CHAPTER 34

FUNDAMENTALS OF SAFETY MANAGEMENT

January 28, 1986

The O-ring seal in the booster rocket eroded, and blow-by burned a hole in the external fuel tank. Suddenly, mission 51-L exploded before a worldwide audience on live television. The screens in the control room went blank; only a white S remained at the top of each mission control monitor screen. Seventy seconds after launch, the Challenger space shuttle fell in pieces from 50,000 ft to the ocean below.

October 1986

The Presidential Commission on the Space Shuttle Challenger Accident (the Rogers Commission) presented its findings. Chapter 7, titled "The Silent Safety Program," states:

1. Reductions in the safety, reliability, and quality assurance work force at Marshall and NASA Headquarters have seriously limited capability in those vital functions.
2. Organizational structures at Kennedy and Marshall have placed safety, reliability, and quality assurance offices under the supervision of the very organizations and activities whose efforts they are to check.
3. Problem-reporting requirements are not concise and fail to get critical information to the proper levels of management.
4. Little or no trend analysis was performed on O-ring erosion and blow-by problems.
5. As the flight rate increased, the Marshall safety, reliability, and quality assurance work force was decreasing, which adversely affected mission safety.
6. Five weeks after the 51-L accident, the criticality of the Solid Rocket Motor field joint was still not properly documented in the problem reporting system at Marshall.

Another author writes:[1]

the "press on" mentality had taken hold of NASA's management, and they were able to accept conditions that would have surely provoked the scrub of another launch. . . . Rather than demanding that all those supporting the launch prove that conditions were safe, the senior members of the launch team demanded that their subordinates and the contractor representatives prove that it was *not* safe to launch Challenger.

Safety and Health for Engineers, Second Edition, by Roger L. Brauer

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The space shuttle Columbia came apart and disintegrated during the descent to earth from its orbital mission. The crew of seven astronauts was lost. The Columbia Accident Investigation Board report[2] identified that the physical cause of the loss resulted from a piece of insulating foam from the external fuel tank striking the wing during the second minute after launch. The wing damage manifested itself during re-entry, resulting in structural failure and loss of control and ultimate breakup of the vehicle. The organization's causes of the accident were rooted in cultural traits and organizational practices that were allowed to develop that were detrimental to safety.

There are many stories one could cite that demonstrate the importance management plays in making products and operations safe. As noted early in this book, there are many people who have important roles in safety. Engineers and others who identify hazards that need to be corrected must work with management to be sure that safety is achieved. Implementing safety in an organization requires participation from everyone, from the top of an organization to the bottom. In developing a company culture, top management must incorporate safety as a critical cultural factor.

34-1 ELEMENTS OF MANAGEMENT

What is management? What do managers do? What are the elements of management? The many books and writings on management provide countless definitions of management and what is involved in management. The purpose here is to create a general understanding of management that will provide a framework for addressing how safety can be a part of management and the endeavors of organizations.

Chapter 9 proposed a Goal Accomplishment Model (Figure 9-4) to help identify hazards and controls. The model assumed that organizations have goals that are to be accomplished. There are several elements that contribute to accomplishing the goals:

Activities: knowing what must be done and doing it.

People: having the right number of workers and skills for the activities.

Equipment and Materials: having the right tools, machines, process equipment, and raw materials to extend the activities and to produce the output.

Facilities: having the buildings and systems necessary to make the activities productive.

Physical Environment: keeping the work place and its surround conducive to effective work and healthy workers and community.

Social, Management Environment: providing the leadership, communication, work culture, and motivation for people to work effectively together.

Regulations: having policies, methods, and procedures in place for things to be orderly and safe.

Time: having enough time or organizing time to complete the activities.

Cost: having enough funds to provide the preceding elements necessary to accomplish the organization's goals.

Management involves planning, obtaining, organizing, and orchestrating the elements necessary to achieve the goals.

At a basic level, Grose[3] characterizes the three main elements of management as the three legs of a stool, which represent performance, cost, and schedule. Performance

denotes having defined tasks. Cost includes funds and manpower for the tasks. Schedule involves ordering tasks into a sequence and assigning dates for completion. The three-legged stool of management reflects a model quite suitable for management of projects.

Grimaldi and Simonds[4] identify three steps in an orderly pursuit of an objective. The three steps are organizing, administrating, and managing. Organizing is the structuring of authority and activity relationships and using the resources at hand to meet a group's objectives. It includes the arrangement of subtasks into a coordinated effort. Administrating is carrying out the tasks of planning, organizing, coordinating, and measuring performance that move an organization toward its goals. Managing, although similar, adds the dimension of leadership. Leadership sets the tone for the tasks. It involves the use of facts and persuasiveness to strengthen authority and achieve the goals effectively.

Bittel and Ramsey[5] compiled material on 50 vital areas of concern to professional managers. They built the areas out of three basic ones.

1. Primary management functions, such as planning, organizing, activating, controlling, and decision making.
2. Major business activities, such as finance and accounting, operations and production, marketing and sales, and information management.
3. Environmental resources and constraints, such as human resources, materials, funds, equipment and facilities, consumer demand, economic conditions, natural resources, community influences, and government regulations.

The management process assembles resources and converts them into output, such as products and services, working within a framework of various environments. This complex process, illustrated in Figure 34-1, is another way to describe what management is all about.

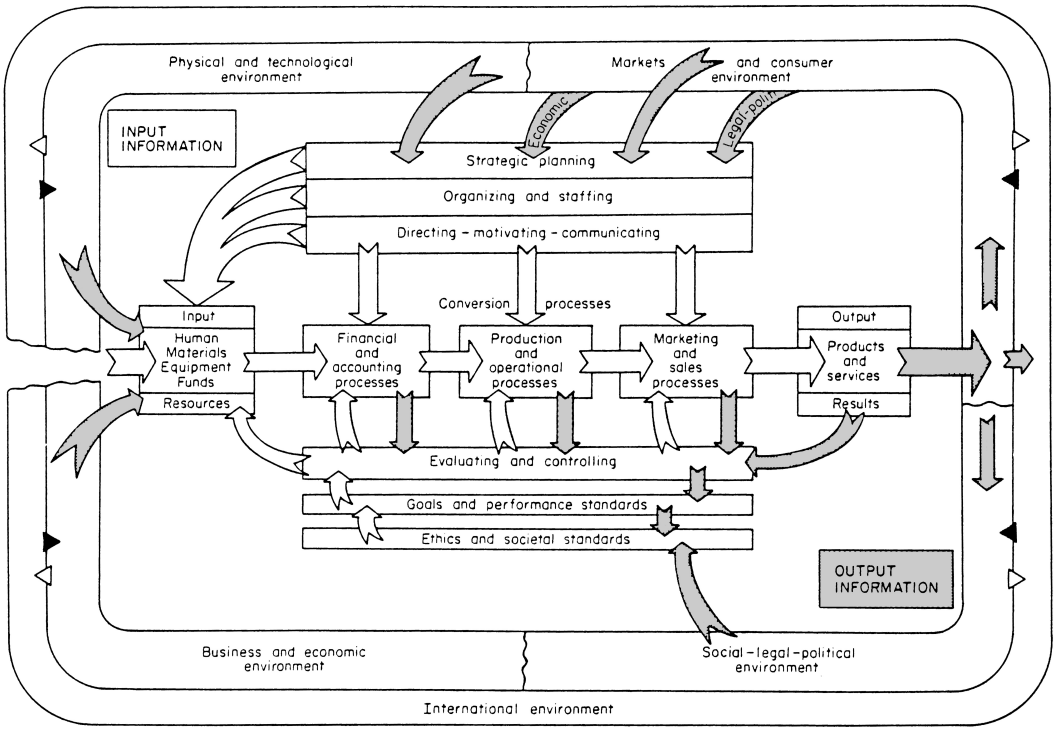
Management is getting things done through other people. Management is the performance of those functions essential to the success of an organization. Safety is part of those functions.

34-2 SAFETY IN AN ORGANIZATION

As noted in Chapter 32, safety begins in an organization with a policy stating the overriding importance of safety. It assigns responsibility, authority, and accountability. An extension of the policy is procedures for implementation.

There are many ways to structure an organization to make it effective. As a result, there are many ways to assign safety responsibilities. For most organizations, there are two major components: line and staff. Line elements of an organization are those that produce a product or deliver a service; they get the work done. Staff elements take care of business matters, such as finance, accounting, research and development, and sales. Staff elements also take care of special matters, such as legal, security, training, engineering, and maintenance. Staff elements assist and facilitate getting the work done, but they do not have authority over line elements. Figure 34-2 illustrates one organizational structure and where safety specialties could be located.

Safety must be a part of every organizational element. Line elements must be sure that the work is done safely and they depend on the training, procedures, and technical assistance of staff elements to know what is safe. Each level of supervision or management in line elements must keep safety paramount. Otherwise, it is likely to lose its importance for levels below. Safety must be part of the leadership characteristics of every



Conceptual rationale for determining scope of subject matter.

Figure 34-1. The management process and its context. (Reprinted with permission from Bittel, L. R., and Ramsey, J. E., eds., *Handbook for Professional Managers*, McGraw-Hill, New York, 1985.)

supervisor and manager. Although safety is important at every level in the line elements, some believe that first-line supervisors are the key. They directly influence the greatest number of workers and the tasks performed. These supervisors have a key role in incorporating safety into the organization.

The safety element of an organization's staff may include several specialties. Beside safety, it may include industrial hygiene, health physics, occupational medicine or nursing, and fire protection. More and more, safety, health, and environmental responsibilities are grouped into one element. Sometimes security may be combined with safety, sometimes all these specialties, with the addition of insurance and workers' compensation functions, are grouped under risk management and sometimes most of these specialties are grouped under a human resources or personnel element.

Where the line element responsible for safety is located in an organization can affect its ability to perform, as seen in the Rogers Commission report on the Challenger accident. It is essential that the safety director or staff person responsible for safety have the ear of top management and serve as the spokesperson for top management in safety matters. Petersen[6] cites four criteria for positioning the staff safety element in an organization:

1. Report to a boss with influence.
2. Report to a boss who wants safety.
3. Have a channel to the top.
4. If possible, install safety under the executive in charge of the major activity.

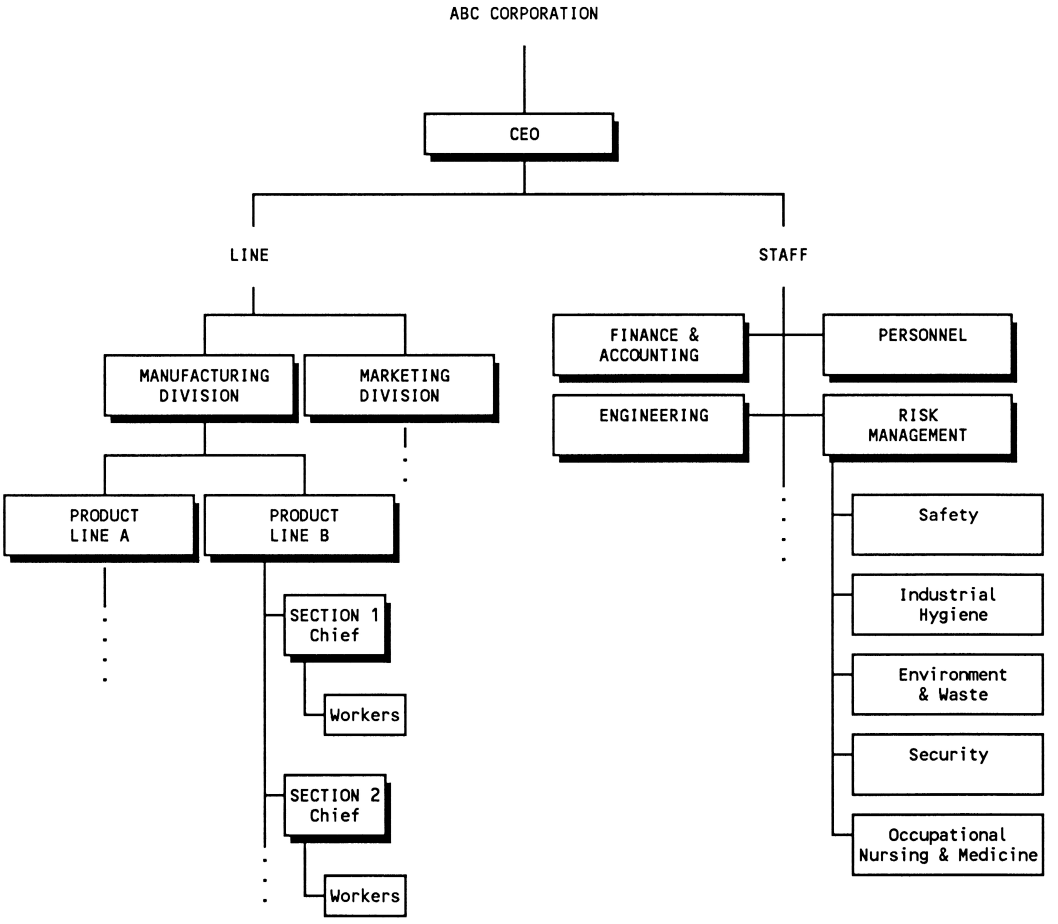


Figure 34-2. Example of one organization and placement of safety functions.

For many small or mid-sized organizations, the staff safety element is only part of one person's job function because having a full-time safety professional as the staff element is not feasible for small organizations. Even part-time specialists should pursue training about hazards, controls, safety management, and legal and regulatory matters. The safety specialist should create access to necessary medical, engineering, and other safety specialists to give the organization support from certified and licensed people. The part-time safety specialists may not qualify for these credentials.

34-3 ACHIEVING SAFETY IN AN ORGANIZATION

There are innumerable theories of management, and managers must apply many theories to the situations they face. Different approaches work better for different situations; different techniques may help or hinder safety. There are many factors that contribute to low accident rates in an organization. These factors are not separate from other objectives for the organization. Achieving safety requires that safety be an integral part of the management process and a component of leadership provided by managers. In this discussion, we consider several management factors that help achieve safety.

Management Style

Different people approach the tasks of management differently. Some are very authoritative, directing virtually every action of their people. Others encourage subordinates to participate in decision making and setting the climate for getting the job done. Management style can affect results.

It is not enough to have safety carefully structured into an organization, nor is having policies, procedures, training, and specialists enough. Having managers at all levels who endorse safety is not enough. The way safety is carried to the workers can significantly influence their performance. Organizational, management, or leadership style strongly influences safety on the job.

One study[7] analyzed the safety records of crews working under particular supervisors. The study found that those supervisors whose crews had a better safety record managed differently from those with poor records. The supervisors with good safety records also had high productivity. The successful supervisors controlled anger and kept stress from the crew, integrated safety into production tasks rather than simply admonishing workers to be safe, and maintained closer contact with their workers.

Accountability

Making safety part of a supervisor's or manager's performance appraisal is one means of achieving safety in an organization. Researchers[8] found that top management can affect safety by knowing the safety records of field managers and using this knowledge for promotions and salary increases. (The knowledge is derived from a cost-accounting system.) The study found that companies using the following techniques had lower accident rates than companies that did not:

1. Use cost accounting to encourage safety of managers.
2. Require managers to do detailed safety planning.
3. Provide new employees with adequate training.

For accountability to work, there must be a way to count success or failure; There must be an accounting system. Many companies use a cost-accounting system (to be discussed further in Section 34-5) for accidents. The cost data must be given to the manager of the relevant department or organization. Data can be organized further by severity and by type of accident, which will help the manager identify what should be corrected.

Other techniques for accountability can be used. One is a safety-by-objectives method. It focuses on actions to be completed, not on costs. For example, a superior can sit with a first-line supervisor, steward, or other manager, and discuss what steps can improve safety in each person's area of responsibility. A safety specialist may participate in the discussion. The outcome is a safety-by-objectives plan that may include employee training, improved discipline, improved housekeeping, motivational programs, and correction of particular hazards. The person responsible for action then lists a few specific objectives to achieve for these areas during a particular period. This one-on-one analysis and planning activity becomes the program for the supervisor. The approach focuses on improvement, regardless of the current record.

Some companies uses completion of a training and certification program for all managers and supervisors in each organizational unit as a "leading" indicator of safety performance. Upper management set quotas for each organizational unit and tracked completion of the required safety training and third-party certification program.[9] The leading indicator does not require the company to wait for accidents, incidents, workers'

compensation claims, and associated costs to measure results. Other results from this approach include improvements in the company's safety culture and even productivity enhancements. The productivity enhancements seem to stem from the increased confidence of work units in handling safety issues immediately and directly and not having to use support staff to resolve many of the more straightforward safety matters.

Audits

Another approach is use of audits. An audit is a process of having insiders from other units of the organization or outsiders evaluate management. An audit can vary in depth. A management audit can be applied to an entire organization or a component of it. The purpose of the audit is to challenge existing policies, procedures, and practices and their underlying concepts and principles. It looks at leadership, how well results are achieved, and better ways to achieve them in the future. An audit can be a tool for improvement. Management audits must be handled cautiously so that they do not become a tool for blame or ridicule.

Within a company, a safety specialist or team of management and safety specialists may conduct an audit of a manager's department. Although Table 34-1 is a list of questions directed primarily at chemical processes, the questions are typical of most audits. The findings presented to the manager should include what things need improvement and ways to improve them. The findings also should address policy and procedural problems that need adjustment to make them effective for this part of the operation.

Paying Attention to Details

Paying attention to details and integrating safety into management of activities makes programs successful. These same characteristics lead to productivity. Because workers want to do a good job and are sensitive to what their employers expect of them, motivating workers is important. Motivation involves sending key messages from top management through the management chain to workers. Typical messages are the company cares, do the job right, achieve good productivity, pay attention to details, and integrate safety into the job tasks.

One safety specialist involved in construction for many years noted: "I can tell how well safety is managed on a job by looking at the housekeeping." If materials, equipment, and scrap are scattered, there is little planning and organizing being done by managers and supervisors. Conversely, having things are in order on the job and having work well organized are signs that managers and supervisors attended to the details of work planning and execution. Safety is likely to be an integral part of such management processes.

Enforcement

Enforcement is not just having rules and someone to enforce them. Enforcement involves planning and communication: clearly explaining the need to do a job right, making sure people know how to do it safely, and conveying a clear understanding of what is expected on the job. It includes motivating workers to achieve desired results, including safety and rewarding correct behavior. Having a good accident record should be reinforced by recognizing the effort expended toward safety at all times. Failure to comply and ignoring safety rules must be recognized as well, but should not be the sole component of enforcement.

TABLE 34-1 Questions Typical of a Safety Audit[a]

1. Are written instructions for the operation in place?
2. Are the instructions current? Has the process changed? Do engineering drawings reflect unit modification? Have modifications been reviewed for process safety?
3. Do the operators follow the written instructions?
4. Is the equipment correct for the process?
5. Are reactants handled and stored correctly?
6. Are necessary items of personal protective equipment in the correct locations?
7. Is ventilation sufficient?
8. Is electrical equipment compatible with the area processes (e.g., explosion-proof electrical equipment in an area where flammable vapors or explosive dusts are present)?
9. What hazardous materials are used in the process? How are the materials stored and in what quantity? What emergency procedures and equipment are available to handle accidental events associated with the materials' storage and usage? How are personnel trained to use these procedures and equipment?
10. What errors in operation are possible and within reason? What would be the consequences of such errors? Will the equipment handle these consequences with minimum risk to life and property? Are equipment safeguards in place and operable?
11. Is explosion relief venting adequate? Is the explosion relief properly directed?
12. What are the provisions for uncontrolled reactions?
13. What personal safeguards are advisable (safety showers, fire-resistant clothing, emergency care, protective equipment)?
14. What are the training provisions for new process operators? Is periodic training given to existing operators and what does it consist of? Are operators challenged by means of emergency training exercises? Is a process simulator advisable for training?
15. In addition to the sprinkler system adequacy, is additional fire protection, such as an automatic dry chemical extinguishing system or a other system, warranted? Is an explosion suppression system warranted?
16. What is the manner of receiving, storing, handling, and transferring hazardous materials and combustible liquids and gases? What controls exist to eliminate contamination of product that could create hazardous polymerization as well as accidental release? What are the most likely possibilities of accidental release? What safeguards exist?
17. Are contamination sensitive bulk materials stored above or below ground? If below ground, what steps are taken to prevent contamination and degree of assurance?
18. Are critical spare parts on hand, such as parts for circulation pumps for refrigeration systems on temperature sensitive materials stored in bulk?
19. Is an emergency dump system needed? If already in place, is it adequate?
20. Are critical maintenance procedures identified? Are personnel trained?

[a] Derived from Krivan, S. P., "Avoiding Catastrophic Loss: Technical Safety Audit and Process Safety; Review," *Professional Safety*, February: 21–26 (1986).

Moving Safety Deeper into the Organization

Chapter 3 introduced the concept of errors in management systems and the management principles of Deming and Juran. Their focus is on quality and encouraging participation in the processes of business to minimize errors (or defects) of all kinds up front and the amount of rework that otherwise occurs after things have gone wrong. Motorola applied these principles in achieving the first Malcolm Baldrige Award for quality and used two kinds of metrics in all company departments. The two metrics were errors and process time, with each department establishing their own definitions for each. Both encompass safety, because errors can be incidents and accidents, and process times are longer when

recovering from incidents and accidents. The continuous improvements of management processes is driven by listening to the customer and requires the participation of all in finding ways to achieve the desired output with the least amount of errors and the shortest process time. Overall, one can seek to reduce errors to one per million opportunities, approximately six standard deviations (6 sigma, σ) out on a normal distribution curve. Today, the philosophy is captured for some companies through a "Six Sigma" quality and management process improvement program.

In applying these management principles, the old methods that use a top-down approach to managing people in an organization disappear and are replaced with more participatory and collaborative work groups. Under the old approach, managers measured subordinate performance individually, often using the errors and failures of individuals to seek improvement from them. However, as Deming points out, individuals can perform no better than is possible under the management processes given them. Instead, improvement stems from having each employee participating in identifying ways to improve the processes so that there are fewer and fewer errors and the process times are shorter and shorter to benefit the customers. The latter approach requires metrics for the processes of a work group and engaging them in improving their work collectively.

Because incidents and accidents are measured as part of the management process, the work group needs to learn what may have contributed to the opportunity for any incident and accident (one type of error) and how the process can be improved to eliminate them. This requires moving safety knowledge deeper into the work group. The old management approach positioned safety knowledge in the safety department or in upper tiers of positions. The old approach called on the safety people to fix the problem after there was an incident or accident so that it would not happen again. The emphasis on participation in improving the management processes engages the workers and leaders in understanding the processes, including hazards and controls. All participate in identifying what can be done to reduce the errors, to minimize rework, and to reduce rather than lengthen process times. In attending to management process improvement, the workers need to understand the roles that engineering and administrative controls can play. They need to understand how unsafe conditions and unsafe acts impact the processes. They need to learn how to plan for safe work (process improvement) and how to communicate across the work group to ensure that safe practices are implemented from the plan for safe work.

Behavior-Based Safety

The idea of working collaboratively on improving management processes to reduce errors (including incidents and accidents) and to shorten process times to the benefit of external and internal customers of a work group forms much of the foundation for behavior-based safety techniques. There are two main advocates for these techniques.[10] One can refer to their writings for details about applying this approach. The approach can be effective. The approach has also been somewhat controversial.

The general idea is to help workers gain insight into behaviors and to avoid behaviors that may lead to incidents and accidents. There are a number of methods for achieving this objective. The effectiveness is likely to vary with the work management methods in place and within which this approach is applied.

Chapter 3 discussed various theories of incidents and accidents. Included was a discussion about the relationships between unsafe acts and unsafe conditions and their relative roles in causing accidents. The discussion noted that some early studies tried to establish that one or the other was likely to be the cause of an incident or accident. The

discussion also cited other studies that established that both were likely to have a role in events leading to an accident or incident.

The management context is likely to impact the effectiveness of engaging workers in understanding and applying information about human behavior in incidents and accidents. In some work environments, workers were assumed to be contractors, and thus, responsible for their own safety. This implies that the worker must be able to control both unsafe conditions and unsafe acts. Management left them on their own. A century ago, this approach was common in mining.

Under the legal philosophies that preceded workers' compensation being a no-fault process, workers were responsible for their own behavior with regard to risk and safety and also had some responsibility for their behavior as it may impact a fellow worker's safety. The theories of assumption of risk, contributory negligence by employers, and the fellow servant rule all placed responsibility for behavior on the individual (see Chapter 6).

Under a top-down management philosophy, a supervisor evaluates a worker's performance based on behaviors exhibited during the evaluation period. Then the supervisor establishes performance goals for the next rating period. Some early approaches to monitoring safe work behavior[11] were formal and some were informal. A more informal approach involved handing out a card to a worker observed performing a task correctly and safely as a means of positive feedback.

In a collaborative environment that focuses on continuously improving the overall process performance, the emphasis is on changing the process through policy, technology, procedures, materials, and other means. In achieving safety, there is a need to analyze many things. Included in the analysis are behaviors associated with the process changes and the risks and dangers that they may pose. There is a need to document how the process is to work and to train everyone engaged in the process about how to perform each task correctly. There is a need to understand what can go wrong and how incorrect task performance may contribute to the resulting errors (including incidents and accidents). The approach may involve simulations of various kinds, encouraging feedback among all participants and even establishing methods for measuring process performance, including individual behavior by participants.

Approaches for changing worker behavior that do not use effective feedback techniques, that operate in work climates with top-down management environments, and do not have clearly defined processes for doing things correctly are less likely to achieve measurable changes in safety performance. Collaborative work environments that engage everyone in the work group in improving processes and the overall performance for customers have a better chance for success with behavior-based safety methods, because work behaviors are simply a component of the processes that are the focus of the group.

Safety Committees

Whether an organization uses traditional management methods or methods that emphasize continuous improvement and quality through highly collaborative work groups, one technique for improving safety is through safety committees. Some state workers' compensation laws recognize safety committees as an effective means of lowering incidents and accidents that lead to workers' compensation claims.

Use of safety committees is one way of expanding participation in safety improvement efforts. The approach falls somewhere between the top-down management methods and the collaborative methods that engage everyone on quality improvement of management processes.

There are several ways to form committees and to select participants. There are many ways to assign roles and responsibilities to committees and their members. One can have one committee for an entire organization with representatives from each major work group. One can also have a committee within each work group with rotating membership from among all members of the work group. There may be a tiered structure for safety committees throughout the organization.

In general, the benefits are expanding participation in achieving safety, increasing the emphasis on safety, and moving safety responsibility from top management and the safety office into work groups. To be effective, the safety committees must have a clearly defined role and members must gain an understanding of hazard recognition, evaluation and control, and how safety can be managed. Members need to know where to obtain assistance from management, specialists, and others and how to impact processes and budgets. They need to know how to impact change to reduce risk.

34-4 SAFETY AND COST

Like any other element of achieving the goals of an organization, safety must be converted to a single common denominator—cost. Accidents and injuries cost money, as do claims, legal fees, lost production time, and compliance with government requirements. Chapter 3 discussed direct, indirect, insured, and uninsured costs, and Table 4-1 listed hidden costs of accidents. Table 34-2 lists uninsured costs. Safety and productivity go hand in hand. The costs of preventing accidents need to show a return on the profit line or at least show avoidance of expenses that would otherwise occur.

Expressing Costs

The accident costs in the United States amount to more than $600 billion per year. This figure is overwhelming to most people, but it has little meaning for the ordinary person, and it certainly has little motivational potential. Costs need to be expressed in terms that are useful. Expressing costs in the right terms can help people understand the importance of safety and its contribution to company profit. Although each level may have a preferred way of expressing cost data, it can help first-line supervisors and workers understand the importance of safety, and if expressions of cost are understood by workers, they are certainly understandable by managers.

TABLE 34-2 Uninsured Costs

Deductible part of insurance policy
Lost wages for those not insured
Wages paid to injured persons not covered by workers' compensation
Overtime work required as a result of an accident
Supervisor time related to an accident
Repairing, replacing, or cleaning up after an accident
Learning period for a new or replacement worker
Accident investigation cost
Costs to prepare and file reports
Uninsured medical costs
Costs of litigation activities
Other

One way to express cost is in dollars per $100 of pay. It is easy to understand that workers' compensation premiums cost $12.85 for each $100 of salary and that lost time costs a given department $8.50 for every $100 paid in salary.

Another way to express cost is in terms of the number of items produced. A company may bake bread or manufacture television sets. It is easy to understand that each $100 loss requires that the company produce and sell an additional 500 loaves of bread or 25 television sets. This is derived from the equation

$$\text{Cost of loss} = P(N)U, \tag{34-1}$$

where

P is the profit margin in percent,

N is the number of its products necessary to cover the loss, and

U is the unit selling price for the products.

The volume of business necessary to cover a loss or expense is another way to express cost. For each $100 loss, a construction company that has a profit margin of 5% will have to bid and be awarded $2,000 in jobs. This is shown mathematically as

$$\text{Cost of loss} = P(V), \tag{34-2}$$

where V is the dollar volume of business. If the company bids on 10 jobs for each 1 it gets, they must bid on $20,000 in jobs to cover the $100 loss. For a claim of $10,000, the company must bid on $2 million and win $200,000 in jobs.

Another way to express cost is in the number of hours a worker must put in to cover the cost of a loss. The cost of a $100 loss for a worker who earns $10.00 per hour is 10 hr. The cost of a $2,000 loss requires 200 hr of work, or approximately 5 weeks.

Another way to present cost, particularly to managers, is to compare actual versus budgeted expenses. A company may use the history of losses or safety costs in the entire company to estimate future costs per unit of time, which may be a month, quarter, or year. The actual costs for each period can be plotted against budgeted costs to demonstrate to managers how well they are doing in controlling safety costs. Presenting similar accident costs for individual departments makes the information more meaningful to particular managers.

Another way to express cost to top managers and company shareholders is cost of accidents or illnesses per share. An alternate is to express the cost of accidents and illness that could have been avoided as additional earnings per share that could have been achieved.

Other expressions for cost are cost-benefit ratios, return on investment (ROI), and risk. The first two are explored further in the following text, and Chapter 36 addresses risk and risk analysis.

Cost and Benefit

A popular way to justify business expenditures is by comparing the cost of some expenditure with the benefit achieved in financial terms. In cost-benefit analysis, the dollar values of all benefits and costs connected with program alternatives are estimated and then compared. Not all cost and benefits can be converted to quantitative terms; some may be expressed only qualitatively. A final decision applies both to quantitative and qualitative factors.

There are several criteria for evaluating costs and benefits:

1. the cost-benefit ratio
2. net benefits, that is, benefits minus costs

TABLE 34-3 Costs and Benefits for Different Parties

Case	Company	Buyer or Public	Opinion
1	Benefits < costs	Benefits < costs	Very unacceptable for both parties
2	Benefits > costs	Benefits > costs	Very acceptable for both parties
3	Benefits < costs	Benefits > costs	Unacceptable unless there is government subsidy for the company
4	Benefits > costs	Benefits < costs	Unacceptable unless: (a) the condition is allowed by government or (b) compensation is made to the public

3. rate of return, such as the annual benefit relative to cost
4. payback period (the time required to recover costs from benefits)

The parties that bear the costs are not always the ones who gain the benefits, which creates some dilemmas for decision makers. Consider the four cases suggested in Table 34-3 for companies and buyers or the public who are involved in costs and benefits. They do not always agree or have the same solutions in mind for differing opinions.

Governments use cost-benefit analysis for public policy. A key question is whether the cost to implement government regulations is worth the benefits derived. The use of cost-benefit analysis for justification of government regulations was challenged in the courts. In June, 1981, the Supreme Court upheld the OSHA cotton dust standards and noted that cost-benefit analysis is not required by the OSHAct, whereas feasibility analysis is. Feasibility means the potential of accomplishing something. Currently, in proposing new or revised regulations. OSHA and other agencies prepare a cost analysis and estimate benefits, including human lives saved.

Another dilemma in evaluating the cost and benefits of safety is assessing an economic value for human life. A related factor is the economic value when human pleasures of activity are interrupted by disability. Is a corporate executive worth more than a laborer? Is an engineer worth more than a housewife? The answers are not easy. Placing a value on human life is not easy. However, in settlements of lawsuits, these decisions are made regularly.

Return on Investment

Return on investment (ROI) is a widely used method for analyzing the performance of investments in a company or investments for an individual. Whether investments are in stocks, bonds, or real estate, an investor wants to know what the annual return will be. The concept suggests that a person must spend money (invest) to earn money on the investment (return). The concept is very similar to a cost-benefit ratio.

There are costs to control hazards, but a company should see a return on this type of investment. The return may be reduced loss rates and reduced insurance premiums, increases in productivity, or better services.

Cost Accounting

The need to use safety costs in management requires keeping track of safety costs. An accounting system must track actual expenditures. There are many kinds of safety costs, as noted in Tables 4-1 and 34-2.

Other Safety Applications for Cost

Cost information can be used in other ways to help achieve safety. For example, accident claim rates and product return and failure costs can be used to select suppliers of parts, assemblies, and components; accident records, insurance rates, and claim records can be used as criteria in selecting contractors; cost of product failures, complaints, accidents, compliance with standards, and claims can be used as criteria for setting performance incentives of suppliers and contractors.

EXERCISES

1. A fast food hamburger restaurant operates on a 4% profit margin.
   (a) If hamburgers sell for $0.60 each, how many hamburgers must the restaurant sell to cover lost profits from a $500 accident?
   (b) If the restaurant sold only hamburgers and on the average, 1,000 were sold each day, how many days' profit are lost because of the accident?
2. A car company decides to reduce cost by not installing an $18 per car safety improvement. If a human life is assumed to be worth $875,000 on the average, how many automobiles would have to be produced to cover 13 death claims per year?
3. Obtain a chart of an organization. Identify where safety elements of the organization are located. Suggest where improvements might be made and what the changes would accomplish.

REVIEW QUESTIONS

1. Describe what managers do.
2. How is safety implemented in an organizational structure?
3. Explain the role of safety specialists in an organization.
4. How can management style affect safety in an operation?
5. Why is accountability important in managing safety?
6. How can accountability be accomplished without using accident costs and accident rates?
7. What is a safety audit? What is its purpose?
8. How is paying attention to details related to successful safety programs?
9. How is enforcement useful in safety management?
10. What are three ways to express cost of safety?
11. Explain how cost and benefit can be used to justify safety programs.
12. Explain return on investment and how it can be used for safety.
13. How can safety cost be used to select and provide incentives for contractors and suppliers?

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