Job Safety Analysis
Its Role Today

By David D. Glenn

The process of breaking down a job into its constituent steps, listing the hazards associated with those steps and developing procedures to reduce those hazards appears to be accepted theoretically in the SH&E profession more than it is practiced. Job safety analysis (JSA), sometimes called job hazard analysis (JHA), has long been a safety program building block. Is the process still useful as a risk control technique?

What Is JSA?

JSA refers to both the analytical process of developing safer job procedures and to the document that is developed as a result of the analysis (NSC, 2009, p. 240). The most influential source for its format has been National Safety Council's (NSC) three-column form (Figure 1, p. 50). This form first appeared (albeit with different headings) in the fifth edition of *Accident Prevention Manual for Industrial Operations* (NSC, 1964, p. 10), although a "job breakdown" technique was described in the first edition (NSC, 1946, pp. 495-496) that related a job's "sequence of events" or "main steps" to its "safety factors" or "key points."

IN BRIEF
- Job safety analysis (JSA) has been a widely recognized tool for hazard identification, employee training and incident investigation.
- Experience suggests most companies and most SH&E practitioners currently devote little attention to JSA development and use.
- This article explores the history of JSA and its application to current causes of cost-driving injuries and severe potential incidents. JSA value can be increased by suggested changes to the tasks covered, personnel involved and the process of managing engineering controls.

ASSE's *Dictionary of Terms Used in the Safety Profession* makes no distinction between JSA and JHA (Lack, 2001, p. 58). This article uses JSA because that term has been in use longer and appears to be in current usage no less than JHA.

The various purposes of JSA are reflected in the chapters in which different editions of the *Accident Prevention Manual* (*APM*) have included the subjects: safety training (NSC, 1964, p. 1), hazard control (NSC, 1974, p. 104) and hazard identification (NSC, 2009, p. 229). Other uses include incident investigation, employee involvement and supervisory education (Swartz, 2001, p. 2). Bird and Germain (1990) summarize the benefits of JSA-derived procedures done correctly as "among the most valuable tools imaginable for such important activities as job orientation, task instruction, task observation, group meetings, employee coaching, accident/incident investigation, skill training" (p. 148).

David D. Glenn, CSP, is a national accounts manager, global loss prevention, at Chartis Insurance in Chicago. He holds a B.A. from the University of Notre Dame and an M.S. in Industrial Management from Northern Illinois University. Glenn is a professional member of ASSE's Northeastern Illinois Chapter.

JSA Is Embedded in the SH&E Profession—Or Is It?

In addition to the authoritative sources cited, other documents suggest JSA is integrated into SH&E professional practice guidance. Examination blueprints for both the associate safety professional (BCSP, 2010b, p. 3) and CSP (BCSP, 2010a, pp. 1, 4) designations include JSA among the expected knowledge and skill subjects. OSHA's 1989 Safety and Health Management Guidelines include "routine job hazard analyses" among the core hazard identification methods. Those guidelines have been incorporated into OSHA's (2008) consultation materials and partnership programs, such as the Voluntary Protection Programs (p. 27).

Book-length treatments of the subject were not published until 2001 (Swartz) and 2008 (Roughton & Crutchfield). Nearly one in seven technical sessions at ASSE's most recent professional development conferences included JSA-related terminology (Table 1, p. 52). However, of the 1,367 technical sessions at those conferences, only one (Swartz, 2003) had JSA as its primary subject matter. Furthermore, ANSI Z10-2005, Occupational Health and Safety Management Systems, uses JSA terminology only in the advisory column of the document (AIHA, 2005, p. 6), where it is included in a list of possible employee participation activities rather than for any intrinsic value of its own.

The 2008 *Safety Professionals Handbook*, which involved a large number of SH&E professionals as contributors and peer reviewers and an even larger number to validate its content (*Professional Safety*, 2008, p. 20), mentions JSA in only two places (Haight, Vol. I, pp. 158, 565).

In addition, a recent survey of ASSE members ranked JSA well behind audits, training, corrective actions and even near misses as a leading indicator of safety performance (Janicak & Ferguson, 2009, p. 4). In the author's experience in insurance loss control consulting, interest in JSA by insured companies and loss control consultants has diminished noticeably over the past decade as well.

In considering whether the concept is of current value, it may be helpful to visit its origins and development.

JSA Origins

JSA appears to have evolved from the scientific management practice of job analysis (JA). In fact, the first safety author to use the term *job safety analysis* was writing about JA (Heinrich, 1931, p. 96). The safety connection to scientific management is explicit in the subtitle to Heinrich's *Industrial Accident Prevention: A Scientific Approach.*

Scientific management began with Frederick Taylor's proposal to improve wage-setting methods (Drury, 1922, p. 75). The time studies involved in this process consisted of "an analysis of a job as a whole into the elementary movements of man and machine" (Drury, p. 77). Lillian Gilbreth, another scientific management founder, wrote in 1914 that the standardization of work methods led to safety benefits: "The results of standardization. . . . The fact that instructions are written provides against wrong methods of handling work" (Spriegel & Myers, 1953, p. 421).

The process of JSA preceded Heinrich's use of the term. A safety engineer from General Electric wrote in 1930 that "job analysis should bring out the hazards of the operations" so that standard procedures could be established (Goodspeed, p. 32). A 1927 NSC magazine published "Job Analysis for Safety," which described a process of subdividing the operations, listing related hazards and adopting standard methods for streetcar operators (p. 80).

It is not surprising that a transport operator may have been the first position to which JSA was applied. The liability from mass transit crashes and the belief that crashes were associated disproportionately with some operators led psychologists to devote extensive attention to the operator position in the 1920s (Burnham, 2009, pp. 67-73). A safety historian observes that "job analysis was used to bring out risks just as it was being employed to enhance output" and "was also used to fit the worker to the task" (Aldrich, 1997, pp. 158-159).

For the decades after Heinrich, the terminology used in this area is somewhat confusing as safety professionals discussed safety benefits of JA at the same time the process of JSA development was sometimes called JA. An example of the latter case comes from a steel industry superintendent:

> The first step, job analysis, is one that requires much time and effort if it is to be done right. First, every job done by any man in the department or unit being studied must be carefully scrutinized and every hazard noted . . . . [I]t is then necessary to decide the best means for eliminating them or minimizing the possibility of injury from them. (Johnson, 1941, p. 459)

An example of derivative safety benefits of JA comes from a 1945 safety textbook:

> Job analysis is an essential part of production control and as such its technique has become well developed and widely established in American manufacturing practice. It involves the accurate and detailed description of each job in terms of duties, tools required, methods, sequence of operations, and working conditions. As would be expected, such a procedure of itself eliminates a high proportion of accident hazards. When, to adequate job analysis, the other necessary factors of successful mass production are added, namely, planning, supervision, training and continuous control, we get a high degree of safety as an inherent part (we might say as "a by-product") of quantity production. (Blake, p. 69)

JA had a prior meaning to JSA as shown by a question asked at the 1939 National Safety Congress: "Does job analysis help promote safety? Why?" (Clover, p. 403). At the same conference, an industrial relations manager delivered a paper claiming safety benefits from JA and stressing the procedural element, such as establishing "the most approved methods" and "laying down safe practices" (Dooley, 1939, p. 509). This speaker went on to be the director of the Training Within Industry (TWI) section of the War Manpower Commission (TWI Angles, 1943, p. 1) whose job instruction documents were cited later by NSC.

Heinrich's Use of the JSA Term & the JSA Process

Heinrich (1931) used the JSA term as a way of emphasizing the safety benefits of JA as an employee selection tool:

> **Job Analysis.** In the application of the principles of accident prevention it is sometimes found that difficulty is experienced in correcting unsafe practices chiefly because employees are inherently unsuited to the work which they are obliged to perform. . . . There is another way to attack the situation, however, and that is to analyze the job and then, accepting employees as they are, select the man best fitted to the peculiarities of the work. This is fitting the job to the man rather than fitting the man to the job. Job safety analysis, in other words, has a place in accident prevention. Such analysis of a given job will show whether the work is heavy or light,

In considering whether the JSA concept is of current value, it may be helpful to visit its origins. JSA appears to have evolved from the scientific management practice of job analysis.

Figure 1

Three-Column JSA Form & Instructions

National Safety Council **JOB SAFETY ANALYSIS** *INSTRUCTIONS ON REVERSE SIDE*	JOB TITLE (and number if applicable): PAGE ____ OF ____ JSA NO. ____		DATE:	☐ NEW ☐ REVISED
	TITLE OF PERSON WHO DOES JOB:	SUPERVISOR:	ANALYSIS BY:	
COMPANY/ORGANIZATION:	PLANT/LOCATION:	DEPARTMENT:	REVIEWED BY:	
REQUIRED AND/OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT:			APPROVED BY:	

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	RECOMMENDED ACTION OR PROCEDURE

INSTRUCTIONS FOR COMPLETING THE JOB SAFETY ANALYSIS FORM

Job Safety Analysis (JSA) is an important accident prevention tool that works by finding hazards and eliminating or minimizing them *before* the job is performed, and *before* they have a chance to become accidents. Use JSA for job clarification and hazard awareness, as a guide in new employee training, for periodic contacts and for retraining of senior employees, as a refresher on jobs that run infrequently, as an accident investigation tool, and for informing employees of specific job hazards and protective measures.

Set priorities for doing JSAs: jobs that have a history of many accidents, jobs that have produced disabling injuries, jobs with high potential for disabling injury or death, and new jobs with no accident history.

Select a job to be analyzed. Before filling out this form, consider the following: The purpose of the job What has to be done? Who has to do it? The activities involved How is it done? When is it done? Where is it done?

In summary, to complete this form you should consider the purpose of the job, the activities it involves, and the hazards it presents. If you are not familiar with a particular job or operation, interview an employee who is. In addition, observing an employee performing the job, or "walking through" the operation step by step may give additional insight into potential hazards. You may also wish to videotape the job and analyze it.

Here's how to do each of the three parts of a Job Safety Analysis:

SEQUENCE OF BASIC JOB STEPS

Examining a specific job by breaking it down into a series of steps or tasks, will enable you to discover potential hazards employees may encounter.

Each job or operation will consist of a set of steps or tasks. For example, the job might be to move a box from a conveyor in the receiving area to a shelf in the storage area. To determine where a step begins or ends, look for a change of activity, change in direction or movement.

Picking up the box from the conveyor and placing it on a handtruck is one step. The next step might be to push the loaded handtruck to the storage area (a change in activity). Moving the boxes from the truck and placing them on the shelf is another step. The final step might be returning the handtruck to the receiving area.

Be sure to list *all* the steps needed to perform the job. Some steps may not be performed each time; an example could be checking the casters on the handtruck. However, if that step is generally part of the job it should be listed.

POTENTIAL HAZARDS

A hazard is a potential danger. The purpose of the Job Safety Analysis is to identify ALL hazards both those produced by the environment or conditions and those connected with the job procedure

To identify hazards, ask yourself these questions about each step:

Is there a danger of the employee striking against, being struck by, or otherwise making injurious contact with an object?

Can the employee be caught in, by, or between objects?

Is there potential for slipping, tripping, or falling?

Could the employee suffer strains from pushing, pulling, lifting, bending, or twisting?

Is the environment hazardous to safety and/or health (toxic gas, vapor, mist, fumes, dust, heat, or radiation)?

Close observation and knowledge of the job is important. Examine each step carefully to find and identify hazards the actions, conditions, and possibilities that could lead to an accident. Compiling an accurate and complete list of potential hazards will allow you to develop the recommended safe job procedures needed to prevent accidents.

RECOMMENDED ACTION OR PROCEDURE

Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness.

Begin by trying to: (1) engineer the hazard out; (2) provide guards, safety devices, etc.; (3) provide personal protective equipment; (4) provide job instruction training; (5) maintain good housekeeping; (6) insure good ergonomics (positioning the person in relation to the machine or other elements in such a way as to improve safety).

List the recommended safe operating procedures. Begin with an action word. Say exactly what needs to be done to correct the hazard, such as, "lift using your leg muscles." Avoid general statements such as, "be careful."

List the required or recommended personal protective equipment necessary to perform each step of the job.

Give a recommended action or procedure for each hazard.

Serious hazards should be corrected immediately. The JSA should then be changed to reflect the new conditions.

Finally, review your input on all three columns for accuracy and completeness. Determine if the recommended actions or procedures have been put in place. Re-evaluate the job safety analysis as necessary.

Note. *Reprinted from* Accident Prevention Manual for Business and Industry: Administration and Programs *(13th ed.), by NSC, 2009, Chicago: Author. Reprinted with permission.*

> whether it requires strength, skill, quickness of hand or eye, judgment of distance or all combined. It will indicate whether previous experience or training is required, whether a correct sense of color, hearing or smell is necessary, and any other special physical or mental qualities. (p. 97)

Heinrich then describes the process recognizable as JSA:

> In addition, it will break the job down into its several constituent operations and show the hazards of each so that the latter may be recognized in advance and made known to the employee, and so that he may be fully instructed in avoiding them.

This paragraph and the accompanying example figures of a completed JA persisted largely unchanged in future editions of Heinrich's book.

In the fourth edition (1959), the last sentence describing the JSA process was replaced by a four-page discussion of "methods safety analysis" (pp. 86, 89-91), which Heinrich indicates is "a somewhat different approach" from JA and JSA (p. 86). The process is familiar and hints at the three-column format:

> **Making the Analysis.** The methods safety analyst examines each step of the job or process from its very beginning with respect to the method, machine or material involved to see if any or all of these three can be responsible for the occurrence of accidents. If he finds a step that is potentially hazardous he notates (alongside the step description) the type of accident apt to be caused. He has a record, therefore, of 1) the steps of the job, 2) those steps which might be hazardous and 3) a means of reference for additional study of these steps, if necessary, in order to apply the proper corrective [action]. (p. 89)

Therefore, it appears that the person who first used the JSA term in safety continued to associate it with job placement purposes only, and later borrowed a mechanical engineering term to describe the writing of safe procedures associated with specific job steps, instead of using JSA in this sense. The fifth edition of *Industrial Accident Prevention* was published in 1980. Its only mention of JSA was as a supervisory method for collecting information about "whether or not certain known workable controls are in effect" (p. 116). The subtitle of the book changed as well to *A Safety Management Approach*. Thus, both scientific management and its JA practice were superseded in an influential safety management text.

Evolving Terms & Format

Other terms were used for the concept of JSA in addition to JA. Fife (1942) explained that, in contrast to incident investigation, listing hazards and designing controls in advance should be called "advanced job analysis" (pp. 682-684). Blake (1945) distinguished the analysis performed by the foreman from the safety function's follow-up "on-the-job safety analysis" (p. 77). A technology professor (Cox, 1949) used the term *safety analysis* to describe "dividing our job or operation into small sections . . . [to] secure not only an efficient and safe operation, but one in which the method is definitely established" (p. 28).

The connection to method is incorporated in another variant of the term. "Job method analysis has been surprisingly effective in reducing accidents. It has been found very profitable to have a competent person or committee make a safety analysis of every job in the plant" (Rogers, 1949, p. 14). Thus, in the 1930s and 1940s, vocabulary to describe the JSA process included SA, AJA, OTJSA and JMA, in addition to the longer-established term, JA.

The format for JSAs was based on job breakdown sheets. Samples provided in Heinrich (1931, pp. 97-98), Blake (1945, p. 71) and *APM* (NSC, 1946) include job-identifying data, job steps and safety information included as either "key points" or "remark" (p. 496).

APM states its source for job instruction as a pamphlet from TWI, a World War II-era government agency that trained foremen and supervisors to train the influx of inexperienced workers in wartime industrial production (NSC, 1946, p. 498). This source included a breakdown sheet example and asserted that if "key points" are taught successfully, the worker "won't be 'fighting' the work—making mistakes—getting hurt" (Dooley, 1942, p. 2). Job breakdowns were taught in TWI's job instructor training program (Dooley), one of three 10-hour training programs the agency offered (TWI Angles, 1943, p. 2).

Scientific management involved preparing "an instruction or method card for each separate operation, to show in detail, and step by step, just how the operation is to be performed and what tools are to be used in doing it" (Person, 1929, p. 363). Job breakdown and instruction cards had equivalent meanings in *APM* (NSC, 1946, p. 495). Breakdowns came to be used synonymously with written job analyses in personnel management (Calhoun, 1949, p. 150). The most current *APM* (NSC, 2009) retains "job breakdown" terminology in the JSA directions (p. 242).

Possibly due to the influence of wartime training initiatives (Powers, 1948, p. 49), the concept of job breakdown was still addressed at safety conferences in the 1950s. Fugal (1952) described his organization's use of this format. "The job breakdown sheet calls for a listing of important steps in the operation. Opposite each step are listed the key points. A key point in the job is considered anything in the step that might injure the worker . . ." (pp. 84-85).

In a roundtable discussion concerning the ques-

Table 1

ASSE Professional Development Conference Proceedings

Key-word searches were performed on the CD-ROMs of ASSE's Professional Development Conference Proceedings from 2001 to 2009. The proceedings consist of presenter-provided materials that represent the content covered in each conference's technical sessions. Searches were performed for "job safety analysis(es)," "job hazard analysis(es)," "JSA" and "JHA." The results are tabulated below.

Year	Location	Number of sessions	JSA/JHA mentions
2001	Anaheim, CA	87	15
2002	Nashville, TN	122	20
2003	Denver, CO	126	20
2004	Las Vegas, NV	136	19
2005	New Orleans, LA	172	23
2006	Seattle, WA	193	17
2007	Orlando, FL	173	22
2008	Las Vegas, NV	177	17
2009	San Antonio, TX	181	19
	Total	**1,367**	**172**

tion, "Are Job Hazard Breakdowns Being Used," the format was equated with the JSA process. "Several plants reported using job safety analysis or hazard breakdowns for training new employees and transferees" (Coulon, 1953, p. 25). The sources treat job breakdowns primarily as a job instruction training tool (Blake, 1945, p. 71; NSC, 1946, p. 495; Fugal, 1952, pp. 84-85). Basing a JSA on this tool may be why procedure-based control methods (Janicak, 2008, p. 158; NSC, 2009, p. 244; Swartz, 2003, p. 4) are emphasized more than design-related controls in the JSA process.

The breakdown sheet used to document the JA was combined eventually with the term JSA and the three-column format.

> The job analysis procedure is one method of finding all the steps which make up the job, what must be taught about each step, and the order in which the operations should be arranged for instructing the worker. . . . In some cases, a separate heading is used to indicate the safety precautions to be included. The analysis is then called a "job safety analysis." (NSC, 1964, p. 10)

While that source probably popularized the JSA format known today, the earliest published use of "a simple three-column worksheet" that lists "in proper sequence the elementary steps of the method or operation" in the first column, hazards in the second column, and "the proposed method for the elimination or control of each hazard" in the third column was a 1950 address to the NSC Metals Section by a Bethlehem Steel assistant superintendent (Bennett, p. 41). That paper also explicitly connects JSA to prior job study practices. "There is nothing new or complicated in the mechanics of our Job Safety Analysis plan. It differs from an Operations Analysis only to the extent that safety is given importance equal to other job factors, and that time study has been eliminated as a factor."

The Metals Section address was introduced by Bethlehem Steel's safety engineer who explained that since he attended the 1946 Congress, they had developed a plan. "We call it job safety analysis and it is a major part of our safety program" (Morgan, 1950, p. 40).

Therefore, there is evidence that the steel industry used the JSA term and the associated three-column format before that pairing became widespread. This may explain why JSA is believed to have originated from that industry (Swartz, 2002, p. 27). Earlier evidence of the industry following a JA process for safety includes a 1941 address by an Inland Steel superintendent (Johnson, p. 458).

Based on the evidence in safety publications and conference presentations, JSA as a term, as a format and as a process grew out of the earlier JA practice and the associated job breakdown sheet documentation and training tool. JSA's purpose largely was to develop standard procedures that could then be used to train workers. Implicit in this approach is that most hazards are behavior-related and that desired behavior can be achieved through development and enforcement of documented standard work methods. Whether those premises and purpose remain valid will determine the value of JSA to current professional practice.

JA Comes Full Circle

Bird (1974) is associated with the broadening of JSA to include all aspects of a job, not just safety and health considerations. His *Management Guide to Loss Control* includes a chapter on proper job analysis (PJA), which has the underlying assertion that "all factors (including safety, quality and production) must be included in the analysis and procedure" (p. 60). Later, using the term *job/task analysis* (JTA), Bird and Germain (1990) explained the limitations of JSA's effectiveness:

> Another method with some question as to its complete success has been job safety analysis. This approach frequently examines the work only from the perspective of safety and health. It has resulted in safer work. But it has also resulted in duplication of effort and paperwork, with safety procedures, quality procedures, efficiency procedures, etc. Because job procedures which deal only with safety are not related to the primary purpose for doing the work, they tend to get ignored in the face of other pressures. (p. 147)

Those who agreed with Bird's PJA or JTA approach continued to revise the term. A presenter at the 1977 National Safety Congress delivered a paper on "total job analysis" which "includes pinpointing of key quality and production factors rather than just the key safety factors" (Barenklau, p. 3). Citing the popularity of total quality management, Perkinson (1995, p. 63) advocated Bird's "task analysis" as a way of involving the safety function in broader business concerns.

Manuele (2000), citing Bird and Germain, suggests terms that relate to management's several goals, such as "TAPES for Task Analysis for Productivity, Ergonomics and Safety; or TAPCERA for Task Analysis for Productivity, Cost Efficiency and Risk Assessment" (p. 19). NIOSH researchers (Robertson, Cooper & Wiehegen, 2004) working in the mining industry assert "job training analysis [JTA] . . . is much different than Job Safety Analysis (JSA)" because "JTA is far more holistic in concept and approach" (p. 4). Whether a new term was needed for marketability reasons, it appears these authors essentially advocate a return to JA, understood in its original all-aspects sense.

Current Imperatives for the Profession

While the SH&E profession's object is the "prevention of harm to people, property and the environment" (ASSEF & BCSP, 2007, p. 3), in the context of occupational safety, practitioners can support business objectives most effectively by addressing cost-driving loss types. It may be constructive to view these losses from an aggregate perspective and also single catastrophic events that could affect an employer.

Liberty Mutual's annual workplace safety index provides a workers' compensation cost-focused report of "the most disabling workplace injuries in the U.S." that is derived from several sources (LMRIS, 2009). Overexertion is the most significant injury event category in the index, accounting for 24% of the total cost. This category includes injuries related to lifting, pushing, pulling, holding, carrying or throwing.

Ranked fourth, bodily reaction includes bending, climbing, reaching, standing, sitting, and slipping or tripping without falling. When combined with repetitive motion, these three strain-related event categories account for 38% of the cost burden tracked by the index. Strain-type injuries, therefore, appear to be the most significant single injury cost driver when considered across American businesses.

While focusing on strain-type injuries may address historic cost drivers to most organizations, it does not prevent fatalities or other serious events that can have significant financial impact on a business. Manuele's (2008b) recent writings on serious injuries and fatalities assert that those events occur under different circumstances than more common injury types, such as:

1) when unusual or nonroutine work is being performed;
2) when upsets occur (meaning normal production operations become abnormal);
3) in nonproduction activities;
4) where sources of high energy are present;
5) in what can be called at-plant construction operations (p. 34).

While addressing all risks is desirable, it may be more feasible to address those with the most likely or most severe outcomes. This concept is expressed commonly in the risk matrix that classifies a given hazard along axes of probability and severity (DOD, 2000, pp. 18-19). Strain-type injuries and serious injuries (including fatalities) appear to warrant the most attention in occupational SH&E practice. Is JSA helpful toward these ends?

JSA & Ergonomics

NIOSH (1997) defines ergonomics as "the science of fitting workplace conditions and job demands to the capabilities of the working population" with special reference to "assessing those work-related factors that may pose a risk of musculoskeletal disorders" (p. 2). NIOSH describes job analyses for ergonomic purposes: "Job analysis breaks a job into its various elements or actions, describes them, measures and quantifies risk factors inherent in the elements, and identifies conditions contributing to the risk factors" (p. 23).

The similarity to the JSA process was noted by Montante (1994) who proposed the term *ETA* for "an ergonomic approach to task analysis" (p. 18). Swartz (2001) asserts, "Many ergonomic hazards can be identified and eliminated while completing a job hazard analysis" (p. 131).

As Burke (1992) explains, ergonomic risk reduction methods may occur in one or more of the following four categories: input, output, machine or worker:

> The input is the item or items to be processed, moved or acted upon in any way by a specific worker. The output is the final condition of that input as a result of the actions

Based on the evidence in safety publications and conference presentations, JSA as a term, as a format and as a process grew out of the earlier JA practice and the associated job breakdown sheet documentation and training tool.

taken by the worker during the task being studied. The machine is the tangible concrete object(s) to which the worker will be exposed. This would include the workstation, tools, carts, environmental conditions and many other items. The worker is just that, the human worker. (pp. 159-160)

Note that only one of the four categories, the worker, encompasses job procedures. The other categories involve physical circumstances whose related interventions would involve engineering controls. JSA, therefore, would be of value primarily to the extent that the process identifies strain-related hazards created by physical conditions.

This has implications for who performs JSA and how the process is implemented. The traditional process (NSC, 2009, p. 245; OSHA, 2002, pp. 2, 4; Swartz, 2003, p. 2) of having a supervisor develop the JSA with employee input may not identify the strain-related risk factors and a supervisor may not have the authority to correct significant design issues.

Therefore, JSA development should have the following characteristics in order to address industry's primary injury type cost generator:

•Involve those who are knowledgeable about ergonomics in the analysis so they can identify strain risk factors and their root causes, both physical and behavioral.

•Ensure that the strain risk factors which arise from physical conditions are addressed by managers who can approve changes to equipment, layout, material, tool and other engineering controls.

Incorporating ergonomics into JSA development requires extra steps. That is, the third column of the form (recommended action or procedure) is limited to behavioral aspects while ergonomic improvements often involve physical changes. Therefore, before a final procedure can be documented, the necessary physical controls should be implemented. Ergonomic risk factors still can be documented in the potential hazards column, with an indicator if there is uncontrolled risk. The JSA development process should account for how physical controls will be addressed for strain hazards identified during JSA development and how the form will be revised in both the second and third columns after the physical controls have been implemented.

JSA & Serious Injury Prevention

Although some strain-type injuries qualify as "serious," the term is used here mostly for "low-probability/serious-consequence events" that result in death or high numbers of lost workdays (Manuele, 2008b, p. 34). Most JSA guidelines provide prioritization criteria that could be labeled "worst first" in selecting jobs for JSA development. However, is JSA a useful technique for addressing the specific types of serious injury circumstances cited?

Nonroutine Tasks

The 2009 *APM* advises that jobs done "infrequently or on an irregular basis" should be subject to prejob instruction based on the applicable JSA (p. 248). A critical element in developing the task inventory preparatory to breaking the job down is to "include not only the tasks that a person normally does but also the tasks that they might be called on to do in unusual situations. Experience has shown that the latter category is a major source of accident loss" (Bird & Germain, 1990, p. 149).

In proposing an all-risk "job hazard assessment," Geronsin (2001) includes "nonroutine activities or processes" in evaluating the severity of hazards (p. 25). OSHA (2006) requires employers to specify the "methods the employer will use to inform employees of the hazards of nonroutine tasks"

Focus Four Hazards in the Construction Industry

Primary causes of:

Electrocution fatalities
•Contact with overhead powerlines
•Contact with live circuits in panels
•Poorly maintained cords and tools
•Lightning strikes

Struck-by fatalities
•Falling objects
  •Rigging failure
  •Loose or shifting materials
  •Equipment tipover or malfunction
  •Lack of overhead protection
•Vehicle and equipment strikes
  •Backing incidents
  •Workers on foot
•Flying objects

Caught-in-between fatalities
•Trench/excavation collapse
•Rotating equipment
•Unguarded parts
•Equipment rollovers
•Equipment maintenance

Fall-related fatalities
•Unprotected sides, edges and holes
•Improperly constructed walking/working surfaces
•Improper use of access equipment
•Failure to properly use personal fall arrest system
•Slips and trips (housekeeping)

Note. *Adapted from "Safety Training for the Focus Four Hazards in the Construction Industry," by Associated General Contractors of America, 2006.*

in their written hazard communication programs. The procedural emphasis of JSA appears to be particularly well-suited to task-specific performance, including those that are nonroutine.

Abnormal/Upset Production Operations

In discussing the application of JSA as a tool to develop the OSHA-required PPE hazard assessment, Mansdorf (1999) asserts, "JSA/JHA should also include 'what if' analysis for nonroutine and upset conditions . . . because accidents commonly result from deviations from work practices and normal operations" (p. 58). This is not likely covered by most JSAs as performed, but could be added as an explicitly required item to specific job steps in the first column of the form.

Nonproduction Activities

Presumably, maintenance and servicing comprise most nonproduction-type activities. For example, ANSI/ASSE Z244.1-2003 on the control of hazardous energy (lockout/tagout) requires "each unique piece of equipment, system or process shall have detailed procedures developed and documented for the control of hazardous energy during servicing or maintenance activities" (ANSI/ASSE, 2009, p. 18). The sample lockout/tagout program and policy supplied in an annex to that standard mentions JSA as a method for developing these procedures (p. 39).

Maintenance and servicing may involve a myriad of other hazards in addition to those that are energy-related. This brings up the critical need to distinguish jobs (or tasks) within a single job classification. "The term 'job,' in the context of the job hazard analysis program, represents a sequence of definite steps or separate activities that together accomplish a work goal. *It does not represent the occupation of the worker*" (emphasis in original, Swartz, 2001, p. 6).

For nonproduction activities, the number of jobs could be large and challenging to capture fully and to prioritize effectively. Rather than develop "a larger number of breakdown sheets" (Blake, 1945, p. 76), it may be more practical to develop general practices that are transferrable across similar jobs (Bird & Germain, 1990, p. 148).

High Energy Sources

In addition to lockout/tagout procedures, JSA has been listed as a primary method of protecting nonutility employees engaged in "tasks that might expose workers to the hazards associated with electrical lines and equipment" (Tompkins, 2004, pp. 5-6).

At-Plant Construction

Similar to maintenance activities, construction projects can involve many tasks that probably do not have an existing JSA. However, the serious injury risks can be managed by developing JSAs for tasks that involve OSHA's "focus four" hazards for construction: falls from elevation, struck-by, caught-in/between and electrical shock (sidebar, p. 54). Many hazards on that list are either created by, or avoided through, worker behavior, so procedures based on JSA should be effective.

None of this discussion is intended to overemphasize the role of individual behavior in prevention of serious incidents. The broader considerations are explained as follows:

> Since the majority of the causal factors for incidents that result in serious consequences are systemic, the safety efforts should be directed to improving the system. Focusing prevention efforts principally on the worker will not address systemic problems. In a safety management system that concentrates on worker behavior, management allocates resources predominantly to the worker behavior aspects of safety. Thus, inadequate attention is given to systemic causal factors deriving from design and engineering shortcomings, the hazards in the operational procedures, and the system of expected behavior that has developed. (Manuele, 2008a, p. 56)

Thus, even a well-written JSA cannot guarantee serious injury avoidance by itself. It can, however, be a tool for defining the expected behavior and the process of implementing a JSA program may help identify design and engineering shortcomings. As with ergonomics, the latter consideration is reason to involve in the JSA development process those with authority to make physical changes. Among the methods Manuele (2008a) suggests for reducing serious injury potential is "the implementation of a prejob planning and safety analysis system. Its purpose is to provide a means to study how the work is to be done and the hazards and risks that may be encountered before the work actually commences" (p. 62).

Conclusion

Repackaging of the JSA term over time (sidebar, p. 56) suggests that its underlying concept has not sustained sufficient perceived value. This may be due to the limited effectiveness of procedural controls for some injury causes, such as musculoskeletal disorders. It also may be attributable to the lower return-on-investment from developing JSAs for lower-risk jobs.

JSA can contribute most to reduction of cost-driving risks if changes are made to process implementation and emphasis. The JSA development process should specify how physical controls will be addressed and how the form will be revised following the implementation of those controls.

The task inventory for which JSAs will be developed should include severe injury potential job types, such as nonroutine tasks, nonproduction ac-

A well-written JSA can be a tool for defining the expected behavior and the process of implementing a JSA program may help identify design and engineering shortcomings.

JSA-Related Terms Used in This Article

Although there are some distinctions among some of the following, these terms have been used by cited sources to convey substantially similar or overlapping meanings to job safety analysis (JSA).

Advanced job analysis (AJA)
Ergonomic task analysis (ETA)
Job analysis (JA)
Job breakdown (JB)
Job hazard analysis (JHA)
Job hazard assessment (JHA)
Job hazard breakdowns (JHB)
Job method analysis (JMA)
Job/task analysis (JTA)
Job training analysis (JTA)
Hazard breakdowns (HB)
Methods safety analysis (MSA)
On-the-job safety analysis (OTJSA)
Proper job analysis (PJA)
Safety analysis (SA)
Task analysis (TA)
Task analysis for productivity, cost efficiency and risk assessment (TAPCERA)
Task analysis for productivity, ergonomics and safety (TAPES)
Total job analysis (TJA)

tivities, high energy source exposures and at-plant construction. The sequence of basic job steps or potential hazards columns should include abnormal/upset conditions that are related to normal job steps. The potential hazards column should include ergonomic risk factors, which suggests that those who develop the JSA should have ergonomic knowledge and experience. These guidelines will increase the business value of JSAs by aligning with exposures and controls of high-cost incidents. **PS**

References

Aldrich, M. (1997). *Safety first: Technology, labor and business in the building of American work safety, 1870-1939*. Baltimore: Johns Hopkins University Press.

ANSI/AIHA. (2005). American national standard for occupational health and safety management systems [ANSI Z10-2005]. Fairfax, VA: Author.

ANSI/ASSE. (2009). Control of hazardous energy: Lockout/tagout and alternative methods [ANSI/ASSE Z244.1-2003 (R2008)]. Des Plaines, IL: Author.

ASSE Foundation (ASSEF) & BCSP. (2007). *Career guide to the safety profession* (3rd ed.). Des Plaines, IL: Author. Retrieved Aug. 25, 2009, from **www.asse.org/foundation/publications/docs/2007_Career_Guide.pdf**.

Associated General Contractors of America. (2006). Safety training for the focus four hazards in the construction industry (Susan Harwood Grant No. 46C5-HT09). Washington, DC: U.S. Department of Labor. Retrieved Sept. 11, 2009, from **www.agc.org/galleries/career/FocusFour01.pdf**.

Barenklau, K. (1977). Total job analysis. *NSC Transactions, 5*, 3-11.

Bennett, R.S. (1950). Job safety analysis. *Transactions of the 38th National Safety Congress* (Vol. 18, pp. 41-43). Chicago: NSC.

Bird, F. (1974). *Management guide to loss control.* Loganville, GA: Institute Press.

Bird, F. & Germain, G. (1990). *Practical loss control leadership*. Loganville, GA: Institute Publishing/International Loss Control Institute.

Blake, R. (1945). *Industrial safety*. New York: Prentice-Hall.

BCSP. (2010a, Dec.). Comprehensive practice exam blueprint (6th ed.). Savoy, IL: Author.

BCSP. (2010b, Dec.). Safety fundamentals exam blueprint (6th ed.). Savoy, IL: Author.

Burke, M. (1992). *Applied ergonomics handbook.* Chelsea, MI: Lewis Publishers.

Burnham, J. (2009). *Accident prone: A history of technology, psychology and misfits of the machine age.* Chicago: University of Chicago Press.

Calhoon, R. (1949). *Problems in personnel administration.* New York: Harper & Brothers.

Clover, H. (1939). Roundtable discussion of the Meat Packing, Tanning and Leather Industries Section. *Transactions of the 28th National Safety Congress.* Chicago: NSC.

Coulon, V.P. (1953). Roundtable discussion: Paper Converting Division. *Transactions of the 41st National Safety Congress* (Vol. 27, pp. 24-25). Chicago: NSC.

Cox, W.N. (1949). Safety analyses an aid to on-the-job instruction. *Transactions of the 37th National Safety Congress* (Vol. 15, pp. 27-28). Chicago: NSC.

Department of Defense (DOD). (2000, Feb. 10). Standard practice for system safety (MIL-STD-882D). Wright-Patterson AFB, OH: SAF/AQR Deputy Assistant Secretary.

Dooley, C.R. (1939). How can job analysis and merit rating programs help solve accident prevention problems? *Transactions of the 28th National Safety Congress.* Chicago: NSC.

Dooley, C.R. (1942, May). How to instruct a man on the job (Bulletin No. 2-C). Washington, DC: War Manpower Commission, Training Within Industry Division. Retrieved Sept. 2, 2009, from **www.library.illinois.edu/archives/e-records/ALA%20Archives/2050006/Box%206/2850006-006-006-Training_Within_Industry_1943_opt.pdf**.

Drury, H. (1922). *Scientific management: A history and criticism.* New York: AMS Press.

Fife, J.A. (1942). Safety through advanced job analysis. *Transactions of the 31st National Safety Congress* (Vol. 1, pp. 682-685). Chicago: NSC.

Fugal, G.R. (1952). Start them right. *Transactions of the 40th National Safety Congress* (Vol. 15, pp. 82-90). Chicago: NSC.

Geronsin, R. (2001, Dec.). Job hazard assessment:

A comprehensive approach. *Professional Safety, 46*(12), 23-30.
Goodspeed, M.C. (1930, July). Job analysis reveals the accident causes. *National Safety News, 32*, 112-113.
Haight, J. (Ed.). (2008). *The safety professionals handbook* (Vol. I & II). Des Plaines, IL: ASSE.
Heinrich, H.W. (1931). *Industrial accident prevention: A scientific approach* (1st ed.). New York: McGraw-Hill Book Co.
Heinrich, H.W. (1959). *Industrial accident prevention: A scientific approach* (4th ed.). New York: McGraw-Hill Book Co.
Heinrich, H.W., Petersen, D. & Roos, N. (1980). *Industrial accident prevention: A safety management approach* (5th ed.). New York: McGraw-Hill Book Co.
Janicak, C. (2008). Benchmarking and performance criteria. In J. Haight (Ed.), *The safety professionals handbook: Management applications* (Vol. I). Des Plaines, IL: ASSE.
Janicak, C. & Ferguson, L. (2009). Integrating safety performance measures into the safety management system. *Proceedings of ASSE's Safety 2009 Professional Development Conference, USA.*
Job analysis for safety. (1927, April). *National Safety News*, 80.
Johnson, H.W. (1941). Job analysis: Its relation to safety. *Transactions of the 30th National Safety Congress* (Vol. 1, pp. 458-461). Chicago: NSC.
Lack, R. (2001). *The dictionary of terms used in the safety profession* (4th ed.). Des Plaines, IL: ASSE.
Liberty Mutual Research Institute for Safety. (2009). Workplace safety index. Hopkinton, MA: Author. Retrieved Nov. 5, 2010, from **www.libertymutualgroup.com/omapps/ContentServer?c=cms_document&pagename=LMGResearchInstitute%2Fcms_document%2FShowDoc&cid=1138365240689.**
Manuele, F. (2008a). *Advanced safety management: Focusing on Z10 and serious injury prevention.* New York: John Wiley & Sons.
Manuele, F. (2008b, Dec.). Serious injuries and fatalities: A call for a new focus on their prevention. *Professional Safety, 53*(12), 32-39.
Manuele, F. (2000, April). Task analysis for productivity, cost efficiency, safety and quality. *Professional Safety, 45*(4), 18-22.
Mansdorf, Z. (1999, Sept.). Hazard assessments. *Occupational Hazards*, 57-58, 60, 62, 64.
Montante, W. (1994, Feb). An ergonomic approach to task analysis. *Professional Safety, 39*(2), 18-22.
Morgan, E.D. (1950). Introduction to job safety analysis. *Transactions of the 38th National Safety Congress* (Vol. 18, p. 40). Chicago: NSC.
NIOSH. (1997, March). *Elements of ergonomics programs: A primer based on workplace evaluations of musculoskeletal disorders* (NIOSH Publication No. 97-117). Cincinnati, OH: U.S. Department of Health and Human Services, CDC, Author.
NSC. (1946). *Accident prevention manual for industrial operations* (1st ed.). Chicago: Wm. H. Pool Co.
NSC. (1964). *Accident prevention manual for industrial operations* (5th ed.). Chicago: Author.
NSC. (1974). *Accident prevention manual for industrial operations* (7th ed.). Chicago: Author.
NSC. (2009). *Accident prevention manual for business and industry: Administration and programs* (13th ed.). Chicago: Author.
OSHA. (1989, Jan. 26). Safety and health management guidelines, issuance of voluntary guidelines. Washington, DC: U.S. Department of Labor, Author. Retrieved Aug. 19, 2009, from **www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=12909**.
OSHA. (2002). Job hazard analysis (OSHA 3071). Washington, DC: U.S. Department of Labor, Author. Retrieved Oct. 18, 2007, from **www.osha.gov/Publications/osha3071.pdf**.
OSHA. (2006). Hazard communication [29 CFR 1910.1200(e)(1)(ii)]. Washington, DC: U.S. Department of Labor, Author. Retrieved Sept. 11, 2009, from **www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099.**
OSHA. (2008, April 18). Voluntary Protection Programs (VPP): Policies and procedures manual (CSP 03-01-003). Washington, DC: U.S. Department of Labor, Author. Retrieved July 7, 2009, from **www.osha.gov/OshDoc/Directive_pdf/CSP_03-01-003.pdf.**
Perkinson, L. (1995, Aug.). JSA: A new look for an old friend. *Occupational Hazards*, 63-66.
Person, H. (Ed.). (1929). *Scientific management in American industry.* New York: Harper & Brothers Publishers.
Powers, M.L. (1948). Job safety analysis: How to apply the facts. *Transactions of the 36th National Safety Congress* (Vol. 2, pp. 47-51). Chicago: NSC.
Professional Safety. (2008, April). The safety professionals handbook: An interview with editor-in-chief Joel Haight. *Professional Safety, 53*(4), 20-22.
Robertson, S., Cooper, D. & Wiehegen, W. (2004). Safety improvements for roof bolter operators. *Proceedings of ASSE's Safety 2004 Professional Development Conference, USA.*
Rogers, R.L. (1949). Essentials of accident control. *Transactions of the 37th National Safety Congress* (Vol. 30, pp. 12-15). Chicago: Author.
Roughton, J. & Crutchfield, N. (2008). *Job hazard analysis: A guide for voluntary compliance and beyond.* Oxford, U.K.: Butterworth-Heinemann.
Spriegel, W. & Myers, C. (Eds.). (1953). *The writings of the Gilbreths.* Homewood, IL: Richard D. Irwin.
Swartz, G. (2001). *Job hazard analysis: A guide to identifying risk in the workplace.* Rockville, MD: Government Institutes.
Swartz, G. (2002, Nov.). Job hazard analysis: A primer on identifying and controlling hazards. *Professional Safety, 47*(11), 27-33.
Swartz, G. (2003). Job hazard analysis: The key to injury prevention. *Proceedings of ASSE's Safety 2003 Professional Development Conference, USA.*
Tompkins, P. (2004). High-voltage electric safety: Safety precautions for working on or near high-voltage power lines. *Proceedings of ASSE's Safety 2004 Professional Development Conference, USA.*
TWI Angles. (1943, March 10). Issue No. 1. Chicago: Training Within Industry, District No. 15. Retrieved Sept. 1, 2009, from **www.library.illinois.edu/archives/e-records/ALA%20Archives/2050006/Box%203/2850006-003-010-Job_Evaluation_and_Training_Joint_Sub_committee_on_1944_opt.pdf**.