Task Analysis for PRODUCTIVITY, COST EFFICIENCY, SAFETY & QUALITY

By FRED A. MANUELE

The system proposed offers safety professionals the opportunity to improve the effectiveness of safety management endeavors while at the same time positively affecting the results for which management is measured.

Today's business climate requires a higher level of management effectiveness, part of which is stringent measurement of the contributions of individuals toward achieving entity goals. Demands to reduce costs and improve productivity and quality are never-ending.

Many safety practitioners perceive a need to bring additional value to their companies and to be recognized as problem-solvers whose counsel is desired because they help achieve management goals. One mark of success is being sought for advice; it results from activities which convince internal customers that the safety practitioner is a resource who helps them achieve their goals. "Being on the manager's page" is a commonly used phrase among safety practitioners.

Job safety analysis methodologies have been available for decades. They have been used effectively in some companies, and tried and abandoned in others due to a perceived notion of excessive time requirements.

Nevertheless, reflecting on the current business climate and considering the probability of achieving more-effective safety management results, anecdotal data suggest that safety practitioners should consider the benefits of transforming long-established job safety analysis methods into a task analysis system that incorporates ergonomics, productivity, cost efficiency and quality.

RATIONALE

Several factors gave impetus to this proposal, including reviews of data on ergonomics applications; extensive studies of injury and illness investigation reports; and successes in combining quality considerations within what originally were job safety analysis systems.

A significant amount of anecdotal data indicate that application of ergonomics principles to reduce occupational risk often also leads to improved productivity and lower operating costs (and sometimes improved quality). The data are voluminous, which suggests that much can be gained by revising task analysis systems.

The author has long used a simple definition of occupational ergonomics (comparable to that found in the literature): "Occupational ergonomics is the art and science of designing the work to fit the worker." To better reflect the reality of the anecdotal data collected, the definition now reads: "Occupational ergonomics is the art and science of designing the work to fit the worker to achieve optimum productivity and cost efficiency, and minimum risk of injury."

Note the order of productivity, cost efficiency and risk of injury. Emphasizing possible productivity and cost-efficiency gains is a different approach than that found in most ergonomics literature. It is to the advantage of safety practitioners who seek accomplishment and recognition to take such an approach.

Consider this example: A safety professional had difficulty convincing a plant manager that ergonomics studies were needed to understand the operation's injury and illness experience. Reluctantly, the plant manager conceded and created a study team. After the ergonomics improvements had been made, production personnel performed cost-benefit analyses and concluded that not only had risks been reduced, but productivity and cost efficiency had been favorably impacted as well.

Since then, the safety professional includes—prominently—the possibility of improving productivity, cost efficiency and quality in his proposals for ergonomics studies. His counsel is now in greater demand. As lessons such as these reflect, it should be the exception when an ergonomics task analysis is proposed solely for safety purposes—productivity and cost efficiency should be assessed as well.

Other factors have influenced this proposal. Incident analyses to determine causal factors often conclude that the operations and work methods being analyzed are not the most-productive or efficient. Furthermore, as employee participation has grown through involvement and empowerment initiatives, workers have often recommended safer, easier and more-productive ways to perform work than the prescribed methods. The task analysis method proposed requires employee involvement because of the benefits that can be gained from their participation.

THE APPROACH THAT WORKS

Safety practitioners should convert traditional job safety/hazard analysis methods into a task analysis system that addresses safety, ergonomics, productivity, cost efficiency or quality—choosing whatever combinations have the best likelihood for acceptance and success (after considering operational needs and opportunities).

A few safety professionals have developed such systems. In one situation, a safety professional broadened job safety analysis procedures to include quality considerations; this was the best approach based on his organization's needs—and it works. His system addresses safety risks and quality specifications in an activity flowchart, and considers process alternatives and preventive actions. In the examples reviewed, it was obvious that consideration is given to the best, most-efficient way to accomplish a task.

Giving this system a new name related to management goals will facilitate its marketing (e.g., TAPES for Task Analysis for Productivity, Ergonomics and Safety; or TAPCERA for Task Analysis for Productivity, Cost Efficiency and Risk Assessment).

JOB OR TASK

The terms "job" and "task" have been used frequently thus far. The term "job" has several meanings; it may designate an occupation title or a specific task assignment. The term "task" is more limiting in scope, often used to refer to a part of a job; it is *tasks* that are to be analyzed. In *Practical Loss Control and Leadership*, Bird and Germain offer this definition of a task: "a segment of work which requires a set of specific and distinct actions for its completion" (150). That definition is proposed for use in the extended task analysis system.

REVISING SAFETY'S MARKETING APPROACH

In today's highly competitive business climate, having operating personnel perform job safety analyses may not be a high priority. Like it or not, that simply is reality. In addition, performing job analyses solely for safety purposes can be perceived as separating safety from the core business. As Bird and Germain explain:

> [Job safety analysis] usually 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, and confusion with safety procedures, quality procedures, efficiency procedures, etc. Because procedures which deal only with safety are not always perceived to be related to the primary purpose for doing the work, they tend to get ignored in the face of other pressures (149).

Safety's marketing opportunities can be greatly enhanced if the task analysis system is perceived to have a direct impact on operational needs and is consistent with management goals. Management speaks the language of productivity, cost efficiency and quality. Extending task analysis systems will give safety practitioners greater opportunity to "get on the manager's page."

Safety practitioners are often frustrated by management decisions that seem to indicate lack of support. On a given day, managers must consider multiple proposals that require spending money. Safety proposals must compete against all other proposals. The system detailed here will help move safety proposals higher up the priority ladder.

This in no way suggests that the thoroughness of the safety and ergonomics aspects of a combined task analysis be diminished in purpose or scope. Conducting such task analyses often better serves safety management purposes.

A LITERATURE REVIEW

Thirty-five safety-related texts were reviewed to determine what has been said about relating job safety analyses to productivity, cost efficiency or quality; such references are few and mostly brief.

For example, in *Safety and Health For Engineers,* Brauer says, "A job safety analysis can be completed concurrently with other forms of task analysis common to industrial practice" (463).

In *Lockout/Tagout: The Process of Controlling Hazardous Energy,* Grund comments, "This technique can break down lockout/tagout procedures into a series of measurable steps in which each task is analyzed for its effectiveness, safety and necessity" (261).

Hammer refers to effectiveness and efficiency when discussing procedure analysis in *Occupational Safety Management and Engineering:*

> A procedure analysis is a set of instructions for sequenced actions to accomplish a task. . . . Analyses must ensure that the procedures are not only effective and efficient but safe (134).

National Safety Council (NSC) has a training program entitled "Job Safety Analysis: Identifying and Controlling Hazards and Managing the Process." The instructor's guide for Module 1 states:

> The process of developing a job safety analysis enables employees to identify task-related hazards and to establish safer work procedures that management endorses, improving workplace safety, productivity and quality (1-1).

In "An Ergonomic Approach to Task Analysis," Montante explains how analyses benefit the overall business system:

> An ergonomic approach to task analysis expands the scope of traditional methods by evaluating, step-by-step, how the human operator interacts with machine, product, system and work environment. This analysis helps determine whether task demands match—or exceed—human capabilities. Regardless of analysis approach, results can substantially benefit the overall business system (18).

Two other authors have written extensively on the desirability of job analyses that encompass all aspects of work to be performed. In "Proper Job Analysis and Procedures," Chapter 5 in *Management Guide to Loss Control,* a book published in 1974, Bird asserts that job analyses should address more than safety.

Practical Loss Control Leadership, first published in 1985, offers a more-extensive treatment of Bird's original work. Chapter 7 is titled "Task Analysis and Procedures." (Note that "job analysis" became "task analysis.")

Bird's "proper job analysis and procedure" is based on the following premises. They were sound 25 years ago—and are today; it is unfortunate that few safety practitioners have adopted them.

> [This] chapter is based on the concept that all elements of a worker's job, such as quality, production, safety and health, are inseparable. Any one or all can affect the others, and to consider them as separate elements when teaching a worker to do his job is to invite the confusion and misunderstanding that leads to downgrading incidents.
>
> It just isn't possible to do a job efficiently if all aspects of the job are not considered as part of the standard procedure to get it done. Efficiency requires the best use of people, equipment, materials and environment, all working together to produce optimum results (60).

Bird proposed that one standard task procedure be developed to encompass all aspects of a task and that such a procedure could best be written if all task factors were included in the task analysis process. That also serves as the premise of this article. The method proposed begins with the job safety/hazard analysis procedures with which most safety practitioners are familiar.

GETTING STARTED

Those who wish to pursue this process should read the referenced chapters in *Management Guide To Loss Control* and *Practical Loss Control Leadership;* they are thought-provoking.

NSC's *Accident Prevention Manual For Business and Industry: Administration & Programs* offers a traditional dissertation on job safety analysis (134+). It has been expanded to include productivity and quality in the Council's training program. Practitioners may want to consider developing their knowledge by taking a course on job safety analysis as well.

THE TASK ANALYSIS PROCESS

Task analysis procedures are not reviewed in detail here. The references discussed offer a good review. The "Task Analysis" section in *Human Factors Design Handbook, Second Edition* is also recommended (760+). Discussion here will focus on aspects of the Bird and Germain system and that advocated by NSC.

Bird and Germain present "a systematic, practical approach to preparing and using task procedures and/or practices" in seven stages:

1) Inventory occupations.

2) Inventory all tasks within each occupation.

3) Identify the critical tasks.

4) Analyze the critical tasks: a) break tasks down into steps or activities; b) pinpoint loss exposures; c) make an improvement check; d) develop controls.

5) Write procedures of practices.

6) Put to work.

7) Update and maintain records (150).

NSC's program features these steps:

1) Occupational job inventory (job task inventory).

2) Job (task) selection.

3) Sequence of basic job steps: using a standard form, break down the job task into observable steps.

4) Hazard identification.

5) Hazard control measures.

6) Job safety analysis review/approval.

7) Implementation (2, 6, 7).

Some similarities and differences exist between these two strategies. Each proposes developing occupational and task inventories.

DEVELOPMENT OF INVENTORIES

Although the focus here is safety-related priorities—because that is the field of endeavor for safety practitioners—it should be understood that the purpose is to extend the analysis system into other areas; discussion with production and quality control personnel may result in selection of tasks for priority consideration that are also of interest to them. Thus, as task analysis is extended, systems and corresponding forms must be revised to include appropriate columns to capture the desired information.

Bird and Germain state, "The first step in developing a comprehensive task inventory is to produce a complete list of all occupations"; the second step is "listing all the tasks performed within each occupation" (151-52). In its program, NSC proposes, "The first step is to develop a comprehensive job task inventory for every occupation or job title in the organization" (2-6).

Although developing an inventory of *all occupations* may be manageable, developing an inventory of *all tasks* is daunting. Few of today's "lean" organizations could achieve that—even if it were desirable. Consider a typical auto parts manufacturing location: 1,000 employees, each performing a minimum of 10 tasks. Developing an inventory of each task could be so time-consuming that it might never be completed. Both models propose that critical tasks be selected for analysis; it seems that approach is more practical and attainable.

IDENTIFYING TASKS TO BE ANALYZED

Some tasks are inherently more hazardous than others, and should be given priority for analysis if they present a potential to create an incident that may produce serious injury, illness, property damage or environmental damage.

To determine what tasks to analyze, the following factors should be considered:

- actual incident history, including OSHA recordable and lost workday cases, and workers' compensation history;
- incidents that, under slightly different circumstances, could have resulted in serious injury or damage;
- input from workers on tasks they perceive to be hazardous;
- hazardous, non-routine tasks (e.g., maintenance and trouble-shooting);
- other known high-hazard tasks;
- new tasks with which workers may not be familiar.

Throughout this process, judgment and experience will prevail. Input from and involvement of those who perform the

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tasks—the workers—is crucial as well. Actual incident history will indicate which tasks should be given priority, yet one must also consider "near-miss" incidents that could have produced serious harm or damage as well as tasks about which workers express concern. To identify those, a modification of the critical incident technique must be applied; this requires worker input. As Tarrants observes:

> In applying the technique, an interviewer questions a number of persons who have performed particular jobs within certain environments and asks them to recall and describe unsafe errors that they have made or observed, or unsafe conditions that have come to their attention (304).

The intent is to have workers identify as many critical incidents as they can recall, especially those that produced no injury or damage. The interviewer should seek to identify tasks out of which low-probability incidents could occur that might result in serious injury or damage.

"How to Identify Costly Risks Before Costly Losses Occur," Chapter 5 of Allison's *Profitable Risk Control,* also offers some helpful guidelines for identifying tasks to be analyzed (44+). Unfortunately, serious injuries too often occur while workers are performing non-routine tasks, and they deserve special attention.

For safety purposes, what is being sought is hazards, in the broad sense. Hazards encompass all aspects of technology and activity or inactivity that produce risk. A hazard is defined as the potential for harm; thus, hazards include the characteristics of things, and the actions or inactions of people. Although the process of identifying tasks to be analyzed begins with hazardous operations, keep in mind that the end product will also be used to address a combination of productivity, cost efficiency, quality and/or ergonomics.

SETTING PRIORITIES

Once tasks are identified, analysis priorities must be determined. This is not necessarily a scientific process; employee concerns (real or imagined) may determine what tasks are analyzed first.

In the priority-setting process, it may be useful to adapt a risk assessment method, such as that contained in NSC's training program (2,13-17). However, such a system should be used with caution. If risk scores are the only priority determinants, incidents that could produce catastrophic results (fatalities, loss of facility, environmental damage) and, thus, have low occurrence probability with only a few people performing the related tasks, will be subordinated in the decision-making process. Sometimes, good judgment will dictate that such incidents be placed atop the priority list, even though their score is low.

The following is excerpted from NSC's training program. These are the captions on the risk assessment form.

SAMPLE RANKING SYSTEM

Job Task   Severity   Exposure   Probability   Total

The first column lists each identified task. For each, numerical values (point values) are assigned to reflect: potential for severity of injury, property damage or production interruption; frequency of exposure; and incident probability. These entries are totaled in the last column. NSC cautions that the numerical scorings are "arbitrary," a warning which implies that the developer of a rating system must use good judgment in selecting rating category descriptions and the numerical scorings.

For all categories, input from knowledgeable people, including hourly workers, must be gathered when selecting numerical scorings. Following are example scorings.

Severity of Harm or Damage

Assumptions would be made as to the worst credible outcome of an incident in selecting a numerical rating for severity.

0=Negligible: Probably no injury or illness; no production loss; no lost workdays.
1=Marginal: Minor injury or illness; minor property damage.
2=Critical: Severe injury or occupational illness with lost time; major property damage; no permanent disability or fatality.
3=Catastrophic: Permanent disability; loss of life; loss of facility or major process.

Exposure

Exposure considers the number of employees who perform a task, the number of times an individual employee performs the task, or both. A sample classification ranking follows.

0=A few employees perform the task up to a few times a day.
1=A few employees perform the task frequently.
2=Many employees perform the task frequently.

Probability

Determining the likelihood of a hazard-related incident is a judgment call, since a satisfactory statistical base that can be used as a reference is rare. Probability is expressed in probable occurrences per unit of time or operations or activity (e.g., per shift, number of times task is performed, per year). Determinations are influenced by several factors, including hazards associated with the task; difficulty in performing the task; complexity of the task; and whether work methods encourage error. Suggested probability scorings are:

0=Low probability (extremely unlikely to unlikely, but possible to occur).
1=Moderate probability (likely to occur sometime).
2=High probability (will occur several times, possibly frequently).

Numerical point values assigned to each task for severity, exposure and probability are added to produce a risk score, which can be as low as 0 or as high as 7. Each task is then given a risk ranking from which judgments can be made in setting analysis priorities.

This system does not produce absolute guides; risk assessment is as much art as science. To satisfy employee concerns, it may be prudent in actual practice to analyze certain tasks with lower scores before those with higher scores. Also, as noted, special attention may need to be paid to low-probability incidents that have serious injury or damage potentials. In addition, several tasks may receive the same rating, which requires further judgment in order to set priorities.

It is recommended that a risk assessment method be applied in setting analysis priorities *and* in developing criteria descriptions and scoring systems that are suitable to specific operations.

EXTENDING THE TASK ANALYSIS PROCESS

Once tasks are identified for analysis and priorities set, task analyses follow. To extend this process to encompass ergonomics, productivity, cost efficiency or quality, the safety practitioner must understand the conceptual significance of what is to be undertaken. The conventional job safety analysis system must be rewritten; the safety practitioner must convincingly conduct several analyses using the extended system; and a training program to indoctrinate others into the revised system must be initiated.

This must be achieved on a "designer" basis to ensure that the system realistically addresses needs and opportunities and can overcome barriers in individual operations. In designing such a system, the following extrapolations (taken principally from the resources reviewed) must be considered. When determining which to include in an extended task analysis system, aspects of productivity, cost efficiency, quality and safety should be considered.

- What is this task to accomplish?
- Is this task necessary?
- Does a more-efficient way to perform this task exist?
- Is equipment appropriate to the task?
- Would efficiency be improved if other equipment was provided?
- Is equipment maintained properly?
- Is equipment used properly?
- Do environmental conditions negatively affect task performance (e.g., illumination, noise levels, air contaminants)?
- Would revisions in workplace layout and configuration improve task performance effectiveness?
- Does a written, easily understood procedure exist that is appropriate for all aspects of the task?
- Is staffing adequate?
- Is the task structured to encourage deviation from established procedures?
- Do methods prescribed to perform the task encourage risky behavior?
- Could employee errors be attributed to workplace or work methods design?
- Is the design of the workplace or work methods overly stressful?
- Does the task require excessive physical exertion, awkward body postures, extreme reaching, bending, twisting, etc.?
- Does the design of the workplace or work methods provoke error?
- Can work methods be redesigned to make errors less likely?
- Do task requirements induce fatigue?
- Are task requirements difficult?
- Is easy access provided for maintenance tasks?
- Is storage and use of smaller quantities of hazardous substances practical?
- Can hazardous substances be replaced with less-hazardous alternatives?

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COMPUTERS & DATABASES

Obviously, opportunities abound to create software programs to facilitate an extended task analysis system. Beyond that is the importance of sharing the lessons learned within an organization where similar tasks are performed. That need suggests development of databases and access to them. Of special significance is the ability to share analyses with facilities worldwide (to eliminate redundancies).

CONCLUSION

The system proposed offers safety professionals a great opportunity to improve the effectiveness of their safety management endeavors while at the same time positively affecting the results for which management is measured. The principal measure of the success of such a system will be the extent to which operations people seek its use. ■

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