the machine in question or the JHA process, and be cooperative in answering questions. To start, ask the worker whether s/he would like to help complete a JHA on job X or Y. Most workers are willing to help develop safe working procedures. The supervisor must also have working knowledge of the job to ensure s/he knows what hazards to look for. It is essential to observe the worker completing the job.

This method is most highly rated because it provides for supervisor involvement, employee participation and feedback. It also facilitates learning; both the supervisor and worker will come away much more knowledgeable than when they started. If the worker is completing a job step and the hazards have not been corrected, the potential for injury remains. Workers often suggest that no one ever asks their opinion—JHA does. Conditions at the work site will also be improved as a result of JHA, since ergonomic improvements can be readily identified and corrected.

The downside to this method is that jobs performed infrequently may be missed by the one-on-one method. In addition, it may not be possible to analyze jobs performed off site. For example, some employees work in the field where analyzing each job may not be practical.

Figure 2

Job Hazard Analysis Form for Rough Draft

JHA NUMBER: _____ TITLE OF JHA: _____

LOCATION (FACILITY): _____

NAME OF PERSON COMPLETING JHA: _____ SIGNATURE: _____

NAME OF PERSON(S) ASSISTING IN JHA: _____

DATE COMPLETED: _____ DATE REVISED: _____ DATE REVIEWED: _____

RECOMMENDED PPE: _____

BASIC JOB STEPS	HAZARDS PRESENT IN EACH JOB STEP	CORRECT AND SAFE PROCEDURES FOR COMPLETING THE JOB

Hazard Selection for the middle column:

SB = Struck By	CB = Caught Between	CW = Contact With
SA = Struck Against	CO = Caught On	O = Overexertion or Repetitive Motion
CBY = Contacted By	FB = Fall to Below	FS = Fall At the Same Level
CI = Caught In		E = Exposure to Chemicals, Noise etc.

Group discussion analysis is the second method. Instead of being on the factory floor or at the construction site with an individual, a group of supervisors and employees collectively analyzes a job in a classroom setting. All involved must be familiar with the selected job in order to offer comments and agree with the established procedure. A discussion leader is needed as is a scribe to record job steps. Flip charts are effective as visual aids during this process.

This method requires open conversation, which allows the group to learn more about the job. Each group member will have a different level of knowledge regarding the job, which is why it is advantageous to have workers present. Who knows more about completing their jobs than workers? The overall knowledge of the group is the strong feature of this method. Everyone should leave the training room much more aware of how to safely perform the task. In addition, once a JHA is completed, no one else needs to review it after it has been documented; it can be placed at the employee's machine, at the worksite or in a binder for ready reference.

The downside is the difficulty of getting all necessary individuals into the classroom at the same time. Also, if the discussion leader is not effective, time could be lost arriving at the agreed-on safe methods for completing the task.

The third method is the recall and check process. Here, the supervisor records what s/he can recall about job steps and hazards, then asks a worker or other supervisor if the procedures are correct. If done incorrectly, this method can pose problems. First, the supervisor must have a good memory so all details can be recorded. It is also possible that checking with others to verify accuracy of the JHA may be overlooked. To prevent this, the names of employees who participated in the JHA process should be documented.

The least-desirable method is to allow supervisors to create JHAs without actually observing a job or discussing it with employees. This is called the absentee method (Swartz)—and it can cause the quality of JHA documents to suffer. Despite this drawback, some organizations regularly complete JHAs in this manner, in essence sanctioning an ineffective paper tiger.

Step 3: Prepare Forms

Three basic forms are needed to conduct a JHA: 1) a job list form; 2) a rough draft JHA form; and 3) an approved JHA form (Armco).

Job List Form

As noted, job listing begins the process; it allows management to select jobs for analysis. Everyone should provide input into development of this list. Jobs identified can be highlighted as they are completed. New jobs or those that were omitted when the original list was designed can be added at any time. Management must assign and allocate jobs to review in order to properly fix the priorities of jobs and coordinate JHAs completed in various departments and on different shifts.

Rough Draft JHA Form

The rough draft form (Figure 2) is the copy that each supervisor will use when analyzing an

Figure 3

Job Hazard Analysis—Approved Copy

JHA NUMBER 156 TITLE OF JOB Changing stone on bench grinder DATE JHA WAS COMPLETED 10/19/00

PERSON COMPLETING JHA Sam Spitale PERSON ASSISTING IN JHA Peter Belanger

LOCATION / FACILITY Fabricating plant DATE JHA WAS REVISED: 7/22/01

RECOMMENDED PPE: Safety glasses, gloves

BASIC JOB STEPS	HAZARDS PRESENT IN EACH JOB STEP	CORRECT AND SAFE PROCEDURES FOR COMPLETING THE JOB
1. Lockout bench grinder	1. No hazard	1. Pull wall plug on bench grinder and place end of plug in lockout device. Add completed tag to device. Place key in your pocket.
2. Remove guard	2. CW sharp edges	2. Using a screw driver or wrench, remove side guard for the worn stone. Loosen spark shields, tongue guards and tool rests to move them out of the way. Wear gloves to protect the hands from sharp edges.
3. Remove worn stone	3. CW sharp edges	3. Place a wedge between the tool rest and the grinding wheel on the opposite side to remove the retaining nut on the worn stone. Remove the nut, washer and worn stone. Wear gloves to protect the hands from sharp edges.
4. Ring test new stone	4. No hazard	4. Support the center of the new stone with a wooden dowel, tap the stone with a plastic handle of a screw driver at 12, 3, 6 and 9 o'clock. Listen for the metallic ringing sound. If the stone does not "ring", replace it.
5. Install stone	5. CW sharp edges	5. Slide new stone onto shaft, add washer and nut. Tighten nut with box-end wrench per manufacturers guidelines, wearing gloves to protect the hands.
6. Install guard	6. CW sharp edges	6. Re-install side guard, place and tighten tool rest 1/8 in. from the stone. Place and tighten the upper tongue guard 1/4 in. from the stone and reset the spark shield. Wear gloves.
7. Remove lockout; test stone	7. SB stone fragments	7. Remove lockout device. Plug in grinder. Stand off to the side before turning grinder on to ensure it is operating properly.

Hazard selection for the middle column: SB = Struck By; CW = Contact With; CBY = Contacted By; CB = Caught Between; SA = Struck Against; CI = Caught In; CO = Caught On; O = Overexertion or Repetitive Motion; FS = Fall at the Same Level; FB = Fall to Below; E = Exposure to Chemicals, Noise, etc.

employee at the workstation or task. Once supervisors learn to complete a JHA, the observation and recording process will come more easily.

Because time is often short on the factory floor or at the construction site, the rough draft will be just that—a document with changes and line-outs. The supervisor is expected to review what was written on the form before stopping the observation and allow the worker to comment on the findings. The entire job should be observed and documented before the JHA is passed for review.

Approved JHA Form

This is the final copy of each approved JHA (Figure 3). The subject in this example is the common bench grinder, a tool that can be found in almost every industrial location. The figure depicts a final form, which outlines guidelines for changing stones on a bench grinder. The rough draft form is first submitted by the supervisor. If acceptable, it is then developed into the final copy. Final and approved JHA forms are the safe procedures documents, accessible at appropriate sites for review and problem solving.

Step 4: Complete JHA Forms, Document Steps

The rough draft and final copy forms each have three columns: basic steps, potential hazards and safe procedures (Westinghouse). Most JHAs contain six to 10 basic steps. Each step recorded in the left-hand column should contain only three to six words and be correctly recorded. Each step is to be listed in the exact order it occurs. During observation, the supervisor should ask basic questions such as, "What is the first thing you do when you start the machine?" "Then, what do you do?" In the basic job step, only the "what" associated with the task is identified; the information in this section is deliberately kept brief.

In the next column, potential hazards associated with each step are recorded. Can the worker(s) be struck by an object, strike against an object, make contact with a chemical, be caught between two or more objects or be contacted by a hot part or other object? Other hazards may include having a foot or whole body trapped in a hole or confined space; overexertion or similar ergonomic hazards; fall at the same level or to a lower level; caught on a moving object; or exposure to an injurious chemical or other environmental risk. The supervisor asks the worker about potential hazards and watches for any hazards not apparent to the worker.

The safe procedures column combines the basic step and potential hazards into a correct safe working procedure. This procedure identifies the how, what, when, where and why of the job step (which can make this portion of the JHA somewhat wordy). Those involved should strive to minimize this problem where possible to ease reading. However, the

entire correct job procedure and method to avoid injury must always be included. The supervisor verifies the procedure's accuracy by reading it back to the worker.

Once the rough draft has been completed and the supervisor has formatted it into a readable style, the JHA should be reviewed by someone who understands the quality needed in completed JHAs. If the draft is unacceptable, it should be returned to the supervisor for correction. In the early stages of a JHA program, many documents will likely be returned. However, the more one works to correct and fix rough drafts, the better the quality of the finished product.

Once the rough draft is approved, it is ready to become a finished document. At this point, accurate information from the rough draft is formatted (typed) and the finished copy is ready for filing and posting. Copies may also be displayed at select workstations so that workers or new employees have access to the safe procedures at all times. Many organizations maintain a binder with all approved JHAs. Electronic access is another option.

JHAs should be modified as needed. These documents should be regularly reviewed, corrected and updated by the safety committee, workers and/or management. Each JHA is designed to be a living document—it is never truly finished. Completed documents are also excellent safety meeting material. Ask employees to review completed copies of the JHAs to determine whether the job form needs to be updated. Before an unusual or seldom-performed job is performed, have all workers involved view the document for safety reminders as well as the need for revisions.

Another benefit is the program's potential to solve problems discovered during an injury investigation. In this case, one might ask whether a JHA exists for the job involved in the incident. If not, one must be developed. If a JHA does exist, what was omitted that allowed the worker to be injured? Was a step missing? Was a PPE detail overlooked? Injury investigation forms should be modified to allow for JHA checks after any injury occurs.

What to Include/Exclude on the Forms

When completing the rough draft and final copy JHA forms, essential elements to include at the top of the form are:

- JHA number from the job list;
- name or title of the JHA;
- date the JHA rough draft was completed;
- name of the person completing the JHA;
- name(s) of individuals(s) who assisted;
- facility or location;
- date the approved rough draft was received from the supervisor;
- recommended PPE.

In most cases, some items on the initial (rough copy) JHA may be recorded incorrectly or omitted. Those responsible for training or evaluating completed JHA forms should correct such errors by focusing on the following guidelines:

- Do not omit any essential elements on the above list.
- In the basic steps column: 1) Keep words used to a minimum. This can usually be accomplished by using six or fewer words. 2) Ensure words used identify basic steps; words should not describe more than the "what" associated with the basic step. 3) Most JHAs will contain fewer than 10 basic steps.
- In the potential hazards column: 1) Identify hazards by using code letters such as SB (struck-by), CO (caught-on), etc.; this will save time while writing the JHA. 2) Be sure to identify only legitimate hazards, not risks that are highly improbable or unlikely.
- In the safe procedures column: 1) Provide solutions to avoid potential hazards in each basic step. 2) Align the numbers in all three columns so that the completed form is easier to read and follow. For example, if seven basic steps are involved, then seven numbers should also appear in the hazards and safe procedures columns. If the basic step contains no hazard, simply enter "no hazard" or place dashes across the column to aid the reader. 3) Ensure that the narrative is easy to read and provides correct information to safely and correctly perform the job. 4) Identify any special PPE that must be worn for the entire job or for particular steps. 5) Keep the narrative specific and eliminate wordiness that may cause confusion.

A JHA should be modified as needed. Each JHA is designed to be a living document—it is never truly finished.

Hazards to Look For During Analysis

Injury Sources

Each year, millions of workplace injuries and illnesses occur in the U.S., which analysis shows can generally be attributed to 11 primary hazardous sources (Eninger). During each JHA step, the supervisor must decide whether the employee is subject to any of the following:

1) struck by (SB)
2) struck against (SA)
3) caught between (CB)
4) contact with (CW)
5) contacted by (CBy)
6) caught on (CO)
7) caught in (CI)
8) fall, same level (FS)
9) fall to below (FB)
10) overexertion (O)
11) exposure (E)

During walkthrough at any facility or construction site, supervisors should be alert to these potential injury causes. Using the abbreviated code letter after each injury source saves time during the JHA observation process.

Injury Source Definitions

- A struck by injury occurs when the worker is struck by one or more objects. The injury could be the result of a falling brick, a backing forklift, a loose chuck key flying from an activated drill press, a hammer being used to drive a nail, whipping steel banding that has been cut or welding sparks. The object is in motion when it strikes the person. Additional injuries can take place after being struck-by or for any of the 11 sources. For instance, a work-

The JHA program also has the potential to help solve problems discovered during an injury investigation.

er can be struck and injured by the rear end swing of a forklift and be knocked to the floor, causing him/her to dislocate a hip.

•A struck against injury is caused by the worker making contact with a fixed or moving object. The worker or a part of his body is in motion at the time contact is made. For example, suppose a length of pipe has been placed over the handle of a wrench to gain leverage. As the worker pulls on the pipe, it slips off the wrench; the worker's momentum carries him rearward until he makes contact with an object. Similarly, a worker might injure her shin while walking through a plant if she walks into a valve protruding into a darkened walkway. Raising one's head while under shelving or racking can result in a bump on the head.

•Caught between injuries are caused by hazards that are referred to as pinch points. Closing a drawer or door on a hand, getting fingers caught in conveyor rollers, and getting a foot caught between a post and a backing forklift are common examples. Such hazards are easy to identify and correct.

•The contact with hazard involves contact with chemicals, sharp or jagged edges, hot surfaces or electricity. The person or object can be in motion when the injury occurs. Many contact with injuries startle the victim. To reduce or minimize such hazards, ensure that machines are guarded, HazCom program guidelines are followed and job evaluations focus on these hazards.

•The contacted by hazard is similar to the contact with incident. However, instead of the worker initiating the action that causes contact with the object, the worker is forced by other means into contact with the object. This can include a worker being sprayed by acid, contacted by hot steam or gases, or splashed by a chemical or harmful substance. The injurious substance of the contacting agent, not the force of the contact, determines whether it is a true contacted by injury. The injurious agent can be toxic, extremely hot or cold, corrosive, radioactive, electrified or otherwise injurious.

•The caught on injury involves the worker having a part of his/her clothing, working attire or body caught on a moving or stationary object. Injuries can be caused by being caught on ends of steel banding, nails, tails of steel coils, tips of crane hooks, strands of wire rope, ends of pipes and protruding valves.

•The caught in incident involves a person or part of a person's body being caught in an enclosure or hole. Inadvertently placing a foot in a hole while walking or being locked in a vault or other enclosure are examples. This type of incident is rare.

•Fall, same level incidents cause many injuries and deaths. The conditions of the walking and working surfaces can be the biggest factor regarding falls. Ice, snow, sand, untied shoelaces, protruding pipes and valves, grease, oil and cracks in the floor are all contributing causes.

•The fall-to-below incident is one that can easily result in a serious injury or fatality. Working on a roof, using a ladder, walking on a crane runway, erecting steel or working on a scaffold are all potentially dangerous and could result in a fall to below. A worker can also walk into a hole, a shaft, off a plank or walkway or drive off a dock with a piece of powered equipment.

•The overexertion injury occurs when a worker places too much pressure or strain on some part of the body. These injuries can be caused by manual handling; using extreme force on an object that is stuck; using an unsafe posture or position while completing a task; attempting to support a heavy object that is off balance or falling; or any repetitive motion process.

•Environmental exposures involve radiation, gases, vapors, fumes, dusts, mists, temperature extremes, oxygen deficiencies and noise. The results of an environmental exposure can be acute, such as exposure to sulfuric acid, or chronic, such as exposure to asbestos fibers. Many exposures can be detected and corrected during the JHA observation. If the supervisor is incapable of analyzing and correcting these hazards, an industrial hygienist should be called in to resolve the problem.

Unsafe Conditions

During any inspection or employee observation in a facility or worksite, management and workers should be aware of physical conditions that pose a potential hazard (U.S. Steel). For the most part, unsafe conditions can be identified from the following sources:

1) lack of or inadequate safeguards;
2) poor or inadequate lighting;
3) poor housekeeping practices or physical conditions;
4) presence of flammables, fire and explosion hazards;
5) inadequate or defective warning systems;
6) poor or inadequate maintenance procedures;
7) environmental hazards such as chemicals, dusts, mists, radiation or noise;
8) tools that lack guards, defects in objects or equipment that poses a hazard;
9) placement of objects that protrude into aisles;
10) plant layout hazards that provide inadequate clearance or congestion;
11) holes, pits, shafts and other elevated walking or working areas;
12) hazardous walking and working surfaces;
13) workbenches, tables, shelving, tools and other work areas that contribute to ergonomic problems;
14) unsafe personal protective equipment or clothing;
15) machines or objects that do not warn of movement;
16) hazardous placement of stored product.

Unsafe Behaviors

Employees must be trained to avoid potential injuries and should understand that their behavior can lead to workplace injuries. Management must watch for unsafe behavior such as:

1) failure to warn of or signal movement;
2) distracting others who are working;
3) failure to abide by speed or load limits;
4) failure to wear prescribed personal protective equipment;
5) disabling or removing guards or electronic devices;
6) use of defective tools or parts;
7) working, sitting or standing on moving dangerous equipment;
8) failure to use lockout/tagout procedures when working on equipment or devices;
9) failure to use correct body stances and positions to prevent repetitive motion injuries;
10) improper lifting, carrying, loading or sorting;
11) unauthorized use of equipment or tools.

Appropriate site-specific checklists can be developed from the list of factors that can lead to unsafe work practices and potential unsafe work area conditions. This information can help identify the various situations that contribute to worker injuries and illnesses. The preceding list can help anyone attempting to make a safer workplace.

The full and correct use of the JHA program will likely lead to the discovery of deficiencies in the facility safety and health program. Specifically:

•Anticipate the use of more maintenance projects for corrective action.

•Correct any condition that could cause injury or may violate a regulation as soon as it is discovered.

•Correct any condition that can be improved, such as moving trip/fall hazards, improving lighting, replacing lights or improving work gloves. If a major deficiency is discovered, have it corrected before completing the JHA; do not allow employees to work in a hazardous setting.

Employee training is another area that may be associated with a particular job being studied. Asking the right questions during the analysis may reveal a deficiency in an employee's knowledge base and skills set.

Conclusion

When correctly applied in the workplace, a JHA program produces measurable results. Injuries are reduced, employee and supervisor awareness increases, working conditions are improved, safe working procedures are created, and ergonomic hazards are reduced or eliminated.

Obtaining management approval and support is an essential first step. Once this commitment is made, proceed into training and hands-on writing of job observations. Emphasize quality over quantity for finished JHAs.

During the JHA process, understanding those conditions and employee behaviors that contribute to injuries and illnesses is essential. Through the observation of employees at work, the hazards, systems and actions that contribute to physical harm can be addressed.

Recognizing the 11 potential injury sources while conducting JHAs is one of the most important actions a supervisor can take to improve workplace safety. The mere awareness of these hazards through working with JHAs can help all involved be more alert to potential injury risks. ■

References

Assn. of Casualty and Surety Companies (ACSC). *Supervisor's Safety Guide Book.* New York: ACSC, January 1967.

Alliance of American Insurers. "An Introduction to Job Safety Analysis." *National Safety News.* July 1981.

American Insurance Assn. (AIA). *Supervisor's Safety Guide Book.* Washington, DC: AIA, December 1972.

Anderson, J.W. "JSA: Your Route to Safety." *Today's Supervisor.* Feb. 1993: 10-11.

Armco Steel Corp. *Industrial Safety & Hygiene Manual.* Middletown, OH: Armco, 1972.

Brown, D.B. *Systems Analysis and Design for Safety.* Englewood Cliffs, NJ: Prentice-Hall, 1976.

Chicago Bridge & Iron Co. N.V. "CB&I Safety—Commitment and Performance." <http://www.chicago-bridge.com/const.html>.

Colvin, R. *The Guidebook to Successful Safety Programming.* Chelsea, MI: Lewis Publishers, 1992.

DeReamer, R. *Modern Safety and Health Technology.* New York: John Wiley & Sons, 1980. 160-166.

Eninger, M.U. *Bethlehem Supervisory Safety Manual*. Bethlehem, PA: Normax Publications, 1972.

Hendrick, K.M. "Working with JSA." *The LIFESAVER.* Winter 1980: 16-19.

Johnson, W.G. *MORT Safety Assurance Systems.* Chicago: National Safety Council, 1980. 193, 194, 254, 277, 292-294, 327, 501.

Jones, J.W., et al. *Promoting Safety by Reducing Human Error.* New York: American Management Assn., June 1986. 41-44.

Kapp, S. "Why Job Safety Analyses Work." *Safety + Health.* April 1998: 54-58.

Kumar, A. "Analyzing System Safety." *Pollution Engineering.* June 2000: 46-47.

LeNoble, J. *Workplace Safety in Action: Job Safety Analysis.* Neenah, WI: J.J. Keller & Associates, 1996.

Libertiny, G.Z. *Product Safety Hazard Analysis.* New York: American Society of Mechanical Engineers, May 1977.

Manuele, F. *On the Practice of Safety.* New York: Van Nostrand Reinhold, 1993. 13, 37, 56.

Manuele, F. "Task Analysis for Productivity, Cost Efficiency, Safety and Quality." *Professional Safety.* April 2000: 18-22.

National Safety Council (NSC). *Job Safety Analysis: Accident Prevention Manual.* Itasca, IL: NSC, 1997. 134-139.

Perkinson, L. "JSA: A New Look for an Old Friend." *Occupational Hazards.* Aug. 1995: 63-66.

Roughton, J. "Managing a Safety Program Through Job Hazard Analysis." *Professional Safety.* Jan. 1992: 28-31.

Shults, J.D. "MSHA Hits Pay Dirt with JSA." *Safety + Health.* May 1991: 38-41.

Smith, L.C. "Let's Wed JIT and JSA." *National Safety News.* Jan. 1970: 75-77.

Spence, S. "A Case for Job Safety Analysis." *The Locomotive.* 3(61): 55-60.

Stearns, F. "Job Safety Analysis Gives Steps to Uncover Accident Causes." *National Safety Council Power Press & Forging Newsletter.* March/April 1984.

Sutcliffe, V. "Improve Safety Through Job Hazard Analysis." *Occupational Hazards.* Oct. 2000: 55-56.

Swartz, G. *Job Hazard Analysis.* Rockville, MD: Government Institutes, 2001.

OSHA. "Safety and Health Program Management Guidelines." *Federal Register.* Jan. 26, 1989: 3904-3916.

U.S. Steel Corp. *Principles of Accident Prevention in United States Steel.* Pittsburgh: U.S. Steel Corp., 1976.

Westinghouse Corp. "Accident Prevention for Manufacturing Management." *Job Safety Analysis.* Pittsburgh: Westinghouse Corp., 1967.

Zeigle, J. "How to Keep the Dust Off Job Safety Analyses." *Industrial Safety & Hygiene News.* Oct 2000: 65-66.