

Independent contractor fatalities in the mining industry: A look at contributing factors

E.A. Barrett and L.L. Rethi

Mining engineer and safety engineer, respectively, NIOSH-Pittsburgh Lab, Pittsburgh, Pennsylvania

Abstract

Throughout all segments of the United States mining industry, 163 independent contractor employees were fatally injured between 1990 and 1997. Factors that contributed to these injuries were identified after reviewing descriptive information contained in Mine Safety and Health Administration fatality reports for each of the incidents. Thirty-three unique contributing factors were identified and multiple factors were noted for each fatality. Those most frequently discerned were "failure to follow 'standard operating procedures'"¹ (35% of the fatalities), "poor positioning of employee" (26% of the fatalities) and "failure to maintain equipment" (23% of the fatalities). Contributing factors were then associated with the accident and job classifications of the victims. Factors having the highest frequencies in the top five accident classifications where most fatalities occurred were as follows: powered haulage — "failure to maintain equipment"; machinery — "poor positioning of employee"; slip/fall of person — "inadequate fall protection" and "failure to wear safety line"; electrical — "equipment contact with power line"; and falling/rolling/sliding rock — "poor positioning of employee." Among the job classifications in which most fatalities occurred, leading contributing factors were as follows: truck driver — "failure to follow standard operating procedures" and "poor positioning of employee"; laborer/utility man/pumper — "poor positioning of employee"; mechanic/repairman and welder — "failure to follow standard operating procedures." Recommendations for utilizing contributing factor information as a basis for safety training are proposed. Training programs may be developed that inform independent contractor employees of factors which, in the past, have contributed to fatal injuries in their job classifications. Then, by combining this information with contributing factors identified in "related" accident classifications, a truly focused training intervention that addresses very specific workplace hazards may be developed.

Introduction

Fatal injuries to independent contractor employees remain a major concern throughout the mining industry. The Mine Safety and Health Administration (MSHA) reported that between 1990 and 1997, 163 of 792 total mining industry fatalities occurred among independent contractors working on mine property. Nearly two-thirds of these fatalities (107 of 163) occurred at surface operations, 21 at underground operations and 35 at mills or preparation plants. Metal/nonmetal mining accounted for 62% (101 of 163) of the fatalities, and coal mining accounted for the remaining 38% (62 of 163).

Safety practitioners continue to search for information from which to develop effective training interventions aimed at reducing injuries among independent contractor employees. This search has become even more critical now as the new Part 46 production-operator and independent contractor requirements for training plan development and implementation became effective in October 2000. It is posited that if factors contributing to injuries are identified in a meaningful work context, then training strategies may be developed to address them more effectively. The goals of this paper are to identify first those factors that contributed to 163 independent contractor fatalities throughout all segments of the mining industry over an eight-year period. Suggestions are then made on utilizing this information to develop more meaningful training that addresses specific problem areas in a work context.

Background

Two studies of factors that contributed to incidents in the mining industry are discussed, as each relates to the subject of this paper. In the first, Sanders and Shaw conducted an in-depth analysis of more than 300 underground mining industry accidents and found, in every case, that more than one factor contributed to the accident. This is consistent with the belief of most safety practitioners that an accident, with the exception of those determined to be "Acts of God," cannot have just one single cause.

Sanders and Shaw grouped their contributing factors into six general categories: management, physical environment, equipment design, work itself, social/psychological environment and worker/coworker characteristics. A total of 57 contributing factors were identified in these categories and presented as a model called CFAC (Contributing Factors in Accident Causation). At the time, this model was unique for several reasons. Management's role and the social-psychological environment were stressed. The influence of co-workers was also recognized. Further, classic human factor variables were recognized both in the physical environment and equipment design categories. The latter included, for ex-

¹ The term "standard operating procedures" used by MSHA in their fatality reports infers the use of *accepted work practices*, written or not, that are commonly used to safeguard the worker.

ample, noise, bad lighting and pollutants and included poor original equipment design or workplace arrangement for operational effectiveness.

In the second example, Woodward Associates completed an investigation of more than 300 fatal and nonfatal surface and underground mining accidents to determine the applicability of new methods for investigating mine accidents. A methodology was designed and developed with the belief that it is never sufficient to identify only unsafe acts and unsafe conditions as contributing factors; "reasons" for the existence of these conditions should also be explored. The study claimed that "reasons" should be identified because, often, many possible factors are not considered once a set of "facts" is discovered that seemingly explains the accident.

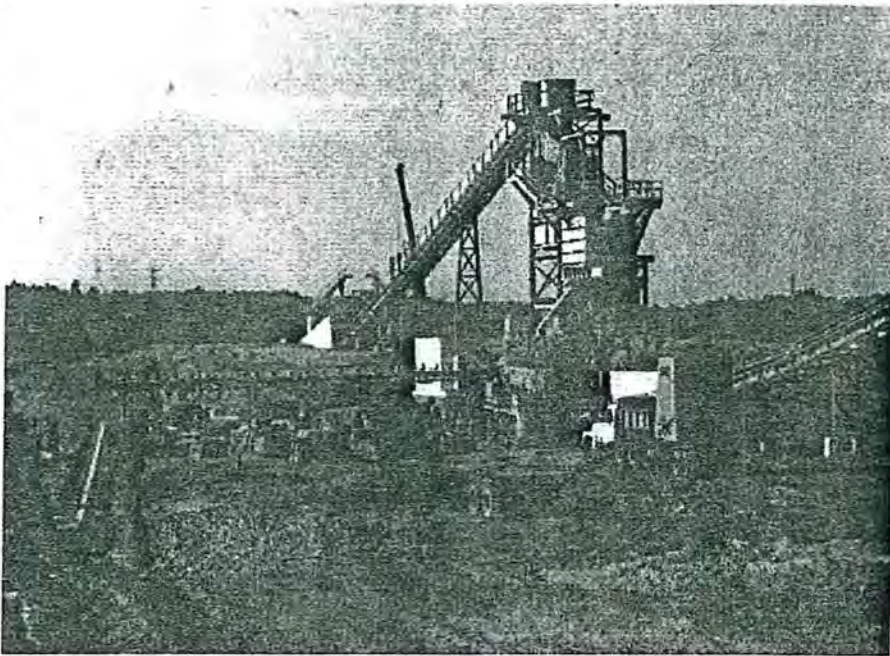
The Woodward study identified contributing factors and placed them into broad categories or classes in order to observe the "proportion of incidents" in which certain kinds of factors were found.

Those identified in more than 30% of the incidents included: "inadequate job definition and training" (67%), "work environment hazards" (52%), "inadequate task performance supervision" (48%), "worker violation of work procedures" (38%) and "inadequate equipment maintenance" (33%). Other contributing factors that were found in at least 12% of the incidents were *poor tool or equipment design, inadequate protective equipment, worker stress, tool or equipment failure and incorrect tool or equipment*.

In both the Sanders/Shaw and Woodward studies, trained investigators conducted visits to the mines where the injuries occurred. Here, they interviewed various individuals, i.e., the injured worker (if possible), safety representatives, supervisors and witnesses. In certain cases, they visited accident sites and inspected the equipment involved. These were in-depth investigations with the objective of discovering as many contributing factors as possible.

Contributing factors

Sources of data. In contrast to the manner in which data were acquired in the studies noted above, 33 contributing factors were identified by reviewing 163 MSHA fatal accident reports involving independent contractor employees. Each fatality had at least one of the 33 contributing factors associated with it, and most of the fatalities had multiple contributing factors identified with them. An obvious constraint in this search for factors is the varying quantity of information contained in the individual reports. The Code of Federal Regulations, Title 30, Part 50, mandates that an operator immediately report a mining fatality to the MSHA District or Subdistrict office. A team of persons then gathers relevant information from on-site visits and interviews of those involved in, or knowledgeable about, the incident. The team may even solicit "expert" opinion as it examines important details. Concluding MSHA accident investigation reports, thus, contain a large amount of substantive, reliable information that describe incidents, including various types of unsafe acts and unsafe conditions determined to have contributed to a fatality, the physical factors involved, and the conclusions reached.



Independent contractors working at a surface operation.

Other data for this report were compiled by accessing MSHA's "Accident/Injury/Illness" (AII) database and evaluating relevant information using the *SPSS for Windows*² data analysis package. This source includes information submitted by companies for incidents on mine property that are defined as "accidents, occupational injuries or occupational illnesses." Mining company officials are required to complete MSHA Form 7000-1 (Mine Accident, Injury and Illness Report) and submit it within ten working days following each reportable incident. Data on many variables from the 7000-1 report are then entered into a database as a "case." Each "case" contains information on more than 50 variables relating to accident characteristics, mine characteristics, accident costs and demographics, including experience, job characteristics and personal injury data. There often is missing data in some fields. Thus, the database represents a comprehensive account of all information known about each reportable mining accident.

Identification criteria. Contributing factors were identified according to the following three criteria:

- Only those factors that were reported by the persons who originally investigated the incident were considered. These were found embedded throughout various portions of the fatality reports, but most were located in the "Description of Accident" and "Conclusions" sections. The wording chosen to describe these contributing factors is invariant with that used in the reports. Further, no interpretations of the incidents' details were made; nothing was "read" into the accident situation and the descriptions appearing in the reports were not amended.
- Only principal factors that were judged to have significantly contributed to the injury were included on the list. Certain impertinent factors appeared in some of the

² SPSS is an acronym for Statistical Package for the Social Sciences. It is an integrated system of computer programs designed for the analysis of empirical, social science

Table 1 — Contributing factors in independent contractor fatalities, 1990 to 1997.

No.	Contributing factor
001	Failure to maintain equipment
002	Failure to follow "standard operating procedures"
003	Failure to provide barriers (e.g., cones, tape, fences and construction horses)
004	Inadequate fall protection/failure to wear safety line
005	Poor visibility/bad weather conditions
006	Improper guarding of equipment, machinery, etc.
007	Poor footing on walking/working surfaces; slip/trip/fall
008	Failure to secure material (e.g., loads on trucks and overhead loads)
009	Poor positioning of employee (e.g., in dangerous locations)
010	Not using a tag line
011	Alcohol
012	Failure to wear seat belt
013	Improper use of equipment (e.g., beyond the equipment's intended use)
014	Equipment contact with power line
015	Failure to maintain safe distance around fixed or mobile equipment
016	Failure to recognize and/or avoid hazard
017	Failure to communicate
019	Failure to block equipment/machinery
019	Failure to support roof
020	Operate equipment/trucks over edge of highwall
021	Material beyond angle of repose (trimmed stockpile)
022	Inadequate berm
023	Improper driving actions (e.g., speeding; bad driving habits)
024	Exited vehicle (e.g., jumping from a moving vehicle)
025	Failure to lock out/tag out (of any energy source)
026	Hazards associated with working in a confined space
027	Fall of material (e.g., loads from truck, stockpile, highwall, overhead)
028 ^a	Failure of management to address safety problems
029	Failure to conduct preshift examination or equipment inspection
030	Failure to use or wear personal protective equipment
031 ^b	Inadequate mining methods
032	Other, NEC (not elsewhere classified)
033 ^c	Management failure to enforce regulations/instructions

^a Relates to management's failure to take corrective action on hazards they knew or should have known existed.

^b Relates to using the wrong methods for extraction, such as undercutting a highwall without taking necessary precautions.

^c Relates to enforcement of regulations that already exist or instructions provided to workers.

Table 2 — Number of fatalities for the commodity and location of three most frequently identified contributing factors.

Factor*	Type of facility	Surface	Underground	Mill	Preparation plant
002	Coal	10	5	-	2
	Metal	3	3	2	-
	Nonmetal	6	0	2	-
	Sand/Gravel	6	-	-	-
	Stone	13	0	5	-
009	Coal	7	0	-	6
	Metal	2	2	2	-
	Nonmetal	2	0	2	-
	Sand/Gravel	8	-	-	-
	Stone	8	0	4	-
001	Coal	10	2	-	5
	Metal	8	0	0	-
	Nonmetal	1	0	0	-
	Sand/Gravel	2	-	0	-
	Stone	5	0	5	-

* (002) "Failure to follow 'standard operating procedures'" was identified in a total of 57 fatalities. The leading location and commodity was surface, stone mines where 13 fatalities occurred. This was followed closely by surface, coal mines where ten fatalities occurred.

(009) The next most frequent contributing factor was "poor positioning of employee"; it was identified in a total of 43 fatalities. Eight of these occurred at sand/gravel operations, eight at surface, stone mines, seven at surface, coal mines; and six at preparation plants.

(001) "Failure to maintain equipment" was identified in a total of 38 fatalities. The leaders were surface, coal mines where ten fatalities occurred and surface, metal mines where eight occurred.

reports, but, unless they directly contributed to the incident, they were not considered. For example, in one "slip/fall of person" accident, it was reported that the victim fell approximately 4-m (12 ft) to a concrete floor. The main contributing factor was "worker was not secured with a safety belt and line." The report also stated, however, that the victim was lifting a strainer bucket that had a missing handle which "could have" contributed to losing his balance. The latter was judged to be indirect and, therefore, not added to the list.

- Final-contributing factors included only those agreed upon by both authors. If a particular factor was identified by just one person, its relevance was discussed. If mutual agreement was reached, then that factor was added to the list.

The 33 contributing factors were then coded with a variable number for tracking purposes and for determining distributions and frequencies. The list of factors and their assigned variable numbers are shown in Table 1. Most of the factors are straightforward and require no additional comments. For clarification, some include examples of conditions or situations.

Overview. Using the Woodward Associates' model for presenting data, contributing factors identified most frequently in the population of 163 fatalities were "failure to follow 'standard operating procedures,'" "poor positioning of employee" and "failure to maintain equipment." Each of these factors is shown below with the number and percent of fatalities in which it was found:

- 002: "Failure to follow 'standard operating procedures'" — 57 fatalities (~35%)
- 009: "Poor positioning of employee" — 43 fatalities (~26%)
- 001: "Failure to maintain equipment" — 38 fatalities (~23%)

The commodity and location where these fatalities occurred appear in Table 2. The data are provided as general information only, because no attempt was made to determine whether a correlation would exist between contributing factors and commodity or location where the independent contractor fatalities occurred.

One or more of the following contributing factors were found in more than 10%, but less than 20%, of the fatalities:

- 016: Failure to recognize and/or avoid hazard — 28 fatalities (~17%)
- 028: Failure of management to address safety problems — 27 fatalities (~17%)
- 004: Inadequate fall protection/failure to wear safety line — 23 fatalities (~14%)
- 033: Management failure to enforce regulations/instructions — 21 fatalities (~13%)
- 013: Improper use of equipment — 19 fatalities (~12%)
- 023: Improper driving actions (ex. speeding, bad driving habits) — 19 fatalities (~12%)
- 029: Failure to conduct pre-shift, on-shift or equipment inspection — 18 fatalities (~11%)
- 018: Failure to block equipment/machinery — 18 fatalities (~11%)

Finally, one or more of the remaining twenty-two contributing factors were found in less than 10% of the fatalities. The leading ones in this group are:

- 005: Poor visibility/conditions/bad weather — 14 fatalities (~9%)
- 008: Failure to secure material (ex. loads on trucks) — 12 fatalities (~7%)
- 024: Exited vehicle (ex. jumping from moving vehicle) — 11 fatalities (~7%)
- 012: Failure to wear seat belt — 11 fatalities (~7%)

Table 3 is a summary of all 33 contributing factors and the number of fatalities in which each was identified.

Accident classifications

MSHA categorizes mining accidents in 21 distinct classification codes. At least one independent contractor fatality (out of 163) occurred in 14 of these 21 classifications. They include:

- Electrical
- Exploding vessels under pressure
- Explosives and breaking agents
- Falling, rolling or sliding rock or material of any kind
- Fall of face, rib, pillar, side or highwall (from in place)
- Fall of roof or back (from in place)
- Handling material
- Powered haulage
- Hoisting
- Ignition or explosion of gas or dust
- Machinery
- Slip or fall of person
- Handtools
- Other³

More than 80% of the 163 fatalities occurred in just five accident classifications. The largest number was in “powered haulage” (55 fatalities). This was followed by “machinery”

Table 3 — Total number of fatalities for each contributing factor.

No.	Contributing factor	Fatalities
001	Failure to maintain equipment	38
002	Failure to follow “standard operating procedures”	57
003	Failure to provide barriers (e.g., cones, tape, fences and horses)	6
004	Inadequate fall protection/failure to wear safety line	23
005	Poor visibility/bad weather conditions	14
006	Improper guarding of equipment, machinery, etc	3
007	Poor footing on walking/working surfaces; slip/trip/fall	3
008	Failure to secure material (e.g., loads on trucks and overhead loads)	12
009	Poor positioning of employee (e.g., in dangerous positions)	43
010	Not using tag line	2
011	Alcohol	1
012	Failure to wear seat belt	11
013	Improper use of equipment, (e.g., beyond the equipment’s intended use)	19
014	Equipment contact with power line	8
015	Failure to maintain safe distance around fixed or mobile equipment	1
016	Failure to recognize and/or avoid hazard	28
017	Failure to communicate	7
018	Failure to block equipment/machinery	18
019	Failure to support roof	1
020	Operate equipment/trucks over edge of highwall	5
021	Material beyond angle of repose (trimmed stockpile)	5
022	Inadequate berm	5
023	Improper driving actions (e.g., speeding; bad driving habits)	19
024	Exited vehicle (e.g., jumping from a moving vehicle)	11
025	Failure to lockout/tag out (of any energy source)	5
026	Hazards associated with working in a confined space	1
027	Fall of material (e.g., load from truck, stockpile, highwall and overhead)	2
028 ^a	Failure of management to address safety problems	27
029	Failure to conduct preshift examination or equipment inspection	18
030	Failure to use or wear personal protective equipment	5
031 ^b	Inadequate mining methods	6
032	Other, not elsewhere classified (NEC)	4
033 ^c	Management failure to enforce regulations/instructions	21

^a Relates to management’s failure to take corrective action on hazards they knew or should have known existed.

^b Relates to using the wrong methods for extraction, such as undercutting a highwall without taking necessary precautions.

^c Relates to enforcement of regulations that already exist or instructions provided to workers.

(32); “slip or fall of person” (17); “electrical” (15); and “falling, rolling or sliding rock” (13). Table 4 shows the number and percent of fatalities in all 14 classifications.

In the following sections, contributing factors having the highest frequencies in the top five accident classifications are noted. Table 5 then summarizes all of the contributing factors in these five accident classifications and the number of fatalities associated with each factor.

Powered haulage. “Failure to maintain equipment” was identified most often; it was found in 18 of 55 fatalities. This was followed by “improper driving actions” (17 fatalities), “failure to follow ‘standard operating procedures’” (16 fatalities) and “poor positioning of employee” (13 fatalities).

Machinery. “Poor positioning of employee” was the most frequent contributing factor; it was identified in 13 of 32

³ The remaining eight classifications in which zero independent contractor fatalities were reported are: Entrapment, Fire, Nonpowered haulage, Impoundment, Inundation, Stepping or kneeling on object and Striking or bumping.

Table 4— Accident classifications, independent contractor fatalities 1990 to 1997.

All	Frequency	Percent	Cummulative percent
Powered haulage	55	33.7	33.7
Machinery	32	19.6	53.3
Slip or fall of person (from elevation or on same level)	17	10.4	63.7
Electrical	15	9.2	72.9
Falling, rolling or sliding rock or material of any kind	13	8.0	80.9
Explosives and breaking agents	7	4.3	85.2
Other (not classified among the other 20)	6	3.7	88.9
Fall of face, rib, pillar, side or highwall (from in place)	4	2.5	91.4
Handtools	4	2.5	93.9
Handling material	3	1.8	95.7
Ignition or explosion of gas or dust	3	1.8	97.5
Hoisting	2	1.3	98.8
Exploding vessels under pressure	1	0.6	99.4
Fall of roof, back, or brow (from in place)	1	0.6	100.0
Totals	163	100.0	100.0

fatalities. The next highest factor, "failure to follow 'standard operating procedures'" was noted in ten of the fatal injuries. These were followed by "failure to maintain equipment" in nine fatalities and "failure to secure materials" (e.g., loads on trucks) in eight fatalities.

Slip or fall of person. The leading factor in this accident classification was "inadequate fall protection/failure to wear safety line." It was found in 14 of 17 fatalities. The second highest factor, identified in six fatalities, was failure to follow "standard operating procedures."

Electrical. For the 15 fatalities in this accident classification, "equipment contact with power line" was identified in eight of them. "Failure to lock out/tag out" was noted in four fatalities.

Table 5 — Total number of fatalities for contributing factors in five leading accident classifications.

Contributing factors	Accident classifications					Total
	Powered haulage	Machinery	Slip or fall of person	Electrical	Falling/Rolling/Sliding rock	
001 Failure to maintain equipment	18	9	1	3	1	32
002 Failure to follow "standard operating procedures"	16	10	6	3	5	40
003 Failure to provide barriers (e.g., cones, tape, fences, horses)	2	1	1	—	2	6
004 Inadequate fall protection/failure to wear safety line	1	4	14	—	1	20
005 Poor visibility/bad weather conditions	4	2	2	—	2	10
006 Improper guarding of equipment, machinery, etc.	—	2	1	—	—	3
007 Poor footing on walking/working surfaces; slip/trip/fall	—	1	2	—	—	3
008 Failure to secure material (e.g., loads on trucks, overhead loads)	1	8	—	—	2	11
009 Poor positioning of employee (e.g., in dangerous locations)	13	13	2	1	7	36
010 Not using a tag line	—	1	—	1	—	2
011 Alcohol	—	1	—	—	—	1
012 Failure to wear seat belt	8	3	—	—	—	11
013 Improper use of equipment (e.g., beyond equipment's intended use)	6	5	1	1	1	14
014 Equipment contact with power line	—	—	—	8	—	8
015 Failure to maintain safe distance around fixed or mobile equipment	—	—	—	—	—	0
016 Failure to recognize and/or avoid hazard	5	5	2	2	6	20
017 Failure to communicate	4	1	—	1	1	7
018 Failure to block equipment/machinery	8	6	—	1	2	17
019 Failure to support roof	—	—	—	—	—	0
020 Operate equipment/trucks over edge of highwall	4	1	—	—	—	5
021 Material beyond angle of repose (trimmed stockpile)	1	—	—	—	4	5
022 Inadequate berm	4	1	—	—	—	5
023 Improper driving actions (e.g., speeding; bad driving habits)	17	2	—	—	—	19
024 Exited vehicle (e.g., jumping from a moving vehicle)	8	3	—	—	—	11
025 Failure to lockout/tagout (of any energy source)	—	1	—	4	—	5
026 Hazards associated with working a confined space	—	—	—	—	—	0
027 Fall of material (e.g., loads from truck, stockpile, highwall, overhead)	—	2	—	—	—	2
028 Failure of management to address safety problems	5	2	4	2	5	18
029 Failure to conduct preshift examination or equipment inspection	6	3	—	2	2	13
030 Failure to use or wear personal protective equipment	—	2	—	2	—	4
031 Inadequate mining methods	2	1	—	—	2	5
032 Other, not elsewhere classified (NEC)	—	—	1	2	—	3
033 Management failure to enforce regulations/instructions	4	3	3	2	2	14

Falling/rolling/sliding rock or material of any kind. The most common factors were "poor positioning of employee," found in seven of 13 fatalities and "failure to recognize and/or avoid hazard," identified in six fatalities. "Failure to follow 'standard operating procedures'" and "failure of management to address safety problems" were found in five fatalities each.

Job classifications

MSHA's accident/injury/illness database includes more than 200 occupations or job classifications (job titles). Table 6 shows that at least one independent contractor fatality occurred in 38 of these classifications.

Most fatalities were reported in the job classification of "truck driver." This was followed by "laborer/utility man/pumper" (17 fatalities); "mechanic/repairman" (13 fatalities); and "welder" (11 fatalities). Combined, these four job classifications accounted for over half of the 163 fatalities.

The leading contributing factors in these four job classifications are noted below. Table 7 summarizes all of the contributing factors identified and the number of fatalities associated with each.

Truck driver. Twenty-four different contributing factors were identified in 45 fatalities in this job classification. "Poor positioning of employee" and "failure to follow 'standard operating procedures'" were each noted in 14 fatalities. Other leading contributing factors, in 11 fatalities each, were "improper driving actions and failure to maintain equipment."

Laborer/utility man/pumper. Eighteen factors were identified as contributing to 17 fatalities in this job classification. In six of these fatalities, "poor positioning of employee" was a factor. Both "failure to maintain equipment" and "inadequate fall protection," "failure to wear safety lines" contributed to five fatalities each.

Mechanic/repairman. A total of ten factors were identified in 13 fatalities in this job classification. "Failure to follow 'standard operating procedures'" was noted in five of these fatal injuries. Both "failure to block equipment/machinery" and "poor positioning of employee" were found in four fatalities each.

Welder. Thirteen contributing factors were identified in 11 fatalities in this job classification. "Failure to follow 'standard operating procedures'" was identified in eight fatalities. The next most common factor, in five fatalities, was "failure to recognize and/or avoid hazard."

Summary and recommendations

In summary, 33 unique factors were identified as having

Table 6 — Job classifications, independent contractor fatalities, 1990 to 1997.

	Frequency	Percent	Cumulative, %
Truck driver	45	27.6	27.6
Laborer/utility man/pumper	17	10.4	38.0
Mechanic/repairman	13	8.0	46.0
Welder	11	6.7	52.8
Shotfirer/shooter/blaster	7	4.3	57.1
Bulldozer operator/tractor/heavy equipment	7	4.3	61.3
Unknown or NEC	7	4.3	65.6
Outside foreman	6	3.7	69.3
Drill helper	5	3.1	72.4
High lift operator/front end loader	4	2.5	74.8
Electrician	3	1.8	76.7
Power shovel operator/pitman	3	1.8	78.5
Watchman/guard	3	1.8	80.4
Superintendent	3	1.8	82.2
Trainee	2	1.2	83.4
Cinpl/med/bone yard operator/crusher	2	1.2	84.7
Carpenter	2	1.2	85.9
Engineer-electrical, ventilation, mining	2	1.2	87.1
Prep plant foreman/mill foreman	2	1.2	88.3
Drill operator	1	0.6	89.0
Section foreman/shift boss	1	0.6	89.6
Belt/conveyer man	1	0.6	90.2
Mechanic repairman	1	0.6	90.8
Labor foreman/bulging foreman	1	0.6	91.4
Miner NEC	1	0.6	92.0
Crane operator/dragline/backhoe	1	0.6	92.6
Belt/conveyer man	1	0.6	93.3
Mechanic helper	1	0.6	93.9
Mason	1	0.6	94.5
Wireman/communications repairman	1	0.6	95.1
Coal MN sampler	1	0.6	95.7
Hoistman/engineer	1	0.6	96.3
Barge attendant/boat/dredge	1	0.6	96.9
Highwall drill helper	1	0.6	97.5
Highwall drill operator	1	0.6	98.2
Water truck operator	1	0.6	98.8
Maintenance foreman	1	0.6	99.4
Mine foreman/mine manager/owner	1	0.6	100.0
Totals	163	100.0	100.0

contributed to 163 independent contractor fatalities over an eight-year period. Several contributing factors were identified more frequently in the study population. The most common one, "failure to follow 'standard operating procedures,'" was found in 57 fatalities. This was followed by "poor positioning of employee," (43 fatalities), "failure to maintain equipment" (38 fatalities), "failure to recognize and/or avoid hazard" (28 fatalities), "failure of management to address safety problems" (27 fatalities), "inadequate fall protection/failure to wear a safety line" (23 fatalities) and "management failure to enforce regulations/instructions" (21 fatalities).

In developing training interventions aimed at reducing the number of independent contractor fatalities, these leading factors should command most of the attention; however, consideration also should be given to the remaining contributing factors to provide a comprehensive and meaningful safety training program. The quality and effectiveness of such training would depend on how the data are used. Several possibilities exist. One approach would be to base the training on those contributing factors associated with the employee's

Table 7 — Total number of fatalities for contributing factors in four leading job classifications.

Contributing factors	Job classifications				Total
	Truck driver	Laborer Utility man/ Pumper	Welder	Mechanic/ Repairman	
001 Failure to maintain equipment	11	5	1	3	20
002 Failure to follow "standard operating procedures"	14	4	8	5	31
003 Failure to provide barriers (e.g., cones, tape, fences, construction horses) ¹	1	1	—	3	
004 Inadequate fall protection/failure to wear safety line	4	5	2	—	11
005 Poor visibility/bad weather conditions	4	2	—	—	6
006 Improper guarding of equipment, machinery, etc.	—	1	—	—	1
007 Poor footing on walking/working surfaces; slip/trip/fall	—	2	—	—	2
008 Failure to secure material (e.g., loads on trucks and overhead loads)	5	2	2	—	9
009 Poor positioning of employee (e.g., in dangerous locations)	14	6	4	4	28
010 Not using a tag line	—	—	—	—	0
011 Alcohol	—	—	—	—	0
012 Failure to wear seat belt	5	—	—	—	5
013 Improper use of equipment (e.g., beyond the equipment's intended use)	3	3	2	1	9
014 Equipment contact with power line	3	—	—	—	3
015 Failure to maintain safe distance around fixed or mobile equipment	—	—	—	—	0
016 Failure to recognize and/or avoid hazard	5	3	5	—	13
017 Failure to communicate	4	1	—	—	5
018 Failure to block equipment/machinery	5	2	2	4	13
019 Failure to support roof	—	—	—	—	0
020 Operate equipment/trucks over edge of highwall	3	—	—	—	3
021 Material beyond angle of repose (trimmed stockpile)	4	—	1	—	5
022 Inadequate berm	3	—	—	—	3
023 Improper driving actions (e.g., speeding; bad driving habits)	11	—	—	—	11
024 Exited vehicle (e.g., jumping from a moving vehicle)	6	—	—	—	6
025 Failure to lockout/tagout (of any energy source)	—	—	—	2	2
026 Hazards associated with working a confined space	—	1	—	—	1
027 Fall of material (e.g., loads from truck, stockpile, highwall, overhead)	—	1	—	—	1
028 Failure of management to address safety problems	6	3	3	1	13
029 Failure to conduct pre-shift examination or equipment inspection	5	2	2	2	11
030 Failure to use or wear personal protective equipment	1	—	—	2	3
031 Inadequate mining methods	1	—	—	—	1
032 Other, NEC (not elsewhere classified)	1	—	—	—	1
033 Management failure to enforce regulations/instructions	8	1	4	1	14

job title. For example, it was noted that four factors contributed most frequently to the 45 truck driver fatalities — “*poor positioning of employee*” (14 fatalities); “*failure to follow 'standard operating procedures'*” (14 fatalities); “*improper driving actions*” (11 fatalities) and “*failure to maintain equipment*” (11 fatalities). These could be featured in a hazard recognition training exercise designed specifically for truck drivers. To cover all possible workplace situations, however, the remaining 20 contributing factors identified in the “truck driver” job classification (Table 7) also should be addressed in the training program.

Another approach for using this information would be to base the training intervention on contributing factors associated with accident classifications. One could review recent company lost-time injury reports and identify the accident classifications in which most incidents are occurring. If, for example, “slip or fall of person” was found to be a major source of incidents at the mine, then a hazard recognition training exercise could be developed that focused on the 13 contributing factors identified in this accident classification (Table 5). The major emphasis, though, should be on “*inadequate fall protection/failure to wear a safety line*” (14 fatalities) and “*failure to follow 'standard operating procedures'*” (six fatalities), since these factors were identified most frequently.

Finally, the information could be used to develop training that stresses the most likely factors that may contribute to independent contractor fatalities in specific job- and task-related work areas. In other words, by combining factors associated with fatalities in related accident *and* job classifications, the training would address a wide variety of problem areas.

For example, 21 factors identified in the “powered haulage” accident classification may be combined with 24 factors identified in the “truck driver” job classification to form the basis for a training exercise. The four leading factors identified in each of these classifications — “*failure to follow 'standard operating procedures,'*” “*failure to maintain equipment; poor positioning of employee*” (e.g., in dangerous locations); and “*improper driving actions*” (e.g., speeding and bad driving habits) would be joined with the remaining factors to form a training program that focuses on recognizing hazards identified with specific tasks that truck drivers perform (Table 8). This could be used, for instance, as a topic for discussion in a prejob safety meeting to heighten employee awareness prior to a truck driver beginning a new job.

A second example may be to combine the 27 contributing factors identified in the “machinery” accident classification with the 18 factors found in “laborer/utility man/pumper” job

Table 8 — The four leading factors identified in the “Powered haulage” accident classification and the “Truck driver” job classification.

Truck driver	Powered haulage
1. Poor positioning...	1. Failure to maintain...
2. Failure to follow standard...	2. Improper driving...
3. Improper driving...	3. Failure to follow standard...
4. Failure to maintain...	4. Poor positioning...

classification. The primary focus of the resulting training would be those factors that overlap — “*poor positioning of employee*” (e.g., in dangerous locations), “*failure to maintain equipment*” and “*failure to follow ‘standard operating procedures’*”— as well as the two factors with high frequencies, viz. “*failure to secure material*” (e.g., loads on trucks and overhead loads) and “*inadequate fall protection/failure to wear safety line.*” This would provide a solid basis for hazard awareness training of persons performing tasks associated with any of these related job titles.

Complete MSHA investigation reports of recent mining industry fatalities are available on-line at www.MSHA.gov/STATS/STATINFO.HTM.

By reviewing these reports using the criteria noted, safety practitioners and trainers may identify contributing factors

Table 9 — The four leading factors identified in the “Machinery” accident classification and the “Laborer/Utility man/Pumper” job classification.

Laborer/Utility man/Pumper	Machinery
1. Poor positioning...	1. Poor positioning...
2. Failure to maintain...	2. Failure to follow standard...
3. Inadequate fall protection...	3. Failure to maintain...
4. Failure to follow standard...	4. Failure to secure...

and incorporate them into meaningful instructional materials. Contributing factor information, which in the past has not received much attention, could become an important component in training programs. Such training, grounded in past experiences in which workers are informed of dangers involved in the conduct of their tasks, has the potential to improve safe job performance that may result in fewer injuries.

References

- Sanders, M.S., and Shaw, B.E., 1988, “Research to Determine the Contribution of System Factors in the Occurrence of Underground Injury Accidents,” US Bureau of Mines Contract JO348042, Essex Corp., Final Report.
- Schaffer, L., 1986, “Research Study to Determine the Applicability of New Methodologies in Mine Accident Investigations,” US Bureau of Mines Contract JO308008, Woodward Associates, Final Report.



[Home Page](#) | [International Customers](#) | [Help](#) | [Your Account](#) | [Cart & Checkout](#)

- [Electronics](#)
- [Photo](#)
- [Movies](#)
- [Books](#)
- [Toys](#)
- [Video Games](#)
- [Home](#)
- [Garden](#)
- [Sports](#)
- [Baby](#)
- [Flowers & Gifts](#)
- [Jewelry & Watches](#)
- [See More](#)

Search for:

You are here: [Home Page](#) > [Books](#) > [Science & Technology](#) > [Technology](#) > [Mining](#)

Transactions (2001)

Author: Multiple Contributors



[See larger photo.](#)



List Price: ~~\$84.00~~
Our Price: **\$78.12**
You Save: \$5.88 (7%)

Availability: Usually takes 1 business day to process before shipping.

Shipping Cost: To see the shipping cost for this item, add it to your cart.

[See all Books by Multiple Contributors](#)

Trade Cloth, 2001

Pub. Date: Feb 2002, Publisher: Society of Mining Metallurgy and Exploration
ISBN: 0873352203, Dimensions (Inches): 11.46x8.38x1.04

Description

This collection is an invaluable resource of technical papers published in "Mining Engineering and Minerals & Metallurgical Processing, " plus additional papers published only in this book. Fully indexed by title, author, and subject.

[Top of Page](#)

Gifting Options



Gifting options for this item:

- [Gift Wrap](#)
- [Gift Message](#)
- [See details.](#)

[Email this page to a friend.](#)

Ordering Help

- [Track Your Orders](#)
- [Questions About Your Order](#)

Shipping & Returns Help

- [Shipping Costs & Times](#)
- [Our Return Policy](#)

Store Help

- [Find a Store](#)
- [Wal-Mart Stores Info](#)

Still Have Questions?

- [Online Customer Service](#)
- [Product Recall Info](#)

[Security & Privacy](#) | [Sign Up for More Values](#) | [Terms of Use](#) | [Wal-Mart Credit Cards](#) | [Join our Affiliate Program](#)
[Store Finder](#) | [Sam's Club](#) | [Company Information](#) | [Jobs at Walmart.com](#) | [See All Departments](#)

capw039