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Relationships between supervisory safety contributions and productivity accomplishment among limestone quarries.

J Owen Weber

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RELATIONSHIPS BETWEEN SUPERVISORY SAFETY CONTRIBUTIONS AND PRODUCTIVITY ACCOMPLISHMENT AMONG LIMESTONE QUARRIES

A Dissertation

Presented to
The Graduate Faculty of
The School of Physical Education
of West Virginia University
in Partial Fulfillment of the Requirements for
the Degree of Doctor of Education

by

J. Owen Weber, M.B.A.
Morgantown, West Virginia
1990

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CHAPTER 1

Introduction

Between 1966 and 1988 the industrial safety movement made a quantum leap forward in achieving the national recognition that it was previously denied. Prior to 1970, safety in most companies was looked upon as more of an impediment to production activities than a legitimate source of cost containment and increased productivity. Management assumed, as it had since time immemorial, that employees would work safely owing more to personal common sense than to any adherence to company safety policies. In general, safety became only a priority concern of management when the frequency of injury/incidents, exceeded some internally imposed and often capricious standard. When the frequency rate reached such a level, attention was directed to on-the-spot solutions and after-the-fact analysis as to the cause of the suspect incidents.

The impetus to change was more the result of social legislation than a sudden awakening to a debilitating condition. In December 1970, Congress passed, and the President signed, the Williams-Steiger Occupational Safety and Health Act (OSHAct), which became effective on April 28, 1971. The underlying purpose of this far-reaching Act was to ensure "so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources." (55)

Passage of the OSHAct was primarily the result of a belief by Congress that business was not doing enough to protect its primary resource and that many states who previously had jurisdiction either had mediocre safety codes or lacked the teeth to enforce the law. The Honorable Phillip Burton, Representative from California, summed up the feelings of many legislators when he appended a separate and concurring view to the majority report recommending the passage of HR16785, which, with modifications, became the Occupational Safety and Health Act. Representative Burton stated:

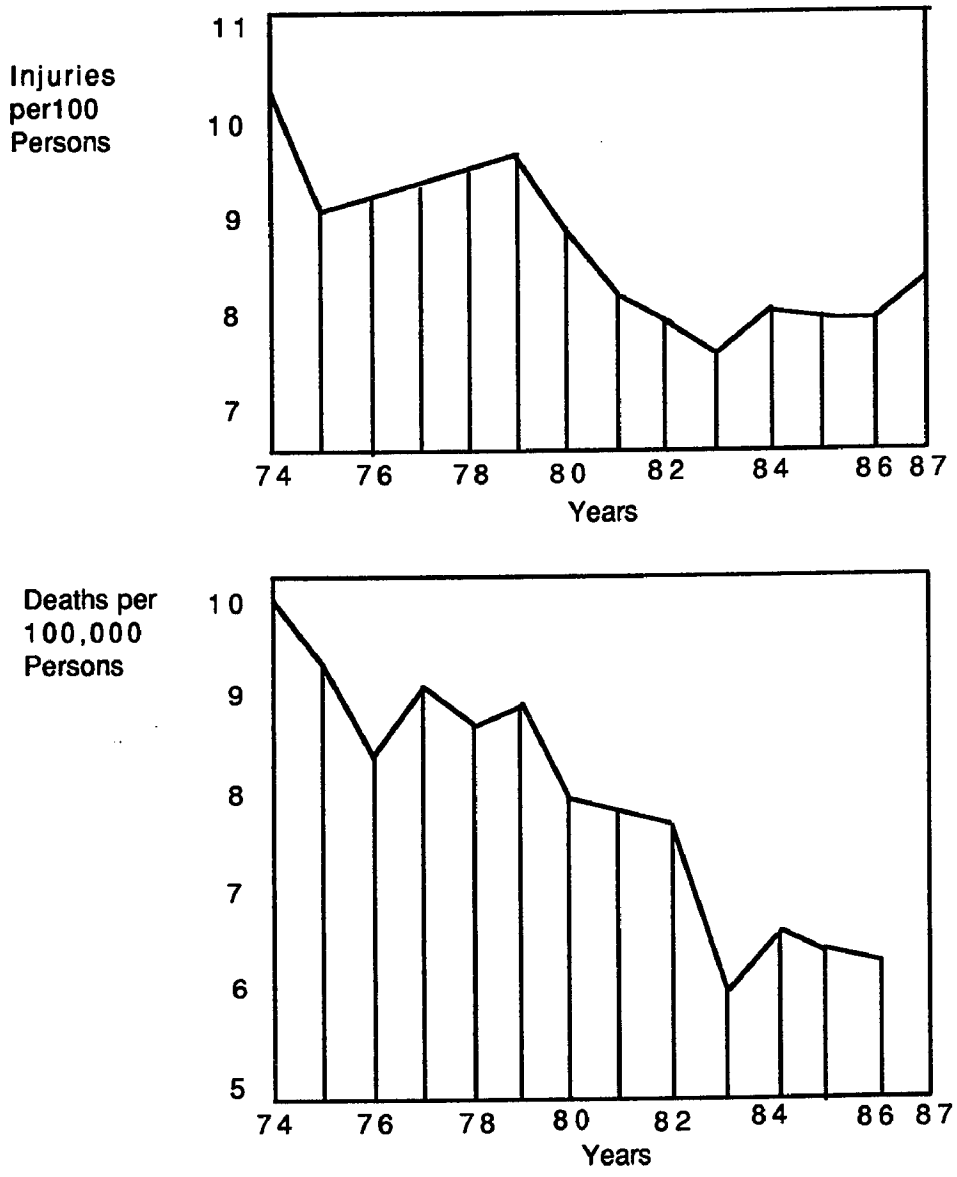
> "While I share the conviction that standard-setting and enforcement is an appropriate Federal responsibility, I am gravely concerned that this bill may not go far enough to reach and remove the root causes of the macabre facts of life in the working place. More specifically, I am convinced that most of the diseases and a substantial portion of deaths and injuries are not the result of worker carelessness, but are avoidable by management's exercise of preventative measures." (53)

The OSHAct was, therefore, designed to forever change the landscape of occupational safety by sending a clear signal to U.S. companies that more adequate methods of providing for and monitoring safety affairs were necessary and that a formalized system of safety activities should be established. Failure to do so would subject individual companies not only to the "penalties" established by the federal government in the form of citations and fines but, also, to the public scorn and indignation that would arise.

Initially, it might appear that such social legislation and public accountability were successful in reducing on-the-job deaths and injuries. In fact, as Figure 1 illustrates, injuries did decline precipitously in the period preceding 1975, and again from 1979 to 1983 after gradually rising from 1975 to 1979. More than anything else, however, these figures may simply confirm the thesis put forth by Eula Bingham, former OSHA chief in the Carter administration, in which she argues that "workplace accident trends seem to run in cycles, reflecting a three to five-year lag between policy changes and their results."(46)

Figure 1

INJURY AND DEATH ON THE JOB



Source: U.S. Bureau of Labor Statistics

1987 deaths per 100,000 persons not available

If Bingham's thesis is correct, then Figure 1 may indeed bode unsafe times for U.S. workers in the future. After steadily declining for four straight years, the rates of work related injuries and deaths rose across a broad front in 1984 whereupon deaths decreased for the next two years while injuries at first stabilized then increased 5% from 1986 to 1987. (52)

What went wrong? According to Bingham's theory, the 1984 increases came three years after the Reagan administration started cutting health and safety enforcement and five years after employers slashed health and safety spending. These two actions were not incongruous. Since 1980 the federal government has undergone a philosophical transformation in the enforcement of federal safety standards. These changes are best illustrated by OSHA which is no longer deployed with the tools of a police force bent on penalizing companies "after-the-fact" for violations. Instead, the agency is equipped to act as a national consultative service more interested in overseeing the establishment of a safe workplace. This metamorphosis was predicated on two assumptions: first, that companies truly cared about the health and safety of their employees and; second, that safety managers were professionally trained to manage change in such a way as to maximize performance while minimizing costs.

Unfortunately, most safety departments today are structured around atavistic concepts rather than contemporary management techniques and thus have only a negligible impact on the firm's safety efforts or

profitability. The government, under the aegis of the OSHAct, has permitted companies to foster this philosophy since their emphasis has been exclusively on environmental conditions rather than behavioral manifestations. The government's emphasis was best summed up by Dr. Alexander L. Strasser in a Occupational Health and Safety editorial column when he wrote:

> "OSHA initially was safety, rule and regulation oriented. The emphasis was on bread and butter safety issues.... The first OSHA inspectors, considered not to be very well trained, paid inordinate attention to the rulebook. They appeared to live by the regulations even if it meant taking action that was not always logical or in the best interest of the public....OSHA inspectors were so concerned with minor technicalities that more important safety lapses may have been overlooked." (50)

As a result, between 1970 and 1980 many companies staffed their safety departments with individuals that were more in tune with the demands of the government than with the mission(s) of the firm; i.e., profit and employee welfare. Thus, when many companies finally realized the "costs" associated with their safety departments and the corresponding diminution of governmental enforcement, they opted for the easy way out by reducing their safety staff. This trend continued through the decade of the eighties right up to the present.

What then can be done? Because of the diversity in the size of the companies within the various industries, it would be virtually impossible to designate "one right approach." One common denominator, however,

among virtually all companies is the front-line supervisor. Therefore, it would seem obvious that any efforts undertaken to reduce safety maladies should be oriented to this "key" employee.

Unfortunately, many companies still rely on their supervisors to primarily perform the traditional duties of supervision.(38, 17) These include:

- Maintain order
- Keep work on schedule
- Maintain equipment
- Establish work methods and procedures
- Instruct workers
- Assign work/tasks
- Keep men busy
- Supervise work
- Adjust complaints
- Maintain morale
- Control costs and quality

Although such duties have been historically designed to incorporate an emphasis upon safety, a tremendous void has existed as to not only what actual safety responsibilities a supervisor has, but more importantly, how can such activities be measured and what impact do supervisory safety related responsibilities have on the overall productivity accomplishment of the enterprise.

The essence of this study was to examine the relationship between how enterprise employees evaluate the safety related contributions of

their front-line supervisors and the overall productivity accomplishment of the given enterprise. Much of the safety literature assumes that the supervisor's impact is essential to the development and maintenance of a low-hazard workplace. These assumptions appear reasonable and may, in fact, be completely valid. This study, however, attempted to examine the statistical relationship between a supervisor's perceived safety contributions and the enterprise's actual productivity. Productivity was selected as the comparative base because of the continuing controversy that abounds in the safety literature concerning such traditional variables as accident frequency and severity rates.

Statement Of The Problem

The problem involved in this study was to compare supervisory safety contributions with productivity accomplishment in selected limestone quarry locations. Supervisory safety contributions were based upon a listing by Goberni (19) published in 1977. The productivity accomplishment measure consisted of limestone tons per man hour that were produced at quarry locations. A solution to this problem was contingent upon completion of the following sub-problem tasks:

1. Construction of a questionnaire for soliciting responses from a jury of experts for confirming applicability of supervisory safety contributions.

2. Solicitation of jury member cooperation.

3. Development of a survey instrument consisting of supervisory safety duties and responsibilities that could be used to assess the safety contributions of front-line supervisors.

4. Pilot-test survey instrument in a selected limestone quarry to determine the instrument's efficacy.

5. Enlist support and cooperation of 10 quarry superintendents who would permit the researcher to randomly select 10 employees or 25% of the work force, whichever is greater, to serve as survey respondents.

6. Administer questionnaire and collect and organize data in order to interrelate contributions to productivity accomplishment measure.

7. Adaptation of a productivity accomplishment measure based upon limestone tons per man hour that were produced at particular quarry locations.

8. Test the relationship between supervisory safety contributions and productivity for selected limestone quarries.

Purpose Of The Research

The purpose of this study was to make available to enterprise safety function manager's research based data which should be useful in ascertaining the utility of individual and grouped supervisory safety contributions on the firm's productivity while concomitantly identifying areas of opportunity among and between supervisors that will permit the development of specific and focused safety training.

Significance Of The Study

This study was justified by the need to determine the actual impact that a front-line supervisor has on the overall enterprise safety efforts. Private and non-private enterprises have for years been conditioned to evaluate their safety efforts by utilizing after-the-fact parameters such as injury frequency and severity rates. Such rates, however, do very little either to ameliorate the safety efforts or to isolate primary causes. On the other hand, a reliable measure of supervisory safety contributions could be used not only to detect existing safety maladies, but also to portend future safety opportunities so that management could initiate a corrective plan of action that would eliminate or minimize impending injury incidents. Furthermore, such a measure could be used as a component in the overall appraisal system as well as a tool in ascertaining training deficiencies in individual supervisors.

Limitations

Generalizations and inferences made as a result of this study were based upon consideration of the following limitations;

1. Statements of responsibility included in the survey instrument were those suggested as being important from published literature, previous research, and jury of expert confirmation.
2. All quarries were selected from one enterprise.
3. Questionnaire respondents were individuals selected by plant management who in turn agreed to permit such personnel to participate.
4. Questionnaire respondents' interpretations of and feelings toward the survey instrument and individual items were of an individualistic nature.
5. The literature review yielded a paucity of books and/or articles germane to the research topic.

Definitions

Accountability: Extent to which a subordinate is expected to be held accountable to a superior for proper discharge of assigned duties and tasks. (34, 192)

Authority: The right to decision-making as well as the power to command obedience in performance of tasks by other persons who occupy subordinate positions. (34, 191)

Enterprise: An essentially person-directed and multiple-mission network of interacting operational entities, i.e., functions and corresponding systems and subsystems designed to assure facilitation of these functions as well as achievement of the mission. (34, 99-100)

Management: The art and science of (a) stating appropriate missions of a given enterprise, (b) formulating and directing pertinent programs to achieve these missions, and (c) establishing and utilizing structural operating entities for functions, under which programs can be strategically and systematically grouped. (34, 43)

Responsibility: Obligation of an individual to perform tasks and carry out duties that have been assigned by a person who occupies a superior position. (34, 191-102)

Safety: A mission oriented plan of management that is implemented and maintained through managerial personnel of producing and servicing operations as cost-effective risk countermeasures to protect, conserve, and improve humanity, property, and efficacy resources of any enterprise. The plan should contribute significantly to enterprise profitability by optimizing prevention of harm-inflicting contacts. Secondarily, safety incorporates loss countermeasures in the form of minimization activities which should alleviate, mitigate, and restrain detrimental effects upon enterprise resources when harm-inflicting contact prevention efforts are not as effective as desired.

Safety Function: All of the operations and associated activities that are designed and promoted by the safety staff, some of which may need to be performed by specialist personnel of that department and some, of necessity, which must be performed by individuals who are located in other departments or units both within or without the enterprise.

Supervisor: Any individual having authority, in the interest of the employer, to hire, transfer, suspend, lay-off, re-call, promote, discharge, assign, reward, or discipline other employees, or responsibility to direct them, or to adjust their grievances, or effectively to recommend such action if in connection with the foregoing the exercise of such authority is not of a merely routine or clerical nature, but requires the use of independent judgment. (54, 136) In this particular study any foreperson was considered to be a supervisor.

Supervision: Actions performed by individuals who have been granted oversight authority for other persons, facilities, equipment, or materials which are intended to influence the latter by ways and means that enable prestated objectives to be achieved. (34, 44)

Outline Of The Remainder Of The Dissertation

Chapter Two reviews the relevant literature concerning the role and importance of the supervisor; their measurable duties and accountability; and the impact that they have on safety and productivity.

Chapter Three describes the methods and procedures of the research to accumulate and to evaluate the data.

Chapter Four describes the data collected, analyzes the data and presents the findings. Supervisory safety contributions are compared and analyzed by limestone quarry and by productivity in an effort to test for a relationship.

Chapter Five provides the summary, conclusions and recommendations of the study. A bibliography and appendices will conclude the report.

CHAPTER 2

Review Of Related Literature

A review of literature relevant to the study at hand revealed five key topical areas. These areas, to be addressed in this section, include supervisory importance, supervisor safety responsibilities and concomitant activities, supervisory accountability and measurability, line performance as a function of supervisory activities, and improved output as a result of enhanced safety performance.

Supervisory Importance

The importance of the first-line supervisor to the overall effectiveness of the safety function has long been recognized by enlightened members of the safety community. H. W. Heinrich, who many consider the father of modern industrial safety, postulated ten axioms of industrial safety over fifty years ago. His belief in the importance of the supervisor was clearly stated in one of these axioms when he wrote:

> "The supervisor or foreman is the key man in industrial accident prevention. His application of the art of supervision to the control of worker performance is the factor of greatest influence in successful accident prevention..." (24)

Grimaldi and Simonds echoed Heinrich's sentiments exactly when they wrote several years later that "the immediate supervisors of the workers, more than any others, are the key persons in implementing safety." (20, 25) Grimaldi and Simonds went on to write that "the first line supervisor is the key person in maintaining day-to-day safety requirements" (20, 71) and "supervisor contacts are without question the most important means of motivating employees for safety." (20, 148) In discussing the same subject, Russell DeReamer refers to a study of accident case histories which reveals why a supervisory approach to accident prevention is effective. He concludes that "the supervisor is the only person who can control men, machines, and working conditions on a daily, full-time basis. The supervisor is closest to the person most likely to get hurt. He can take direct action." (10, 5) Similarly, Anton states that the most important person in the organizational safety chain "is the front-line supervisor who deals most directly with the employee and thus bears the greatest responsibility for implementing the safety and health program." (2,2)

The importance of the supervisor cannot be overstated. Lateiner's experience with hundreds of supervisors and thousands of employees "proves that competent supervisors can eliminate in a reasonable and practical way at least 50 percent of all unsafe acts and conditions. They are thus able to prevent one-half of all injuries on the job." (30, 80)

Another study, conducted by Planek and his colleagues of 148 safety experts representing National Safety Council member companies

revealed that most respondents saw the supervisor as the crucial link directly affecting employee behavior. Returns received from 100 out of 145 safety officials gave the highest importance ratings to supervisory effectiveness and to management participation. (39)

Similarly, a staff article in Occupational Hazards dealing with decentralizing a company safety program emphasizes the importance of the supervisor by making statements roughly as follows:

1. Safety must be a line responsibility.

2. First Line Supervisors must be trained in safety.

3. Middle managers should be used as safety training instructors.

4. Accident losses should be charged to the department operating costs.

5. The supervisor's safety record should be considered at the periodic performance salary review.

6. Engineers should receive safety training, as they design the work environment.

7. Engineers should consult safety before launching a project. (49)

Of the seven components recommended for a decentralized program, the first five items point to the importance of line responsibility for

safety. Furthermore, a recent study conducted in three Asian developing countries found that of twelve safety activities investigated, first-line supervision was the highest rated activity for explaining differences between low injury-rate firms and high injury-rate firms. In fact,

> "applying the Wilcoxon test, the statistical association between the involvement of supervisors and lower injury rates was found to be highly significant at the 1 per cent level in all three countries. So supervisory participation contributed to better safety performance in enterprises within the lower half of injury-rate distribution curves as well as in companies at the upper half." (6, 115)

It appears that virtually all safety professionals agree that the first-line supervisor plays an important role in the overall safety function. The only debate is whether they are the key component. Although cautioning against delegating total responsibility for the success of the safety program down to the line supervisor, Marcum recognizes that the safety management system will operate effectively when components and constituents are shared with those individuals under which producing and servicing activities take place. (34, 162) Michael Krikorian, in an ASSE Journal article, supports Marcum's contention by writing that:

> "The success of the safety program depends in large part on how well supervisors accept their responsibility in carrying out the principles of an accident prevention program." (29)

Likewise, Petersen, et. al., feel that the idea of the supervisor being the key in accident prevention is axiomatic. "Supervisors are those persons between management and the workers who translate

management's policy into action." (25, 80) As such, they are as Likert referred to them, the "linking pin" between management and employees. (32) Thus, as Petersen concludes:

> "although the supervisor is the key to safety, management has a firm hold on the key chain. It is only when management takes the key in hand and does something with it that the key becomes useful." (25, 80)

However, in order for management to take the key in hand and do something, it must have a reasonable idea as to what safety activities are the responsibility of the supervisor so that the latter can be properly held accountable for the implementation of said activities.

Supervisor Safety Responsibilities And Concomitant Activities

While most safety professionals clearly recognize the importance of the supervisor, they are less clear as to the specific tasks and activities that fall within their designated circle of responsibility. The NSC Accident Prevention Manual points out the supervisor's responsibilities, in general, are as follows:

1. Establish work methods
2. Give job instructions
3. Assign people to jobs
4. Supervise people at work
5. Maintain equipment and the workplace. (37, 146)

The manual then goes on to show how safety is attained:

> "These principal responsibilities of the supervisor are the very activities through which the work of preventing accidents is carried out." (37, 146)

Thus the supervisor, as the lowest level line manager, can best affect safety performance by formulating safety work routines, providing proper training and coaching, ensuring maximum placement of personnel, motivating employees and adhering to high standards of housekeeping and machine maintenance.

Peterson, et. al., define four key tasks that belong to the supervisor in every safety program. These tasks include

1. Investigating all accidents to determine underlying causes.
2. Inspecting his area routinely and regularly to uncover hazards.
3. Coaching (training) his people so they know how to work safely.
4. Motivating his people so they want to work safely. (25, 300)

Denton is more specific as to a supervisor's safety activities. He identifies ten tasks as follows:

1. Safeguarding the safety of the department employees and protecting plant equipment.
2. Providing necessary safety equipment and enforcing its use.
3. Concentrating on good housekeeping procedures.
4. Providing and checking for safe tools.
5. Knowing the medical and physical limits of employees.
6. Providing on-the-job training.
7. Helping develop continuous participation in safety by employees.
8. Helping prepare, utilize, and update job hazard analysis (J.H.A.).
9. Making necessary minor accident investigations that occur in their department.
10. Helping provide positive safety rewards. (8, 23)

Denton then goes on to say that "the responsibility of supervisors" is also to be aware of the hazards of the workplace and to protect employees accordingly. Similarly, supervisors should also provide adequate job knowledge to employees ready to undertake unfamiliar jobs, teach methods, and develop and maintain a high interest in working safely. (8, 24) Telling a supervisor that he is responsible for safety is not enough, however, as Homer writes, "convincing them to accept the responsibility and associated accountability is another." (27, 57) Homer goes on to write that the best way to accomplish this is to show how safety can impact productivity, sales, and ultimately, profits.

In essence, however, the paucity of literature relevant to supervisory safety activities is consistent with Goberni's 1976 findings wherein he found "little, if any, research had been completed concerning the safety program responsibilities of front-line supervisors." (19, 13) Goberni sought to overcome this dearth of research by conducting his own research designed "to identify safety program responsibilities of front-line supervisors based on consensus agreement." (19, 121)

Analyzing "literature, insurance company references, and safety program manuals of various companies," Goberni was able to ascertain 74 statements of responsibilities. (19, 123) Utilizing the jury of experts technique, Goberni then assembled "twenty safety practitioners from industry, insurance companies, and governmental agencies," and 115 front-line supervisors from "twenty-nine manufacturing or service enterprises" to serve and refine Goberni's list of abstracted statements.

The essential finding of Goberni's research, apart from the identification of the initial list of responsibilities, was that 69 of the 74 statements, or 93 percent, were found to be either very important (30%) or above average in importance (63%) by the two disparate groups, i.e. safety practitioners and front line supervisors. (19, 124)

Additionally, a coefficient of correlation of 0.8672 indicated "fairly good agreement" between the jury members and supervisor respondents about order of importance of the 74 items. It is the research based statements of Goberni's study that constitute the cornerstone of the present undertaking.

Supervisory Accountability And Measurability

Since most safety practitioners and existing enterprises have failed to identify and utilize anything close to Goberni's list of supervisory safety responsibilities, it stands to reason then that most companies are therefore deficient in holding their supervisors truly accountable for their safety contributions. Supervisors, like employees, are going to maximize their performance in those areas where they are most likely to be appraised. Given the present environment, most producing and servicing companies still emphasize production and productivity while minimizing safety and other social oriented goals.

Much of this emphasis on production to the exclusion of safety is predicated on the belief that the former results in profits while the latter contributes to increased costs. The irony is, nothing is farther from the truth.

In his study of the relationship between organizational climate measures and organizational performance measures, Benjamin found high correlations between safety and return on net worth (.84) and safety and lost time accidents (-.82). (3, 70) Benjamin concluded that "more profitable plants are perceived as safer plants" and that "strong perceptions of safety in plants are accompanied by few accidents." (3, 84) Thus, one way of increasing corporate profits is by improving one's safety performance.

Phillip Drotnig contends, however, that a major problem confronts corporate social programs, such as safety, when:

> "Social goals are perceived as peripheral rather than an integral element of normal operations..... If an employee is held accountable for traditional corporate tasks whose performance will determine his success or failure, and is also urged to undertake social objectives on which his performance is not measured, the result is inevitable. Even the most well intentioned employee will devote his time and attention to the functions on which his career progress depends." (11, 259)

Based on the two previous sources, it appears that if an enterprise is truly interested in improving their return on net worth, one way of doing so will be to pay closer attention to their overall safety contributions. Likewise, one way of paying closer attention to their overall safety contribution will be to hold their individual supervisors accountable for their safety efforts just as if those efforts were production oriented. Syllogistically, it then follows that a firm's return-on-net worth can be improved by holding individual supervisors accountable for their safety efforts. One way of doing so would be to identify those safety related responsibilities germane to their job and then hold them accountable by periodically measuring their contributions. Petersen states that:

> "most supervisors today know that they are responsible for safety, and they know what they should be doing yet they do not do it. Why? Because they usually are not held accountable. That is they are not measured in safety." (40, 11-12)

Wygal's research confirms Petersen's theses by finding that while supervisors in general may be aware of a social concern of higher management for the safety of employees, "safety performance was best where supervisors also recognized such performance to be important to their evaluation as supervisors." (58, 142) In other words, it's not just good enough that supervisors are aware of the importance of safety; in addition, they must constantly and consistently translate this awareness into job performance.

Many academicians and practitioners are cognizant of the need to hold supervisors accountable for safety performance. Russell DeReamer ties safety into performance evaluation, insisting that supervisors and managers must assume:

> "full day to day responsibility for safety where safety performance is a factor in a supervisor's chances for advancement or an increase in pay." (9)

Similarly, Fred Foulkes, in a Harvard Business Review article stated that:

> "top management must take safety and health into account in supervisory evaluations. As in other areas, goals and objectives need to be set." (15)

Hammer succinctly states that supervisors "should be held directly responsible to ensure that all personnel under their supervision maintain safe working habits and observe stipulated rules." (21, 113) Likewise, Grimaldi and Simonds write that "holding the line accountable

for the implementation of safety must be the key to safety achievement." (20, 355)

D. A. Weaver consolidates the above by writing that:

> "Accountability should be fixed near the point of control. The point of control lies in the line organization. Therefore, safety management must devise procedures to fix accountability at the point of control. This means something counted or measured with sufficient reliability and validity that line management accepts it for appraisal, blame, correction and reward...." (56, 422)

In a similar view, Dan Petersen, the most prolific of all safety practitioners, has identified five principles of safety management of which number four is particularly appropos for the study at hand. In essence, Petersen states that management procedures that fix accountability are the key to effective supervisory safety performance. Petersen goes on to base this principle

> "on the belief that a line manager will achieve results in those areas in which management is measuring him. The concept of accountability is important for this measurement. The lack of procedures for fixing accountability is safety's greatest failing. We have preached line responsibility for many years. If we had spent this time devising measurements for fixing accountability on line management, we would still be achieving a reduction in our accident record." (41, 22-23)

Tarrants defines measurement as "essentially a decision-making activity, and the usefulness of measures must be evaluated in terms of their ability to provide information that will improve accuracy and

validity of the decisions made." (51, 4) "The main function of a measure of safety performance," Tarrants writes, "is to reveal the level of safety effectiveness in the organization within which establishment of accident control is desired." (51, 14)

Unfortunately, most present measures of safety results are after-the-fact and thus are more oriented toward penalties rather than positive change. The speciousness of the traditional methods of measuring supervisory performance is best articulated by the following quote from an article entitled "Evaluating Safety Supervisors: More Than Just Counting The Injuries:"

> The traditional method of evaluating how well a supervisor is performing the safety function is to determine the number of first-aid and medical cases, lost-work injuries, and the severity of those injuries in the department. In addition, reports may serve to indicate the amount of property damage losses that have occurred in the department.
>
> While such an evaluation may be somewhat valid, often it does not accurately reflect the effort and concern a supervisor is giving to the health and safety program. First, there is always the possibility that an uncontrollable injury has been charged to the department, which the supervisor could have done absolutely nothing to prevent. Such uncontrollable types of injuries may result in lost workdays from a back disability, hernia, tendonitis, or a variety of situations. In spite of excellent worker training and supervisory performance, there are incidents involving an uncontrollable act or violation of a safety rule that can result in injury.
>
> Yet it is possible for a supervisor who does little to provide for the safety and health of his or her employees to have a satisfactory statistical safety performance. Through good fortune alone, no injuries may have occurred in this super-

> visor's department. This is particularly discouraging to the supervisor who has taken steps to carry out an effective program yet is charged with an uncontrollable injury.
>
> Because of these variables, other measurable elements of an effective safety and health program should be considered... The initiation of a supervisory evaluation program provides management with a measuring devise to assure that meaningful safety efforts are being used by the supervisor..." (43)

Instead of utilizing after-the-fact measures such as frequency and severity rates to measure safety performance, companies interested in improving their safety are going to have to adopt a more innovative approach to gauging their safety output.

One approach, recommended by Petersen, is the employee effectiveness survey, and as such, is a before-the-fact measure rather than an after-the-fact result. (40, 109) As Petersen writes, "this technique consists of asking the employees in one manner or another what is happening, and getting an impression from them as to their perceptions of the effectiveness of current activities." (40, 112) In a sense, such an approach would have the employees, rather than the supervisor, serve as the agent of influence.

Hobson, in an article entitled "Why Employees Should Rate Supervisory Effectiveness" writes that subordinate feedback to supervisors can serve to direct behavior, influence goals, and provide reinforcement, as does feedback in the opposite direction." (26) Such a process should improve supervisory effectiveness since employees,

those most closely affected by the behavior and performance of the supervisor, are in a unique position to evaluate such performance.

To overcome the implications of hierarchical structure and power asymmetry between supervisors and subordinates, however, Hobson recommends that such feedback be collected anonymously each month, or at least quarterly, by using a standardized instrument, and that the results become an integral component of the supervisor's overall evaluation (26) The benefits of such upward feedback should include (1) an overall increase in organizational effectiveness as a result of enhanced supervisory effectiveness; (2) identification of training needs; and (3) improved employee satisfaction. (26)

Along the same lines, another "veteran management consultant" has recommended to his clients a technique designed to get supervisors ""rehired" who have lost the trust or faith of his employees or as he states, "has been sacked by his subordinates." This technique:

> "starts with an anonymous survey that asks employees who work for the manager in question to rate him - or her - in five critical areas: Supervisory skills, communication skills, interpersonal skills, job behavior, and training and development of subordinates. The survey consists of dozens of true-false and multiple-choice questions, along with a few open-ended essay questions." (13, 60)

Although relatively rare, research on upward feedback has yielded encouraging results. In a study of teacher behavior, Gage found that such behavior, as described by their pupils, "did change in the direction

of pupils' ideals as a result of getting feedback." (16) In two other studies, Bryan, (5) and Gage, Runkel and Chatterjee (17), the researchers also found that teacher behavior changed significantly in the direction of rater ideals from one rating period to another while a control group's behavior not given the ratings remained status quo.

Similarly, Daw and Gage found that a principals' behavior was positively affected by the ratings received from teachers under their authority. (7)

Similar results have been obtained with studies of supervisory behavior. In what appears to be one of the first published accounts of upward feedback, Maloney and Hinrichs of Esso Research found that

1. 25 percent of the subordinates said they had seen lasting changes in their supervisors;
2. 88 percent of the supervisors said they had tried to change after getting their reports;
3. 75 percent of the supervisors wanted a second run; and
4. 60 percent of both supervisors and subordinates agreed that productivity had been favorably affected by the program. (33)

Sirota and Coryell utilized first-line manager feedback in a survey conducted in five plants of a large electronics manufacturing company and found that 87% of the supervisors said the program was either very worthwhile or quite worthwhile as a means of letting them know where they stood or for use as a "guide to managerial self-improvement." In

addition, supervisors indicated such results enabled them to learn more about themselves as managers as well as "a better understanding of other employee attitudes and feelings." Similarly, 80% of the managers felt the feedback influenced the way they managed. (47)

Hegarty has also found that supervisors themselves felt that they became better supervisors as a result of upward feedback (22) and that supervisor performance in the eyes of their subordinates had also improved as a result of the feedback that supervisors received from subordinates. (23)

Thus, although few companies have availed themselves of the opportunity to utilize line personnel as a source of assessing supervisory effectiveness, those that have have found conclusively that all parties concerned have benefited. Employees benefit because they feel that they are participating in an important decision-making process; supervisors benefit because they are made aware of deficiencies that otherwise may have gone unnoticed; and the enterprise benefits as a result of the changed behavior in both the employee and the supervisor. Therefore, supervisory effectiveness surveys as well as surveys designed to elicit perceived supervisory contributions, based on employee input would appear to be an excellent method for ascertaining how well a supervisor is performing his/her safety responsibilities.

Line Performance As A Function Of Supervisory Activities

The criticality of measuring the supervisor's safety performance is best understood in terms of his/her impact on subordinates' safety. Bird, (4) Adams, (1) and Weaver (56) each found supervisory ineffectiveness to be a leading cause of accidents/incidents. Similarly, Zabetakis, in his study of quarry accidents, also found " assignment of responsibility, and authority, and accountability; employee selection, training placement direction and supervision" a major cause of such incidents. (59)

The groundwork for such findings was laid over fifty years ago when the Hawthorne study at Western Electric revealed that the attitudes of employees could be significantly changed by the development of a cooperative atmosphere between workers and supervisors. (44) McGregor also found that the day-to-day balance of supervisors and his/her concomitant implementation of policies was far more important in affecting change than the mere existence of such policies. (35)

As a result, employees' attitudes often reveal the quality of supervision. A 1969-1970 survey of working conditions showed workers' satisfaction to be significantly correlated with the adequacy of resources and the competence of their supervisors. (42) Another study, conducted for a national restaurant chain in 1977 found "a strong correlation between how the employees ranked their unit managers (supervisors) and the performance of their units. The better supervisors produced better operating results." (45) Still another study found that "effective

supervision" was a precursor to the organization's ability to realize productivity gains. (18, 76) Thus, as the competency of the supervisor increases, as perceived by the employee, productivity increases will follow.

How important is attitude in controlling incidents and improving safety and productivity? An extensive study of supervisors from 47 companies showed "that as a positive attitude toward safety increased, the number of accidents per employee dramatically decreased." (28) Likewise, the development of a sound safety attitude throughout an enterprise was predicated on how well the supervisors met their safety responsibilities. (28) Consequently, incidents will decrease when attitudes improve as a result of supervisors effectively performing their safety responsibilities.

Additionally, Falcione found that subordinates who perceived supervisors to be more credible, especially on the basis of safety and qualification factors, were generally more satisfied with their supervision. (14) Dunbar also found that:

> "whether subordinates associate safety with their manager's safety related behavior may depend on the extent to which they perceive their manager as being interested in their general welfare. That is, through the support he or she provides, the manager may significantly influence the way subordinates think about safety." (12)

Smith, et. al, also found that low accident rate plants used a humanistic approach in dealing with employees in which greater levels

of informal workers-supervisor interaction were encouraged. (48) In a sense, this finding is consistent with Likert's findings in which he found that productivity increases were a function of perceived and actual supervisory control. (31)

Thus, although limited in number, as in most other safety areas, the existing research seems to indicate that the supervisors' day-to-day behavior and implementation of safety policies - or lack of implementation - will have a major impact on the employee's attitude and thus the enterprise's safety efforts. The question now arises: "Will the effective implementation of safety policies have a positive impact on the enterprise's productivity?"

Improved Output As A Result Of Enhanced Safety Performance

As the previous section illustrated, a supervisor's behavior clearly affects the attitudes, and thus the performance, of his or her subordinates. The research conclusively proves that supervisors can positively or negatively impact the safety or productivity barometers of a given enterprise. What has not been proven or validated is what impact improved safety performance has on the overall productivity of an enterprise.

Robert Moschetta, former Safety Manager of Beaver Creek Coal Company, conducted his own study over a four year period to ascertain what impact safety had on production. His findings, as illustrated in Figure 2, reveal that as safety improved, i.e., lost time accident incidence

rate declined, productivity - as measured by marketable coal tons per man day – increased. Although not statistically validated, Mr. Moschetta nevertheless feels strongly that the improved productivity, as set forth in Figure 2, is clearly the result of the improved safety performance at his quarry. (36)

This study sought to statistically prove Mr. Moschetta's supposition that productivity does, in fact, increase when employees perceive their front line supervisors as successfully fulfilling their safety related duties and responsibilities while concomitantly optimizing their contribution to the enterprises' safety efforts.

Statistical Analysis

In an effort to procure a contemporaneous statistics and research methodology source that was both timely and topical, a review of literature on the subject was undertaken. One book by Hair, Anderson and Tatham and entitled Multivariate Data Analysis was selected on the basis of meeting the above criteria.

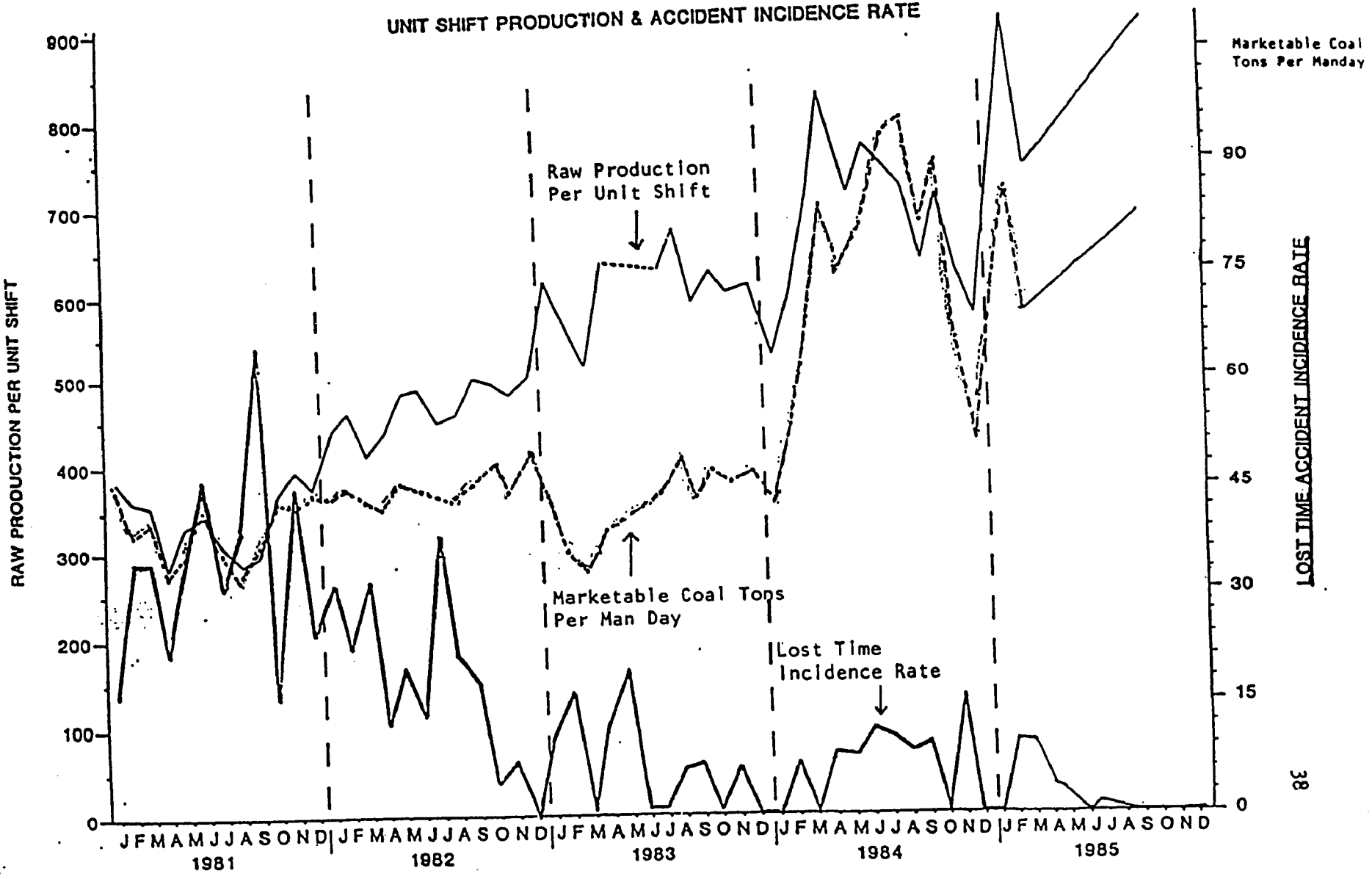
While the authors acknowledge that multivariate data analysis "is not easy to define," they go on to write that "it refers to all statistical methods that simultaneously analyze multiple measurements on each individual or object under investigation. Any simultaneous analysis of more than two variables can be loosely considered multivariate analysis."

Their succinct and cogent explanation on analysis of variance, regression analysis, correlation analysis and partial correlation analysis was topical and germane to the present study. As they write, while "several books and articles have been published on the theoretical and mathematical aspects of these tools ... few books, however, have been written for the researcher who is not a specialist in math or statistics." Thus, the book was an indispensable tool in the formulation and implementation of the Methods and Procedures and Data Analysis sections that follow.

FIGURE 2

BEAVER CREEK COAL COMPANY

UNIT SHIFT PRODUCTION & ACCIDENT INCIDENCE RATE



CHAPTER 3

Methods And Procedures

The problem involved in this study was to compare supervisory safety contributions with productivity accomplishment in selected limestone quarry locations. The methods and procedures utilized to complete this research are described in this chapter.

Development Of The Questionnaire For Soliciting Responses From A Jury Of Experts

The supervisory safety duties and responsibilities that were used as item components in the formation of the survey instrument were drawn initially from the Goberni study. (19) These seventy-four item components were the result of (a) a review of existing literature; (b) an analysis of reference material published by major insurance companies as well as safety program manuals of selected companies; and (c) the solicited input from twenty safety practitioners from various enterprises who comprised the jury of experts.

In an effort to revalidate Goberni's item components, another jury of experts technique was undertaken. Six jurors with the requisite knowledge necessary to evaluate a supervisor's safety duties and responsibilities in a limestone quarry were asked to complete a two-fold questionnaire. In the first section, each juror was asked to agree or

disagree as to whether or not each of the seventy-four previously identified supervisory safety duties and responsibilities were still valid criteria for measuring supervisory safety contributions.

In the second section, jurors were asked to list any additional supervisory safety duties and responsibilities which they felt were within the domain of the front-line supervisor but which had not been included in the original 74 responsibilities. Appendix A contains a copy of the evaluation instrument.

Responsibilities receiving a majority of agreeable responses were accepted Each of the original seventy-four items were agreed upon by at least five of the six respondents. In addition, no additional duties or responsibilities were proffered for future inclusion.

Solicitation Of Jury Member Cooperation

Solicitation of jury member cooperation was expedited since all prospective jurors were either professionally acquainted with the researcher or with one of the researcher's doctoral committee members. A letter explaining the research study was forwarded to each of the jurors. A copy of this letter can be found in Appendix B. Jurors were instructed to complete both sections of the questionnaire and return it to the researcher in the self-addressed, stamped envelope within one week after receipt. In addition, jurors were asked to complete a Jury Member Qualification Form as illustrated in Appendix C.

Construction Of The Survey Instrument

Since no additions or deletions were deemed necessary by the jury of experts, the survey instrument consisted of Goberni's original seventy-four item components. After the item components were determined, each item was then provided with seven response categories;

strongly agree, agree, slightly agree, undecided,
slightly disagree, disagree and strongly disagree.

Following Likert, weights were assigned to each response with a weight of 7 for responses most favorable to a supervisor's safety contributions and a weight of 1 for least favorable responses. Weights of 6, 5, 3, 2 were assigned to intermediate responses while a weight of 4 was reserved for undecided responses. The questionnaire utilizing the above characteristics with Goberni's original seventy-four duties and responsibilities is illustrated in Appendix D.

Enlistment of Support And Cooperation Of Participating Enterprise

The Corporate Safety Director for APAC, Inc. was contacted to determine the viability of his firm's inclusion in the study. As one of the top ten producers of limestone in the United States with thirty-five main locations and over 100 total locations in sixteen states, APAC was a logical candidate for this investigation.

Appendix E contains a copy of the letter and the prospectus that was sent to the APAC Corporate Safety Director. One week after mailing the letter, a telephone contact was made to ascertain their interest and the Corporate Safety Director's willingness to participate.

Once the Corporate Safety Director agreed to participate in the study, the next step was to select a quarry to pilot test the survey instrument. It was determined that a quarry in Arkansas would be the pilot location and that the survey would be administered during the second week in September, 1989. Instructions as to how to administer the questionnaire were given over the telephone to the plant Safety Director by the researcher on September 11, 1989.

Subsequent to the instructions, all eleven limestone quarry production employees of the designated quarry were given the survey instrument for completion. The purpose of this pilot test was to determine the employees' ability to complete the questionnaire and to ascertain any respondent problems with the survey instrument. A telephone conversation on September 20, 1989 between the plant Safety Director of Plant #2 and the researcher, revealed no inherent problems with the survey instrument. As a result, it was decided to include the pilot study responses into the final sample. Also during this telephone conversation, the plant Safety Director reconfirmed the applicability of each of the 74 statements of supervisory duties and responsibilities.

Based on the results of the September 20, 1989 telephone conversation between the plant Safety Director at the pilot location and the researcher, the latter made a telephone call to the Corporate Safety Director to inform him of the pilot findings. During this conversation the researcher proposed adding several questions to the survey instrument that would attempt to explore organizational culture in each quarry. The researcher was informed that this was outside the original purpose of the study as outlined in the July 31, 1989 letter; and would therefore not be considered since upper management had approved the study's undertaking as proposed. The researcher was also informed during this conversation that APAC was prepared to proceed with the study as originally proposed and that the survey instrument would be immediately sent to ten additional limestone quarries. It was mutually agreed that this would be the next step.

Administration Of Questionnaire

The first step in collecting the data was to disseminate the survey instrument to the various production personnel in each of the 10 quarries. Either all employees were to be given the opportunity to complete the instrument in the case of small size plants (under 20 production employees) or the plant Safety Director was to select every other production employee from the payroll register for those quarries having more than 20 employees. It was agreed that employees would be given time prior to the end of their shift to complete the instrument. It was further determined that the plant Safety Director would be on hand

during this time to handle the instrument as well as to review the instructions.

Employees were asked to complete the questionnaire for their current supervisor. It was stressed that their responses would be completely confidential and, in fact, the survey was designed to protect their anonymity. It was equally stressed that the survey was only one component that had been sanctioned by upper management in an effort to get a true picture of the overall safety program within the quarry. Employees were instructed to look upon the instrument as an opportunity to help the company provide a better and more suitable work environment.

Measures Of Dependent Variables

Each participating quarry was asked to supply the researcher, via the Corporate Safety Director, with the output (in limestone tons per man hour) for the previous twelve months. This figure was computed by taking the total tons of limestone mined during the designated period and dividing by the total number of man hours worked for that period.

These man hours were inclusive of all producing and servicing employees associated with the limestone quarry operation at each location. This productivity accomplishment measure provided a uniform method for determining productivity among various limestone quarry locations.

On October 10, 1989, the Corporate Safety Director was contacted by the researcher to tell him of the study's progress and also to request further data that would be helpful in measuring additional dependent variables. Appendix F contains a copy of the October 10, 1989 letter. Specifically, the researcher was desirous of obtaining information pertaining to the frequency and severity of accidents at each quarry location as well as the dollar amount of medical expenses incurred at each location for the past twelve months. The latter information was requested rather than workman's compensation data because of the myriad of states involved in the study and the governmental imposed differences that exist between states as to the recording and reporting requirements of Workman's Compensation data.

On October 12, 1989, the researcher was contacted by the Corporate Safety Director and informed that the additional data requested would not be forthcoming for two reasons. First, since every limestone quarry location also contained subsidiary businesses such as concrete and/or asphalt plants and/or construction companies, it would be virtually impossible to segregate or isolate the accident data and medical expenses by quarry employees since in-house computers were programmed by location and not by type of business or standard industrial classification (S.I.C.) code. Second, even if possible, the time constraints for completion imposed by the researcher made it impossible to complete or provide anything more than originally proposed. As a result, the data

could be obtained for only one measure of a single dependent variable - productivity.

Preparation of Data

Including the pilot survey results, completed survey instruments were obtained from 106 respondents. An inspection of their questionnaires, however, showed that for reasons which will be later discussed, a number of respondents rated their supervisor the same or near the same on all items.

Respondents rating more than 90% of the items in any single category (including undecided) were eliminated from the analysis. This reduced the number of usable respondents to 92. Table 1 illustrates the distribution of the total and usable survey respondents by limestone quarry.

The data for the 92 usable cases was entered and verified. An SPSS x file was created to further process and analyze the data.

As the questionnaire items on the survey instrument had been judged as relevant and important to supervisory safety contributions by the Jury of Experts and applicable to the pilot location by the plant Safety Manager, the questionnaire was developed without a "don't' know" and/or "not applicable" response category. As a result, however, many respondents may have answered a question or questions on the basis of speculation or some other general principle. On the other hand, it may

be reasonable to expect respondents to select the "undecided" category or simply not answer the question for those items where they lacked either information or knowledge to do so or where they felt the items were not applicable.

Table 1

Total and Usable Survey Respondents by Limestone Quarry

Quarry	Total Respondents	Usable Respondents
1	10	7
2	11	11
3	11	11
4	9	6
5	10	10
6	10	9
7	9	7
8	8	7
9	10	8
10	8	10
11	10	6
	106	92

In order to eliminate items that were unobservable or inapplicable to respondents, a frequency distribution of all 74 items was produced. Those items which were answered "undecided" or not answered at all by more than 10% of the respondents were eliminated from further analysis. This process reduced the number of items from 74 to 57.

The responses to the items were then recoded to reflect the treatment of the "undecided" category as either "don't know" or "not applicable":

Strongly agree	= 6
Agree	= 5
Slightly agree	= 4
Slightly disagree	= 3
Disagree	= 2
Strongly disagree	= 1
Undecided or no answer	= missing

Development of Indices

The recoded responses to the 57 items were then used to construct six indices of supervisory safety contributions. The first index was an overall measure of supervisor safety contributions. To construct the index the mean of all non-missing values of all fifty-seven items was calculated. However, if any respondent failed to give non-missing responses to at least 40 of the items, those items were assigned a missing value on the index and thus received no value for that item. Of the 92 respondents' surveys, this process was required only once.

In addition to looking at supervisory safety contributions in their entirety, it was posited that some areas of safety may be more important than others. As revealed in Chapter 2, many safety professionals believe that supervisory responsibilities can be grouped or classified into dominant areas of responsibility. As previously discussed, Petersen (25,300) states that the "four key tasks that belong to the supervisor in every safety program" are:

1. Investigating all accidents to determine underlying causes.
2. Inspecting his areas routinely and regularly to uncover hazards.
3. Coaching (training) his people so they know how to work safely.
4. Motivating his people so they want to work safety.

Likewise, Denton (8,23) writes that "the main concern of the first-line supervisor should be the on-going safety training of and safe

performance by their employees. "In addition, it is to a great extent, the responsibility of supervisors to be aware of the hazards of the working environment." (8, 24) Similarly, "it is also the job of supervisors to teach methods of and keep interest high in working safely." (.24) Additionally, it is "the department supervisor's responsibility to investigate all accidents no matter how small." (8, 29) Thus, like Petersen, Denton believes that the four primary responsibilities of a front-line supervisor are motivating, training, inspecting and investigating.

Furthermore, in the Smith, Cohen and Cohen study, it was found that low accident rate plants versus high accident rate plants were characterized as having on-going motivational practices, enhanced training, hazard control procedures and established accident investigations and recordkeeping practices. (48) In addition, Smith, et. al, found that a greater number of management factors were a critical element in separating low accident rate plants from high accident rate plants. (48) They defined management factors not only as a commitment to safety but also the presence and enforcement of policies as well as the optimal utilization of resources. Thus, the presence of management factors only broadens the duties of the supervisor since not only is the first-line supervisor a member of management but each of the management factor characteristics mentioned above is clearly a supervisory responsibility.

Therefore, in an effort to more finitely determine whether or not a relationship existed between supervisory safety contributions and productivity, the researcher grouped the questions into categories that

the literature review revealed as not only germane to supervisory duties and responsibilities but also endemic to enterprises characterized as having low accident rates. Since many safety duties and responsibilities may be perceived as socially acceptable and therefore encouraged, while others may be thought of as an imposition and thus contrary to previously established goals and objectives, it was felt that grouping the questions into research based categories and constructing an index to measure each category would serve to determine a meaningful relationship between categories of supervisory safety contributions and productivity.

Thus, the 57 remaining supervisory safety contribution statements were segregated a priori by the researcher into five sub-sets or indices approximating the five safety components generally associated with supervisors and/or enterprises with low accident rates. These components were: management policies, motivational techniques, training practices, hazard control and accident investigation. In addition, a sixth index was constructed that represented the totality of the survey items.

The category of Management Policies included those statements that demonstrated or implied a commitment to safety as well as the enforcement of rules and procedures developed by the supervisor or upper management. For example, "strictly enforces all safety rules and regulations established by the enterprise," or "requires each employee to clean up his assigned work area daily," would be representative of the types of supervisory safety contributions included in the management policy category. Fifteen items were classified under the heading of Management Policies. (Items 3, 8, 13, 28, 39, 41, 50, 54, 59, 60, 63, 64, 67, 68, 73) To construct the index, the mean of all non-missing values of these items was calculated. Any respondent failing to give non-missing responses to at least 10 of the items was coded as missing.

The second category of supervisory safety contribution survey items pertained to Motivational Techniques. As such, this category included the most "humanistic" or behaviorally oriented items. Emphasis was on direct and indirect means of communications as well as encouraging a positive attitude toward safety. Statements that included words like "instills," "cooperative," "promotes" and "encourages" typified the kinds of supervisory safety contributions that were included under the rubric of motivational techniques. Ten items were classified in the category Motivational Techniques. (Items 7, 10, 11, 12, 16, 19, 32, 27, 33, 70). To construct this index, the mean of all non-missing values of these items was calculated. Failure to give a non-missing response to at least 7 items resulted in being coded as missing.

The third category of supervisory safety contributions was classified as Training Practices. This category contained statements that were oriented toward training or instruction. As such, this category encompassed eight items. (Items 14, 15, 18, 25, 30, 36, 52 and 74). The index was constructed by calculating the mean of all their non-missing values. The index value was coded as missing if less than 5 items had non-missing responses.

The fourth category of supervisory safety contributions was designated Hazard Control. Statements pertaining to observations and inspections, especially of conditions and physical resources, made up the majority of the statements in this category. Eighteen items were classified under the heading of Hazard Control. (Items 2, 4, 5, 6, 9, 20, 24, 26, 33, 35, 38, 42, 43, 51, 55, 58, 61, and 71). Like the other indices, this index was constructed by calculating the mean of their non-missing values. Failure to give a non-missing response to at least 10 items resulted in being coded as missing.

The final category of supervisory safety contributions was labeled Accident Investigations. This category was comprised of statements oriented toward after-the-fact analysis and investigation. Six items were classified under the heading of Accident Investigation. (Items 1, 17, 21, 34, 53, and 72). The index value was the mean of all their non-missing items. The index value was coded as missing if less than four items had non-missing responses.

Each of the six indices, the five categories of supervisory safety contributions as well as a composite category had a potential range for a high of 6 (strongly agree on all items) to a low of 1 (strongly disagree on all items).

Analysis of Data

STEP 1: The first step in the data analysis was to perform a series of one-way analyses of variance to compare the measures of supervisory safety contributions between quarries. This analysis was first run for each of the 57 items. This output displayed the magnitude of differences in the respondent evaluations by quarry for each survey item. These differences measured the degree of consensus within the work group with respect to this evaluation. This type of data analysis would be of particular value in specifying the relative strengths and weaknesses of each supervisor in every aspect of safety effectiveness included in the constructed indices. Such information would provide an invaluable basis for focused supervisory safety effectiveness training.

STEP 2: A one-way analysis of variance was then run for each of the constructed indices. This analysis of variance compared the overall safety contributions of the supervisors as well as their effectiveness in each of the five behavioral categories. In addition, the mean value of each index for each quarry was used as a measure of supervisory safety contributions in order to test their relationship to productivity.

STEP 3: Simple regression analysis was then performed on each of the survey items to check the direction of the relationship between the respondent evaluations and quarry output as well as the significance of the relationship. The Y variable, or dependent variable, was designated as limestone quarry productivity while the X variable, or independent variable, was the evaluations of the 92 respondents for each of the specific survey items being analyzed.

STEP 4: The next step in the analysis was to create another data set using each quarry as the unit of analysis. This file was made up of 11 cases, each consisting of the six indices of supervisory safety contributions and the one measure of productivity (tons of limestone produced per man hour).

STEP 5: Pearson correlation coefficients were calculated between productivity and each of the supervisory safety contribution indices to examine the relationship between supervisory safety contribution and productivity.

STEP 6: Partial correlation coefficients were then run between the index of each of the categories of supervisory safety contributions and productivity while simultaneously controlling the other four categories.

CHAPTER 4

Data Analysis

The purpose of this chapter is to present and analyze the data as it pertains to the relationship between supervisory safety contributions and limestone quarry production. Summary data are presented in a narrative format and supported by comparison tables in the chapter.

Results Of Supervisory Safety Contribution Item Revalidation

The first step in the research was to revalidate previously developed statements of supervisory safety duties and responsibilities and to determine if any additions or deletions were necessary. A jury of experts composed of six practicing safety professionals were asked to respond in writing to the applicability of the previously determined statements. Each statement received a minimum score of 83.33% (Five out of six) reaffirming their 1989 applicability. Furthermore, no additions or deletions of supervisory safety duties and responsibilities were suggested.

Results Of Pretest

Once the statements were revalidated the next step was to assign scales to the statements and to pilot test the instrument in a selected

limestone quarry to determine the ease of completion and the applicability of statements. The pilot study identified no inherent problems so the next step was to have employees from 10 additional limestone quarries complete the questionnaires. After reducing the sample from 106 to 92 because of presumed biased response patterns, the data was ready to be analyzed.

Results Of Preliminary Item Response Analysis

Table 2 illustrates the response pattern by relative frequency (percentage) for each of the original seventy-four supervisory safety contribution statements. As the table shows, supervisors were rated overwhelmingly high on their contributions to safety. Very few respondents indicated a disagreement relative to their front line supervisor and the designated survey item.

The respondents tended to rate their supervisors performance on the supervisor safety contribution items as being good. This is illustrated by the fact that seventy-five percent (75%) or more of the respondents rated their supervisor's performance as 5 or 6 on 51 of the 74 items. Also, over fifty percent of the respondents tendered a 5 or 6 rating on all 74 items.

Due to this distribution, average evaluations between supervisors are unlikely to differ greatly. This may indicate, however, that relatively small differences in the mean score may be indicative of behaviorally significant differences in supervisory safety contributions.

The percentage score in the undecided category for each of the survey items ranged from 0% to 30% with very few respondents failing to answer the question. This range resulted in the decision to treat the undecided category as a missing value and therefore eliminate those items with more than a 10% missing value. Consequently, 17 supervisory safety contribution items were eliminated from further analysis. Table 3 reports the supervisory safety contribution items that were removed from the study.

TABLE 2

Frequency Distribution (in Percent) of Measures of Supervisory Safety Contributions by Score*

ITEM	ST. A.	A.	SL. A.	UN.	SL. D.	D.	ST. D.	N.A.
ITEM 1	42.4	46.7	4.3	6.5	0	0	0	0
ITEM 2	28.3	55.4	13.0	1.1	0	1.1	1.1	0
ITEM 3	28.3	52.2	15.2	1.1	2.2	1.1	0	0
ITEM 4	32.6	42.4	12.0	8.7	2.2	1.1	0	1.1
ITEM 5	33.7	54.3	6.5	4.3	0	0	1.1	0
ITEM 6	33.7	44.6	16.3	1.1	0	4.3	0	0
ITEM 7	28.3	51.1	10.9	5.4	0	4.3	0	0
ITEM 8	37.0	55.4	6.6	0	0	1.1	0	0
ITEM 9	39.1	46.7	13.0	1.1	0	0	0	0
ITEM 10	34.8	52.2	7.6	2.2	1.1	2.2	0	0
ITEM 11	45.7	42.4	6.5	2.2	0	1.1	0	2.2
ITEM 12	23.9	51.1	15.2	6.5	1.1	2.2	0	0
ITEM 13	30.4	46.7	16.3	5.4	0	0	0	1.1
ITEM 14	30.4	45.7	14.1	7.6	0	1.1	0	1.1
ITEM 15	22.8	50.0	10.9	9.8	2.2	4.3	0	0
ITEM 16	28.3	53.3	14.1	2.2	0	2.2	0	0
ITEM 17	48.9	42.4	6.5	2.2	0	0	0	0
ITEM 18	29.3	47.8	10.9	7.6	2.2	2.2	0	0
ITEM 19	39.1	45.7	12.0	2.2	0	1.1	0	0
ITEM 20	40.2	50.0	8.7	1.1	0	0	0	0

(table continues)

(Table 2 continued)

ITEM	ST. A.	A.	SL. A.	UN.	SL. D.	D.	ST. D.	N.A.
ITEM 21	35.9	43.5	14.1	6.5	0	0	0	0
ITEM 22	23.9	43.5	12.0	16.3	1.1	2.2	0	1.1
ITEM 23	18.5	47.8	6.5	21.7	2.2	1.1	1.1	1.1
ITEM 24	35.9	43.5	10.9	2.2	1.1	3.3	1.1	2.2
ITEM 25	30.4	45.7	16.3	4.3	0	2.2	0	1.1
ITEM 26	25.0	50.0	16.3	6.5	1.1	1.1	0	0
ITEM 27	17.4	33.7	8.7	32.6	1.1	4.3	0	2.2
ITEM 28	27.2	56.5	9.8	4.3	1.1	1.1	0	0
ITEM 29	25.0	43.5	14.1	14.1	1.1	1.1	0	1.1
ITEM 30	30.4	47.8	12.0	7.6	0	0	1.1	1.1
ITEM 31	29.3	48.9	7.6	10.9	0	1.1	0	2.2
ITEM 32	28.3	50.0	15.2	3.3	0	2.2	1.1	0
ITEM 33	34.8	45.7	12.0	1.1	1.1	1.1	1.1	3.3
ITEM 34	19.6	47.8	19.6	6.5	2.2	2.2	1.1	1.1
ITEM 35	28.3	57.6	9.8	3.3	0	0	1.1	0
ITEM 36	23.9	55.4	13.0	3.3	0	0	1.1	3.3
ITEM 37	39.1	41.3	9.8	5.4	1.1	0	1.1	2.2
ITEM 38	31.5	50.0	10.9	5.4	1.1	0	1.1	0
ITEM 39	22.8	45.6	19.6	5.4	2.2	3.3	1.1	0
ITEM 40	20.7	51.1	6.5	18.5	0	0	0	3.3
ITEM 41	40.2	38.0	15.2	2.2	3.3	1.1	0	0
ITEM 42	22.8	48.9	14.1	6.5	3.3	1.1	2.2	1.1

(table continues)

(Table 2 continued)

ITEM	ST. A.	A.	SL. A.	UN.	SL. D.	D.	ST. D.	N.A.
ITEM 43	30.4	44.6	14.1	6.5	1.1	2.2	1.1	0
ITEM 44	19.6	54.3	17.4	3.3	1.1	2.2	2.2	0
ITEM 45	18.5	40.2	13.0	20.7	2.2	2.2	2.2	1.1
ITEM 46	17.4	43.5	15.2	18.5	2.2	1.1	1.1	1.1
ITEM 47	17.4	38.0	10.9	25.0	2.2	2.2	1.1	3.3
ITEM 48	18.5	52.2	14.1	12.0	1.1	2.2	0	0
ITEM 49	13.0	43.5	14.1	23.9	1.1	2.2	0	2.2
ITEM 50	30.4	50.0	14.1	2.2	0	1.1	1.1	1.1
ITEM 51	32.6	41.3	19.6	4.3	0	1.1	1.1	0
ITEM 52	29.3	50.0	9.8	6.5	1.1	1.1	1.1	1.1
ITEM 53	33.7	44.6	9.8	9.8	1.1	1.1	0	0
ITEM 54	29.3	43.5	17.4	4.3	0	3.3	2.2	0
ITEM 55	25.0	52.2	13.0	6.5	0	2.2	1.1	0
ITEM 56	28.3	50.0	6.5	14.1	1.1	0	0	0
ITEM 57	21.7	42.4	10.9	22.8	0	0	0	2.2
ITEM 58	32.6	55.4	7.6	3.3	0	0	0	1.1
ITEM 59	27.2	51.1	12.0	3.3	3.3	2.2	1.1	0
ITEM 60	27.2	43.5	16.3	8.7	2.2	0	1.1	1.1
ITEM 61	34.8	42.4	16.3	4.3	0	1.1	1.1	0
ITEM 62	28.3	48.9	9.8	10.9	1.1	0	1.1	0
ITEM 63	28.3	41.3	14.1	7.6	1.1	3.3	2.2	2.2
ITEM 64	40.2	43.5	9.8	4.3	1.1	0	1.1	0

(table continues)

(Table 2 continued)

ITEM	ST. A.	A.	SL. A.	UN.	SL. D.	D.	ST. D.	N.A.
ITEM 65	32.6	42.4	12.0	8.7	1.1	0	1.1	2.2
ITEM 66	22.8	51.1	8.7	12.0	3.3	0	1.1	1.1
ITEM 67	35.9	48.9	10.9	1.1	0	1.1	1.1	1.1
ITEM 68	33.7	43.5	14.1	6.5	0	0	1.1	1.1
ITEM 69	22.8	41.3	12.0	18.5	1.1	1.1	1.1	2.2
ITEM 70	39.1	44.6	9.8	3.3	0	1.1	1.1	1.1
ITEM 71	27.2	56.5	9.8	4.3	0	0	0	2.2
ITEM 72	35.9	43.5	10.9	8.7	0	0	0	1.1
ITEM 73	30.4	45.7	14.1	8.7	0	0	0	1.1
ITEM 74	30.4	46.7	9.8	6.5	0	2.2	2.2	2.2

ST. A = Strongly Agree
A. = Agree
SL. A = Slightly Agree
UN. = Undecided
ST. D. = Strongly Disagree
D. = Disagree
SL. D. = Slightly Disagree
N.A. = No Answer

TABLE 3

Supervisory Safety Contributions Eliminated from Data Analysis When Missing Values Exceeded Ten Percent

ITEM NUMBER	SUPERVISORY SAFETY CONTRIBUTION	MISSING PERCENT
22.	Makes special contacts with problem employees as predetermined by the safety department	17.4
23.	Attends meeting at least monthly with the safety department	22.8
27.	Submits to his superior monthly written reports of inspections of tools and equipment	34.8
29.	Seeks the advice of the safety department regarding policies, rules, or procedures as they relate to his area	15.2
31.	Enforces the recommendations made by the company physician regarding the limitations of an individual employee	13.1
40.	Completes reports which will analyze or determine causes of accidents and indicates corrective measures	21.8
45.	Makes daily checks of rigging (ropes, cables, chains) equipment in use, with monthly detailed inspections, and records the details of these inspections	21.8

(table continues)

(Table 3 continued)

ITEM NUMBER	SUPERVISORY SAFETY CONTRIBUTION	MISSING PERCENT
46.	Reports weakness in the job safety analysis as revealed by observing the particular operation	29.6
47.	Makes one safety observation per day, with each employee being observed at least twice per month	28.3
48.	Conducts weekly instruction of employees in proper work methods, safety rules and regulations, and records this instruction	12.0
49.	Instructs crane operators under his jurisdiction in the proper methods of crane operation	25.1
56.	Is trained and certified in first aid and is capable of administering emergency treatment	14.1
57.	Reports observable physical limitations of his employees to the safety department for evaluation	25.0

(table continues)

(Table 3 continued)

ITEM NUMBER	SUPERVISORY SAFETY CONTRIBUTION	MISSING PERCENT
62.	Reviews accident causes, rule violations, unsafe acts, and lack of specific job instructions, as indicated by trends outlined by the safety department	10.9
65.	Holds brief safety meetings with employees before starting work on hazardous or special jobs which are not part of the employee's routine, daily activity	10.9
66.	Sees that all rigging (ropes, cables, chains) is used according to recommended practices	13.1
69.	Notifies the safety department of poor housekeeping conditions which cannot be corrected	20.7

Results Of Data Analysis

Since the remaining 57 survey items lent themselves to being grouped into the "key task" areas of supervision that were uncovered in the literature review, subsequent data analysis was undertaken by looking at group composites by task area although individual scores were still discernable.

One-way analysis of variance was run to ascertain any significant difference on how supervisors were perceived as fulfilling their supervisory safety duties among the eleven quarries. Analysis of variance (ANOVA) is a method of determining what the probability is that the observed differences of the mean responses of groups receiving different experimental treatments are the result of sampling variations. Tables 4-8 provide the results of the analysis of variance for each of the survey items classified within each of the designated supervisory safety contribution group as defined in Chapter 3.

The mean ($\bar{x}$) supervisory safety contribution score for each item within each quarry as presented in Tables 4-8 was deemed useful as a measure of comparing supervisory scores for selected items. Given that virtually all supervisors were evaluated in the 4 to 6 range, mean scores for each supervisory safety contribution item ranged between 4.5 and 5.5. Because of the limited sample size, any such variance among supervisory mean scores may indicate a behaviorally significant difference even where no statistically significant difference exists since

a variance of one within a range of 4.0 - 6.0 would indicate that employees can discern differences - subtle or otherwise - in how their supervisors perform their safety duties and responsibilities.

The standard deviation(s) in Tables 4-8 indicate the amount of consensus among group members with respect to their supervisory evaluation. A standard deviation of zero (0) would indicate complete consensus among group members whereas a standard deviation that approximates a score of one (1) would indicate a total lack of consensus which in turn could indicate the employees inability to evaluate that item or be indicative of a high degree of inter-group conflict between group members.

Given the small number of respondents from each quarry, the lack of a statistically significant difference as measured by the F probability being less than .05 in Tables 4-8 does not necessarily indicate that there are no behaviorally important differences in supervisory practices. The existence of a statistically significant difference, however, does indicate a high level of inconsistency between supervisors with respect to how they fulfill their safety duties and responsibilities. Eleven supervisory safety contribution items were found to be statistically significantly different among limestone quarries at the .10 level between limestone quarries. The items with their levels of significance at .10 or less for each of the supervisory safety contribution indices are as follows:

MANAGEMENT POLICIES (TABLE 4)

ITEM	
63. Gives special attention to employees who repeatedly violate safety rules and regulations, or exhibit unsafe work practices, in order to correct them	.098
73. Is familiar with safety and health-related legislation	.011

MOTIVATIONAL TECHNIQUES (TABLE 5)

70. Conducts group safety meetings weekly, monthly, or whenever specified	.005

TRAINING PRACTICES (TABLE 6)

No items were significant at the .10 level

HAZARD CONTROL (TABLE 7)

9. Checks to see if required safety equipment is being used or worn	.027
20. Recognizes pinch points (any point where it is possible to be caught between moving parts and stationary parts) and eliminates them when possible	.012
71. Inspects emergency equipment (oxygen apparatus, fire hoses, first-aid supplies) and makes appropriate corrections where required	.010

ACCIDENT INVESTIGATION (TABLE 8)

1. Investigates all lost time and recordable (medical only) accidents	.090
17. Sees that all of his employees receive prompt medical attention when injured	.005
21. Questions an injured person in detail regarding the accident	.002

34. Investigates any and all near-miss accidents	.103
72. Investigates all accidents which result in property damage	.006

Of interest is the fact that some of the above items are basic to safety supervision and, therefore, statistically significant differences in ratings among the quarries may suggest important operational differences. Also, of interest is the fact that no items in the Training Practices group were found to have significant performance variations among quarries.

TABLE 4

Analysis of Variance of Supervisory Safety Contributions Between Limestone Quarries: Management Policies

ITEM	QUARRY	N	$\bar{X}$	S
3. Demands good housekeeping practices and maintains high standards of cleanliness of operations	1	7	5.43	.53
	2	11	5.09	.83
	3	10	5.20	.79
F ratio = .55	4	6	4.83	.41
d. f. = 10,80	5	10	4.70	1.25
F probability = .84	6	9	5.00	1.00
	7	7	5.29	.49
	8	7	4.86	.69
	9	8	5.00	1.07
	10	10	5.20	.42
	11	6	5.00	.63
8. Is satisfied that employees under his jurisdiction thoroughly understand the safety rules of the enterprise	1	7	5.00	.00
	2	11	5.45	.69
	3	11	5.09	.70
F ratio = .90	4	6	5.17	.41
d. f. = 10,81	5	10	5.60	.52
F probability = .54	6	9	5.00	.71
	7	7	5.00	1.41
	8	7	5.29	.49

(table continues)

(Table 4 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	9	8	5.38	.74
	10	10	5.50	.53
	11	6	5.33	.50
13. Sees that all company vehicles assigned to him are maintained in safe operating condition	1	6	4.83	.75
	2	10	4.80	.42
	3	11	5.09	.70
F ratio = 1.32	4	5	5.20	.45
d. f. = 10,75	5	10	5.50	.71
F probability =.24	6	9	5.00	.71
	7	7	5.14	.69
	8	6	5.17	.41
	9	7	4.86	.90
	10	10	5.50	.71
	11	5	5.60	.89
28. Assures the safety of his employees and of those who may enter into his area of operation	1	6	4.83	.41
	2	11	4.73	.65
	3	10	5.20	.63
F ratio = .95	4	6	5.33	.52
d. f. = 10,77	5	10	5.20	1.23
F probability = .49	6	9	5.11	.60

(table continues)

(Table 4 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	7	7	5.00	1.00
	8	7	4.86	.69
	9	7	5.43	.53
	10	10	5.40	.52
	11	5	5.40	.52
39. Never permits tools or equipment	1	6	4.83	1.17
to be used for purposes other than for	2	11	4.91	.83
which they were intended	3	11	4.64	.50
F ratio = .36	4	5	4.80	.45
d. f. = 10,76	5	10	4.70	1.57
F probability = .96	6	9	5.00	1.32
	7	7	5.14	.38
	8	6	5.17	.98
	9	7	4.43	1.27
	10	10	5.00	.82
	11	5	4.60	1.52
41. Strictly enforces all safety rules	1	6	5.33	.82
and regulations established by the	2	11	5.09	.70
enterprise	3	11	4.82	.87

(table continues)

(Table 4 continued)

ITEM	QUARRY	N	$\bar{X}$	S
F ratio = .80	4	5	4.80	1.10
d. f. = 10,79	5	10	5.50	.71
F probability = .63	6	9	5.44	1.01
	7	7	4.71	1.38
	8	7	5.14	.90
	9	8	5.00	1.07
	10	10	5.40	.52
	11	6	5.33	.82
50. Maintains safety signs and	1	7	5.43	.79
bulletin boards in a clean and	2	11	5.00	.45
legible condition	3	11	5.18	.76
F ratio = .60	4	6	5.00	.00
d. f. = 10,78	5	9	4.78	1.56
F probability = .81	6	8	5.25	.89
	7	7	4.86	1.34
	8	7	4.86	.90
	9	8	5.00	.76
	10	10	5.50	.53
	11	5	5.00	.71

(table continues)

(Table 4 continued)

ITEM	QUARRY	N	$\bar{X}$	S
54. Requires each employee to clean up his assigned work area daily	1	7	4.57	1.40
	2	11	5.55	.69
	3	11	5.00	.45
F ratio = 1.26	4	4	4.75	.50
d. f. = 10,77	5	10	4.50	1.51
F probability = .27	6	9	4.67	1.58
	7	7	5.14	.69
	8	7	4.86	.69
	9	7	4.26	1.70
	10	10	5.50	.53
	11	5	5.00	.71
59. Prevents the use of tools or equipment found to be defective	1	7	5.00	1.00
	2	11	4.82	.60
	3	11	4.82	.60
F ratio = .72	4	6	4.83	.41
d. f. = 10,78	5	10	4.60	1.43
F probability = .70	6	9	5.22	1.30
	7	7	4.86	1.34
	8	5	5.00	.71
	9	8	4.88	1.36
	10	10	5.60	.52
	11	5	5.20	.45

(table continues)

(Table 4 continued)

ITEM	QUARRY	N	$\bar{X}$	S
60. Makes sure that bulletin boards are kept up to date, with notices that are no longer applicable removed	1	7	5.14	.90
	2	10	5.20	.79
	3	10	4.80	.79
	4	6	4.83	.75
F ratio = 1.14	5	9	4.78	1.48
d. f. = 10,72	6	7	5.29	1.11
F probability = .35	7	6	5.00	.63
	8	7	4.29	.76
	9	7	5.29	.76
	10	10	5.50	.52
	11	4	5.00	.00
63. Gives special attention to employees who repeatedly violate safety rules and regulations, or exhibit unsafe work practices, in order to correct them	1	7	5.00	.82
	2	10	5.10	.57
	3	11	5.18	.75
	4	5	5.40	.55
	5	9	4.22	1.30
	6	7	5.14	1.46
F ratio = 1.70	7	6	3.67	1.97
d. f. = 10,72	8	6	5.00	.89
F probability = .098	9	7	4.71	1.50
	10	10	5.30	.67
	11	5	5.40	.55

(table continues)

(Table 4 continued)

ITEM	QUARRY	N	$\bar{X}$	S
64. Is sure that the men assigned to a particular job are capable of performing that job F ratio = .62 d. f. = 10,77 F probability = .79	1	6	5.17	.75
	2	11	5.18	.87
	3	11	5.09	.70
	4	6	5.00	.63
	5	9	5.11	1.61
	6	9	5.44	.73
	7	7	5.29	.49
	8	6	5.00	.63
	9	8	5.12	.99
	10	10	5.60	.52
	11	5	5.80	.45
67. Takes any reasonable action required to prevent an accident where an immediate danger exists F ratio = .79 d. f. = 10,79 F probability = .63	1	7	5.29	.49
	2	11	4.73	.79
	3	11	5.00	.63
	4	6	5.17	.41
	5	10	5.20	1.55
	6	8	5.50	.53
	7	7	5.00	1.41
	8	7	5.00	.82
	9	7	5.29	.76
	10	10	5.60	.52
	11	6	5.33	.52

(table continues)

(Table 4 continued)

ITEM	QUARRY	N	$\bar{X}$	S
68. Assures that outside contractors' employees are not endangered by the operations under his jurisdiction F ratio = .74 d. f. = 10,74 F probability = .68	1	7	5.14	.69
	2	11	4.82	.75
	3	10	4.80	.79
	4	6	5.17	.41
	5	10	5.20	1.55
	6	5	5.40	.89
	7	7	5.43	.53
	8	7	5.00	.82
	9	8	5.25	.71
	10	10	5.50	.53
	11	4	5.50	.58
73. Is familiar with safety- and health-related legislation F ratio = 2.55 d. f. = 10,72 F probability = .011	1	3	5.33	1.15
	2	11	4.55	.69
	3	11	5.00	.63
	4	5	5.20	.45
	5	10	5.50	.71
	6	8	5.75	.46
	7	6	5.33	.52
	8	7	4.86	.69
	9	8	5.25	.71
	10	10	5.40	.52
	11	4	5.00	.00

TABLE 5

Analysis of Variance of Supervisory Safety Contributions Between Limestone Quarries: Motivational Techniques

ITEM	QUARRY	N	$\bar{X}$	S
7. Stimulates interest and attention toward the practice of accident prevention through daily contact with his employees	1	7	4.86	.69
	2	11	4.91	.83
	3	11	5.00	.63
	4	5	5.20	.45
F ratio = .73	5	10	5.00	1.15
d. f. = 10,76	6	8	5.50	.53
F probability = .69	7	7	4.71	1.25
	8	6	5.17	.75
	9	6	4.83	1.60
	10	10	5.50	.53
	11	6	4.67	1.37
10. Takes the initiative in helping to make a success of the safety program	1	6	5.17	.41
	2	11	5.18	.60
	3	11	5.09	.70
	4	6	5.33	.52
F ratio = .59	5	10	5.30	1.25
d. f. = 10,79	6	9	5.67	.71
F probability = .81	7	7	5.00	1.41
	8	7	5.00	.58
	9	7	5.00	.82

(table continues)

(Table 5 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	10	10	5.30	.48
	11	6	4.83	.98
11. Personally attends all safety meetings	1	7	5.14	.38
	2	10	5.00	.47
F ratio = 1.57	3	11	4.90	.70
d. f. = 10,77	4	6	5.67	.52
F probability = .13	5	10	5.60	.70
	6	9	5.67	.50
	7	6	5.67	.52
	8	6	5.33	.52
	9	8	5.50	.76
	10	10	5.30	1.25
	11	5	5.80	.45
12. Encourages employee use of the safety suggestion system	1	7	5.00	.00
	2	11	4.82	.75
F ratio = .88	3	11	4.82	.60
d. f. = 10,75	4	4	5.25	.50
F probability = .55	5	10	5.20	.42
	6	8	4.38	1.69
	7	7	5.29	.76

(table continues)

(Table 5 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	8	7	5.14	.69
	9	6	5.00	1.26
	10	10	5.30	.67
	11	5	5.00	.71
16. Gives personal support to	1	7	5.29	.76
all safety activities and safety	2	11	4.64	.67
procedures	3	11	5.09	.70
F ratio = .61	4	6	5.33	.52
d. f. = 10,79	5	10	5.20	1.23
F probability = .80	6	9	5.00	.71
	7	7	5.14	.38
	8	7	5.00	.82
	9	7	4.86	1.46
	10	10	5.30	.48
	11	5	5.20	.44
19. Instills a sincere attitude toward	1	7	5.14	.90
safety in all of his employees	2	11	5.09	.70
F ratio = 1.04	3	11	4.90	.54
d. f. = 10,79	4	6	5.33	.82
F probability = .42	5	10	5.30	1.25
	6	8	5.75	.46

(table continues)

(Table 5 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	7	7	5.29	.58
	8	7	5.00	.58
	9	8	5.00	.93
	10	10	5.50	.53
	11	5	5.60	.55
32. Develops a safety awareness	1	7	4.86	.69
in all employees through personal	2	11	5.18	.75
safety contracts	3	11	5.00	.63
F ratio = .89	4	5	5.20	.45
d. f. = 10,78	5	10	4.80	1.48
F probability = .54	6	9	5.56	.73
	7	7	5.14	.69
	8	6	5.33	.82
	9	7	4.43	1.27
	10	10	5.00	.67
	11	6	4.67	1.37
37. Promotes attendance of employees	1	6	5.67	.52
at safety meetings	2	11	5.09	.83
F ratio = .66	3	10	5.00	.67
d. f. = 10,74	4	5	5.20	.45
F probability = .76	5	9	5.33	1.66

(table continues)

(Table 5 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	6	9	5.44	.73
	7	7	4.86	.90
	8	7	5.00	.82
	9	7	5.57	.53
	10	10	5.30	.67
	11	4	5.50	.58
44. Develops a cooperative safety attitude in his men through the application of preventive and corrective discipline	1	6	5.17	.75
	2	11	4.64	.50
	3	11	4.64	.50
	4	5	5.00	.00
F ratio = 1.09	5	10	4.70	1.42
d. f. =10,78	6	9	5.00	1.58
F probability = .38	7	7	4.00	1.53
	8	7	5.00	.82
	9	7	4.86	1.07
	10	10	5.40	.52
	11	6	5.00	.63
70. Conducts group safety meetings weekly, monthly, or whenever specified	1	7	5.86	.38
	2	11	4.81	.60
	3	10	4.90	.74

(table continues)

(Table 5 continued)

ITEM	QUARRY	N	$\bar{X}$	S
F ratio = 2.82	4	6	5.50	.55
d. f. = 10,77	5	10	5.60	.52
F probability = .0049	6	8	5.87	.35
	7	7	5.29	.49
	8	6	5.17	.75
	9	8	4.62	1.30
	10	10	5.40	.52
	11	5	4.40	1.95

TABLE 6

Analysis of Variance of Supervisory Safety Contributions Between Limestone Quarries: Training Practice

ITEM	QUARRY	N	$\bar{X}$	S
14. Personally instructs each new employee in his assigned work area on safety requirements of the job and records the instruction	1	6	5.00	.89
	2	11	4.91	.70
	3	10	5.20	.63
	4	5	5.80	.45
F ratio = .87	5	8	5.50	.53
d. f. = 10,73	6	9	5.11	.78
F probability = .57	7	7	5.00	.56
	8	7	4.86	.69
	9	5	5.00	1.73
	10	10	5.30	.67
	11	6	5.00	.63
15. Develops safe work procedures using the methods of the job safety analysis	1	6	4.83	.75
	2	10	4.80	.79
	3	11	5.09	.54
F ratio = 1.21	4	4	5.25	.50
d. f. = 10,72	5	10	4.90	1.20
F probability = .30	6	8	4.00	1.70
	7	7	5.14	.38
	8	7	4.86	.69

(table continues)

(Table 6 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	9	4	5.00	2.00
	10	10	5.40	.52
	11	6	5.17	.41
18. Instructs employees in the	1	7	4.71	1.11
inspection of rigging (ropes,	2	11	5.18	.60
cables, chains) before use	3	11	5.27	.65
F ratio = .66	4	5	5.40	.55
d. f. = 10,74	5	10	4.80	1.13
F probability = .76	6	7	4.86	1.21
	7	7	5.14	.69
	8	6	4.83	.75
	9	6	5.50	.55
	10	10	5.00	1.15
	11	5	5.40	.55
25. Instructs employees in the	1	7	5.14	.69
proper methods of housekeeping	2	10	5.10	.74
F ratio = 1.11	3	10	5.00	.82
d. f. = 10,76	4	5	4.80	1.64
F probability = .94	5	10	5.00	1.25
	6	8	5.37	.74
	7	7	5.14	.38

(table continues)

(Table 6 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	8	7	4.86	.69
	9	8	5.00	.75
	10	10	5.40	.70
	11	5	4.80	.84
30. Is thoroughly familiar with and instructs employees in emergency procedures	1	7	4.86	.69
	2	11	4.72	.65
	3	10	5.10	.57
F ratio = 1.11	4	4	5.50	.58
d.f. = 10,73	5	8	5.75	.46
F probability = .37	6	9	5.11	1.62
	7	7	5.14	.69
	8	7	5.00	.58
	9	7	5.29	.76
	10	10	5.40	.52
	11	4	5.00	.82
36. Provides complete safety instruction to all employees prior to their assignment of duties	1	6	4.67	.52
	2	11	4.91	.54
	3	11	4.82	.60
F ratio = 1.27	4	6	5.17	.41
d.f. = 10,75	5	9	4.89	1.54
F probability = .26				

(table continues)

(Table 6 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	6	7	5.71	.49
	7	7	5.14	.70
	8	7	5.00	.82
	9	7	5.00	.82
	10	10	5.50	.53
	11	5	5.00	.00
52. Trains employees in the most	1	6	5.00	.63
efficient and safe manner of	2	11	5.00	.77
performing their jobs	3	11	5.09	.70
F ratio = .74	4	5	5.20	.45
d. f. = 10,74	5	10	5.00	1.49
F probability = .68	6	7	5.43	.53
	7	6	5.17	.41
	8	6	5.17	.75
	9	8	4.75	1.03
	10	10	5.60	.52
	11	5	4.60	1.52
74. Provides periodic instruction	1	6	5.33	.82
in proper lifting procedures	2	11	5.00	.63
F ratio = .62	3	11	5.09	.54
d. f. = 10,73	4	4	5.25	.50
F probability = .79				

(table continues)

(Table 6 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	5	10	4.90	1.52
	6	7	5.43	1.51
	7	7	5.29	.76
	8	5	5.00	.71
	9	7	4.71	1.38
	10	10	5.30	.48
	11	6	4.33	1.75

TABLE 7

Analysis of Variance of Supervisory Safety Contributions between Limestone Quarries: Hazard Control

ITEM	QUARRY	N	$\bar{X}$	S
2. Properly maintains equipment under his jurisdiction	1	7	5.14	.38
	2	11	5.09	.70
F ratio = .88	3	11	4.91	.83
d. f. = 10,80	4	6	5.00	.00
F probability = .55	5	10	5.30	.48
	6	8	5.25	.46
	7	7	4.71	1.38
	8	7	4.86	.69
	9	8	4.62	1.68
	10	10	5.50	.53
	11	6	5.33	.82
4. Urges employees to become proficient in first aid practices	1	6	5.33	.52
	2	11	5.27	.79
F ratio = .89	3	10	5.00	.82
d. f. = 10,72	4	5	4.80	.45
F probability = .55	5	10	5.40	.52
	6	9	4.89	.93
	7	7	4.71	1.60
	8	5	5.00	.71

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	9	7	5.00	1.00
	10	10	5.60	.52
	11	3	5.33	.58
5. Reduces and/or eliminates fire	1	7	5.00	.58
and general property hazards	2	9	5.00	.50
F ratio = 1.50	3	10	5.20	.63
d. f. = 10,77	4	6	5.33	.52
F probability = .16	5	10	5.70	.48
	6	9	5.44	.73
	7	7	4.57	1.62
	8	7	5.00	.58
	9	8	5.25	.71
	10	10	5.50	.53
	11	5	5.40	.55
6. Inspects for unsafe acts and	1	7	5.00	.58
conditions and takes prompt	2	11	5.00	.77
corrective action to reduce or	3	10	5.00	.82
eliminate them	4	6	5.17	.75
F ratio = .51	5	10	5.20	1.32
d. f. = 10,80	6	9	4.89	1.27
F probability = .88	7	7	4.71	1.38

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	8	7	4.86	.69
	9	8	4.75	1.39
	10	10	5.50	.53
	11	6	5.33	.52
9. Checks to see if required safety	1	7	5.14	.90
equipment is being used or worn	2	11	4.91	.54
F ratio = 2.18	3	11	5.10	.70
d. f. = 10,80	4	6	5.00	.63
F probability = .027	5	10	5.80	.42
	6	8	5.75	.46
	7	7	5.14	.69
	8	7	5.00	.83
	9	8	5.12	.83
	10	10	5.60	.52
	11	6	5.17	.75
20. Recognizes pinch points (any point	1	7	5.00	.58
where it is possible to be caught between	2	11	4.82	.60
moving parts and stationary parts) and	3	11	5.18	.60
eliminates them when possible	4	5	5.40	.55
	5	10	5.40	.52

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
F ratio = 2.50	6	9	5.67	.71
d. f. = 10,80	7	7	5.43	.53
F probability = .012	8	7	5.14	.69
	9	8	5.12	.64
	10	10	5.70	.48
	11	6	5.83	.41
24. Takes immediate steps to correct	1	7	5.14	.69
unsafe conditions	2	11	5.09	.83
F ratio = .40	3	10	5.40	.52
d. f. = 10,77	4	5	5.20	.84
F probability = .94	5	9	5.11	1.27
	6	9	5.00	1.58
	7	7	4.57	1.51
	8	7	4.86	.69
	9	7	5.00	1.53
	10	10	5.40	.70
	11	6	5.00	.63
26. Concentrates corrective activities	1	7	5.00	.58
toward adverse accident trends	2	11	4.64	.81
F ratio = 1.07	3	10	4.90	.74
d. f. = 10,75	4	6	4.67	.82
F probability = .39				

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	5	9	5.00	1.22
	6	8	5.50	.53
	7	7	5.14	.69
	8	7	4.86	.90
	9	5	5.20	.45
	10	10	5.40	.52
	11	6	5.17	.75
33. Sees that necessary safety equipment	1	7	5.14	.96
is provided for each job	2	10	5.00	.67
F ratio = .84	3	9	4.78	.67
d. f. = 10,77	4	6	5.17	.41
F probability = .59	5	10	4.90	1.45
	6	9	5.67	.71
	7	7	5.14	1.07
	8	7	5.00	.82
	9	7	5.00	.82
	10	10	5.60	.52
	11	6	5.00	1.55
35. Properly identifies all pinch points	1	7	5.00	.58
(any point where it is possible to be caught	2	10	4.90	.57
between moving parts and stationary parts)	3	11	5.18	.60

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
which cannot be eliminated	4	5	5.20	.45
F ratio = .59	5	10	5.00	1.56
d. f. = 10,78	6	9	5.56	.73
F probability = .81	7	7	5.29	.49
	8	7	4.86	.69
	9	7	5.14	.69
	10	10	5.30	.48
	11	6	5.17	.41
38. Is sure that his men are physically	1	7	4.86	.90
fit before assigning work to them	2	11	5.00	.63
F ratio = 1.04	3	11	4.91	.83
d. f. = 10,76	4	6	5.00	.00
F probability = .42	5	10	5.10	1.56
	6	8	5.75	.46
	7	6	5.17	.41
	8	6	4.83	.98
	9	8	5.12	.64
	10	10	5.50	.53
	11	4	5.50	.58

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
42. Inspects safety equipment worn by employees to determine its condition F ratio = .55 d. f. = 10,74 F probability = .85	1	7	4.57	1.27
	2	11	5.00	.77
	2	11	5.00	.63
	4	4	4.25	.96
	5	9	4.78	1.48
	6	8	5.00	1.69
	7	5	5.20	.45
	8	6	5.00	.89
	9	8	4.62	1.30
	10	10	5.30	.48
	11	6	4.67	.52
43. Assures that proper safety practices have been designed into each operation performed in his area F ratio = .85 d. f. = 10,75 F probability = .58	1	7	4.71	.76
	2	11	5.18	.87
	3	10	4.90	.57
	4	5	4.40	1.52
	5	8	4.87	1.64
	6	8	5.62	.52
	7	7	4.86	1.46
	8	6	5.00	.63
	9	8	4.87	.99
	10	10	5.40	.52
	11	6	5.17	.75

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
51. Sees that proper lifting devices are used for each job	1	7	4.71	1.50
	2	11	4.73	.79
F ratio = .87	3	11	4.82	.75
d. f. = 10,77	4	5	5.00	.00
F probability = .56	5	10	5.00	1.56
	6	8	5.12	.83
	7	7	5.29	.49
	8	6	5.00	.63
	9	8	5.12	.83
	10	10	5.70	.48
	11	5	5.20	.84
55. Visually inspects lifting devices prior to using them	1	7	4.43	1.13
	2	11	4.64	.67
F ratio = 1.53	3	11	5.18	.75
d. f. = 10,75	4	5	5.00	.00
F probability = .15	5	10	4.60	1.35
	6	8	4.87	1.36
	7	6	5.50	.55
	8	6	5.00	.63
	9	7	5.29	.76
	10	10	5.60	.52
	11	5	5.20	.45

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
58. Is satisfied that his employees thoroughly understand the safety rules of the enterprise F ratio = 1.18 d. f. = 10,77 F probability = .32	1	6	5.33	.52
	2	11	5.00	.63
	3	10	5.30	.82
	4	6	5.00	.00
	5	10	5.60	.52
	6	7	5.29	.76
	7	7	5.57	.53
	8	7	5.00	.58
	9	8	5.25	.46
	10	10	5.40	.52
	11	6	5.00	.63
61. Observes his employees in the performance of their jobs and corrects any unsafe acts being committed by them F ratio = .62 d. f. = 10,77 F probability = .79	1	7	5.14	.69
	2	11	4.73	.79
	3	10	5.20	.79
	4	5	5.40	.55
	5	10	5.00	1.49
	6	9	5.00	.87
	7	7	4.86	1.46
	8	6	5.00	.63
	9	7	5.14	.90
	10	10	5.50	.53
	11	6	5.50	.54

(table continues)

(Table 7 continued)

ITEM	QUARRY	N	$\bar{X}$	S
71. Inspects emergency equipment (oxygen apparatus, fire hoses, first aid supplies) and make appropriate corrections where required	1	6	5.17	.75
	2	10	4.70	.67
	3	11	4.91	.54
	4	6	5.00	.00
F ratio = 2.58	5	10	5.30	.48
d. f. = 10,75	6	6	5.67	.52
F probability = .0096	7	6	5.33	.52
	8	7	4.86	.69
	9	8	5.37	.52
	10	10	5.60	.52
	11	6	5.33	.52

TABLE 8

Analysis of Variance of Supervisory Safety Contributions Between Limestone Quarries: Accident Investigation

ITEM	QUARRY	N	$\bar{X}$	S
1. Investigates all lost time and recordable (medical only) accidents	1	7	5.57	.53
	2	11	5.73	.47
F ratio = 1.73	3	11	5.09	.07
d. f. = 10,75	4	6	5.00	.00
F probability = .090	5	10	5.62	.52
	6	8	5.62	.74
	7	7	5.29	.49
	8	7	5.14	.38
	9	6	5.33	.82
	10	10	5.60	.52
	11	4	5.20	.45
17. Sees that all of his employees receive prompt medical attention when injured	1	7	5.43	.53
	2	9	4.89	.78
F ratio = 2.81	3	11	5.00	.63
d. f. = 10,79	4	6	5.50	.55
F probability = .0050	5	10	5.80	.42
	6	9	5.78	.44
	7	7	4.43	.53
	8	7	5.14	.69

(table continues)

(Table 8 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	9	8	5.75	.46
	10	10	5.50	.53
	11	6	5.67	.52
21. Questions an injured person in detail regarding the accident	1	6	5.33	.52
	2	10	4.40	.52
F ratio = 3.19	3	11	5.09	.70
d. f. = 10,75	4	5	5.20	.84
F probability = .0019	5	10	5.20	.63
	6	9	5.78	.44
	7	6	5.17	.41
	8	7	5.29	.76
	9	7	5.14	.69
	10	10	5.70	.67
	11	5	5.40	.55
34. Investigates any and all near-miss accidents	1	7	4.86	1.07
	2	11	4.45	.52
F ratio = 1.67	3	11	4.91	.83
d. f. = 10,74	4	5	5.00	.00
F probability = .103	5	10	4.40	1.35
	6	8	5.75	.46
	7	7	4.86	.38

(table continues)

(Table 8 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	8	6	5.33	.82
	9	6	4.50	1.38
	10	10	4.90	.88
	11	4	4.25	1.50
53. Questions all witnesses to an accident in an attempt to determine the cause	1	6	5.33	.52
	2	11	4.82	.75
	3	11	5.18	.75
F ratio = .98	4	4	5.25	.50
d. f. = 10,71	5	9	5.56	.35
F probability = .47	6	8	5.62	.52
	7	7	5.00	.58
	8	6	5.33	.82
	9	6	5.00	1.55
	10	10	5.40	.52
	11	4	5.00	.82
72. Investigates all accidents which result in property damage	1	7	5.29	.76
	2	11	4.82	.87
F ratio = 2.75	3	11	4.82	.60
d. f. = 10,72	4	5	5.20	.45
F probability = .0062	5	10	5.60	.52

(table continues)

(Table 8 continues)

ITEM	QUARRY	N	$\bar{X}$	S
	6	7	5.86	.38
	7	6	5.33	.52
	8	6	5.00	.63
	9	5	5.60	.55
	10	10	5.60	.52
	11	5	5.20	.45

Another statistical tool that was used to examine the relationship between individual supervisory safety contribution items and limestone quarry productivity was simple regression analysis. Whereas correlation analysis involves measuring the closeness of the relationship between two variables, simple regression analysis refers to the technique used to derive an equation that relates the dependent variable (limestone quarry productivity) to the independent variable (supervisory safety contribution scores). The underlying foundation of regression analysis is mathematical so that any relationship between variables is a mathematical relationship and not necessarily a cause and effect relationship.

Tables 9-13 provide the results of the simple regression analysis between the 57 supervisory safety contribution items grouped by category and limestone quarry productivity. Using the F test probability to once again determine any statistical significance it was found that only two supervisory safety contribution items were significantly related to productivity at the .05 level. These items were:

63. Gives special attention to employees who repeatedly violate safety rules and regulations, or exhibit unsafe work practices, in order to correct them ($p = .01$)

50. Maintains safety signs and bulletin boards in a clean and legible condition ($p = .05$)

Further analysis of Tables 9-13 revealed that three additional items were significant at the .10 level. These items were:

15. Develops safe work procedures using the methods of the job safety analysis ($p = .09$)

17. Sees that all of his employees receive prompt medical attention when injured ($p = .06$)

73. Is familiar with safety- and health-related legislation ($p = .08$)

Tables 9-13 also reveal that the r value for all 57 items is positive. This finding indicates not only a positive relationship between supervisory safety contributions and productivity but also that an improvement in the former will yield improvements in the latter.

TABLE 9

Simple Regression Analysis Between Supervisory Safety Contributions and Limestone Quarry Productivity: Management Policies

ITEM	r	r^2	F TEST	P
3. Demands good housekeeping practices and maintains high standards of cleanliness of operations	.12	.02	1.35	.25
8. Is satisfied that employees under his jurisdiction thoroughly understand the safety rules of the enterprise	.00	.00	0	1.00
13. Sees that all company vehicles assigned to him are maintained in safe operating condition	.02	.00	.04	.85
28. Assures the safety of his employees and of those who may enter into his area of operation	.04	.00	.16	.69

(table continues)

(Table 9 continued)

ITEM	r	r^2	F TEST	P
39. Never permits tools or equipment to be used for purposes other than for which they were intended	.01	.00	.02	.89
41. Strictly enforces all safety rules and regulations established by the enterprise	.11	.01	1.03	.31
50. Maintains safety signs and bulletin boards in a clean and legible condition	.21	.04	4.02	.05
54. Requires each employee to clean up his assigned work area daily	.13	.02	1.65	.20
59. Prevents the use of tools or equipment found to be defective	.16	.03	2.43	.12

(table continues)

(Table 9 continued)

ITEM	r	r^2	F TEST	P
60. Makes sure that bulletin boards are kept up to date, with notices which are no longer applicable removed	.17	.03	2.56	.11
63. Gives special attention to employees who repeatedly violate safety rules and regulations, or exhibit unsafe work practices, in order to correct them	.27	.07	7.04	.01
64. Is sure that the men assigned to a particular job are capable of performing the job	.08	.01	.56	.46
67. Takes any reasonable action required to prevent an accident where an immediate danger exists	.06	.00	.27	.61

(table continues)

(Table 9 continued)

ITEM	r	r^2	F TEST	P
68. Assures that outside contractors' employees are not endangered by the operations under his jurisdiction	.08	.01	.58	.45
73 Is familiar with safety and health-related legislation	.18	.03	3.07	.08

TABLE 10

Simple Regression Analysis Between Supervisory Safety Contributions and Limestone Quarry Productivity: Motivational Techniques

ITEM	r	r^2	F TEST	P
7. Stimulates interest and attention toward the practice of accident prevention through daily contact with his employees	.08	.01	.58	.45
10. Takes the initiative in helping to make a success of the safety program	.00	.00	.00	.98
11. Personally attends all safety meetings	.07	.01	.41	.52
12. Encourages employee use of the safety suggestion system	.03	.001	.08	.78
16. Gives personal support to all safety activities and safety procedures	.08	.01	.64	.43

(table continues)

(Table 10 continued)

ITEM	r	r^2	F TEST	P
19. Instills a sincere attitude toward safety in all of his employees	.03	.00	.06	.81
32. Develops a safety awareness in all employees through personal safety contacts	.03	.00	.06	.81
37. Promotes attendance of employees at safety meetings	.04	.00	.14	.71
44. Develops a cooperative safety attitude in his men through the application of preventive and corrective discipline	.11	.01	1.13	.29
70. Conducts group safety meetings weekly, monthly, or whenever specified	.01	.00	.01	.92

TABLE 11
Simple Regression Analysis Between Supervisory Safety Contributions and Limestone Quarry Productivity: Training Practices

ITEM	r	r^2	F TEST	P
14. Personally instructs each new employee in his assigned work area on safety requirements of the job and records this instruction	.11	.01	1.06	.31
15. Develops safe work procedures using the methods of the job safety analysis	.12	.03	2.89	.09
18. Instructs employees in the inspection of rigging (ropes, cables, chains) before use	.11	.01	1.13	.29
25. Instructs employees in the proper methods of housekeeping	.06	.00	.30	.59
30. Is thoroughly familiar with and instructs employees in emergency procedures	.08	.01	.55	.46

(table continues)

(Table 11 continued)

ITEM	r	r^2	F TEST	P
36. Provides complete safety instruction to all employees prior to their assignment of duties	.07	.01	.47	.50
52. Trains employees in the most efficient and safe manner of performing their jobs	.05	.00	.22	.64
74. Provides periodic instruction in proper lifting procedures	.04	.00	.11	.74

TABLE 12

Simple Regression Analysis Between Supervisory Safety Contributions and Limestone Quarry Productivity: Hazard Control

ITEM	r	r^2	F TEST	P
2. Properly maintains equipment under his jurisdiction	.10	.01	.98	.32
4. Urges employees to become proficient in first aid practices	.05	.00	.18	.67
5. Reduces and/or eliminates fire and general property hazards	.05	.00	.22	.64
6. Inspects for unsafe acts and conditions and takes prompt corrective action to reduce or eliminate them	.13	.02	1.50	.22
9. Checks to see if required safety equipment is being used or worn	.15	.02	1.94	.17

(table continues)

(Table 12 continued)

ITEM	r	r^2	F TEST	P
20. Recognizes pinch points (any point where it is possible to be caught between moving parts and stationary parts) and eliminate them when possible	.10	.01	.93	.34
24. Takes immediate steps to correct unsafe conditions	.14	.02	1.69	.20
26. Concentrates corrective activities toward adverse accident trends	.03	.00	.06	.81
33. Sees that necessary safety equipment is provided for each job	.06	.00	.32	.57
35. Properly identifies all pinch points (any point where it is possible to be caught between moving parts and stationary parts) which cannot be eliminated	.04	.00	.14	.71

(table continues)

(Table 12 continued)

ITEM	r	r^2	F TEST	P
38. Is sure that his men are physically fit before assigning work to them	.02	.00	.02	.89
42. Inspects safety equipment worn by employees to determine its condition	.00	.00	0	1.00
43. Assures that proper safety practices have been designed into each operation performed in his area	.01	.00	.01	.90
51. Sees that proper lifting devices are used for each job	.04	.00	.11	.74
55. Visually inspects lifting devices prior to using them	.10	.01	.90	.35
58. Is satisfied that his employees thoroughly understand the safety rules of the enterprise	.04	.00	.14	.71

(table continues)

(Table 12 continued)

ITEM	r	r^2	F TEST	P
61. Observes his employees in the performance of their jobs and corrects any unsafe acts being committed by them	.12	.01	1.28	.26
71. Inspects emergency equipment (oxygen apparatus, fire hoses, first aid supplies) and makes appropriate corrections where required	.01	.00	.01	.91

TABLE 13

Simple Regression Analysis Between Supervisory Safety Contributions and Limestone Quarry Productivity: Accident Investigation

ITEM	r	r^2	F TEST	P
1. Investigates all lost-time and recordable (medical only) accidents	.12	.01	1.23	.27
17. Sees that all of his employees receive prompt medical attention when injured	.20	.04	3.59	.06
21. Questions an injured person in detail regarding the accident	.08	.01	.56	.44
34. Investigates any and all near-miss accidents	.02	.00	.04	.84
53. Questions all witness to an accident in an attempt to determine the cause	.09	.01	.74	.39

(table continues)

(Table 13 continued)

ITEM	r	r^2	F TEST	P
72. Investigates all accidents which result in property damage	.03	.00	.09	.76

Like Tables 4-8, Table 14 numerically reports the results of the comparison of supervisory safety contribution indices between limestone quarries. Unlike Tables 4-8, however, Table 14 shows the mean value of the six indices of supervisory safety contribution items that were classified within the designated group. For example, the mean score for the all item index would be calculated by adding together all of the scores for all items and for all respondents and then dividing by the number of items.

Also, as in the previous tables, the standard deviation is a measure of the degree of consensus while the F probability is the indicator of statistical significance. Review of Table 14 reveals that the only statistically significant difference between the various limestone quarry supervisors is in the ways and means of accident investigation as measured by the Accident Investigation index.

The next data analyses that was undertaken was to directly test the relationship between supervisory safety contributions and limestone quarry productivity by using the Pearson r Correlation test. Table 15 reports the results of this statistical test by comparing productivity to each of the six supervisory safety contribution indices. Using the index of all the items, no statistically significant relationship was observed (r=.-247, p=.46). Correlation analysis between the indices of the five categories of supervisory safety contributions and limestone quarry productivity also produced no statistically significant difference between the variables. Correlations ranged from r= -.583 to .302 with only the Training Practices Index approaching statistical significance (p=.06).

TABLE 14

Analysis of Variance of Supervisory Safety Contribution Indices Between Limestone Quarries

ITEM	QUARRY	N	$\bar{X}$	S
Average of All Valid Items	1	7	5.05	.52
F ratio = .57	2	11	4.94	.35
d. f. = 10,78	3	11	5.00	.41
F probability = .83	4	5	5.17	.25
	5	10	5.13	.95
	6	9	5.27	.75
	7	7	5.05	.58
	8	7	4.98	.59
	9	7	5.03	.88
	10	10	5.43	.33
	11	5	5.26	.38
Average of Management Policies Items	1	7	5.04	.60
F ratio = .53	2	11	4.99	.40
d. f. = 10,80	3	11	4.98	.41
F probability = .86	4	6	5.02	.30
	5	10	5.02	1.07
	6	9	5.16	.77
	7	7	4.99	.69
	8	7	4.93	.59
	9	8	4.98	.84
	10	10	5.43	.36

(table continues)

(Table 14 continued)

ITEM	QUARRY	N	$\bar{X}$	S
	11	5	5.32	.35
Average of Motivational Techniques Items	1	7	5.20	.39
F ratio = .66	2	11	4.94	.32
d. f. = 10,80	3	11	4.93	.40
F probability = .76	4	5	5.30	.32
	5	10	5.20	.95
	6	9	5.35	.65
	7	7	5.03	.54
	8	7	5.08	.60
	9	8	4.91	.99
	10	10	5.33	.33
	11	6	4.97	.79
Average of Training Practices Items	1	6	4.99	.53
F ratio = .39	2	11	4.96	.41
d. f. = 10,75	3	11	5.08	.40
F probability = .95	4	4	5.41	.41
	5	10	5.02	1.14
	6	9	5.04	.99
	7	7	5.14	.40
	8	7	4.92	.61
	9	6	5.20	.91
	10	10	5.36	.37
	11	5	5.10	.45

(table continues)

(Table 14 continued)

ITEM	QUARRY	N	$\bar{X}$	S
Average of Hazard Control Items	1	7	4.97	.59
F ratio = .74	2	11	4.93	.40
d. f. = 10,81	3	11	5.01	.47
F probability = .68	4	6	4.99	.29
	5	10	5.18	.93
	6	9	5.26	.84
	7	7	5.03	.79
	8	7	4.93	.60
	9	8	5.03	.73
	10	10	5.51	.32
	11	6	5.20	.43
Average of Accident Investigation Items	1	7	5.27	.55
F ratio = 2.00	2	11	4.86	.39
d. f. = 10,76	3	11	5.02	.40
F probability = .045	4	6	5.17	.28
	5	10	5.32	.53
	6	8	5.76	.41
	7	7	5.17	.27
	8	6	5.22	.65
	9	6	5.21	.88
	10	10	5.45	.45
	11	5	5.16	.52

TABLE 15

Statistical Relationship (Pearson Correlation Coefficients) Between Supervisory Safety Contributions and Limestone Quarry Productivity

INDEX	r	N	P
Average of All Valid Items	-.247	11	.46
Average of Management Policies Items	-.321	11	.34
Average of Motivational Techniques Items	-.170	11	.62
Average of Training Practices Items	-.583	11	.06
Average of Hazard Control Items	-.019	11	.96
Average of Accident Investigation Items	.302	11	.37

The final data analysis consisted of measuring the strength of the relationship between the dependent variable or limestone quarry productivity and a single independent variable or supervisory safety contribution index when the effects of the other indices were held constant. Table 16 shows that when controlling for the effects of each of the other indices, all five supervisory safety contribution indices were significantly correlated with limestone productivity. Two of the indices were found to be positively correlated to limestone quarry productivity while three of the indices were found to be negatively correlated with productivity. The former indices consisted of the Hazard Control and Accident Investigation items while the negatively correlated indices included Management Policy, Motivational Techniques and Training Practices. Positive correlations imply that an improvement in the supervisory safety contribution indices would also lead to increased productivity. Conversely, a negative correlation implies that the higher the supervisory safety contribution score, the lower the productivity.

TABLE 16

Statistical Relationship (Partial Correlation Coefficients)* Between Supervisory Safety Contributions and Limestone Quarry Productivity

INDEX	r	N	P
Average of Management Policy Items	-.900	11	.003
Average of Motivational Techniques Items	-.846	11	.008
Average of Training Practices Items	-.796	11	.016
Average of Hazard Control Items	.850	11	.008
Average of Accident Investigation Items	.785	11	.018

* Partial correlations for each index were calculated using the remaining four indices as control variables.

CHAPTER 5

SUMMARY, ESSENTIAL FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

General Summary

The problem involved in this study was to compare supervisory safety contributions with productivity accomplishment in selected limestone quarry locations.

The purpose of this study was to make available to enterprise safety function manager's research based data which should be useful in ascertaining the utility of individual and grouped supervisory safety contributions on the firm's productivity while concomitantly identifying areas of opportunity among and between supervisors that will permit the development of specific and focused safety training.

The foundation of the study rested on the research based supervisory safety duties and responsibilities that were developed in the mid 1970's. To revalidate these duties and responsibilities, the researcher solicited the input from six expert jurors - evenly split between academia and private enterprise - to determine their present day (1989) applicability. Each of the 74 statements were overwhelmingly reconfirmed as being applicable with five out of six experts (83%) in agreement as to their applicability. It was felt that these results reconfirmed the applicability and the timeliness of the previously determined supervisory safety duties and responsibilities.

To construct these statements into a usable survey instrument designed to have line employees evaluate their supervisor's contributions to safety, a seven-point Likert scale was utilized. Employees could evaluate their supervisor relative to each statement on the basis of strongly agree, agree, slightly agree, undecided, slightly disagree, disagree, or strongly disagree.

After pilot testing the instrument with eleven employees in a selected limestone quarry and uncovering no actual or inherent problems with the instrument, the decision was made to solicit the cooperative support of ten additional plant safety directors from a leading U.S. limestone producer.

With the ninety-five additional respondents from ten selected quarries, the total sample for this study was eleven quarries and 106 respondents. Depending on the information desired, these quarries and/or respondents became the independent variable(s) with the dependent variable being the limestone production in tons per man hour.

The nature of the data required the simultaneous utilization of two research designs and concomitant data analysis. The first analysis was conducted by using analysis of variance to analyze the variables which were the response patterns by quarry. The second research design and analysis treated the item responses as the independent variable and the

productivity per man hour as the dependent variable thereby facilitating the utilization of simple regression analysis.

Analysis of variance was used to analyze supervisory safety contributions by quarry and by key task area. F test probabilities were calculated to determine any significant difference between quarries. Regression analysis was performed to ascertain any relationship between productivity and individual items or key task areas. A Pearson correlation was completed as a comparative measure of association between key task areas and productivity. Finally, a partial correlation analysis was performed to assess the relationship between the key areas and productivity holding each of the other task areas constant.

Essential Findings

Examination of the data collected and assembled into tables that appear in Chapter 4, resulted in the following essential findings after seventeen of the original seventy-four items were eliminated from the study because of insufficient responses.

1. Respondents overwhelmingly agreed that their supervisors were successfully fulfilling their safety related duties and responsibilities.

2. Employees appear able and willing to differentially evaluate their supervisors relative to their safety contributions.

3. Eight of the fifty-seven supervisory safety contribution items were significantly different at the .05 level between limestone quarry supervisors based upon analysis of variance. These contribution items were:

9. Checks to see if required safety equipment is being used or worn

17. Sees that all of his employees receive prompt medical attention when injured

20. Recognizes pinch points (any point where it is possible to be caught between moving parts and stationary parts) and eliminates them when possible

21. Questions an injured person in detail regarding the accident

70. Conducts group safety meetings weekly, monthly, or whenever specified

71. Inspects emergency equipment (oxygen apparatus, fire hoses, first aid supplies) and makes appropriate corrections when required

72. Investigates all accidents which result in property damage

73. Is familiar with safety- and health-related legislation

4. Analysis of variance statistically differentiated between limestone quarry supervisors at the .10 level on three additional supervisory safety contribution items. These items were:

1. Investigates all lost-time and recordable (medical only) accidents

34. Investigates any and all near-miss accidents

63. Gives special attention to employees who repeatedly violate safety rules and regulations or exhibit unsafe work practices in order to correct them

5. Use of regression analysis revealed a positive relationship among all 57 supervisory safety contributions and productivity.

6. Use of regression analysis revealed a statistically significant difference existed at the .05 level between two supervisory safety contribution items and limestone quarry productivity. These were:

63. Gives special attention to employees who repeatedly violate safety rules and regulations, or exhibit unsafe work practices, in order to correct them

50. Maintains safety signs and bulletin boards in a clean and legible condition

7. Use of regression analysis revealed that three additional supervisory safety contribution items were significantly related to productivity at the .10 level. These items were:

15. Develops safe work procedures using the methods of the job safety analysis

17. Sees that all of his employees receive prompt medical attention when injured

73. Is familiar with safety- and health-related legislation

8. Analysis of variance revealed that when supervisory safety contributions were grouped into key task areas, only one task area was significantly different between supervisors. The significantly different

task area was Accident Investigation. The other four task areas, Management Policies, Motivational Techniques, Training Practices and Hazard Control were not found to be significantly different between the quarries.

9. Correlation analysis revealed no relationship between the supervisory safety contribution indices and productivity.

10. Partial correlation analysis revealed that all five indices of supervisory safety contribution items were significantly related to productivity. Three indices were negatively related while two indices were positively related. These findings were as follows:

INDEX	r	P
Management Policy Index	-.900	.003
Motivational Techniques Index	-.846	.008
Training Practices Index	-.796	.016
Hazard Control Index	.850	.008
Accident Investigation Index	.785	.018

Conclusions

The following conclusions are the result of the study's essential findings:

1. The seventy-four supervisory duties and responsibilities were revalidated by a jury of experts. However, not all items were applicable to this study.

2. Although respondents rated their supervisors favorably as to the fulfillment of their safety related duties, enough variance did exist to suggest that respondents can discern actual or behavioral differences in the way supervisors complete their tasks.

3. Differences exist between quarries in the way that respondents perceive their supervisor's fulfilling their supervisory safety contributions. If all supervisors are expected to perform the same activities, the findings suggest that they are (a) either not complying with the specified activities; (b) are interpreting them differently; or (c) performing them in a manner that results in differing perceptions of performance among their subordinates.

4. The item-by-item analysis as performed in this study identified supervisor performance differences among quarries for each item. The procedure, therefore, is applicable to other situations where the identification of performance differences is desired. Some possible applications are the formulation of supervisor training/development programs, the comparison of performance to some standard such as a job description and the comparison of actual activities performed to the subordinates perception of performance.

5. While no significant difference existed between the individual supervisory safety contributions and productivity, based upon grouping of items into the major task areas, vis-a-vis indices, significant differences were identified. This would seem to indicate that respondents were more discerning with the way supervisors performed the sum of their duties rather than the individual parts.

6. There are statistically significant relationships between the five defined indices of supervisory safety contributions and the output of the quarries by the tons per man hour.

7. Three of five indices are negatively correlated with output which may be the result of inter-item correlations since all fifty-seven of the items were shown to have a positive correlation with output when simple regression analysis was performed.

8. Negative correlations between supervisory safety contribution indices and productivity may also be the result of short-term impact as opposed to long-run vision. For example, as training increases, it's only logical that productivity would decrease in the short run as employees are away from their job. However, productivity and safety effectiveness should increase over time as employees become more adroit in fulfilling the requirements as outlined in the specified training program(s). Likewise, employees may temporarily rebel against the kinds of supervisory safety contributions contained within the Management Policy index thereby causing productivity to decline in the short run.

However, as they come to appreciate the utility of said statements, productivity should increase in the long run.

9. Positive correlations on the other hand, were found to exist between both productivity and Hazard Control and productivity and Accident Investigation. Although speculative, these findings seem to imply that the more the supervisor undertakes the traditional safety duties and responsibilities of a line manager, the more that productivity will increase.

Recommendations

Based upon the overall results of this study, recommendations for subject matter utilization and for further research were deemed apropos.

Recommendations For Subject Matter Utilization

1. The participating enterprise should consider using the results to ascertain which quarry's and supervisors are rated higher than others in fulfilling supervisory safety duties and responsibilities.

2. Special recognition and/or rewards could be established for those quarries and supervisors receiving higher than average evaluations.

3. Supervisory safety training programs could be developed that would focus on those areas where deficiencies occur.

4. Training programs could be targeted to those supervisors scoring below below some previously developed norm such as the mean (x) score for item or index.

Recommendations For Further Research

1. Consideration should be given to replicating and expanding the study by obtaining ratings as to the respondents' perceived importance for each of the seventy-four items as well as the evaluation of the supervisory level of performance. The methodology used in this survey weighted all of the items equally which in fact may not be the case.

2. Research should be undertaken to confirm the key task groupings. This could be accomplished by either using a jury of experts techniques or by performing a cluster analysis.

3. Research should be undertaken to determine the extent and magnitude of the inter-item correlations. Factor analysis or Bayesian regression analysis would be the appropriate statistical measure.

4. Research should be repeated using a larger number of respondents and locations to verify present study results.

5. Should the present study be repeated, the following changes are suggested as being appropriate:

A. Negatively worded questions should be constructed to ascertain response patterns.

B. Either survey questions should be removed or a not applicable category included on the survey instrument for each question to minimize non-response bias.

C Instructions for completing the survey instrument should be given to respondents by the researcher or one designated individual to ensure uniformity.

D. Additional independent variables should be identified for inclusion in future research.

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APPENDIX A

Safety Duties And Responsibilities To Be Assessed By The Jury Of Experts

The foregoing list is representative of accepted safety program responsibilities of front-line supervisors as published by the literature, insurance company references, and individual enterprise safety program manuals. Place a check ( ) in the column which reflects your agreement of disagreement with the listed statement of responsibility. After completing this section, please list any further safety program responsibilities of front-line supervisors which you feel are considered to be under their jurisdiction which this list has not stated.

	Agree	Disagree
1. Investigates all lost-time and recordable (medical only) accidents.	( )	( )
2. Properly maintains equipment under his jurisdiction.	( )	( )
3. Demands good housekeeping practices and maintains high standards of cleanliness of operations.	( )	( )
4. Urges employees to become proficient in first aid practices.	( )	( )
5. Reduces and/or eliminates fire and general property hazards	( )	( )
6. Inspects for unsafe acts and conditions and takes prompt corrective action to reduce or eliminate them.	( )	( )

	Agree	Disagree
7. Stimulates interest and attention toward the practice of accident prevention through daily contact with his employees.	( )	( )
8. Is satisfied that employees under his jurisdiction thoroughly understand the safety rules of the enterprise.	( )	( )
9. Checks to see if required safety equipment is being used or worn.	( )	( )
10. Takes the initiative in helping to make a success of the safety program.	( )	( )
11. Personally attends all safety meetings.	( )	( )
12. Encourages employee use of the safety suggestion system.	( )	( )
13. Sees that all company vehicles assigned to him are maintained in safe operating condition.	( )	( )
14. Personally instructs each new employee in his assigned work area on safety requirements of the job and records this instruction.	( )	( )
15. Develops safe work procedures using the methods of the job safety analysis.	( )	( )

	Agree	Disagree
16. Gives personal support to all safety activities and safety procedures.	( )	( )
17. Sees that all of his employees receive prompt medical attention when injured.	( )	( )
18. Instructs employees in the inspection of rigging (ropes, cables, chains) before use.	( )	( )
19. Instills a sincere attitude toward safety in all of his employees.	( )	( )
20. Recognizes pinch points (any point where it is possible to be caught between moving parts and stationary parts) and eliminates them when possible.	( )	( )
21. Questions an injured person in detail regarding the accident.	( )	( )
22. Makes special contacts with problem employees as predetermined by the safety department.	( )	( )
23. Attends meetings at least monthly with the safety department.	( )	( )
24. Takes immediate steps to correct unsafe conditions.	( )	( )

	Agree	Disagree
25. Instructs employees in the proper methods of housekeeping.	( )	( )
26. Concentrates corrective activities toward adverse accident trends.	( )	( )
27. Submits to his superior monthly written reports of inspections of tools and equipment.	( )	( )
28. Assures the safety of his employees and of those who may enter into his area of operation.	( )	( )
29. Seeks the advice of the safety department regarding policies, rules, or procedures as they relate to his area.	( )	( )
30. Is thoroughly familiar with and instructs employees in emergency procedures.	( )	( )
31. Enforces the recommendations made by the company physician regarding the limitations of an individual employee.	( )	( )
32. Develops a safety awareness in all employees through personal safety contacts.	( )	( )
33. Sees that the necessary safety equipment is provided for each job.	( )	( )

		Agree	Disagree
34.	Investigates any and all near-miss accidents.	( )	( )
35.	Properly identifies all pinch points (any point where it is possible to be caught between moving parts and stationary parts) which cannot be eliminated.	( )	( )
36.	Provides complete safety instruction to all employees prior to their assignment of duties.	( )	( )
37.	Promotes attendance of employees at safety meetings	( )	( )
38.	Is sure that his men are physically fit before assigning work to them.	( )	( )
39.	Never permits tools or equipment to be used for purposes other than for which they were intended.	( )	( )
40.	Completes reports which will analyze or determine causes of accidents and indicates corrective measures.	( )	( )
41.	Strictly enforces all safety rules and regulations established by the enterprise.	( )	( )
42.	Inspects safety equipment work by employees to determine its condition.	( )	( )

	Agree	Disagree
43. Assures that proper safety practices have been designed into each operation performed in his area.	( )	( )
44. Develops a cooperative safety attitude in his men through the application of preventive and corrective discipline.	( )	( )
45. Makes daily checks of rigging (ropes, cables, chains) equipment in use, with monthly detailed inspections, and records the details of these inspections.	( )	( )
46. Reports weaknesses in the job safety analysis as revealed by observing the particular operation.	( )	( )
47. Makes one safety observation per day, with each employee being observed at least twice per month.	( )	( )
48. Conducts weekly instruction of employees in proper work methods, safety rules and regulations, and records this instruction.	( )	( )
49. Instructs crane operators under his jurisdiction in the proper methods of crane operation.	( )	( )
50. Maintains safety signs and bulletin boards in a clean and legible condition.	( )	( )

	Agree	Disagree
51. Sees that proper lifting devices are used for each job.	( )	( )
52. Trains employees in the most efficient and safe manner of performing their jobs.	( )	( )
53. Questions all witnesses to an accident in an attempt to determine the cause.	( )	( )
54. Requires each employee to clean up his assigned work area daily.	( )	( )
55. Visually inspects lifting devices prior to using them.	( )	( )
56. Is trained and certified in first aid and is capable of administering emergency treatment.	( )	( )
57. Reports observable physical limitations of his employees to the safety department for evaluation.	( )	( )
58. Is satisfied that his employees thoroughly understand the safety rules of the enterprise.	( )	( )
59. Prevents the use of tools or equipment found to be defective.	( )	( )
60. Makes sure that bulletin boards are kept up to date, with notices which are no longer applicable removed.	( )	( )

	Agree	Disagree
61. Observes his employees in the performance of their jobs and corrects any unsafe acts being committed by them.	( )	( )
62. Reviews accident causes, rule violations, unsafe acts, and lack of specific job instructions, as indicated by trends outlined by the safety department.	( )	( )
63. Gives special attention to employees who repeatedly violate safety rules and regulations, or exhibit unsafe work practices, in order to correct them.	( )	( )
64. Is sure that the men assigned to a particular job are capable of performing the job.	( )	( )
65. Holds brief safety meetings with employees before starting work on hazardous or special jobs which are not part of the employee's routine, daily activity.	( )	( )
66. Sees that all rigging (ropes, cable, chains) is used according to recommended practices.	( )	( )

	Agree	Disagree
67. Takes any reasonable action required to prevent an accident where an immediate danger exists.	( )	( )
68. Assures that outside contractors' employees are not endangered by the operations under his jurisdiction.	( )	( )
69. Notifies the safety department of poor housekeeping conditions which cannot be corrected.	( )	( )
70. Conducts group safety meetings weekly, monthly, or whenever specified.	( )	( )
71. Inspects emergency equipment (oxygen apparatus, fire hoses, first aid supplies) and makes appropriate corrections when required.	( )	( )
72. Investigates all accidents which result in property damage.	( )	( )
73. Is familiar with safety-and health-related legislation.	( )	( )
74. Provides periodic instruction in proper lifting procedures.	( )	( )

APPENDIX B

Letter To Jury Of Experts

Explaining Questionnaire

May 3, 1989

Dear.....

I am writing to ask you as one of the experts in industrial safety to participate in a doctoral dissertation designed to assess the impact of front line supervisory safety responsibilities on the overall performance of safety. This dissertation will be the culmination of my studies at West Virginia University and will be dependent on input from safety professionals like yourself.

Your participation in the study has to do with the validation of the enclosed survey questionnaire. Specifically, your involvement will be to check the appropriate box on the line next to each evaluative statement as to whether you "agree" or "disagree" as to its validity as a front-line supervisor safety responsibility. Furthermore, please feel free to include any additional supervisory safety responsibilities that you feel may warrant inclusion in a finalized list.

Please return this questionnaire if at all possible within one week after receipt in the self-addressed, stamped envelope. Additionally, please complete the jury member qualification form which contains questions regarding your current professional involvement in the safety field.

Your professional cooperation in a timely manner will be greatly appreciated.

Sincerely,

J. Owen Weber
6511 Debbie Lane S.
St. Petersburg, FL 33707

APPENDIX C

Jury Member Qualification Form

Name
Title
Organization
Address

Please check "yes" or "no" as to the following:

____yes ____no	Are you currently functioning in a safety-related role?
____yes ____no	Are you currently in command of a safety program or lend support and/or advice on a developmental or evaluative basis to such programs?
____yes ____no	Are you directly or indirectly involved in formulating policy decisions that control the safety program responsibilities of front-line supervisors?
____yes ____no	Are you currently involved in planning, evaluating, or revising safety program components?
____yes ____no	Do you possess at least five years' experience in safety-related matters?

Signature _____

APPENDIX D

Supervisory Safety Duties And Responsibilities Questionnaire To Be Completed By Enterprise Employees

Please rate the following statements in the way that they apply to your foreman/supervisor. Following each statement are seven boxes labeled as follows:

Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
( )	( )	( )	( )	( )	( )	( )

You are to indicate the degree to which you agree or disagree with each statement by checking the appropriate box. Please consider each statement carefully, but do not spend too much time on any one statement. Do not skip any items. There are no "right" or "wrong" answers--the only correct responses are those that are true for you. Remember, rate each of the following statements as to how they apply to your current foreman/supervisor.

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
1. Investigates all lost-time and recordable (medical only) accidents.	( )	( )	( )	( )	( )	( )	( )
2. Properly maintains equipment under his jurisdiction.	( )	( )	( )	( )	( )	( )	( )
3. Demands good housekeeping practices and maintains high standards of cleanliness of operations.	( )	( )	( )	( )	( )	( )	( )
4. Urges employees to become proficient in first aid practices.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
5. Reduces and/or eliminates fire and general property hazards	( )	( )	( )	( )	( )	( )	( )
6. Inspects for unsafe acts and conditions and takes prompt corrective action to reduce or eliminate them.	( )	( )	( )	( )	( )	( )	( )
7. Stimulates interest and attention toward the practice of accident prevention through daily contact with his employees.	( )	( )	( )	( )	( )	( )	( )
8. Is satisfied that employees under his jurisdiction thoroughly understand the safety rules of the enterprise.	( )	( )	( )	( )	( )	( )	( )
9. Checks to see if required safety equipment is being used or worn.	( )	( )	( )	( )	( )	( )	( )
10. Takes the initiative in helping to make a success of the safety program.	( )	( )	( )	( )	( )	( )	( )
11. Personally attends all safety meetings.	( )	( )	( )	( )	( )	( )	( )
12. Encourages employee use of the safety suggestion system.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
13. Sees that all company vehicles assigned to him are maintained in safe operating condition.	( )	( )	( )	( )	( )	( )	( )
14. Personally instructs each new employee in his assigned work area on safety requirements of the job and records this instruction.	( )	( )	( )	( )	( )	( )	( )
15. Develops safe work procedures using the methods of the job safety analysis.	( )	( )	( )	( )	( )	( )	( )
16. Gives personal support to all safety activities and safety procedures.	( )	( )	( )	( )	( )	( )	( )
17. Sees that all of his employees receive prompt medical attention when injured.	( )	( )	( )	( )	( )	( )	( )
18. Instructs employees in the inspection of rigging (ropes, cables,chains) before use.	( )	( )	( )	( )	( )	( )	( )
19. Instills a sincere attitude toward safety in all of his employees.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
20. Recognizes pinch points (any point where it is possible to be caught between moving parts and stationary parts) and eliminates them when possible.	( )	( )	( )	( )	( )	( )	( )
21. Questions an injured person in detail regarding the accident.	( )	( )	( )	( )	( )	( )	( )
22. Makes special contacts with problem employees as predetermined by the safety department.	( )	( )	( )	( )	( )	( )	( )
23. Attends meetings at least monthly with the safety department.	( )	( )	( )	( )	( )	( )	( )
24. Takes immediate steps to correct unsafe conditions.	( )	( )	( )	( )	( )	( )	( )
25. Instructs employees in the proper methods of housekeeping.	( )	( )	( )	( )	( )	( )	( )
26. Concentrates corrective activities toward adverse accident trends.	( )	( )	( )	( )	( )	( )	( )
27. Submits to his superior monthly written reports of inspections of tools and equipment.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
28. Assures the safety of his employees and of those who may enter into his area of operation.	( )	( )	( )	( )	( )	( )	( )
29. Seeks the advice of the safety department regarding policies, rules, or procedures as they relate to his area.	( )	( )	( )	( )	( )	( )	( )
30. Is thoroughly familiar with and instructs employees in emergency procedures.	( )	( )	( )	( )	( )	( )	( )
31. Enforces the recommendations made by the company physician regarding the limitations of an individual employee.	( )	( )	( )	( )	( )	( )	( )
32. Develops a safety awareness in all employees through personal safety contacts.	( )	( )	( )	( )	( )	( )	( )
33. Sees that the necessary safety equipment is provided for each job.	( )	( )	( )	( )	( )	( )	( )
34. Investigates any and all near-miss accidents.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
35. Properly identifies all pinch points (any point where it is possible to be caught between moving parts and stationary parts) which cannot be eliminated.	( )	( )	( )	( )	( )	( )	( )
36. Provides complete safety instruction to all employees prior to their assignment of duties.	( )	( )	( )	( )	( )	( )	( )
37. Promotes attendance of employees at safety meetings	( )	( )	( )	( )	( )	( )	( )
38. Is sure that his men are physically fit before assigning work to them.	( )	( )	( )	( )	( )	( )	( )
39. Never permits tools or equipment to be used for purposes other than for which they were intended.	( )	( )	( )	( )	( )	( )	( )
40. Completes reports which will analyze or determine causes of accidents and indicates corrective measures.	( )	( )	( )	( )	( )	( )	( )
41. Strictly enforces all safety rules and regulations established by the enterprise.	( )	( )	( )	( )	( )	( )	( )
42. Inspects safety equipment work by employees to determine its condition.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
43. Assures that proper safety practices have been designed into each operation performed in his area.	( )	( )	( )	( )	( )	( )	( )
44. Develops a cooperative safety attitude in his men through the application of preventive and corrective discipline.	( )	( )	( )	( )	( )	( )	( )
45. Makes daily checks of rigging (ropes, cables, chains) equipment in use, with monthly detailed inspections, and records the details of these inspections.	( )	( )	( )	( )	( )	( )	( )
46. Reports weaknesses in the job safety analysis as revealed by observing the particular operation.	( )	( )	( )	( )	( )	( )	( )
47. Makes one safety observation per day, with each employee being observed at least twice per month.	( )	( )	( )	( )	( )	( )	( )
48. Conducts weekly instruction of employees in proper work methods, safety rules and regulations, and records this instruction.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
49. Instructs crane operators under his jurisdiction in the proper methods of crane operation.	( )	( )	( )	( )	( )	( )	( )
50. Maintains safety signs and bulletin boards in a clean and legible condition.	( )	( )	( )	( )	( )	( )	( )
51. Sees that proper lifting devices are used for each job.	( )	( )	( )	( )	( )	( )	( )
52. Trains employees in the most efficient and safe manner of performing their jobs.	( )	( )	( )	( )	( )	( )	( )
53. Questions all witnesses to an accident in an attempt to determine the cause.	( )	( )	( )	( )	( )	( )	( )
54. Requires each employee to clean up his assigned work area daily.	( )	( )	( )	( )	( )	( )	( )
55. Visually inspects lifting devices prior to using them.	( )	( )	( )	( )	( )	( )	( )
56. Is trained and certified in first aid and is capable of administering emergency treatment.	( )	( )	( )	( )	( )	( )	( )
57. Reports observable physical limitations of his employees to the safety department for evaluation.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
58. Is satisfied that his employees thoroughly understand the safety rules of the enterprise.	( )	( )	( )	( )	( )	( )	( )
59. Prevents the use of tools or equipment found to be defective.	( )	( )	( )	( )	( )	( )	( )
60. Makes sure that bulletin boards are kept up to date, with notices which are no longer applicable removed.	( )	( )	( )	( )	( )	( )	( )
61. Observes his employees in the performance of their jobs and corrects any unsafe acts being committed by them.	( )	( )	( )	( )	( )	( )	( )
62. Reviews accident causes, rule violations, unsafe acts, and lack of specific job instructions, as indicated by trends outlined by the safety department.	( )	( )	( )	( )	( )	( )	( )
63. Gives special attention to employees who repeatedly violate safety rules and regulations, or exhibit unsafe work practices, in order to correct them.	( )	( )	( )	( )	( )	( )	( )
64. Is sure that the men assigned to a particular job are capable of performing the job.	( )	( )	( )	( )	( )	( )	( )

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
65. Holds brief safety meetings with employees before starting work on hazardous or special jobs which are not part of the employee's routine, daily activity.	( )	( )	( )	( )	( )	( )	( )
66. Sees that all rigging (ropes, cable, chains) is used according to recommended practices.	( )	( )	( )	( )	( )	( )	( )
67. Takes any reasonable action required to prevent an accident where an immediate danger exists.	( )	( )	( )	( )	( )	( )	( )
68. Assures that outside contractors' employees are not endangered by the operations under his jurisdiction.	( )	( )	( )	( )	( )	( )	( )
69. Notifies the safety department of poor housekeeping conditions which cannot be corrected.	( )	( )	( )	( )	( )	( )	( )
70. Conducts group safety meetings weekly, monthly, or whenever specified.	( )	( )	( )	( )	( )	( )	( )
71. Inspects emergency equipment (oxygen apparatus, fire hoses, first aid supplies) and makes appropriate corrections when required.	( )	( )	( )	( )	( )	( )	( )

72. Investigates all accidents which result in property damage.	( )	( )	( )	( )	( )	( )	( )
73. Is familiar with safety-and health-related legislation.	( )	( )	( )	( )	( )	( )	( )
74. Provides periodic instruction in proper lifting procedures.	( )	( )	( )	( )	( )	( )	( )

APPENDIX E

Letter And Prospectus To
Enterprise Manager Soliciting
Support And Cooperation

July 31, 1989

Mr. Dave Bilodeau
Corporate Safety Director
APAC-Inc.
3340 Peachtree Road N.E.
Atlanta, GA 30326

Dear Dave:

As we discussed during our conversation on July 10, I am enclosing an article that I co-authored and published in Professional Safety as well as an article in its final draft entitled Developing A Comprehensive Safety Program. Both articles illustrate my philosophical outlook relative to the field of safety.

Also, as we discussed, I'm enclosing a proposal to undertake safety research with your firm. This research will be the cornerstone of my doctoral dissertation in the field of safety management and needs to be completed by November 1, 1989. Although limited in time I'm confident that by working closely with you, we can complete all work with time to spare.

As I indicated, I'm willing to personally absorb all costs associated with the research although I would be forever grateful if you would have one of your on-site employees (preferably safety manager) administer the rating questionnaire. In addition to absorbing all costs, I will provide a copy of the working draft to you before submitting to my committee so that I can obtain your input as well as ensure that my data and statements are consistent with APAC's mission. Furthermore, if we are able to get together and complete the research within the prescribed time frame, I would be more than happy to be a speaker at your national meeting in Tampa once again at my expense.

Dave, as I indicated, I'm under the gun from a time standpoint and I'm looking to you for assistance. What I need is ten (10) similar companies, i.e., same industry, with at least 10 employees, and a corresponding productivity measure such as tons per man day. I will have the employees rate their supervisor relative to their safety effectiveness then correlate that score with productivity. My hypothesis will be to show that companies that are evaluated most favorably from the standpoint of supervisory safety effectiveness will also have the highest productivity.

As you can see, the study is straightforward and to the point. I'm hoping that we can work something out within the prescribed time frame. Thanks for your consideration and assistance. If I can answer any questions concerning the above or the enclosed, then please do not hesitate to call on me at (813)345-8769. Until then I remain,

Sincerely

J. Owen Weber

Encls.

DOCTORAL DISSERTATION PROPOSAL

FOR

J. OWEN WEBER AND APAC, INC.

INTRODUCTION

Executives for at least the last two decades have questioned the efficacy of their safety programs. Specifically, they have queried 1) the extent to which programs are economically justified; 2) whether the scope of their own safety program is necessary; and 3) whether their in-place programs are in fact the best ones for the company.

Although no single survey can provide either universally applicable findings or address all facets of these questions, the proposed doctoral dissertation will nevertheless seek to address critical aspects of these questions. Similarly, although the dissertation as an academic requirement focuses on critical general issues of safety, APAC has the opportunity to have the research provide specific findings for their company if they permit the research project to use inputs and comparisons from APAC employees and production units.

The principal benefit that APAC should receive from the study is "an increase in the relative efficiency of their safety programs as measured by increased productivity and/or lower economic and human resource costs." This benefit should be realized through the use of the study findings in the safety managers' decision making.

If APAC is seeking to mitigate both the human and economic costs of accidents the study should be of interest. The study will provide information for decisions that will help define the human and economic consequences of alternative courses of action and/or programs.

OBJECTIVES

The proposed doctoral dissertation research has several objectives that should be germane to a profit oriented company like APAC. These objectives include:

1) To ascertain safety duties and responsibilities that should increase productivity? Conversely, are their safety actions that will tend to reduce productivity?

2) To ascertain whether the safety activities performed by the front-line supervisors are consistent with their assigned safety responsibilities?

3) To ascertain whether employees are aware of the safety activities performed by their front-line supervisors and whether their perceptions of such activities differ significantly from reality.

4) To ascertain whether the authorized safety activities performed by the front-line supervisors are perceived to be beneficial to the employees and company?

The study addresses these and other questions by statistically relating the findings from a survey of employees with both the findings of the same survey administered to management as well as selected production output indicators from the sampled production units.

RESEARCH DESIGN

The first step in collecting data will be to disseminate the survey instrument to various line personnel. Either the researcher or a company representative will be on hand during this time. Ideally, the employee can complete the instrument just prior to, or at the close of the work day, since only a few minutes will be required for completion.

Specifically, employees will be asked to complete a questionnaire with seventy-four item components each with seven response categories; strongly agree, agree, slightly agree, undecided, slightly disagree, disagree, and strongly disagree. Weights will be assigned to each response with a weight of 6 for responses most favorable to supervisors and a weight of 0 for least favorable responses. Weights of 5, 4, 2, 1 will be assigned to intermediate responses while a weight of 3 is reserved for undecided responses. Item scores will then be summed to obtain an aggregate score on how the employees perceive the supervisor as fulfilling his supervisory safety duties and responsibilities. The theoretical range of scores is therefore from 0 to 444 for each supervisor. Supervisor scores will then be aggregated to obtain a mean score for each location. It is this figure, supervisory safety effectiveness score for each location, which will be subsequently used as the independent variable in this study. Thus, a high score indicates a favorable attitude toward the supervisor's fulfillment--and ultimately the location's fulfillment--of safety duties and responsibilities while a low score indicates the obverse; i.e., an unfavorable attitude toward the supervisor and ultimately the location. A questionnaire utilizing the above characteristics with the seventy-four duties and responsibilities is attached to this proposal.

Employees will be asked to complete the supervisory safety effectiveness questionnaire for their current supervisor. It will be stressed that their responses will be completely confidential and, in fact, the survey is designed to protect their anonymity. It will be equally stressed that the survey is only one component that has been sanctioned by upper management in an effort to get a true picture of the overall safety program within the boundaries of that given location. Furthermore, employees will be instructed not to look upon the instrument as an opportunity to excoriate the entire supervisory ranks for past differences with individual supervisors but, instead, should utilize this opportunity to help the company provide a better and more suitable workplace.

Each participating location will then be asked to supply the researcher with a predetermined productivity measure such as output per man day for the previous month as well as the previous twelve months. This productivity accomplishment measure should provide a uniform method for determining productivity among various locations.

ANALYZATION OF DATA

Once the questionnaires have been completed, the next major step in the project will be to select the suitable statistical method(s) to analyze the collected data so that appropriate conclusions can be drawn and their statistical significance reported. For measurement of the data, two scales, the ordinal and the interval will be used. The ordinal ranking scale refers to a level of measurement when objects in various categories of scale stand in some kind of relation to the categories. Examples of this relation among classes are: higher, more preferred, more difficult, and so on. The interval scale refers to a level of measurement when a scale has all the characteristics of the two lower type scales, and in addition, the units of measure - or intervals between successive positions - are equal.

Since the dependent variable, output per man day, is an interval scale item and the independent variable, or supervisory safety effectiveness is an ordinal scale item, the most appropriate statistical test is analysis of variance (ANOVA). Analysis of variance is essentially a method for ascertaining from sample data whether one factor really influences another factor or whether the observed association was the result of sampling fluctuation.

In addition, since analysis of variance is only designed to show if a significant difference exists between the composite score of variables, the Scheffe S post hoc test will also be utilized. The Scheffe S test will be utilized to test the significance of the differences between all pairs of means and was selected since it is generally considered to have "the greatest power and is most conservative with a respect to Type I error"

and will therefore lead "to the smallest number of significant differences." These statistical tests will therefore test the relationships that exist between supervisory safety effectiveness and unit productivity.

SUMMARY

APAC's participation is strongly sought for several reasons. First, the company's plant portfolio makes possible ten or more production units in several industries. This will improve the ability to do "among unit analysis" because of the greater comparability of the data. Second, the use of a single company makes the coordination of the study easier. Finally, the use of a single company results in the findings being more meaningful to the selected company.

If APAC agrees to participate in the study, they will receive at no cost the entire detailed analysis of the data used for the dissertation, a special analysis of the data run specifically for APAC, and a presentation of the findings to interested management. In addition, APAC will have the satisfaction of knowing they played an invaluable role in a doctoral student's quest for additional knowledge as well as that same student's eternal appreciation.

APPENDIX F

Letter To Enterprise Manager Requesting Additional Data

October 10, 1989

Mr. David Bilodeau
Corporate Safety Director
APAC-Inc.
3340 Peachtree Road N.E.
Atlanta, GA 30326

Dear Dave:

As of the above date I have received 60 completed questionnaires from 6 locations - three each from Ron Cross' Division and William Scarborough's Division. However, time is running out and I still need at least four more locations with a minimum of ten respondents from each. Would you please see if you could expedite the survey completion from the other divisions?

Additionally, I am in need of the productivity measure for each quarry that we previously discussed. After talking to Ron, this will involve generating two sources of information, namely the 7000-2 quarterly summary of hours worked by limestone quarry employees (only) for the last four quarters (October, 1988 - September, 1989) as well as the limestone tonnage produced at each location, by month, for the months October, 1988 through September, 1989.

Furthermore, if at all possible, I would like to have a listing of the frequency and types of accidents that have taken place at each quarry over the past 12 months as well as the dollar amount of medical expenses incurred - both actual and projected. After discussing the availability and applicability of such information with Ron, he suggested I contact Mike Sheatler, Apec's Claims' Supervisor with United Service Agency, who in turn indicated that the data is available and could be generated if you give him the go ahead. I humbly request that you give Mr. Sheatler the green light since such data will only add credence to the study already underway.

Dave, your timely cooperation in this undertaking is greatly appreciated. I will contact you either tomorrow or Thursday to determine where we stand. Thanks for your help.

Cordially,

J. Owen Weber
6511 Debbie Lane S.
St. Petersburg, FL 33707
(813)345-8769

Relationships Between Supervisory Safety Contributions And Productivity Accomplishment Among Limestone Quarries

J. Owen Weber

ABSTRACT

This study determined the relationship between how employees perceived their supervisors relative to their safety contributions and productivity as measured in limestone tons per man hour.

This study was undertaken for the purposes of providing to enterprise safety function manager's research based data which would be useful in ascertaining the safety contributions of their front line supervisors as well as discovering those items beneficial to focused supervisory training.

The investigator constructed a survey instrument consisting of a Likert scale evaluation of fifty-seven supervisory safety duties and responsibilities. These statements were the result of a jury of experts revalidation of the original seventy-four items. Response pattern bias necessitated the elimination of seventeen items. The resulting instrument was administered and the sample data collected from 106 respondents employed in eleven quarries.

The analysis resulted in the definition of five indices of safety management activities. The developed indices were: Management Policies, Motivational Techniques, Training Practices, Hazard Control and Accident Investigation. The analysis of the partial correlation coefficients identified a significant relationship existing between each of the five indices, comprised of the pertinent safety contribution items, and productivity.

Analysis of variance was also performed to assess the differences that existed between individual supervisors as well as the differences in the way supervisors and selected quarries were evaluated relative to key task indices. The analysis showed that the methodology used in the study can be used to identify training needs and assess the safety contribution levels of supervisors.

J. OWEN WEBER

Home Address:
6511 Debbie Lane S.
St. Petersburg, Florida 33707
Home Telephone: (813)345-8769

Birthdate:10/25/48
Health: Excellent
Marital Status: Married
Office Telephone: (813)894-2360

EDUCATION

Doctor of Education (a.b.d.), West Virginia University, Morgantown, West Virginia.

Prospective graduation date: June, 1990. Specialization in Safety Studies. Program concentrated on the design, implementation and maintenance of safety programs via the utilization of commonly accepted management principles. Dissertation focused on the relationship between supervisory safety contributions and productivity in a selected industry.

Master of Business Administration, University of South Florida, Tampa, Florida.

Degree received in March, 1973. Served as graduate assistant analyzing marketing problems and doing research for Chairman of the Marketing Department.

Bachelor of Business Administration, University of Miami, Coral Gables, Florida.

Degree received in June, 1970. Majored in Personnel Management and Industrial Relations.

WORK EXPERIENCE

Management Consultant (1978–Present)

Sperry-Boom of Florida, 1641 First Avenue North, St. Petersburg, Florida. Primary responsibilities have included developing and implementing training sessions on planning, communications, MBO, conflict resolution, time management, financial/marketing management, self assessment and organizational climate. Between 1984 and 1989 trained over 1500 independent businessmen in the United States, Canada, England, France, of a myriad of strategic plans for major U.S. and Canadian companies and personally developed a safety program for a Texas manufacturing plant that reduced injuries by 66% in 12 months. Additional responsibilities have included a heavy emphasis on the writing and editing of final reports and

comprehensive training manuals. Furthermore, have made numerous formal presentations to top level management for Fortune 500 companies in addition to interfacing regularly with all levels of management.

Lecturer (1980-1983)
West Virginia University, Morgantown, West Virginia. Instructed graduate school safety courses pertaining to occupational legislation and compliance, industrial security, disaster preparedness, property damage and waste minimization, manpower development, research design and measurement, and contemporary beliefs and foundation. Participated in the development and formulation of the school-wide five year plan. Designed a systematic flow chart for utilization in the practical application of professional safety programs.

Operations Trainee (1974-1977)
McDonald's Corporation, 9600 Gandy Blvd., Suite 200, St. Petersburg, Florida. One of three individuals hired against 150 to 200 applicants for accelerated training program designed to provide the company with staff personnel whose background included previous administrative experience and advanced education. Successful fulfillment of the program was predicated on the professional management of a single store. During eighteen months as unit manager was repeatedly recognized as a leader in P & L performance as well as people development. Was one of four managers out of 140 statewide nominated for outstanding manager of the year (1976) in the area of accounting and profitability.

Senior Sales Analyst (1973-1974)
Burger King Corporation, 7360 N. Kendall Drive, Miami, Florida. Responsible for designing and implementing analytical programs in order to provide management with the information necessary to develop maximally effective marketing programs. Other responsibilities included the design and implementation of a national trading area survey, forecasting of future sales, product mix analysis and the analyzation of competitive marketing activities. Excellent experience in Management by Objectives.

PUBLICATIONS

Reviewed for the Water Pollution Control Federation their official safety manual entitled "Guidelines For Developing A Wastewater Safety Program," June, 1983.

Co-authored with Dr. Warren A. DeBord of the University of South Florida an article entitled "Recognizing and Controlling Conflict" that was published in Professional Safety magazine in the November, 1981 issue.

Co-Authored with Dr. Warren A. DeBord of the University of South Florida a case study dealing with the construction equipment industry. This policy case was presented to the Case Research Association's annual meeting (November, 1981) and accepted for publication in their semi-annual journal.

Co-authored with Dr. Kenneth R. VanVoorhis of the University of South Florida a factual case study that revolved around Burger KingCorporation's marketing planning and the ramifications therein. The study was accepted for presentation to Workshop (November, 1974) and for publication by The Intercollegiate Case Clearing House at Harvard University.

Co-authored with Dr. Kenneth R. VanVoorhis, a case study of the fast-foods industry. The study was presented to the Santa Clara Case Workshop (October, 1973) and accepted for publication by The Intercollegiate Case Clearing House at Harvard University. Subsequently published in six casebooks dealing with various facets of marketing and management.

CONFERENCES/PRESENTATIONS

"How to Develop a Plant Safety Program." Presented to the Tri-State Safety Council, Hagerstown, MD. January, 1981. 39 Safety Managers present.

"Recognizing and Controlling Conflict." Presented to the Western Pennsylvania Safety Council, Monroeville, PA. April, 1983. 140 Safety Practitioners present.

"Managing Conflict." Presented to the Management Development Group of Newport News Shipping and Drydock, Newport News, VA. April, 1983. 35 Safety and Industrial Relation Managers present.

"Problem Solving and Decision Making." Presented to the Western Pennsylvania Safety Council's Safety and Productivity Partners for Progress seminar on September 29, 1983. 135 Safety practitioners from Western Pennsylvania present.

"Analysis of Mining Fatalities in the Coal Industry: Management Failure and Governmental Citations, 1983." Presented to The American Council of Governmental Industrial Hygienists, Detroit, MI, May, 1984. 50 Industrial hygienists present.

"Building Your Business by Developing A Professional Image." Presented to the J. I. Case annual convention of Agricultural Implement Dealers, Kansas City, MO, December, 1989. 1500 Dealers present.

"Building Value In Your Business." Presented to the J.I. Case annual convention of Construction Equipment Dealers, Phoenix, AR, February, 1990. 1,000 dealers present.

APPROVAL OF EXAMINING COMMITTEE

Daniel E. Della-Giustina, Ph.D.

Dietrich Schaupp, Ph.D.

Pete Shaffron, Ed.D.

Stanley Wearden, Ph.D.

April 20, 1990
Date

C. Everett Marcum, Chairman, H.S.D.