AN INQUIRY INTO FACTORS THAT MIGHT EXPLAIN DIFFERENCES IN OCCUPATIONAL ACCIDENT EXPERIENCE OF SIMILAR SIZE FIRMS IN THE SAME INDUSTRY

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YAGHOUB SHAFAI-SAHRAI

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This is to certify that the

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presented by

Yaghoub Shafai-Sahrai

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Rollin H. Simonds
Major professor

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ABSTRACT

AN INQUIRY INTO FACTORS THAT MIGHT EXPLAIN DIFFERENCES IN OCCUPATIONAL ACCIDENT EXPERIENCE OF SIMILAR SIZE FIRMS IN THE SAME INDUSTRY

By

Yaghoub Shafai-Sahrai

It has long been recognized that some industries because of the nature of tasks involved, have potentially higher work injury frequency and severity rates than others. Yet, within the same industry firms experience widely different occupational injury rates. Furthermore, within each industry, injury rates tend to be relatively higher for small size firms than large, though some of the small industrial concerns demonstrate excellent safety performance records.

This study was an attempt to investigate empirically some of the factors that could possibly provide an explanation for differences in accident experience and injury rates of similar size firms in the same industry.

A series of hypotheses were formulated to be tested concerning correlates of each of the following factors to

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work accidents. The factors were: 1) Top management's support and involvement in safety; 2) Formal educational level of workers; 3) Age of the employees; 4) Company recreational programs; 5) Promoting safety through employee's family; 6) Safety rules; 7) Marital status of the workers; 8) Worker's length of service in a company; 9) Company age; 10) Accident record keeping system; 11) First line supervisors' relative span of control; 12) Relative age of production machinery and equipment; 13) Physical workplace conditions; 14) Safety devices and controls on machinery; and 15) Safety committees.

Selection of eleven matched-pairs of industrial firms from eleven different industries, located in 16 different locations throughout the State of Michigan, constituted the sample of this study. Each pair was composed of two similar size firms in the same industry but with one of these two having higher injury rates than the other. For collection of data, company visitation and personal interviewing were the principal means. The major findings of this study are as follows:

1) The hypothesis that in the firms with better safety records, top management is highly interested and involved in company's safety

performance, appears to be strongly supported by this study.

2) Formal educational level of employees in the firms studied, did not correlate with the injury rates.

3) Higher average age of employees is positively correlated with better safety performance records of the firms.

4) Companies that provide recreational programs and facilities for their employees, tend to have considerably lower work injury rates than the companies without such programs and facilities.

5) The hypothesis that firms with better safety records have tried to promote safety through employee's family was not supported by this study.

6) Quality and quantity of safety rules showed little correlation with safety performance of the firms studied.

7) Firms employing more married workers on the average tend to have significantly better safety performance records than the firms with

fewer married employees in their employ.

8) This study supported the hypothesis that a positive correlation exists between low accident rates and higher average employee length of service.

9) Age of the companies showed no significant correlation with safety performance.

10) Among the companies studied, those with a better accident record keeping system were found to have considerably lower work injury rates.

11) The larger span of control of the first line supervisors tends to be significantly correlated with higher work injury rates.

12) Relative age of the production machinery and equipment did not tend to correlate with the accident experience.

13) Roomy, and clean shop environment with adequate temperature, ventilation, lighting and noise level, appears from this study, to be significantly correlated with low injury rates.

14) The hypothesis that better and more safety devices on machinery contribute to attainment

of better safety performance records of the companies, was strongly confirmed by this study.

15) Safety committees did not appear from this research to be a significant factor in attainment of a good safety performance record.

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by

Yaghoub Shafai-Sahrai

A THESIS

submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Management

1971

TO: my wife Parvin

my daughter Azita

my son Armin

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ACKNOWLEDGMENTS

The successful completion of a research study of any magnitude is seldom the product of efforts of a single person. This thesis is no exception and I wish to express my deep gratitude and appreciation to the many individuals and organizations who contributed to this field study.

I am extremely grateful and indebted to the People and Government of Iran specially officials of the Imperial Iranian Army who provided me the opportunity to pursue the Ph.D program.

My sincere appreciation goes to the members of my dissertation guidance committee. Professor Rollin H. Simonds, chairman of the committee, who is an internationally known authority in the field of occupational safety management has provided expert counsel, encouragement, assistance and time under demanding work schedules and severe time constraints for which I am deeply grateful. But the debt I owe to Professor Simonds is not likely to be fully repaid. Professor Daniel Kruger generously contributed the initial idea for this endeavor and subsequently provided invaluable advice, encouragement and assistance to which I am sincerely thankful. Professor Robert Penfield supplied the initial impetus and contributed substantially to this work to which

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I wish to extend my gratitude.

I also would like to thank Dr. Dalton E. McFarland, Professor and Chairman of the Department of Management for providing advice and assistance throughout the years of my study.

The author is specially grateful to the presidents of the twenty-two firms included in this study who did not wish to be identified by name. I am also thankful for the assistance received from the employees and officials of the Michigan State Department of Labor. Mr. Don F. Jones, Executive Director, Labor Safety Council of Ontario, provided invaluable references on industrial accident research to which I am sincerely grateful.

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Although generous assistance, direction, cooperation and encouragement supplied by above organizations and individuals contributed to my ultimate success in this endeavor, the content of this study and research conclusions, are of course solely my responsibility.

TABLE OF CONTENTS

Chapter		Page

LIST OF TABLES

Table		Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Discussion

Even though considerable progress has been made over the past half a century in preventing occupational accidents, annual figures indicating frequency[1] and severity[2] rates of work injuries and their resulting costs, still represent a serious problem for managers of today's business concerns.

Achievement of business goals and the maintaining of a healthy and prosperous organization will be impossible unless managers start and lead an active campaign against accidents by fully utilizing every effective resource available to them in order to minimize human and economic losses resulting from work accidents. Perhaps it will be impractical -- if not impossible -- to completely eliminate occupational accidents, but even if it were possible and/or

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[1]Frequency rate is total number of disabling injuries per million employee hours of exposure.

[2]Severity rate is total days lost or charged per million employee hours of exposure.

practical, managerial campaign would have to be continued in order to keep the accident record at that minimum level. Thus prevention of industrial accidents and achievement of occupational safety objectives is a continuous and endless challenge for managers. Many suggestions have been put forward on the industrial injury problem, including stricter legislation, a more intensified educational approach, and financial inducements. Yet none of these can successfully achieve their end without a management's earnest co-operation. It is on them that the onus rests. It should also be recognized that accident prevention is a joint problem for government, business and industrial organizations, insurance companies, employers, employees and other agencies. In other words, occupational safety is everybody's business, but to the man who sits in the manager's chair, it becomes a compelling responsibility, for safety takes account of the experience that what is everybody's business usually turns out to be nobody's business.

It should be obvious that producing more products with lower costs and better quality is an ideal achievement for an industiral concern, but as Henry Ford and other industrial and business entrepreneurs,[3] and pioneers have

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[3]National Safety Council, "50 Years Ago ... What They Were Saying About Safety," National Safety News, Nov 1969.

looked at the subject matter, production without safety is inefficient. Accident prevention is absolutely an essential part of the controlling of the industrial operations. Minimizing industrial accidents is a significant means of reducing costs. If a business concern is proud of providing goods and rendering services to the community to which it belongs, it should also consider the fact that no greater service to humanity can be given than that which seeks to prevent accidents and occupational diseases.

The National Safety Council reports[4] that between 1912 and 1969, accidental work deaths per 100,000 population were reduced 67 percent from 21 to 7. This is an indication of a steady and impressive progress which has been made in reducing work injury rates. But as the challenge continues to further reduce occupational injury rates, it becomes increasingly difficult to maintain the pace of yesterday's steady achievement. Today companies are generally more safety oriented than in the past, but many show little effect of the safety movement.

Despite tremendous achievements in the way of preventing occupational accidents, for the individual employee who as a result of today's work injury suffers from

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[4]National Safety Council, Accident Facts (Chicago, Illinois, 1970), p. 83.

impairment and economic loss, these achievements do not mean much and, in fact, he may even feel much worse off and more unfortunate than his fellow worker who suffered from the same work injury half a century ago. While the worker is almost daily witnessing scientific achievements of unparalleled magnitude, he sees no corresponding improvement in his immediate work environment, while he watches lunar-orbiting astronauts and is confident of their safe return, his assurance of a safe return home from the job has not kept pace.

What is required is a basic reorientation of societal interests, backed by social concern and encouragement, the space program received the requisite financing and manpower to accomplish tasks of unforeseeable complexity. Yet, lack of interest in the simpler problems of occupational safety has left a discouraging scar of human and economic losses on the face of such progress. Illustrative of this dearth of interest is the obviously tremendous imbalance between, for instance, concern for sporting events and for occupational safety. It is not difficult at all for anybody who wishes to observe this proposition for himself in every day life. It was surprised to notice that except in a very few cases, I could not meet anybody in the University, my residential area, or different companies studied that had a fair knowledge about the magnitude of accident toll, especially occupational accidents. Among twenty-five students in the MGT 413 class that I taught in fall term 1970, no one had seen nor heard about "Accident Facts" which is published annually by the National Safety Council. Of course twenty-five students are not too many but if we consider this as a sample, it may very well represent the majority of people in this educational society. Anybody can easily find out for himself the validity of this statement. He can simply ask the people whom he knows, he sees, he meets, and he will be surprised to find even one person who has seen and has looked at the content of "Accident Facts".

It seems to me that "more than fourteen thousand fatalities" and more than two million disabling injuries at work, in a year, should be considered very important and should be given fair attention by everybody in the society. Why not follow safety records, strive, support and urge people and agencies involved to get the first place in the occupational safety race and accident prevention game. This interest and concern must be taught and promoted continuously as has been, still is and will be done in the case of sports and society's other favorite events. It is my true belief that work accidents are absolutely unnecessary and can and should be prevented. As time passes, and technology advances, it may be an even more difficult task to further reduce fatal and disabling injuries and thus society's concern with safety must be more active and creative than ever for technology is not going to slow down and wait for safety to catch up. There is a lot to be learned and discovered in the field of occupational accidents and the management of safety in work environment. It is one of the long recognized and obvious principles of war that a successful fight against any enemy requires perfect knowledge and information about him, and yet such a knowledge is not available about work accidents. Thus, fighting against this enemy will result in failure unless necessary knowledge is collected and fighting strategies are reoriented and based on these facts. It is in recognition of this fact that this study is being undertaken.

Nature of the Problem

According to estimates reported by the National Safety Council,[5] occupational accidents claim more than 14,000 lives and cause over 2,000,000 disabling injuries in the United States each year. Although continued efforts gradually have reduced accidents and their seriousness,

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[5] Accident Facts, op. cit., p. 23.

the improvement rate -- as predicted by one of the experts in the field of Safety Management[6] -- has been decreasing in recent years. Table I-1 indicates the magnitude of the work accident toll for the six year period of 1964 to 1969.[7]

TABLE I-1

FATALITIES AND DISABLING INJURIES FROM ALL WORK ACCIDENTS
1964-1969[8]

Year	Total Deaths	Total Disabling Injuries	Time Lost Man-Days	Total Number of Workers	Deaths per 100,000 Workers
1964	14,200	2,050,000	235,000,000	67,600,000	21
1965	14,100	2,100,000	235,000,000	69,700,000	20
1966	14,500	2,200,000	255,000,000	72,600,000	20
1967	14,200	2,200,000	245,000,000	74,700,000	19
1968	14,300	2,200,000	245,000,000	76,900,000	19
1969	14,200	2,200,000	245,000,000	79,000,000	18

Even though the total number of deaths and disabling injuries are steady over the period covered by Table I-1,

[6]Rollin H. Simonds, John V. Grimaldi, Safety Management (Homewood, Illinois: Richard D. Irwin, Inc., Revised Edition, 1963), p. 3.

[7]These figures have been collected and tabulated as shown in this table from 1965, 66, 67, 68, 69 and 1970 edition of the Accident Facts, pp. 23-39, published annually by the National Safety Council, Chicago, Illinois.

[8]Ibid., p. 25.

because of an increase in total number of workers, the death and disabling injury rate per 100,000 workers have been gradually decreasing. However, the cost of accidents as shown in Table I-2, estimated by the National Safety Council, for the same period has been increasing at a much higher rate. These figures do not include the value of property damage in all accidents, except direct losses in fires.

TABLE I-2

TOTAL COST OF WORK ACCIDENTS FOR THE SIX YEAR PERIOD OF 1964-1969[9]

Year	Total Cost of	% Increase From Prior Year	Cost per Worker to Industry
1964	$5,200,000,000	+ 4%	$75
1965	6,800,000,000	+ 7%	90
1966	6,800,000,000	+ 6%	90
1967	7,300,000,000	+ 7%	95
1968	7,900,000,000	+ 8%	100
1969	9,000,000,000	+ 9%	110

[9]Ibid., p. 25.

There is no agreement among safety men with respect to what is causing the work accident cost boost, but insurance companies which pick up a growing tab, present two causes for the cost gains. First, the area of new chemical materials alone introduce 4,000 new compounds a year, many of them toxic. They include radioactive material, plasma, ore, super speed cutting tools, and toxic metals like beryllium, which are in growing use. The second reason given is that even though accidents are fewer, their severity is higher.[10] Obviously the direct effect of the continuous rise in the wage level and medical and workmen's compensation costs cannot be ignored when one tries to find an answer to the question of "why accident costs rise"? Of course, there are some other factors that play an important role in these cost gains -- like worker's greater awareness of labor-protecting laws and workmen's compensation provisions and so on -- that could be added to the list of causes. Nevertheless, the major purpose of this section is to indicate the magnitude of human and economic losses resulting from work accidents so that the problem can be felt and recognized by: (1) those who have the

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[10]For further discussion see: "Rise in Plant Accident Costs Spurs Industry Safety Drive," Special Report, Iron Age, Vol. 188, No. 18, Nov. 2, 1961, p. 41.

capability of conducting a scientific inquiry to further discover unknown areas of work accidents; (2) those who can do something about preventing these unnecessary mishaps, namely those who design machinery, make, install and operate it; (3) those who provide the physical as well as the psychological environment in which these accidents happen; (4) and, finally, those who ultimately pay for these accidents -- namely end-users or consumers.

So far, figures that have been given were at the National level which include Michigan as well as all other states in the union. However, Michigan, being one of the largest industrial states has contributed to these national figures, and more specifically the Michigan State Department of Labor Annual Report[11] (fiscal year 1968-69) indicates that work load of the bureau of workmen's compensation for the fiscal year 1969-70 is: 53,365 injured workers and 376 fatalities. These are only the compensable injuries that were reported to the Department of Labor and the actual number of first aid cases, doctors cases, and "lost time" injuries that are not compensable -- namely cases that cause less than 7 days lost time and no permanent disability -- is much greater than those reported here. After all,

[11]Michigan State Department of Labor, Annual Report - Fiscal Year 1968-69, Vol. 4, 1969, p. 53.

what should these figures and numbers mean to any one who is exposed to them? What kind of message is supposed to be conveyed to a reader or a listener by these facts? I believe that the best possible answer for these and any other similar questions has been expressed by Professor Simonds in the following words:[12]

> "These facts show that occupational accidents present a problem that qualifies eminently on two counts as one warranting study and significant constructive action in business. It involves consequences of great importance, and it is something over which it is possible and practical for man to exercise control."

Purpose of the Study

Occupational safety studies and work accident reports have revealed that some industries have higher accident rates than others. Yet, it has long been recognized that not only do different industries have different accident frequency and severity rates, but also within the same industry firms experience widely different work injury rates.

The purpose of this research study is to conduct an inquiry into some of the factors that might explain why similar firms in the same industry experience different occupational accident rates, and ultimately to make some useful generalizations about the significance of the role

[12] Simonds, op. cit., p. 4.

that some of these factors might play in causing different (lower or higher) work accident rates. Having this knowledge will be helpful in winning the campaign against industrial accidents and eventually to further prevent the occurrence of human and economic losses.

In the belief that certain factors of managerial attitude toward safety, physical working conditions, characteristics of employees (with respect to age, marital status, number of years spent with the company, attainment of formal education) first line supervisor's relative span of control, accident record keeping procedures, quality and quantity of safety and control devices on machinery; recreational facilities and programs for employees; availability and provisions of medical personnel and facilities, relative age of equipment and machinery in the firms, safety rules, interest of employee families in over all company programs, personalized safety training programs, and company age may be significant in the causation of different accident experience in different firms, the writer formulated the following hypotheses concerning correlates of accidents and subjected each to an experimental design for testing. The hypotheses were:

1. In the firms with lower work injury frequency and severity rates, top management is highly

interested and involved in the company's over-all safety program and actively participates in and supports safety activity.

2. In the firms with better injury frequency and severity rates, workers have higher average attainment of formal education than in firms with relatively poor work injury records.

3. In the firms with better safety records, average age of the employees is higher than the firms having relatively high accident rates.

4. Firms with better safety records have provided recreational programs and facilities for the employees, and by doing so, have helped to bring employees together. This, in turn, has contributed to the establishment of friendly relationships among them and created a favor-able work environment in which employees may be more safety conscious.

5. Firms with low work injury records have tried to promote employees' safety interest through their families.

6. Firms with low work injury experience have established comprehensive safety rules covering all operations, have made sure that all employees

understand them and have consistently enforced them.

7. Average number of married employees is higher in the firms with better safety records than firms with poor safety records.

8. Average number of years spent with the company is higher for employees in the firms with low work injury records than for employees in the firms with high work accident records.

9. Older companies have lower work injury frequency and severity rates than relatively newly established companies.

10. Occupational accident record keeping systems in the firms with better safety records are considerably more comprehensive and efficient than in firms with poor safety records.

11. Relative span of control for every first line supervisor is wider in the firms with high work injury records than in firms with low work injury records.

12. Firms with newer machinery and equipment experience lower work injury frequency and severity rates than firms with older machinery and equipment.

13. In the firms with good occupational safety records, physical working conditions such as relative roominess, lighting, visibility, ventilation are better than firms with poor safety records.

14. There are more and better safety controls and devices on machinery in the firms with better safety records than the firms with poor safety records.

15. Firms with better safety records have established safety committees through which unions and/or employees aid and advise management on matters of worker safety whereas in the firms with poor safety records such committees have not been established.

Summary

It was emphasized in this chapter that despite considerable progress made over the past half a century in the field of occupational accident prevention, annual work injury and fatality figures still represent a serious challenge and problem for managers. Ever increasing costs of accidents were discussed and estimated cost figures for the period of the past six years were tabulated. The purpose of study was depicted and a number of hypotheses were formed to be empirically tested.

CHAPTER II

METHOD OF STUDY

Introduction

This chapter is an attempt to explain the general approach taken in conducting this research project. The hypotheses stated in Chapter I were used as a basis to determine: (1) what data collection techniques should be used to eliminate the gathering of useless information while insuring that relevant data would be collected and that initially unforeseen requirements could later be made; (2) what kind of sampling method must be employed in order to prevent possible sampling errors and to enable the writer to select those industrial concerns which best represent the kind of firms assumed in formulating hypotheses; and (3) what kind of data analysis should be used to test hypotheses, so that evidence can be developed to support generalizations to be made as a result of findings of the study.

The research embodied: (a) Sampling, (b) Data collection; (c) Data classification; (d) Analysis of data; (e) and interpretation of data which will be discussed in this chapter and in the same order.

Sampling Method

Since the purpose of the research was to identify some of the key factors that cause apparently similar business firms in the same industry to have markedly different accident experience, samples selected had to be a number of matched-pairs of industrial concerns. Each of these pairs was comprised of firms of similar size in the same industry, with one of the two having considerably more work injuries than the other. At least two pieces of data and information were needed in order to select a proper sample for the purpose of testing the hypotheses of this research study. These were:

a. Information about availability, number, and location of firms of similar size in the same industry in the State of Michigan;

b. Actual work accident records of these firms in order to match the firm with a very good safety record with the firm with a relatively poor safety record in the same industry.

For this study twenty-two industrial firms in the State of Michigan were selected. These constituted eleven matched-pairs of similar size firms in eleven different industries but with one of the firms in each pair having a relatively much better occupational accident record than the other firm. Relatively small size industrial firms were selected for study because existing knowledge in this field strongly indicates that smaller size industrial concerns have a higher rate of work accidents than larger ones.[1] By smaller companies, for operational purposes of this research study, it is meant the firms which employ between 80 and 650 employees.

Having access to information concerning availability, number, location and other general characteristics (namely, name of company president and officers, number of employees, address, kind of product and so on) of the companies represented no major problem to this writer since it could be gathered from different available directories.[2] But the major question before any other step could be taken toward sampling, was how and from whom to get the actual work injury records of the firms to be included in the sample. Selecting any two firms of similar size in the same industry in the State of Michigan for the purpose of this study would prove

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[1]For reasons given and more detailed discussion see: Chapter III of this work where the subject is elaborated.

[2]The following directory was most helpful to collect this kind of information: Michigan Manufacturers and Financial Record, The Directory of Michigan Manufacturers (Detroit: Manufacturing Publishing Co. 1969).

to be a useless effort unless there was a way of determining their annual occupational accident rates and of knowing that two firms selected in each pair have markedly different accident experience from each other.

Search for a publication or reference that carried the actual work injury rates of individual firms, by name, in the State of Michigan revealed that such a publication or reference does not exist. However, I was able to locate where such information might be available and filed. According to the Michigan State Occupational Safety Standard Act,[3] all employers should submit annual reports of all disabling work injuries to the Michigan State Department of Labor. My initial contact with the Department of Labor started through a letter[4] from Professor Simonds, chairman of my dissertation committee to the Director, Bureau of Safety Regulations in which the Bureau was asked

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[3]Section 15.(1) of Michigan State Occupational Safety Standards Act, Act 282, 1967, p. 573:Imd. Eff. Aug. 1, stipulates that: "To assure the availability of accurate, timely statistical data concerning occupational safety, all employers having one or more employees simultaneously employed shall submit annual reports on a firm and in a manner prescribed by the director, of all disabling work injuries as defined and in accordance with the "Standard method of recording and measuring work injury experience" (Z16.1, latest edition) of the United States of America Standards Institute. Reports shall not call for employees to be identified by name."

[4]See "Appendix A" for Format and Nature of this letter.

to provide me suitable names of companies to be included in the sample. It was also mentioned in that letter that I would probably need more than two names in each industry to start because some would likely not find it convenient to let me get the information. Later, the Director of Bureau of Safety regulations invited Professor Simonds and the writer to a meeting during which he informed us that because of the provisions of the Occupational Safety Standards Act[5] the Bureau could not release actual work injury information of individual firms by name unless prior permission had been obtained from the employer in writing. However, the Bureau provided only the names of 4 to 7 companies in each of eleven different industries which were selected randomly from the list of industries used by the Department of Labor. The list did not include work injury information of the firm nor did it indicate which firm had a better record than the other. Nevertheless, this list of names had an advantage over any other publicly available list. I was sure that these firms would have different work injury experience and record. The next step was to gather general information

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[5]Section 15. (4) of the Act stipulate: "The statistical summary shall not be prepared, published or released in such a manner as to disclose information concerning any individual employer unless prior permission has been obtained from the employer in writing";...

about these firms concerning number of employees, address, name of company president and the kind of product, which was done by referring to different directories. Especially, the Directory of Michigan Manufacturers was heavily consulted. The third step was to write a letter[6] to the presidents or in some cases to the executive vice-presidents of these companies to explain the purpose of this research study and to gain permission to visit the company and interview some of their people who are involved in safety. One week after mailing of the letters, a telephone contact was made with each of these individuals. If their response was positive, they were asked, in addition to the above requests, to provide me a letter of authorization in order to have access to their actual work injury records in the company and in the Department of Labor. Eleven pairs of companies that were most similar in number of employees, kind of product and, if possible in location, but not in work injury records were selected.

At first, I was not sure how many of the firms would agree to participate in this research project and from what I had observed and heard from other candidates in this stage of their program, I expected a high probability

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[6]See "Appendix B" for the format and nature of the letter.

of being turned down by a majority of these companies. This was especially true since the subject of occupational accidents is often touchy. This could represent a serious difficulty -- if it were true -- since the number of firms that the Department of Labor had provided were few, and if the majority of them were not willing to participate, the problem of finding adequate pairs of firms to be matched and of pursuing the study the way it had been designed, would be impractical.

In order to test the effectiveness of the strategy taken -- so advised by Professor Simonds -- I decided to contact first only six companies in three different industries. Letters were sent to these six companies. When I called the persons to whom the letters were addressed, a week or so later, I was astonished to receive six positive and very enthusiastic responses. This experience confirmed the effectiveness of the strategy, so I forwarded letters to other companies. Overall, I contacted twenty-six companies of which only four could not participate in the project for obvious reasons which were communicated to me through very nice and polite letters from these four companies. Table II-1 shows eleven different industries which were randomly selected and from which eleven matched-pairs of industrial firms were chosen to be studied. Industry

Groups Classification as shown in this table conforms to the definition of the Standard Industrial Classification Manual[7] which are also used in the Michigan State Department of Labor for industrial accident analysis and record keeping purposes.

TABLE II-1

TYPES OF INDUSTRIES RANDOMLY SELECTED, FROM WHICH ELEVEN MATCHED PAIRS OF INDUSTRIAL FIRMS WERE CHOSEN TO BE STUDIED

Industry Number	Standard Industrial Classification Code	Industry
1	201	Meat products
2	202	Dairy products
3	203	Canning, preserving
4	251	Household furniture
5	265	Containers and boxes
6	332	Iron and steel foundries
7	335	Non-ferrous metal, rolling, etc.
8	339	Other primary metal products
9	346	Metal stampings
10	354	Metal working machinery
11	371	Motor vehicles and equipment

[7]Office of Statistical Standards, U.S. Bureau of the Budget; Standard Industrial Classification Manual, 1967 Edition.

Table II-2 shows the location of these companies studied and their relative distance from East Lansing. Distances shown in this table are not official and were taken by this writer through the observation of odometer readings.

TABLE II-2

GEOGRAPHICAL LOCATION OF THE COMPANIES STUDIED IN ALPHABETICAL ORDER AND THEIR RELATIVE DISTANCE FROM EAST LANSING

Number of the Firms	Location (All in Michigan)	Distance from East Lansing (one way) in Miles
1	Belding	75
1	Berrien Springs	120
1	Bridgeport	70
1	Chelsea	44
1	Chesaning	45
2	Detroit	85
1	East Jordan	225
1	Grand Haven	96
2	Grand Rapids	64
1	Hamtramck	80
1	Inkster	75
1	Imlay City	82
5	Lansing & vicinity	4 (on the average)
1	Mason	15
1	Muskegon	102
1	Sparta	80

Method of Collecting Data

For the collection of data, two general approaches were taken. First, an attempt was made to gather necessary information from secondary sources, namely publications of Federal, State and Local Governments, private institutions and findings of other researchers conducted in this field or any other field from which findings could be useful in testing hypotheses of this research project. But, because of the rather confidential nature of statistics pertaining to the work injury records of industrial firms, these secondary sources provided very little data needed, and a lot had to be collected originally from the companies studied. Three alternatives were available that the writer could use in collecting data. Those three alternatives were: (1) conducting a personal interview; (2) mailing out a questionnaire and (3) telephoning. Even though a larger number of people could be reached through the use of the second and third alternatives, conducting a personal interview was preferred. This method of collecting data was employed not because it is the most flexible means of obtaining data,[8] nor because non-response could be easily reduced to none,

[8]Julian L. Simon, Basic Research in Social Science - The Art of Empirical Investigation (New York: Random House, Co., 1969), p. 253.

nor because the identity of respondent is known to researcher, but for two stronger reasons. One was the nature of some of the hypotheses formulated. In order to collect useful data pertaining to most of the hypotheses, I had to personally visit the company. An example of this would be the case of physical conditions of the plant with regard to such items as roominess, visibility, temperature, noise, lighting and so on, which could not be fulfilled through use of other methods of collecting data. Another important reason was to have the opportunity to examine company accident records and data. Using this technique of data collection gave me a fair chance to collect some very important viewpoints and also to recognize some other factors that practitioners of safety felt might contribute to a high or low accident rate in industrial firms which were not included or intended to be collected in the original plan for this research project. Some of these viewpoints and facts about actual industrial work environment are reported in Chapter IV without interpretation, since empirical data was not collected to reject or confirm them, but they could be used in formulating hypotheses for future research projects.

The nature of the interview was highly structured, and in order to ensure that every respondent was asked the same question and in the same order, a questionnaire was developed to be used as an interview guide.[9] Some of the questions were of a statistical nature and at the time of telephoning the companies -- a few days after the initial contact letter was sent -- if they said they were partici-pating in the project, I would ask them to prepare statis-tical information about employees, supervisors and the com-pany so that at the time of interviewing these statistics would be ready and little interviewing time would be used in figuring out every single question which was of a statis-tical nature. As examples of those statistical questions, the average number of employee, average age of employees, average number of years spent with the company and so on, can be mentioned.

Visiting every company took place in two separate phases. Phase one constituted the interviewing. The inter-view itself was administered in two different stages. Stage one was very structured and the interviewee was restricted to direct answer to direct questions. In stage two the interviewee was asked to feel free to point out any point of view that he felt had some importance to the subject which was not included in the structured interview. They were also asked to give their opinion on subject matters

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[9]For the nature and format of questionnaire (inter-view guide) see: Appendix C.

pertaining to safety and to present any solution for the existing problems. In summary, in the first stage the interviewee was asked to answer only those questions the writer had asked, but in the second stage I was a listener and allowed the interviewee to express himself. This enabled me to be exposed to many interesting viewpoints, some of the more important of which are reported in Chapter IV, under "other findings" of this study. The second phase of my visit was to have a tour in the plant area and observe the actual working environment. For me, this was one of the most beneficial parts of the research, for it enabled me to visit twenty-two different firms in eleven different industries and to observe in real world situations examples of many concepts, like "potential hazard", "unsafe acts", machine guarding and so on that sound rather intangible in theory. This observation was also necessary for comparing and evaluating physical working conditions of two matched firms in each industry in order to provide empirical evidence of the direct relationship between a good safety record and good physical conditions which are explained in Chapter IV.

Visiting each company also gave me a chance to meet and talk to different people, besides the original interviewee which would be almost impossible if I had used other methods of data collection. Table II-3 shows the number and title of individuals who participated in the interview and/or touring. The total number of these persons exceeds twenty-two, because in some companies more than one person participated.

TABLE II-3

TITLE AND NUMBER OF PERSONS PARTICIPATED ENTIRELY OR PARTIALLY IN THE INTERVIEW

Title	Number
President of the company	6
Treasurer	1
Vice-president of the company	3
Production manager	2
Personnel manager or director	8
Employee or industrial relations manager	4
Plant manager, superintendent or engineer	3
Safety director	3
Company nurse	2
Total	32

Upon completion of touring the plant, I returned to the office where the interview took place and looked at the company records to collect any missing data. Before leaving

each company I requested the authorities to provide me a letter of authorization so that I could have access to actual accident records in the Bureau of Safety Regulation, Michigan State Department of Labor.[10] At first I was rather uncertain that companies would provide me the letter of authorization, but I can happily report that all twenty-two companies responded positively to my request and generously gave authorization immediately upon hearing my request. Now I have twenty-two letters of authorization in my possession as an indication and evidence of human generosity and mutual trust and also one of the best rewards that could ever be given to me, which would always remind me of a remarkable series of contacts.

In addition to what has been said about the data collection process, I would like to mention that I have also called some of the companies for some additional information and they have kindly provided me with whatever piece of data I had asked for.

Analysis of Data

After all necessary data was collected by use of the techniques explained earlier in this chapter,

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[10] For the nature and format of this letter of authorization, see: Appendix D.

application of a suitable statistical method to analyze the collected data constituted the next major step in the process of this research study. This was necessary so that appropriate conclusions could be drawn from the data and their statistical significance could be reported. Since the nature of this study was mainly "qualitative" research, descriptive analysis and interpretation of data was also employed to explain the extent, nature and direction of the effect these factors tended to have on industrial accident experience of the firms studied.

Selection of proper statistical tools to be used in the analysis of data, was determined by the nature and type of scale employed in measurement of data which in turn was dictated by the kind of data collected. For measurement of the data mainly two scales, i.e., the ordinal or ranking scale and the interval scales, were used.[11] Data measured by these scales had to be analyzed by non-parametric or distribution-free statistical methods.[12] A non-parametric

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[11]The ordinal or ranking scale refers to a level of measurement when objects in various categories of scale stand in some kind of relation to the categories. An example of this relation among classes are: higher, more preferred, more difficult and etc.; The interval scale refers to a level of measurement when a scale has all the characteristics of an ordinal scale; when in addition the distances between any two numbers on the scale are of known size.

[12]Sidney Siegel, Non-parametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Co., Inc., 1956), pp. 29-30.

statistical test is a technique which does not make stringent assumptions about parameters of the population from which the sample was drawn. In other words, they do not depend on such assumptions as normality of the population distribution.[13] Among non-parametric tests available for statistical analysis of data, which would be most appropriate in the case of two related (matched) samples, the sign test and especially the Wilcoxon matched-pair signed rank test were employed.[14]

Limitations of the Study

It will be advantageous, at this point, to explicitly comment upon some of the major limitations and difficulties encountered in this study so that before the reader is exposed to the findings of the research and conclusions drawn from them, he will be well aware of the limitations of this study. This knowledge will assist him to make proper use generalizations provided by this endeavor. Some of the

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[13]For more detailed discussion in this subject see the following references: (a) Sidney Siegel, *op. cit.*, pp. 30-31; (b) Delbert C. Miller, *Handbook of Research Design and Social Measurement* (New York: David McKay Company, Inc., 1964), pp. 76-78.

[14]For more information on these tests see: Appendix E of this work or refer to: (a) Sidney Siegel, *op. cit.*, pp. 68-83; (b) Allen Wallis & Harry Roberts, *Statistics: A New Approach* (Illinois - Glenco: The Free Press, 1956), p. 598.

major limitations can be summarized as follows:

Because conducting of personal interviews and company visitations was chosen as the main technique of data collection, a relatively small sample was selected. Sample was composed of eleven matched-pairs of similar size industrial firms in eleven different industries in the State of Michigan. Even though it cannot be considered as a limitation by nature, but this writer wishes to mention that no grants or funds were available and associated in any form with this study nor did I ask or look for any, instead, personal funds were used, but as was very well put by another researcher,[15] the fact that no biased parties had any chance to influence the results or procedure taken, ended up as a net gain.

Another limitation to be mentioned is that as far as accuracy of data is concerned, I had to depend on the data provided by companies and answers given by the interviewees to direct questions.

Even though according to provisions of the Section 15(1) of the Michigan State Occupational Safety Standard Act, all employers having 1 or more employees simultaneously

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[15]Paul E. Sands, Accident Prevention and Governmental Control in the Construction Industry in Michigan and Ohio. Unpublished doctoral dissertation (East Lansing, Michigan, 1964), p. 40.

employed are required to submit annual reports of all disabling work injuries, such a report is not being reported to the Michigan State Department of Labor where I was expecting to get most of the data pertaining to the actual accident records of the firms. While frequency rates could be determined for all companies by using available data in the companies, severity rates could not. Because most of the respondents did not feel that severity rate is a very good indicator of the nature of seriousness of accidents, so they did not keep severity records. Some of the reasons given for this were: (a) that for the same disabling injuries, a markedly variable recovery period is required for different employees; (b) chance factors cause severity rate to fluctuate greatly from year to year and in many cases, such as deaths resulting from heart attacks, the company can exert no control yet finds the severity record greatly effected; (c) for some disabling injuries, different doctors prescribe considerably different periods of treatment; (d) some of the companies bring injured employees to the firm and make them to do anything they can, like dusting company library books, telephoning and so on in order to minimize the number of days lost, which in turn effects severity rate.

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valuable only if it is considered and studied over a fairly large number of years, and because pertinent data was not available for more than one or occasionally two years in the companies, nor in the Department of Labor with regards to number of days lost, frequency rates were used and relied upon in the classification of firms into those with relatively good or poor safety records.

It should be recognized that the above limitations are not only associated with this particular study, nor should they greatly effect the results of it but are general to any endeavor of this nature and in this field of study.

Summary

In this chapter, the general approach taken in conducting this research project was explained. After an introduction to the method of study, the sampling method was reported. The sample included eleven matched pairs of similar size firms in eleven different industries in the State of Michigan. It was also said that for collection of data, personal interviews and company visitations were mainly employed and for the analysis of data appropriate statistical tests, namely Wilcoxon matched-pairs signed-ranks test and signed test, were chosen. Finally, major limitations encountered in this research were commented on.

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CHAPTER III

REVIEW OF THE PERTINENT LITERATURE

Introduction

A relatively extensive review of the existing literature on occupational safety and work accident research was inevitable and a must in the course of this study. One reason for this need was that, after the nature of the problem was defined, and the purpose of study determined, then a search in the literature was necessary to make implicit or explicit deductions which would lead to identification of some of the factors that could qualify as candidates for the cause of the stated problem for this research project. Identified factors would be used as a basis to formulate workable hypotheses to be empirically tested so that the significance of the effect of each of these factors on the causation of the problem could be determined and reported.

Secondly, before formulated hypotheses could be empirically tested, a review of the literature was needed to: (1) Avoid duplication of efforts that were very well validated; (2) Consider other research findings in the sphere of this study so that reconciliation and coordination between fi

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between findings of this and other related studies could be made; (3) Minimize communication deficiencies, by using --as much as possible -- the same words, expressions, definitions, and concepts which were most widely used in other inquiries in this field; (4) Identify areas in which more contributions were needed in order to orient this study in that direction; (5) Include in this research the issues recently developed and questions raised which were not a part of the previous studies; (6) know where occupational accident research presently stands and be aware of trends in this field; (7) And finally, be able to make proper recommendations for future research in this field.

This chapter reviews, in summary, the historical development of occupational safety and industrial accident research to the present time with more emphasis on the subjects most directly related to the variables included in this study.

Occupational Accidents Research Before and After the Industrial Revolution

As far as systematic and scientific study is concerned, for the period of pre-industrial revolution, today's knowledge on occupational accident research is very limited and practically non-existent. However, students of this field of human studies have tried to establish evidences which co

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which could be used as a starting point or a base for further systematic discoveries. The purpose of those endeavors is not and will not be an attempt to prove that work accidents existed even before the industrial revolution -- because it would be a mistake to think that there were few or no injuries[1] -- but to determine whether or not these accidents were apparent or not and how they were dealt with in those days.

It is obvious that from the very beginning -- wherever and whenever it was -- man has found it necessary to survive in a hostile environment. For survival he has worked for himself or someone else, alone or with others, voluntarily or forced despite his wishes. But at any rate work has provided him a means of survival while at the same time presenting serious dangers to that survival.

Today there is no record of the Caveman's work injuries but at the same time it is neither difficult nor unrealistic to say that those who used a stone hammer, undoubtedly hit their thumb several times or dropped it on their foot, as is true even today with much more advanced tools and equipment.

As man broadened his knowledge about his environment

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[1]Simonds, op. cit., p. 16.

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he was able to better protect himself from hazardous work conditions. An example of this would be the case of Roman-Greek miners who would put goat bladders on their faces to protect themselves from the smoke and fumes which existed in the mine.[2] Employers, of course, did not provide this primitive personal protective equipment for the workers. Probably the only group of, so called, employees that were provided the best available protective equipment, were soldiers who received helmets and armor from their employers. While professional soldiers were relatively treated very well, from the safety on the job point of view, the remaining work force of those days, especially workers engaged in heavy works like mining, had no protection at all. We know that minerals were known and used to make war material for soldiers, but we also know that there was no steel chisel or drill to break rocks in order to extract the minerals. What a miner did in those days was to light a fire around a rock until it warmed and expanded. By pouring large quantities of cold water on the warmed and expanded rock, he would then make it contract. The sudden change in temperature created strong stress which caused

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[2]Leo Greenberg, A Railing on Your Roof (Israel, Haifa: Publishing House of the Student Association, Technion, Israel Institute of Technology, 1969; Preliminary edition reproduced for educational and research purposes for this writer's personal use.), p. 4.

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the boulder to crack. This process does not seem to be very dangerous and hazardous unless we begin to think that it was performed underground where lighting, visibility, ventilation and temperature were absolutely inadequate. Considering what is known today about the toxic properties of the lead and mercury which were mined, one writer concludes[3] that: "it is to be expected that the miners died like the veritable flies." Of course, mining and other heavy works were performed by, so called, slaves, most of whom were caught in the process of wars with other tribes or nations. Not only was there no thought of protecting enemy agents from work hazards but it would even be considered as a betrayal. Because of wasteful usage of this work force, constant replenishment of the slave supply was necessary. This explains, in part, the constant need to conduct wars -- to capture new slaves. Even non-slave workers of those days had no better fate than slaves. Greenberg mentions that it was normal for the wives of the miners of Joachimstaal -- presently in Czechoslovakia -- to be widowed seven times in the course of their lives which, themselves, weren't very long.[4]

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[3]Ibid.

[4]Ibid., p. 5.

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It would be appropriate at this point to examine some of the possible reasons why occupational safety was relatively unimportant, at least to the chroniclers.

Firstly, heavy and hazardous work was mostly performed by enemy personnel captured as slaves or convicted criminals and there was no need to protect these workers from any work accident. Secondly, there was no organized industrial activity in a large scale as it exists today and major industrial professions (mining, smithing and carpentry) were performed by individuals in relative roominess and with a slow pace of work. Thirdly, tools used by these workers were primitive and simple, and were not terribly hazardous by nature. Fourthly, communication was so limited that the news of work injuries and fatalities could not diffuse beyond small communities, and aggregate statistics for these work accidents were not therefore available in any kind for any given period. Thus, single events occurring in those small villages or similar communities could not impress and draw the attention of the people. A fifth reason would be that those who engaged in heavy and dangerous occupations were categorized as low class people who were not of great concern to those who made and/or wrote the history.[5]

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[5]Ibid.

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For the same reasons mentioned, there is no empirical research evidence, nor should it be assumed, that there were any kind of provisions or pre-determined arrangements which would regulate worker-employer relationships. It can be concluded that work accident research and occupational safety practices are the consequences of the industrial revolution which is considered as a time when great hazards were created for the working man. The industrial revolution was accompanied by a substantial increase in the frequency and severity of occupational accidents. A review of reasons given for this increase is essential since they provided a basis for the study of work accidents and in fact determined its direction. Greenberg[6] listed five major reasons for the increase of accident rate, as a result of the industrial revolution. Those reasons can be summarized as follows:

1. Crowding, as a result of high concentration of machines in a small area. Crowding in itself is conducive to the occurrence of accidents.
2. High concentration of human beings in a small working area, with its social and psychological implications which made operators apt to have accidents.

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[6]Greenberg, op. cit., p. 6.

3. The pace of work was substantially increased. Because steam power was used instead of human energy which made it possible to operate at any speed and for any length of time that the employer desired. Thus, the number of exposures to possible hazards, per unit of time was greatly increased.
4. The injury causing power was much greater.
5. The simplification of operations to the extent that almost anyone could be taught to perform the given task, eliminated the requirement of passing through a selective and arduous period of apprenticeship, journeyman and master in the Guild System. As a result of this, many young people -- in some cases women and children -- who had no experience, were required to operate hazardous machines.

A closer examination will reveal a similarity between the above listing and some prevailing work accident problem areas of today's industrial concerns. Since the beginning of industrial accident research, these problem areas have been under scrutiny by different researchers and it appears that still a lot has to be discovered if frequency and severity of occupational accidents are to be

further minimized.

According to Jean Surry[7] who recently completed an extensive study in this field, systematic accident research could be said to have been first established with the work of the British Industrial Health Board between the two world wars. In 1919 Greenwood and Woods[8] made a statistical analysis of injuries in a munition factory. Following this study, in 1926, Newbold[9] conducted a very broad study of thirteen factories, the findings of which confirmed earlier results. Jean Surry concluded that:

> "The effects of these two papers on accident research were far-reaching, further in fact than the authors intended."

It should be pointed out that these two studies mainly dealt with the concept of accident proneness which still is subject to controversy among students of the field of industrial accidents. Since this concept was not included, in nor examined by this study, elaboration of the

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[7]Jean Surry, Industrial Accident Research, A Human Engineering Appraisal (Toronto: University of Toronto, 1969).

[8]M. Greenwoods; H. M. Woods, A Report on the Incidence of Industrial Accidents Upon Individuals with Special Reference to Multiple Accidents (London: British Industrial Latigue Board, No. 4, 1919).

[9]E. M. Newbold, A Contribution to the Study of the Human Factor in Causation of Accidents (London: British Industrial Health Research Board, No. 34, 1926).

subject has been avoided. Of course, findings of other studies pertinent to the variables of this study will be discussed under related titles in the remaining parts of this chapter.

Before specific literature pertinent to the areas covered by this study is examined, it seems to be beneficial to look at the relative position of the industrial accidents research compared to other kinds of accidents. Jean Surry's[10] findings indicate that in recent years the proportion of efforts spent on industrial accident research has declined while study of performance influencing factors has flourished. Table III-1 shows the number of accident research papers published from 1920 to 1966 by accident category.

The distribution of accident research papers shown in Table III-1 reflects the fluctuation in public interest in different categories of accidents.

This tabulation may not be free from bias. Jean Surry recognizes this fact and mentions the possible biases which may have influenced the making of this table. However, she argues in her own words: "Despite these causes of bias, it is felt that this ampling of the literature was reasonably representative."

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[10]Surry, op. cit., p. 17.

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TABLE-III-1

DISTRIBUTION OF ACCIDENT RESEARCH LITERATURE BY ACCIDENT CATEGORY AND PUBLICATION DATE[11]

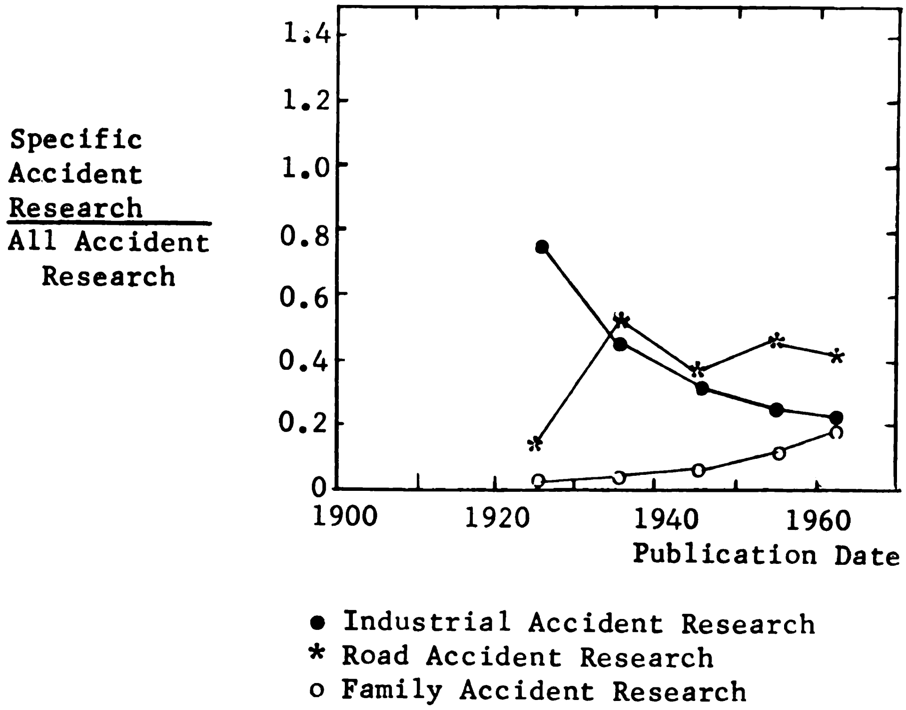
Accident Class	1920 1929	1930 1939	1940 1949	1950 1959	1960 1954	1965 1966	Total
General	1	0	5	11	9	2	28
Industrial	6	11	9	22	19	9	76
Road	1	13	10	44	37	21	126
Aerospace	-	-	3	4	2	4	13
Child	-	1	2	5	7	2	17
Poisoning	-	-	-	4	2	1	7
Home	-	-	-	3	6	1	10
Recreation and sports	-	-	-	-	4	-	4
Hospital	-	-	-	-	2	1	3
Farm	-	-	-	2	2	-	4
Total	8	25	29	95	90	41	288
Annual Publication Rate	0.8	2.5	2.9	9.5	18.0	20.5	6.1

By plotting the same information on a chart, as shown in Figure III-1, it can easily be recognized that after a small start road accidents research has reached a point where it constitutes about 50% of all accident research for the period of 1920-1966. Family (home and child) accident research has been rising but industrial

[11]Adopted from: Ibid., p. 150.

FIGURE III-1

RELATIVE INTEREST IN THREE SPECIFIC ACCIDENT RESEARCH AREAS COMPARED WITH TOTAL ACCIDENT RESEARCH[12]



accident research has been decreasing in relative importance since it started the interest in accident research in the twenties.

This decrease shouldn't be interpreted as lack of interest for industrial accidents in recent years since it may stem, in part, from the fact that early industrial accident studies were most successful in reducing the frequency and especially the severity of accidents.

This concludes a brief review of occupational

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[12] Ibid., p. 152.

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accident research in general which provides a background for examination of literature on specific areas that constitute the remaining part of this chapter.

Company Size and Work Accidents Records

A point was made earlier in Chapter II, that existing knowledge in this field strongly indicates that smaller size industrial firms tend to have a higher accident rates. The interested reader was then referred to Chapter III for possible reasons behind this statement. Before these reasons are discussed, the writer wishes to point out that not necessarily all smaller size companies have poor safety records. In fact, some of them demonstrate excellent safety performance. This may result from the inherent personal contact between the manager and his employees in a small firm which may tend to keep the accidents down while the middle or large size industrial firm may be too large for personal concern. But generally speaking, the majority of larger firms have attained what appears to be an irreducible minimum as far as accident rates are concerned. It is estimated that 70 percent of the accidents occur in small businesses and firms without adequate safety programs.[13]

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[13]Simonds, op. cit., p. 9.

A study by McFarland[14] showed that manufacturing companies employing more than 500 employees, tend to have about a quarter of the accident rate of those with under 50 employees. Table III-2 shows injury rates per million man-hours of all manufacturing and three particular industries.

TABLE III-2

INJURY RATES PER MILLION MAN-HOURS WORKED AND COMPANY SIZE[15]

Number of Employees	All Manufacturing	Particular Industries: Pulp & Paper	Electrical	Chemical
Under 50	12.8	17.0	3.4	7.1
50-100	10.9	12.4	7.7	8.9
100-500	9.6	10.2	4.7	6.4
Over 50	3.6	5.3	1.4	2.4

Why larger firms have lower accident rates, has been explained by different authorities in this field. Professor Simonds' explanation for this phenomena, in his own words is that:[16]

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[14]Ross A. McFarland, The Epidemiology of Industrial Accidents (Harvard: School of Public Health, 1965).

[15]Adapted from: Ibid.

[16]Simonds, op. cit., p. 9.

> "Usually, those large concerns, employing more workers in staff capacities, are in a position to see the economic importance of accident prevention and have developed the best safety programs."

It can also be argued that in a firm of 30 employees with a frequency rate of, for example, 12.8, the employer witnesses one disabling injury a year, whereas the employer of 1000 men with such an injury frequently rate witnesses 30 injuries. It is possible that the fewer injuries per firm, the less concerned the management will be[17] with accident records.

The safety performance of small business organizations has been a matter of concern for government agencies as well as private or educational institutions. In fact, one of the most comprehensive listings of the factors that could possibly explain why small size firms tend to have higher accident rates than larger ones, is provided by one of the government publications.[18] These factors can be summarized as follows:

a. Small firms cannot (or do not) employ full-time safety personnel.

b. The executive of small business carries a complex load and has no technical staff to assist him.

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[17]Surry, op. cit., p. 9.

[18]U. S. Department of Labor, Bureau of Labor Standards, Safety Subjects, Bulletin No. 67, revised 1956 (Washington, D.C.: U.S. Government Printing Office, 1958), p. 11.

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c. He rarely joins any safety organization or attends any safety meetings or conferences.

d. Costs of accidents are not known because small firms don't have detailed cost accounting systems.

e. As there are few employees, the accident rates must be extraordinarily bad to yield a flow of injuries sufficient to arouse a management immersed in its manifold problems of sales, finance and production.

f. Small companies usually can not afford expenditures for which immediate and prompt return is not highly expected.

g. Small businesses are so great in number that communicating the "gospel of safety" to them is impractical by using the promotional method of attack that has been so widely and effectively used with employers of larger companies.

Most of the above mentioned factors were confirmed by the findings of this study, since the companies selected were all in the category of small firms. These findings are discussed in Chapter IV, but as an example, it may be mentioned here as well that none of the top executives in twenty two firms studied were a member of any Safety Organization.

Obviously any large reduction in the industrial accident rates, will have to come mainly from improvement of safety performance of the small firms. This is where more research is needed. I believe, it was in recognition of this fact that Professor Simonds, very well aware of this ne

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this need, advised this writer to include relatively small size firms in the study.

Top Management and Safety Performance of the Firm

In any organization, the legal responsibility for everything that happens belongs to top management, either as represented by a board of directors or as vested in the company president.[19] In the case of safety, not only has this responsibility been assigned to top management as one of the activities of the organization, but in many cases it has been singled out and emphasized more explicitly. This statement can be very easily supported by many evidences provided by the literature on and related to safety. Most important of all would be the reports of actual success in accident prevention in which almost every report attributes this achievement to top management's active support and participation. In a report of "12,000,000 accident free hours",[20] the Visking Company's answer to "How is it done"? was that this outstanding safety record did not result from some magic formulas. Rather, it was the result of many efforts

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[19]Paul Pigors and Charles A. Myers, Personnel Administration, A Point of View and A Method (New York: McGraw-Hill Book Co., Fifth Edition, 1965), p. 579.

[20]National Safety Council, "12,000,000 Accident-Free Hours - How's it Done?", National Safety News, Vol. 68, No. 2, August 2, p. 30.

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to prevent accidents, underlying those efforts three principles were identified and reported. Of course, the number one principle was: top management's interest and support." Another report of success in reducing accidents coming from Packaging Corp.[21] concludes that: "a successful safety program requires three components: 1) top management backing and participation...."

It is also emphasized in that report that only when top management places the same emphasis on safety as on quality and quantity of production, sales and other management functions, then safety efforts will be carried out as they must be successful. Another report from Dupont Co. (U.K.)[22] indicates that two divisions -- operation and construction -- at the company's Maydown plant, have each completed more than one million injury-free hours, since the beginning of 1965. This report also attributes the success to top management's participation and support. It elaborates that many suggestions have been put forward on the industrial injury problem but none of them can successfully achieve their end without top management's earnest cooperation.

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[21]William H. Stubbs, "How a Mill Safety Program Cuts Injuries," Pulp and Paper, Vol. 43, No. 3, March, 1969, p. 146.

[22]Special Report, "The Key to Safety," Personnel Magazine (U.K.); Oct. 1967, p. 25.

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When occupational safety literature is reviewed, one observation is obvious and inevitable. It is impossible to find any argument or even comment which would deny the positive effect that top management's involvement has in achievement of a remarkable safety record. In almost every piece of work done in the field, the need for this involvement is either explicitly emphasized or is considered to be so obvious as to need no elaboration. So far, some of the actual reports from practitioners on outstanding safety performance of the companies have been mentioned. I believe quoting Professor Simonds on this particular subject will serve as the best indicator of what the academic world thinks of top management's responsibility for safety. He contends that:[23]

> "The chief executive ... should be accountable for a poor accident record and might well point to a good accident record as one among many of the evidences of the company's success in progressing toward its major goals."

In addition to practitioners and academicians, government agencies[24] too, have tried to promote the idea that if really good practice in reducing preventable injuries is to be achieved, top management must accept full and definite

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[23]Simonds, _op. cit._, p. 44.

[24]As an example see: U.S. Department of Labor, _op. cit._, pp. 69-70.

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responsibility and pay considerable attention to the task, just as it does to any other functions of vital importance.

In reviewing this part of the literature a good share of attention was applied to the search for material which discussed and/or predicted future executives' role in safety. This writer was curious and interested to find out, as the technology advances, what changes -- if any -- might occur in the management's overall responsibility for safety? The following words typically represent the kind of predictions and expectations which appeared in the recent literature. Management's concern with safety must be more active and creative, for technology is not going to slow down and wait for safety to catch up.[25]

Influence of Age on the Frequency and Severity of Work Accidents

Since the beginning of systematic research on occupational accidents, there have been a number of studies on the nature and extent of the relation between age of workers and work accident rates. Most of these studies have shown that accident rates decline with age since increasing age is usually accompanied by increased experience.[26] A study by

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[25]Joseph R. Shaw, "Safety in Changing World," National Safety News, October, 1969, p. 50.

[26]Norman R. F. Maier, Psychology in Industry (Boston: The Riverside Press, 1955), p. 535.

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Newbold[27] in the metal industries revealed that even if comparisons are made between men of equal experience, but differing in age, accident rates would still tend to decline with increased age. It has also been found that for every kind of industry there is an optimum age point beyond which advancing age is accompanied by an increase in the accident rate. Maier has reviewed studies done by Vernon[28] with regard to establishing the safest optimum age for certain kinds of workers in coal mining. The findings of these studies showed that for coal-face workers, the safest age is between 30 and 39, and for other underground workers it is between 20 and 29. For the transportation industry the optimum safe age is estimated at 65, beyond which a decline in safety is expected to occur. Findings of a study by Browne,[29] attributed this change in accident rates in the later life of the worker to such accompanyments of age as slight deterioration of eyesight, hearing, and general steadiness and balance.

Elderly people commonly have transient attacks of

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[27]E. M. Newbold, A Contribution to the Study of the Human Factor in the Causation of Accidents; Industrial Health Research Board, No. 34).

[28]Maier, op. cit., p. 535.

[29]R. C. Browne, Health in Industry (London: Edward Arnold Publishers LTD).

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dizziness and sometimes are not able to coordinate hand and eye.

Studies summarized by Jean Surry[30] indicated that younger employees have the highest injury rate, but the older apparently have as high a death rate from injuries. It is not clear whether these differences are due to more exposure to hazardous conditions because customarily younger men are assigned to more adventurous or arduous roles or whether in precisely the same role, the younger man tends to make more errors than his elders. Figures III-2 and III-3 illustrate fatalities and injuries from industrial accidents as discussed by Jean Surry.

King[31] has studied the age - accidents relationship in detail and specifically from three different points of view. He analyzed actual injury data with the intention of showing possible differences in the causes of accidents, parts of body injured, and types of injury with differences in age. His findings indicated that the actual accidents sustained, their causes, their nature (type) and parts of body injured differ with age. He then suggested that

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[30] Surry, op. cit., pp. 11-12.

[31] H. F. King, An Age-Analysis of Some Agricultural Accidents, in William Haddon and et al (eds) Accident Research Methods and Approaches (New York: Harper & Row, 1964), pp. 41-47.

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FIGURE III-2

FATALITIES FROM INDUSTRIAL ACCIDENTS AS A FUNCTION OF AGE (Ontario 1965)[32]

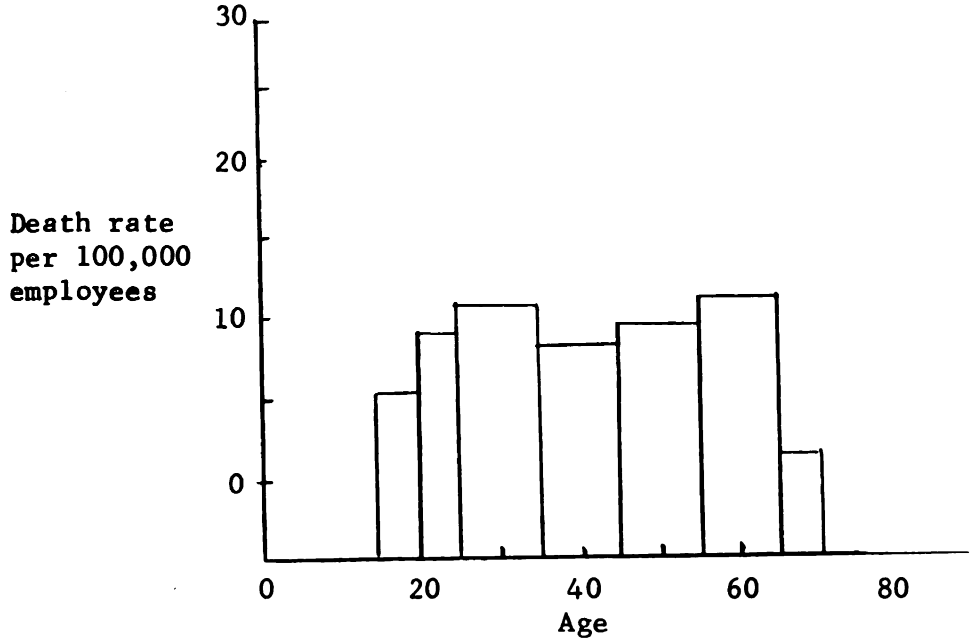
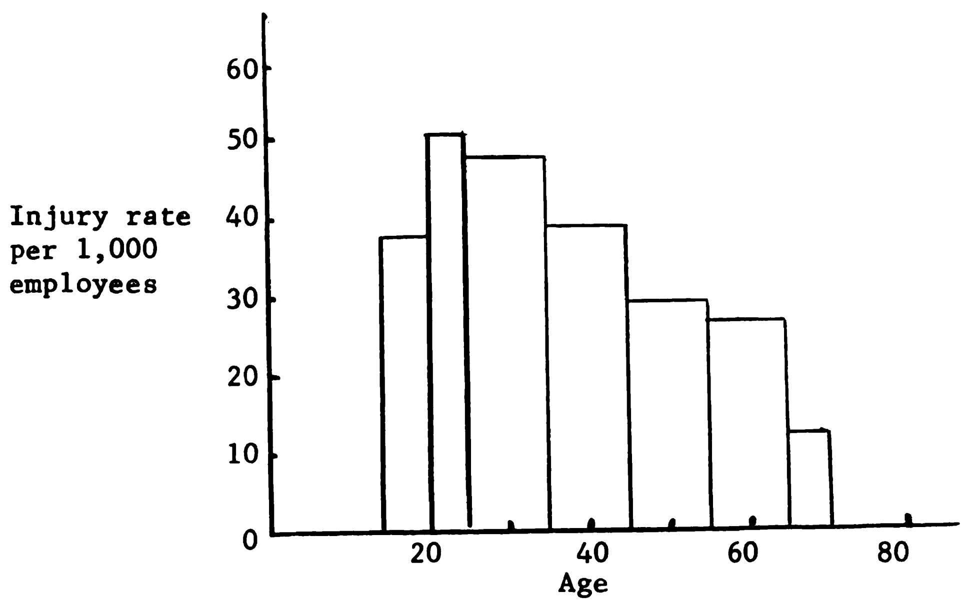


FIGURE III-3

INJURIES FROM INDUSTRIAL ACCIDENTS AS A FUNCTION OF AGE[33]



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[32]Adapted from: Ibid., p. 12.

[33]Ibid.

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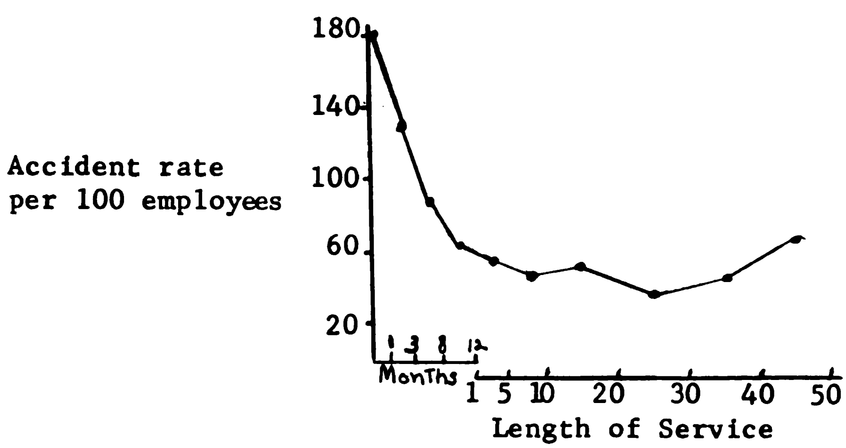
different measures of accident prevention are needed for younger and older persons.

Length of Service and Occupational Accidents

A number of studies have revealed an inverse relationship between the length of service, which implies work experience, and work accidents. A study of occupational accidents in a large industry by Browne[34] indicated a very steep fall in the rate of accidents after the first few months of work and a gentle rise towards the end of the working life. Figure III-4 is an illustration of Browne's findings.

FIGURE III-4

DECLINE IN ACCIDENT RATE AS A FUNCTION OF LENGTH OF SERVICE



[34] R. C. Browne, Health In Industry (London: Edward Arnold Publishers LTD, 1961), p. 31.

A statistical analysis of 227 serious work injuries requiring extended treatment made by McKinnon and others of General Electric Company summarized by DeReamer[35] indicated that length of service is one of the factors influencing the occurrence of accidents which result in injuries. This analysis indicated that workers have more than one and a half times as many injuries during the first year of service as would be expected. Other studies by VanZelst[36]; Chaney[37] and Hanna have shown that the workers with one months experience have rates 1½ to 2 times their accident rate after six months. And for the first day, accidents appear to be a hundred times as high. Early studies by Fisher and Ghiselli, reviewed by Dr. Simonds,[38] have indicated a significant relationship between experience and accident rates. Despite the findings of studies reviewed, there have been some other endeavors which have shown

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[35] Russell DeReamer, Modern Safety Practices (New York: John Wiley and Sons, Inc., 1958), pp. 37-39.

[36] R. H. VanZelst, "Effect of Age and Experience on Accident Rates," Journal of Applied Psychology, Vol. 38, 1954, pp. 313-317.

[37] L. W. Chaney and H. S. Hanna, The Safety Movement in the Iron and Steel Industry, 1907-1917, U. S. Bureau of Laborer Statistics, No. 34.

[38] Simonds, op. cit., p. 404.

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increases in work accident rates with increased experience.[39] But according to Professor Simonds[40] this contradiction may be due to variances in the groups studied. So thorough understanding of the particular work situation under study is a necessity before any generalizations or comparisons can be made. While reviewing the literature, Jean Surry has noticed that high itinerant population of the lumbering, mining, and construction industries have very high accident rates. She contends that of course the inherent higher hazards of these tasks are recognized but it is suggested that more permanency in these industries would considerably reduce rates of accidents.[41] From the literature reviewed and summarized, it can be deduced that in an industrial organization with a stable work force accident rates are expected to be found lower due to the fact that this kind of firm has proportionally more workers with considerable length of service, who are relatively more experienced.

An industrial concern with a high turnover rate and unstable employment, will have in its employ more young employees with insufficient or no experience which most likely will constitute the makings of a poor safety

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[39] For reference to these studies see: Ibid.

[40] Simonds, op. cit., p. 404.

[41] Surry, op. cit., pp. 11-13.

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Worker Participation and Occupational Safety

The concept of employee participation has attracted considerable amount of attention from the students and practitioners of management and human relations in general as well as of occupational safety management in particular. Keith Davis defines participation as: ... "mental and emotional involvement of a person in a group situation which encourages him to contribute to group goals and share responsibility in them".[42] In the case of safety, group goals would be prevention of work accidents. Occupational safety is one of the functional areas in organizations in which employee participation has been widely practiced. But there is no general agreement on the consequences nor on the degree and kind of effective worker participation in overall safety programs. The existing literature indicates that more than any other methods of participation such as, suggestion systems, employee opinion surveys and so on, the safety committee system has been used in practicing worker participation in safety. Davis[43] reports that a large aircraft manufacturing company with a total employee

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[42]Keith Davis, Human Relations at Work. The Dynamics of Organizational Behavior (New York: McGraw-Hill Book Co., 1967), p. 128.

[43]Ibid.

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population of up to 20,000 used a safety committee system in which each department was represented by one of its workers. During a ten year period not one worker had a disabling injury while serving as safety committeeman. He observed a significant difference in safety performance records of workers as committeeman and non-committeeman. He then concluded that part of this difference surely come from the fact that the committeemen were "responsible participating persons with regard to safety. This writer would suggest that only "being responsible" should not be given the full credit for success in a participative system. There must be some other and more important factors which were not ignored by Davis and that influence workers attitude toward safety while they are being responsible committeemen. In this context, three important ideas can be deduced from the above definition of participation given by Davis. Participation results in ego-involvement which in turn provides partial satisfaction for workers' social and psychological needs. It gives workers a chance to release their own resources of initiative and creativity toward safety of the organization. By being in the committee they are in a position and are motivated to contribute to the situation. The third factor is that participation encourages workers to accept responsibility and to become selfinvol

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involved in dealing with the problems brought to the attention of the committee. This sense of self-involvement contributes to successful functioning of committees. It insures the proper implementation of decisions, since workers themselves had a share in making them and want to see that they work successfully.

It should be recognized that not necessarily all participative activities will result in favorable results. Rather, they are subject to some prerequisites, which have a direct and determinant effect on the success of participation. In general, the following condition must be present if a participative program should work successfully. Some of these conditions must be provided by the individual, and some by the environment in which participation should take place. Presence of these conditions may mean that participation will work better in some situations than others and in certain situations it won't work at all. Tannenbaum[44] and his associates have listed the prerequisite conditions for participation. In brief, some of these conditions are as follows: (a) from the cost point of view the value and results of participation should be justifiable, (b) the

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[44]Robert Tannenbaum, et al., Leadership and Organization: A Behavioral Science Approach (New York: Mc-Graw-Hill Book Co., 1961), pp. 88-100.

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participant should have the ability, such as intelligence and knowledge to participate, (c) the subject of participation must be relevant to the participant's organizational unit of interest, (d) mutual communication must be possible for participant, (e) neither party (management or worker) should feel that his position is being threatened by participation, (f) since participation is hardly appropriate in emergencies, its effectiveness is questionable in these situations. There must be enough time to participate before action is required.

In addition to the above conditions, there are some other limiting factors that must be considered before participative methods are adapted. It has been pointed out that today, the complexity of organizations and technology involved make it difficult for workers to participate successfully. Difficulties especially arise when workers make proposals in areas in which they are not competent.[45] When these proposals are rejected, no matter how appropriate the alternative courses of action are, they will be subject to worker's resistance. Some workers even build up a habit to be consulted on every issue, and when they are not consulted they become resentful and alienated. It is difficult

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[45]Davis, op. cit., p. 140.

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to determine the amount of interpersonal trust between participating parties which is prerequisite for open communication, which in turn is a necessary condition for effective participation. Perhaps the most important issue with participation is that it provides a means of manipulating employees, not necessarily by management but by union or other groups. I was told by some interviewees that the union sometimes uses safety issues -- in the safety committee meetings or after -- as a base to influence management on other issues. When the other issue is settled, then the union rarely shows interest on the original and unsettled safety question. Despite some obvious merits inherent in participation, not all organizations have had favorable results from safety committee meetings. Quoting Dr. Simonds:[46] "As a means of administration, committees are usually too cumbersome and slow moving to be very effective." Stronger expressions have been used by practitioners. As an example, the following statements may be quoted:

> "Safety committees are 'for the birds'. The committee defeats the primary purpose of the management approach. It places responsibility for the safety program in the hands of a random group."[47]

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[46]Simonds, op. cit., p. 68.

[47]Laurence F. Mihlon, "What is Wrong with Safety Management," Factory 119:91, Sept. 1961, p. 241.

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Another writer contends that:

> "Safety committees (a form of participation) are not acceptable for they specifically emphasize the question of safety and thus prevent it from being seen as a part of normal operating procedure.[48]

On the other hand, the rather stronger position held by others who talk favorably about participation in general and safety committees in particular, leads to the belief that in fact it is a motivating factor and is being successfully used. Earlier experiments by students of management such as Raethlisberger, Bavelas, and Coch and French -- as reviewed by Davis[49] -- indicated that even though participation has limitations, but when its prerequisites are met and the right kind and amount of participation is selected to match the needs of a particular situation, it offers potential for higher productivity, higher morale and other benefits. Talking about the merits of committees, Dr. Simonds contends that:

> "They are often an effective means of interesting or educating a large number of people in an activity. They may also be a good method for securing co-operation coordination and an exchange of ideas among people not otherwise regularly thrown together;....[50]

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[48]Evan Stallcup, "A Fresh Look at the Safety Program; When Enough is too Much," Personnel, Vol. 38, 1961, p. 27.

[49]For more information see: Davis, op. cit., pp. 133-146.

[50]Simonds, op. cit., p. 68.

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It seems to me that failure or success of the safety committees depends largely upon the quality of planning for it. Not all types of committees can be used successfully in all organizations. If an organization fails to determine and/or establish the type of safety committee which is best suitable to its needs, discouraging results shouldn't be attributed to ineffectiveness of the technique itself. The literature witnesses various ways of classifying safety committees. Among those four main types may be identifiable:

1. Labor - management committee - including union representatives, worker representatives and management.

2. Central safety committee - consisting of all department heads - they normally make policy decisions and the frequency of meeting is monthly.

3. Departmental safety committee - including all supervisors and their foremen. Normally this type of committee meets twice a month.

4. Foremen's safety committee - consists of all men under each foremen. Frequency of meeting is normally once a week.

Actually, there may be some other kinds of committees such as technical and special or a committee which is a combination of all four types mentioned above. There is no one best way of organizing a safety committee which will insure positive results in every organization. Committees must be tailored to fit each organization's needs. Failure is in-

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is inevitable if the organization tries to reorient its safety problems to adapt a particular type of committee just because it worked well elsewhere. It is difficult to make any generalizations based on present knowledge on the impact of employee participation on prevention of occupational accidents. Further research is needed to determine the extent of its effect and to specify its direction.

The First Line Supervisory Span of Control and Work Accident Prevention

No other issue with regards to accident prevention and occupational safety has been emphasized as much as has foremen's importance.[51]

Although there is no general agreement on most issues related to safety at work, however, the "foreman's key role" in accident prevention is one of the rare instances where students and practitioners of this field would vote favorably and unanimously. Dr. Simonds position on this issue is best expressed with the following words:

> "The immediate supervisors of the workers, more than any others, are the key men in accident prevention."[52]

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[51]In this dissertation the "first line supervisor" and "foreman" are used interchangeably.

[52]Simonds, op. cit., p. 13.

Heinrich, another contributor to the field of accident prevention contends that:

> "The first line foreman, moreover is in a peculiarly strategic and tremendously important position so far as attaining results in accident prevention is concerned....[53]

In discussing the same subject, DeReamer refers to the study of accident case histories which has revealed why a supervisory approach to accident prevention is too effective. He concludes in his own words, 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 direction action."[54]

While enough emphasis and consideration has been given to the importance of first line supervision, its limiting component, namely relative span of effective control is not discussed in the safety literature. It must be recognized that the foreman has limited resources. The number of hours that he can work during a day or week is limited. His physical ability, willingness, energy, knowledge, mental ability and experience to work on many problems at

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[53]H. W. Heinrich, Industrial Accident Prevention (New York: McGraw-Hill Book Co., 1959), Fourth ed., p. 47.

[54]Russel DeReamer, Modern Safety Practices (New York: John Wiley & Sons, Inc., 1958), p. 5.

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once have limits. Most important of all, he is limited to his attention to only few things at a time. If the number of workers assigned to each foreman exceeds his abilities to supervise attentively then he won't be much of an effective agent in accident prevention.

Based on limitations recognized for human beings, there have been many attempts to determine the maximum number of people to be assigned to each supervisor. Probably the most discussed concept in, so called, classical management and organization literature involves the idea of span of supervision. For example, Graicunas, hypothesized that an arithmetic increase in the number of subordinates results in an exponential increase in the relationship.[55] He proposed a mathematical formula to determine the number of these relationships as the number of subordinates increases. He identified three kinds of relationship called: a) direct single; b) direct group; and c) cross relationships. According to Graicunas, the total number of relationships under each span of supervision can be computed by using the following equation:

$$r = n(2^{n-1} + n + 1)$$

[55]V. A. Graicunas, Relationship in Organization, in Luther Gulick and Lyndall Urwick (eds.) papers on The Science of Administration (New York: Institute of Public Administration, 1937), pp. 52-57.

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where n = number of subordinates supervised and r = number of relationships. As an example, if the number of workers under each foreman is 12, the number of relationships will be 24,708.[56] Development of this theory was mainly based on the consideration that a foreman not only should supervise individual subordinates but also the interaction among individuals and groups. From the safety and accident prevention point of view, this is still true, even if it is labeled as "classical." Further studies by neo-classical theorists while continuing to consider the classical concept as a basic guide -- have provided evidence to reject the idea that a specific number of subordinates to be effectively supervised can be determined. However, it shouldn't be impractical for any single organization through consideration of the type of work to be carried out, the quality of foreman as well as of workers, and the environmental factors in which supervision takes place, to come up with number of workers that should be assigned to each foreman in that particular concern. Once this

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[56]This concept is discussed in most of the organization and management literature. For more detailed discussion see: a) Joseph Massie, Management Theory in James March, Handbook of Organizations (Chicago: Rand McNally & Co., 1965), pp. 398-399; and b) Rocco Carzo, Jr. and John Yanouzas, Formal Organizations, A Systems Approach (Homewood, Ill., Richard D. Irwin Inc., and The Dorsey Press, 1967), pp. 44-48, 79-96.

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objective is achieved and proved to be efficient, it is less likely that it will be subject to a radical change as the organization grows. A recent study by Professor Simonds indicated that from 1958 to 1966 the average number of subordinates reporting to the chief executive increased from 4.87 to 5.56 which was not a marked increase and neither there was found evidence of such a trend.[57] This study also confirmed the idea that there is no one best or ideal span of control in terms of the specific number of subordinates.

The concept of span of control still remains one of the main areas of controversy among theorists. Not only is occupational safety literature in particular, almost empty with regard to study of the relationship between supervisory span of control and safety, but empirical research on the concept of "span of control," in general, also remains scarce.[58]

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[57]Rollin H. Simonds,"Is Organization Structure Reflecting New Techniques and Theory?", M.S.U. Business Topics, Vol. 17, No. 3, Summer, 1969, pp. 65-71.

[58]Massie, op. cit.

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Effect of Some Employee Background Variables on Job Attitude and Safety

Obviously, there are many factors which can be covered under this title. But only the literature most directly related to background variables included in this study is reviewed. It should be pointed out that some of these variables -- namely age, length of service and experience of the workers -- have been separately reviewed earlier in this chapter. Thus, the remaining background variables are discussed in the following order: a) family background; b) marital status and c) formal education.

a) Family background: It has long been recognized that a worker's family background has an important influence in shaping his work values. For example, results of an empirical study showed that if a boy is raised in a materialistic atmosphere, he will view work as a means of obtaining economic and material returns from a given job.[59] If the boy grows up in a cohesive family group and in a cultured atmosphere, he is most likely to consider work important for it provides him the opportunity to make social

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[59]For more detailed discussion see: John F. Kinnane and Martine W. Pable, "Family Background and Work Value Orientation," Journal of Counseling Psychology, Vol. 9, Nov. 4 (Winter, 1962), pp. 320-25.

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and cultural contributions.[60] Specific implications of findings of this and other similar studies for the field of occupational safety would be that if management knows how its employees' work values have taken shape then it can most effectively influence them in the desired direction. For example, if a company launches a safety program to promote employees' safety interests, emphasizing economic losses from work injuries would be more effective for a worker who has raised in the former family environment. Of course, for the employee who is the product of the latter type family mentioned above, emphasizing the desire for protection of others, desire to excel and be outstanding and in some cases, the desire for leadership, would be more effective. Costello and Zalkind suggest that the chief influence on the development of the individual attitudes is his family.[61] Based on research findings reviewed by these writers, they conclude that many specific parental views on the ways they act and think become part of the employee's attitudinal framework. Obviously, attitude toward safety

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[60]Leon C. Megginson, Personnel - A Behavioral Approach to Administration (Homewood, Ill., Richard D. Irwin, Inc., 1967), pp. 113-115.

[61]Timothy W. Costello and Sheldon S. Zalkind, Psychology in Administration - A Research Organization (Englewood Cliffs, N.J.; Prentice-Hall, Inc., 1963), p. 261.

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could not and should not be considered as an exception to these findings. Family background investigation should help organizations to find workers with desired sets of values and should also serve in influencing and modifying employees' safety, as well as general work attitude, in the desired direction.

b) Marital status and safety at work: Not only does the parental family life have a considerable share in developing employee attitudes, but the conjugal family has an even greater influence on the behavior of the employee towards and at the work. As far as safety is concerned, in general, married workers tend to be more safety conscious than unmarried ones. Part of this difference may come from the difference in age since on the average married employees are older than unmarried. But a large portion of difference in behavior of these two groups of employees is attributable to concern for and influence of the family of married employees. Based on the findings of a recent study it was reported that the financial demands and responsibilities upon the worker will generally increase -- if not with marriage, then certainly with the coming of children.[62]

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[62] John H. Goldthorp et al., The Affluent Worker: Industrial Attitude and Behavior (Cambridge: University Press, 1968), pp. 147-150.

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The employee realizes that a work injury will result in economic loss and suffering which is absolutely unnecessary. In many cases, work injuries result in permanent impairment which is accompanied by loss of job, decrease in income and many other unanticipated consequences. A research study by Ginzberg showed that during the extended depression of the 1930's when a man lost his job and was put on relief, his whole family's attitude toward him frequently changed.[63] He was often considered less of a man than he had been while employed. Often his children declined to accept his discipline or advice. The incidences such as these indicate the significance of work to a married employee. A study by Wight Bakke reviewed by Carvell,[64] has confirmed the findings by Ginzberg and has revealed that loss of job not only altered employee's economic status, but also affected his social status, family affairs and friendships. These findings may suggest that a stable and continuous employment has more vital importance to a married employee than to a single worker. Being so dear married employees are expected to be more careful about their employment and avoid any incident such as work injury that may cause

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[63] Eli Ginzberg, The Unemployed (New York: Harper & Row 1934).

[64] Fred J. Carvell, Human Relations in Business (The Macmillan Co., 1970), pp. 83-84.

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discontinuance. Earlier studies reviewed by Herzberg and his associates, showed that 3 studies provided a "yes" answer to the question of "do married workers like their jobs more than single workers?" Only one study said no and eight other studies indicated that marriage does not appear to make a difference in whether or not a worker likes his job.[65] A study by Harris,[66] indicated that married workers liked their jobs more than unmarried employees. A study of enthusiasm toward teaching, conducted by Chase revealed that married teachers are more enthusiastic than single teachers.[67] Inlow studied satisfaction on the job among employed people who had graduated from college over a period of 20 years and found that married employees tended to be more satisfied with their jobs than those who were not married.[68] A recent study provided evidence the amployees who were included in the study, have taken their present jobs, in

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[65]Fred Herzberg et al., Job Attitudes: Review of Research and Opinion (Pittsburgh: Psychological Service of Pittsburgh, 1957), pp. 23-24.

[66]Frank Harris, "The Quantification of an Industrial Employee Survey, I. Method," Journal of Applied Psychology, Vol. 33, 1949, pp. 103-111.

[67]Herzberg, et al, op. cit.

[68]Gail M. Inlow, "Job Satisfaction of Liberal Arts Graduates," Journal of Applied Psychology, Vol. 35, 1951, pp. 178-181.

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place of lower paying but intrinsically more rewarding ones, chiefly as a result of feelings of family responsibility or of wifely pressure.[69] The same study also revealed that the most "significant others" in the married worker's life will tend to be his wife and his children rather than his mates, fellow unionists or leisure companions.[70] Looking at driving behavior and accidents, unmarrieds have been shown to be significantly more often involved in fatal motor vehicle accidents than the marrieds who are similarly exposed.[71] These studies suggest that marriage influence to a certain extent the attitudes of people. This being the case, any attempt to modify workers' values and attitude in the desired direction should prove positively effective if it is exercised through his immediate family. Davis contends that there is a general agreement that a worker's on-the-job performance is affected by off-the-job influences and one of the most significant is his family.[72] This influence can be either in the direction desired or undesired by the organization. During World War II, in order to prevent or minimize

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[69]Goldthorpe et al., op. cit., pp. 34-36.

[70]Ibid., pp. 148-149.

[71]Haddon et al., op. cit., p. 608.

[72]Davis, op. cit., p. 347.

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preoccupation with family concerns, the families of German soldiers were given strict instructions to avoid references to family deprivations in letters to the front.[73] Furthermore, the family ties served to keep the army from disintegration. Soldiers were warned that disertion (as it was a problem toward the end of the war) would result in severe sanctions being inflicted on the deserter's family.[74] The implication of these studies for safety would be that not only may married employees because of concern for their family be more safety cautious, but also their attitude toward safety on the job can be influenced by their family. Being aware of the significance of this "family effect" students and practitioners of human relations urge managers to develop special approaches to integrate families into the organizational communication system.[75] Different methods have been suggested to achieve this objective, such as mailing of important communications to an employee's family, open house practices, contests, family picnics and

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[73]Edward A. Shils and Morris Janowitz, Cohesion and Disintegration in the Wehrmacht in World War II, in Walter and Douglas Egan (eds), Readings in Organization Theory - A Behavioral Approach (Boston: Allyn and Bacon, Inc. 1968), p. 311.

[74]Ibid., p. 312.

[75]Davis, op. cit., pp. 347-348.

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so on. Obviously, more research is needed to draw more specific generalizations about marriage and family influence on safe behavior at work. It appears that existing knowledge provides an encouraging background for it.

Employee Educational Level

Does educational attainment of workers have a significant effect upon a firm's productivity and profitability? There is no general agreement on the nature of the answer to this question. Findings provided by research studies are heterogeneous and don't allow the formulation of a comprehensive generalization which would be applicable to every organization with any type of work force. However, a review of these findings would reveal the weaknesses and strengths of generalizations made. Some writers and persons interested in the subject have hypothesized that there is a direct and positive correlation between educational level of employees and the firm's productivity.[76] It should be pointed out that "productivity" is used here in the general meaning of the term which would include safety performance of the firm. For a firm can hardly claim to be profitable and productive if its safety record is poor.

A number of studies have been conducted to examine

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[76] See for example: Meggison, op. cit., p. 158.

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the possible relationship between educational level and work attitudes of the employees. Out of 13 studies reviewed by Herzberg and his associates, 5 indicate no difference in job attitude among workers differing in education; 3 studies show an increase in morale with increased education; but the remaining 5 studies reveal that the workers with higher educational level tend to have lower morale.[77] It should be mentioned that the type of workers included in these 13 studies varies considerably. A study by Centers and Control showed a drop in the employee's liking for his job with increased education.[78] Mann found that blue collar workers with high education have low job satisfaction. Similar findings also were found and reported by Neilson at Westinghouse, Mossin for a group of female sales clerks, and Scott and Hayes for workers involved in a routine task. The three studies which showed increased morale with increased education level were conducted by the American Vocational Association which sponsored the study of home economic teachers; by Kessler who studied Job Satisfaction of Veterans rehabilitated under public law 16; and by Scott and Hayes who related retardation in school to job

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[77]Herzberg et al., <u>op. cit</u>., pp. 15-16.

[78]For reference to this and other studies referred here see: Ibid., pp. 27-35.

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satisfaction and found less retarded workers to be more satisfied. The five studies which found no differences in job satisfaction among workers differing in amount of education were mostly conducted in industrial concerns. "No difference" findings were reported by: Ash, who studied a large sample of steel company employees, by Quayle, who studied a group of stenographers, Kornhauser and Sharp whose sample was a group of factory girls, Cain who intensively studied susceptibility to monotony of factory workers, and, finally, by Fryer who studied a group of men with varied occupations who came to an employment agency for assistance in getting jobs.[79]

Considering the findings of studies reviewed, it will be clear why general statements about the role of education in job performance of the workers in general and safety performance in particular cannot be made. It is possible that the difference in findings of these studies may be related to other variables of the samples studied. It has been shown that job satisfaction and safety performance goes up with increasing age. Thus, it is very possible that workers with low educational level whose morale was found to be high were also among the older

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[79]Ibid.

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workers; on the other hand, workers with high education but low morale and relatively poor performance were among younger workers. It can be deduced that in these studies the determinant variable may be age or length of service rather than educational level.

Physical Working Conditions and Occupational Accidents

The human body conceived as a system is flexible but a limited system in its interaction with other elements existing in the environment. Obviously the need for survival necessitates this interaction and the same need determines and regulates the extent, duration and kind of flexibility that the subsystems of the human body should exercise in order to allow optimal interaction and maximize its gains while providing maximum comfort. But if variations in the environmental factors exceed the flexibility limits of the human body, then that survival will be in danger. Interaction with the environment takes place through sensory systems. Any environmental factor interrupting proper functioning of these sensory systems may cause a total break down in the system. The concepts of interruption and break down are better known as work accident and disabling injury. In the literature of occupational safety, accidents are attributed mainly to unsafe a

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acts and/or unsafe conditions. But as one writer contends,[80] unsafe conditions are to some extent, created by human action or inaction. He elaborates that if an unsafe condition exists but nobody is aware of it, then it can't be removed. And if it is known to a person and he does not take any action to correct the unsafe condition, any possible accident and resulting injury must be attributed to his action or inaction rather than to the unsafe condition. This being the case, this writer would suggest that there are two ways that an unsafe condition can be identified. One way would be careful investigation of accidents after they occur. This may reveal possible unsafe condition which existed before and resulted in the mishap. The second way would be through extensive research to discover limitations of the human body, dangerous properties of substances used, etc. Research may begin after occurrence of an accident to scrutinize evidences that could not be revealed by normal investigation. Also, independent from a particular incidence, studies may be conducted to discover conditions that are hazardous but not known to human beings. An example of this would be the research done on the field of human vision.

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[80] Don F. Jones, Human Factor - Occupational Safety, A report to the Labour Safety Council of Ontario, Ontario Department of Labor; no date, p. 10.

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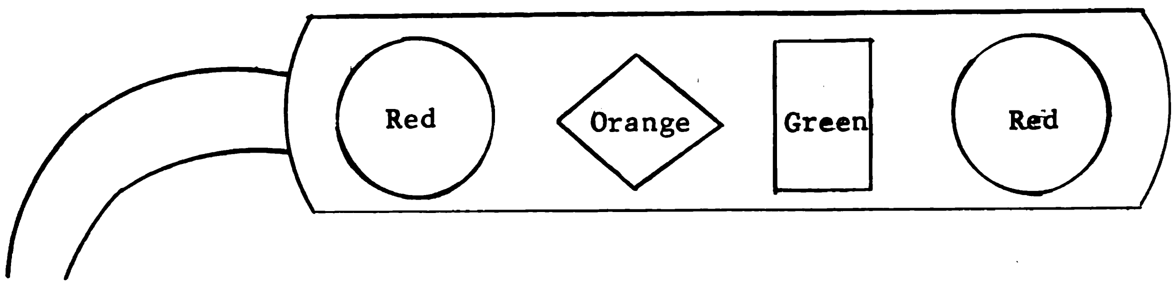
It has been found that man can see about 200^{o} horizontally and 140^{o} vertically when focussed on an object straight ahead.[81] Being aware of these findings, people involved in traffic safety of Montreal (Canada) have started to install new traffic signals which are horizontal rather than vertical. Figure III-4 is an illustration of these new lights.

FIGURE III-5

ILLUSTRATION OF NEW TRAFFIC LIGHTS
IN MONTREAL (1967)[82]



In fact the major aim of the concept of "human engineering" which began during the first world war but continued in earnest as "ergonomics" by a group of scientists during the second world war, is to enable man to work with optimum physical and mental comfort and use his special senses with best effect. In brief, ergonomics deals with the interaction between the worker, his job and his working

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[81]Surry, op. cit., p. 47.

[82]This illustration is adopted from: Ibid., p. 49.

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environment. It combines different scientific disciplines of: a) anthropometry which supplies the data of anatomy and human measurements; b) physiology, which involves the calorific requirements of work and the functioning of the human body such as reception and processing of stimuli and taking of effective action as a result; c) psychology which deals with much that appertains to working life and safe working; d) engineering that attempts to collate the information provided by the above mentioned disciplines and build accordingly.[83]

While human factor engineering remains possibly the most potential part of this field for further development, careful consideration of the previous research findings should prove as effective in prevention of work accidents as will possible future contributions. It seems most appropriate at this time to review the literature on different factors of physical factors of physical working environments and their effect on occupational safety.

Temperature. It has long been recognized that the temperature affects the efficiency of various human

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[83]For further elaboration on the concept of "ergonomics" see for example: a) A. H. Hands, Ergonomics, in William Handly, (ed.), Industrial Safety Handbook (London: McGraw-Hill, 1969), pp. 307-314. b) Alphonse Chapanis, Man-Machine Engineering (Belmont, Calif., Wadsworth Publishing Co., Inc. 1966).

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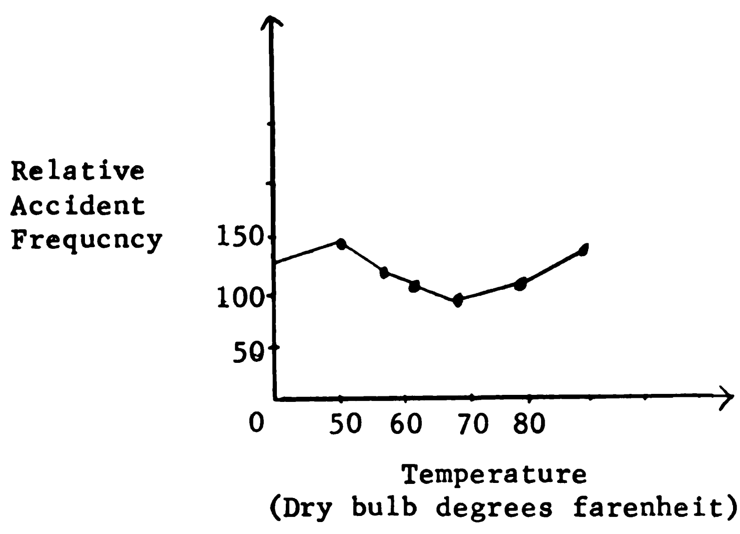
activities. The relation between working environment temperature and accidents has been subject to empirical research studies. An early study by Osborn and Vernon[84] indicated that accidents in the munition factory under study, were at a minimum when the room temperature was 67.5°F. and when the temperature deviated from that optimum, the accident rate increased for both male and female workers in proportion to that deviation. Figure III-5 illustrates the relative accident frequency with variation in the temperature of working environment.

FIGURE III-6

ACCIDENT FREQUENCY RATE VARIATIONS AS A CONSEQUENCE OF CHANGE IN WORKSHOP TEMPERATURE[85]



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[84]E. E. Osborne, et al; Two Contributions to the Study of Accident Causation (London: Industrial Fatigue Research Board Report No. 19, 1922).

[85]This illustration is adopted from: Ibid.

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A study of 44 shop departments in a tractor factory showed that comfortable shop environment appears to be a major determinant of safe behavior.[86] It was also elaborated that workers with low "physical tolerance" under inadequate temperature and noise level, probably have a somewhat higher accident frequency rate than others. A number of studies have been conducted to determine the appropriate temperature level for different types of works and different geographical areas.[87] For example, for sedentary work of office type, the desirable temperature in Britain has been suggested at 65^{o}F. And if temperature increases to above 68^{o}F people tend to feel sleepy and efficiency declines. In mining, a progressive increase in minor accidents rates have been observed in pits with different temperature level ranging from 62^{o} to 85^{o}F. Accident frequency was 3 times more in pits with high temperature than pits having low temperature.[88] It also has been found that accidents of male and female workers are affected similarly by variations in temperature, except that female workers are somewhat

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[86]Vernon Keenan et al; Psychological Climate and Accidents in an Automotive Plant, in Haddon, op. cit., pp. 309-313.

[87]See Browne, op. cit., pp. 64-71.

[88]Maier, op. cit., p. 511.

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less affected by high temperatures than are males.[89] The New York Ventilation Commission's investigation, reviewed by Maier, indicate that physical work was definitely impaired by high temperature and stagnant air. Table III-3 summarizes findings of an experiment which was a part of above investigation.

TABLE III-3

RELATIVE EFFECT OF TEMPERATURE AND AIR ON PHYSICAL WORK[90]

Temperature	Air	Units of Work (100 Optimum)	Fall in Production Due to Stagnant Air	Fall in Production Due to Increase in Temperature
68°	Fresh	100.0	-	-
68°	Stagnant	91.1	8.9	
75°	Fresh	85.2		14.8
75°	Stagnant	76.2	8.6	14.5

Findings of another study suggest that the peripheral vision deteriorates with increasing temperature.[91] This may well

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89Ibid.

90This table is adapted from: Maier, _op. cit._, p. 552.

91A. E. Bursill, "The Restriction of Peripheral Vision During Exposure to Hot and Humid Conditions; _Quarterly Journal of Experimental Psychology_, Vol. 10, Aug. 1958, pp. 113-129.

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lead to the occurrence of an accident. It should be mentioned that extreme cold temperature also creates an inadequate physical environment in which the human body is unable to properly function. This disfunctioning may be a result of sluggish movement, reduction in degree of feeling of fingers of toes, slow unusual response and so on. That may lead to occurrence of an accident which in turn may result in a physical impairment.

Review of the work accident literature reveals the fact that findings of all endeavors in this field have confirmed that a direct and positive relationship exists between accidents and extremely inadequate temperature in the work environment. No one study -- as far as this writer's search could cover -- reports an indifferent or negative effect.

Lighting. Sight undoubtedly is the most important sensor in most occupations. Yet, without proper illumination seeing becomes difficult and in some cases impossible. Unable to see, a worker is expected to have an accident no matter what other personal protective measures have been taken. Obviously natural daylight is the most preferable kind of light to human beings. Although people differ in the amount of light which is most desirable for them, a st

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study by Feree[92] and his associate showed that 65 percent of the subjects studied preferred the intensity of light for reading to be between ten and thirty foot candles.[93] It should be pointed out that the amount of illumination depends upon the task involved. 30 foot candles are recommended for reading, whereas for precision die-making an intensity of 650 foot candles is appropriate.[94] A report of 32 percent reduction in accident rates was made by General Electric Co. as a result of raising illumination level 5 to 20 foot candles in the ecroction shops.[95] Not only is the intensity of light an important factor in overall illumination of the working area but distracting factors such as glare, shadows, color contrasts and reflections must be eliminated. These factors interrupt proper functioning of eyes by fatiguing, discomforting, annoying.

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[92] C. E. Feree and G. Rand, "Good Working Conditions for Eyes," Personnel Journal, No. 15, 1937, pp. 333-340.

[93] A 1 Candella Source delivers 1 foot candle of illumination on a surface when the surface is 1 foot away from the source. For more information in this subject see: a) Browne, op. cit., pp. 55-63; b) Chapanis, op. cit., pp. 53-63.

[94] DeReamer, op. cit., p. 125.

[95] E. J. McCormick, Human Factors Engineering (New York: McGraw-Hill Book Co., 2nd Edition, 1964).

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They can be eliminated by means of relocating light source, shielding and changing light source.

A report by Gary reviewed by Dr. Simonds revealed that according to an estimation made by Travelers Insurance Company, 24 percent of all accidents were due to poor lighting.[96] This figure is self explanatory and indicates the importance of proper lighting in workplaces. It should be recognized that illumination, both natural and artificial, is a highly specialized function and the original design has to be checked by an illumination expert before it is installed.[97] Hazards of improper artificial lighting should be carefully considered, for a survey in England showed an increase of 25 per cent in overall accidents and 75 per cent in accidental falls as a result of the necessity for artificial lighting.[98]

Noise. The review of literature indicates that potential hazards of improper industrial noise level in workplaces have long been recognizes. And yet, increasing

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[96]Simonds, op. cit., p. 407.

[97]For an extensive elaboration of this subject see: Harry Judson and James Brown, Occupational Accident Prevention (New York: John Wiley & Sons, Inc., 1944, pp. 90-100.

[98]Simonds, op. cit.

annual compensation claims of loss of hearing from exposure to industrial noise reveals the prevalence of this hazard[99] which requires further study of the problem, as well as control and enforcement of established rules and standards in the firms. Studies indicate that in addition to preventing loss of hearing, fatigue, inefficiency and accidents can be reduced by controlling noise level.[100] It was revealed that the rhythm of the worker's movements would be disturbed by loud sound. As was observed through reviewing slow-motion plant movies, movements became more irregular as the sound turned louder, increasing the possibility of a sudden jerk that could bring about an accident. Other studies have reported different findings. Kornhauser[101] investigated the effect of noise on the level of productivity of four typists working in a quiet and noisy office. He found no difference when errors, amount typed and number of discarded papers were observed. Studies by Gary and

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[99]David Swankin, "3% Inspected, 90% Unsafe, in AFL-CIO Industrial Union Department: Danger: Men at Work (Washington: Industrial Union Department, 1969), p. 20.

[100]This discussion is based on a condensed report prepared by a periodical from another publication, see: "Ergonomics - New Angle on Employee Health and Safety," Management Review, Vol. 56, No. 12, Dec. 1967, p. 48.

[101]A. W. Kornhauser, "The Effect of Noise on Office Output," Industrial Psychology, No. 2, 1927, pp. 621-622.

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Kryter reviewed by Professor Simonds[102] indicated that steady or expected voices do not have a significant effect on psychomotor activities whereas studies by Farmer and Stevens and his associates have shown that average response time, gross number of errors and number of errors per unit of production increased by the presence of noise with high frequency and level.[103] In studying the effect of noise, four different aspects may be identifiable and should be investigated. The damaging effect of the noise on hearing ability, its effect on work efficiency, interference with verbal communication and finally its annoying effect. Considering all these aspects in the study, may help the investigator in making more workable generalizations which can be applied to the majority of working environments, if not all. Although existing knowledge in this field does not allow such generalizations, reviewing study findings tends to leave the impression that adequate noise level may be associated with safe behavior at work. No research finding has shown an increase in the occupational accident rate by reducing noise to an adequate level.

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[102]Simonds, op. cit., p. 407.

[103]Ibid.

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Accident Record Keeping System and Reporting

It is obvious that no organization can survive without keeping track of its market share, production, sales, costs, profits and losses. Accurate and up-to-date information on these areas is needed to provide a basis for management to evaluate past performance of the organization which it serves, to determine where it stands today, and its expected position in the future. The nature of information available to the manager affects the quality of his decisions which in turn determine the degree of success or failure. For this vital reason, organizations have included the book keeping function to other important functional areas of their organization. This being the fact, it can hardly be accepted that a firm is serious about safety and health, if it does not have at hand the factual information on company's occupational accidents. An early estimation indicated the probability that not more than 5 percent of the separate business concerns keep records which will give them a clear picture of their accidents.[104] One would assume that today the situation is much better than the time when the above estimation was made. There exist many reasons for this expectation. One reason might be the

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[104] John M. Roche, Safety and the Foreman (New York: National Foreman's Institute, Inc., 1951), p. 111.

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existence of state laws requiring all employers to keep records of their work injuries and to submit certain reports to state authorities and also state workmen's compensation laws. The second reason would be availability of improved and standard methods of measuring and recording work accidents, such as Z16.1 and Z16.2; and standard method of accident cost analysis developed by Professor Simonds, which was approved in 1954 for publication by the President's Conference on Occupational Safety.[105] The third reason may be the Federal laws such as the Walsh-Healey Act, requiring government contractors to keep records of injuries in a rather detailed and very specific way. In addition to the above reasons, safety promotion activities by many governmental and private institutions and availability of electronic data processing systems can be mentioned. Although statistics showing the actual number of companies having a comprehensive accident record keeping system do not exist, comments made by one government official[106] reveals that

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[105]Rollin H. Simonds, _Estimating Costs of Industrial Accidents_, U. S. Department of Labor (Washington, D. C.: U.S. Government Printing Office, 1955).

[106]Mr. David Swankin is director of the Bureau of Labor Standards, U.S. Department of Labor who delivered speech in 1969 Occupational Safety and Health Conference of the AFL-CIO Industrial Union Department. For his entire speech content see: Swankin, _op. cit_., pp. 20-26.

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despite the points discussed above, many companies have ignored the advantageous practice of a proper accident record keeping system. His point was that despite provisions of the Walsh-Healey Act, perhaps 75 percent of companies visited for the first time by Department of Labor authorities have not computed their accident rates or have improperly done so.

It should be pointed out that sheer collection and filing of accident data would be a waste of resources. Collected data should be analyzed and interpreted in adequate time intervals, to find out where, when and why accidents occur in workplaces, and who is mostly involved. Farmer[107] reports that as a result of analyzing the records, Miles and Eyre were able to greatly reduce the number of breakages in a group of teashops by finding out when and where they occurred. Then, by rearranging the delivery and removal process waitresses were exposed to less mental strains. By analyzing injuries as a result of weight lifting, Overton[108] was able to reduce the number of injuries by paying attention to the proper ratio between body and weight to be lifted. It should also be mentioned that the considerable

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[107]Eric Farmer, The Causes of Accidents (London: Sir Isaac Pitman & Sons LTD., 1932), pp. 73-74.

[108]For more detailed discussion and reference to this study see: Ibid.

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progress made over the past half century in preventing occupational accidents at the national level is partially due to the collection and analysis of accident data which directed action in the right direction, where it was needed so that progress could be made in preventing accidents.

At the company level too, it is difficult to believe that a firm, without knowing the frequency, nature, severity, cause, place and especially the cost of its occupational accidents, could provide a fairly safe working environment for its members nor could it maintain an impressive safety performance record. It was on the basis of this belief that a record keeping system was included as one of the variables to be investigated in this study.

Machine Guarding, Safety Devices and Controls

Occasionally, discussion has appeared in the literature that most occupational accidents are due to human faults and this argument has been used by management against proposals for guarding of machinery and equipment in the plant. It has also been mentioned that even though lack of proper machine guarding may have caused just a few accidents, the analysis of accidents nevertheless show that machines are the source of about 10 percent of fatalities and permanent total disabilities, and of nearly 25 percent of accidents c

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causing permanent partial disabilities.[109]

Some complaints have been made that supervisors resist the idea of machine guarding and other safety devices because they feel that production will be interferred with.[110] Today there is no logic for such an attitude for it is obvious that production will suffer if the worker has to divide his attention between the immediate task and the unguarded or improperly guarded machine with which he works.

Of course, machine guarding or a device which is partially safe, may actually increase the number of accidents because the operator may overestimate the safety of the machine and become less cautious than he was before the safety device was installed or guarding was provided. Maier points out that men will adjust themselves to the degree of apparent danger, and if that danger becomes less apparent due to safety devices or guarding, then it may result in an increase in the number of accidents.[111] A study by Vernon[112] in England indicated that when traffic density increased it made the danger more apparent which consequently decreased

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[109]Judson, op. cit., p. 101.

[110]DeReamer, op. cit., p. 130.

[111]Maier, op. cit., p. 507.

[112]H. M. Vernon, Accidents and Their Prevention (London: Cambridge University Press, 1936), p. 120.

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the number of traffic accidents. But when roads were empty and straight, the danger became less apparent and drivers underestimated the hazard of speed which led to an increase in the number of accidents. Another example of this would be the difference between the number of urban and rural automobile accidents.

It should also be pointed out that, installing a fairly perfect safety device or machine guarding may protect the operator from one hazard and make him unaware of others. A study by Keenan and his associates in an automotive factory showed that where an obvious danger factor exists, the accidents which occur tend not to be identified with the obvious danger.[113] They also cited that the existence of an impressive obvious hazard seems to contribute to unrelated accidents by delimiting attention and encouraging proneness to involvement in the non-obvious hazards.[114]

Some criteria have been suggested for proper guarding and safety devices which may be listed in order of importance as follows:[115]

a) Impervious - fully protecting from all possible energy release;

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[113]Keenan et al; op. cit., pp. 312-313.

[114]Ibid.

[115]Surry, op. cit., p. 121.

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b) Non interfering (with the man's sensory - control functions required for the task;

c) Fool proof, protecting under all task and stress conditions;

d) Comfortable, no irritation or need for awkward movements;

e) Operator independent, to avoid deliberate removal;

f) Inexpensive.

Machine guarding compared to safety devices and equipment has been more successful. It has been suggested that for further improvement in designing these devices and equipment user opinion, past experience and human factors engineering technology should be considered.[116] It is also recommended that studies should be conducted by psychologists, sociologists, marketing research specialists, and human factor engineers in order to explore reasons why many excellent devices now available are not being used.

In general, existing knowledge in this field suggests that machine guarding and installment of safety devices are effective means of accident prevention if the criteria mentioned above are met.

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[116]International Occupational Safety and Health Information Center: Ergonomics of Maching Guarding (CIS Information Sheet 10, Geneva 1964).

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Status of the Occupational Accident Research

Review of the literature provided a research based background for the factors included in the study. This was the main contribution expected from the content of existing literature. But in addition to extraction of specific study findings, exposure to accident research literature enabled this writer to formulate an overall idea about the present status of research in this field. This ideation may be manifested by saying that accident research in general and occupational accident research in particular is highly heterogeneous in content and emphasis. There are many kinds of accidents occurring in many different places. Numerous factors are candidates for the cause of each accident and often blaming a specific factor is quite arbitrary. Scientific investigation of accidents ranges from intensive study of the effect of specific factor to broad-scale study of accidents. The scarcity of research is clearly felt but lack of coordination among existing research findings is more tangible. It should be pointed out that research in some areas is much more advanced than in others. Engineering has already contributed considerably to reduction of work accidents whereas findings of psychological studies are not comparable partially because psychological variables were not so readily identifiable as are technical factors.

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But it appears that effective accident prevention depends upon findings of more disciplines than the two just mentioned. Medical research is needed to investigate the physiological and pathological effects of environmental and technological factors and the physical circumstances conducive to accidents. Statistical research is required to ascertain what kinds of accidents occur in what numbers to what types of people, in what operations and from what causes. Need for further educational research is obvious since more effective ways of teaching safety are yet to be discovered. More information is needed about calorific requirements of work and the functioning of the body which has to be provided by further physiological research. There is a lot to be learned about properties and characteristics of harmful materials, better machine guarding, more effective safety devices and controls, better personal protective equipment and so on, which necessitates further technical researches. The last area which is in need of research perhaps much more than any other, is psychology since a lot has to be discovered on psychological patterns conducive to accidents. Obviously, this is not a claim for an extensive list of fields which need further improvement in their state of existing knowledge nor it is a complete list of the disciplines which could contribute to the prevention of accidents. Other important areas such as safety regulation, laws, standards are not excused from further improvements.

It should be pointed out that even if needed research in the above areas were undertaken, unless the findings are properly integrated, their utilization can not be optimized. This integration has been missing to a great extent in the accident research so far. But the recent development of the concept of "ergonomics" which embodies most of the essential fields discussed above, appears to be a positive and promising solution to this problem.

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CHAPTER IV

STUDY FINDINGS

Introduction

This chapter is an attempt to report the findings of the field study and is composed of three major sections. The first section includes specific background data and statistics such as company accident frequency and severity rates, number of employees and so on which were determined in the company location through interviewing, reviewing company records or using data obtained from the Michigan State Department of Labor. The second major section deals with the results of testing hypotheses of the study. The third section is a report of findings which were not basically included in the hypotheses of the study but in the course of research were found to be of considerable importance to the field of occupational accident research either by this writer or by interviewees who felt very strongly about the importance of some of the factors. The main body of the chapter follows the same order mentioned above.

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Specific Background Data and Statistics

The reason for enclosure of specific company data and statistics at this point in the report is that interpretation of findings as a result of testing hypotheses will be more meaningful if this background data is considered and kept in mind. The first statistical data to be mentioned is the average number of employees at the employ of each firm since this information was directly or indirectly consulted or used as a basis for computation of other statistical data such as accident rates. Table IV-1 shows the average number of workers employed in the companies studied, at the time of this writer's visit.

The total number of employees of all 22 firms studied was 6,100. Eleven firms with relatively high accident records employed totally 3,195 workers and eleven companies with low accident rates had 2,905 workers at their employ. It is also interesting to note from Table IV-1 that the total number of female employees of the firms with high accident rates constituted approximately one fourth of the total employee population for this latter group of companies whereas total women employees for the firms with low accident rates was approximately one-sixth of the total employment figure. This is not an attempt to attribute higher accident rates to work force composition of the companies

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TABLE IV-1

AVERAGE NUMBER OF EMPLOYEES AT THE EMPLOY
OF COMPANIES STUDIED BY INDUSTRY

Col. No.	Industry	SIC Code*	Firms with HIGH Accident Rates			Firms with LOW Accident Rates		
			Total	Male	Female	Total	Male	Female
1	Meat products	201	300	250	50	275	215	60
2	Dairy products	202	80	73	7	190	150	40
3	Canning preserving	203	190	70	120	125	35	90
4	Household furniture	251	225	175	50	195	105	90
5	Paper containers and boxes	265	155	130	25	80	30	50
6	Iron and steel foundries	332	675	574	101	350	336	14
7	Non-ferrous metal, rolling, etc.	335	160	104	56	350	339	11
8	Other primary metal products	339	375	357	18	275	260	15
9	Metal stamping	346	260	220	40	290	270	20
10	Metal working machinery equipment	354	225	212	13	275	265	10
11	Motor vehicle	371	550	220	330	500	488	12
Total			3,195	2,385	810	2,905	2,493	412

*Standard Industrial Classification Code.

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with respect to employee sex since that hypothesis was not tested in this research, but it leaves an open and potentially fertile ground for further study.

The next statistical data is the companys' accident rates. As was pointed out earlier, frequency rate of companies was determined by using information and data provided by the companies as well as some data collected from the files of the Michigan State Department of Labor. Table IV-2 indicates accident frequency rate of the companies studied. These rates are for 1969 and since generally a firm's accident frequency rates may not change drastically in a relatively short period of time or even in a year to year basis, there is a good probability that these rates may represent companies' safety performance in the recent past and also near future, though they are based on 1969 data. The industry average frequency rates shown in this table are taken from Michigan work injuries cooperative survey[1] and are for the year 1968. It also should be pointed out that these industry average rates represent only those companies that participated in the survey which was on a voluntary basis. It could be speculated that rates would tend to be higher if the average was taken for all the

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[1]Michigan Department of Labor, Michigan Work Injuries Cooperative Survey, 1968.

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TABLE IV-2

THE WORK ACCIDENT FREQUENCY RATES OF THE FIRMS STUDIED

Industry	SIC Code	Firms With LOW Accident Rates	Industry Average Frequency Rates (Michigan)*	Firms With HIGH Accident Rates
Meat Products	201	12.0	37.0	51.7
Dairy Products	202	25.2	36.1	37.0
Canning Preserving	203	18.8	24.8	61.9
Household Furniture	251	25.2	29.9	89.4
Paper Containers and Boxes	265	14.5	17.6	45.1
Iron and Steel Foundries	332	15.5	18.2	69.67
Non-ferrous Metal Rolling, etc.	335	34.1	21.6	45.0
Other Primary Metal Products	339	41.7	32.2	71.1
Metal Stamping	346	16.0	13.8	65.2
Metal Working Machinery	354	44.2	11.1	173.0
Motor Vehicles and Equipment	371	51.6	3.5	128.0

companies in each industry group. The reason for this speculation could possibly be that those firms volunteering for participation may be more safety minded and might have done more in the way of accident prevention and safety. Industry average frequency rates for firms in Michigan were b

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not available for 1969 in any form at the time this study was conducted.

Although data needed for computation of the accident frequency rates were not readily available in the firms, the necessary figures to calculate accident severity rates were even more scarce. In some companies these data did not exist and search for them in other places proved to be unproductive. It was mentioned earlier in Chapter II that most of the firms did not consider the severity rate as a good indicator of the company's safety performance, so they did not keep a record of severity rates. The reasons given by the firms are listed in Chapter II and are not repeated here. Wherever possible, data were gathered and the severity rates of the companies were computed.

It is obvious that severity rate becomes a better indicator of safety performance when it is calculated and considered for a number of years rather than for only one year. The longer the period under study, the smaller will be the possibility that sheer chance factors, such as fatality resulting from heart attack and so on, may have altered the firm's accident severity rate. In spite of the fact that the Table IV-3 shows severity rates for a period of only one year, in most cases it coincides with the direction shown by frequency rate in Table IV-2. In other words,

TABLE IV-3

THE WORK ACCIDENT SEVERITY RATES OF THE FIRMS STUDIED

Industry	SIC Code	Firms with LOW Accident Rates	Firms with HIGH Accident Rates
Meat Products	201	No data	No data
Dairy Products	202	No data	751.8
Canning and Preserving	203	988.0	1383.0
Household Furniture	251	185.0	243.2
Paper Containers and Boxes	265	616.0	1033.0
Iron Steel Foundries	332	804.7	1034.0
Non-ferrous Metal Rolling, etc.	335	588.8	734.2
Other Primary Metal Products	339	1613.0	899.0
Metal Stamping	346	580.0	1789.7
Metal Working Machinery	354	581.1	430.4
Motor Vehicle and Equipment	371	815.0	4130.0

most firms having low frequency rates, tend to have relatively low severity rates as well. By comparing these two tables, it is noticeable that in most cases when frequency rates of the firms are close figures, then their severity rates too, tend to be similar. When frequency rates of two firms differ considerably, then their severity rates too, appear to follow a more or less similar difference pattern.

Another item of background information collected from the firms deals with companies' membership in safety organizations since this could be an indicator of a firm's safety mindedness. According to statistics presented in the "Accident Facts," companies that are a member of the National Safety Council tend to have considerably better safety performance records than non-member companies. As it is shown in Table IV-4, out of eleven firms with low accident rates 8 (or 72.7%) firms are members of a safety organization and only 3 (or 27.3%) hold no membership. From the total of eleven firms with relatively high accident rates 7 (or 63.7%) are not a member of a safety organization and only 4 (or 36.3%) of these firms are members. These figures indicate a direction that could be used for the formulation of a hypothesis that: "The firms that are member of a safety organization, tend to have considerably better safety records, than do non-member firms." Obviously, valid generalizations can not be made at this point with respect to this "membership effect" unless the above hypothesis is empirically tested in a number of firms in different industries which is subject to further research.

The degree of automation of production was also considered to be an important background factor especially from the safety on the work point of view. Previous research studies have indicated that the greater the degree of manual

TABLE IV-4

MEMBERSHIP IN THE SAFETY ORGANIZATIONS

Industry Code	Firms with LOW Accident Rates		Firms with HIGH Accident Rates	
201	Yes			No
202	Yes		Yes	
203		No		No
251		No		No
265	Yes		Yes	
332	Yes			No
335		No	Yes	
339	Yes			No
346	Yes		Yes	
354	Yes			No
371	Yes			No
Total	8-Yes	3-No	4-Yes	7-No
Percent of Firms	72.7% (N=11)	27.3% (N=11)	36.3% (N=11)	63.7% (N=11)

effort involved, the higher accident rates tend to be on the average.[2] As is shown in the Table IV-5, out of the eleven matched-pairs of companies studied the degree of automation of production was the same for 6 pairs and, 3 firms

[2]See for example: Keenan et al.; *op. cit.*, p. 312.

TABLE IV-5

PERCENTAGE OF THE PRODUCTION AUTOMATED IN THE FIRMS AT THE TIME OF STUDY

Industry Code	Firms with LOW Accident Fr. Rates	Firms with HIGH Accident Fr. Rates
201	0-10%	0-10%
202	75-85	41-50
203	41-50	41-50
251	0-10	0-10
265	0-10	41-50
332	0-10	10-20
335	51-60	21-30
339	0-10	0-10
346	51-50	0-10
354	0-10	0-10
371	0-10	0-10
	(Mdn=0-10%)	(Mdn=0-10%)

with relatively low accident rates had a higher degree of automation than their respective matched pairs. Also in two industries, two firms with relatively high accident rates also had a higher degree of automation. Even though these data are not statistically evaluated, it appears that differences in accident rates of the firms studied can hardly be attributed to the difference in the degree of

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their automation in this study. Obviously this discussion does not provide, by any means, evidence to make generalizations about the effect of automation on accident prevention but rather an effort to show how firms included in this study compared with respect to their degree of automation.

It should also be pointed out that the degree of automation was determined through a direct question to interviewees. In some cases the answer was given right away, in some others, the interviewees consulted a more informed person in the matter.

The last background information collected from companies to be mentioned in this section has to do with the safety unit or organization.

As shown in Table IV-6, except in one case, none of the firms included in this study had a separate organizational unit specifically responsible for carrying out the safety function. In most firms the safety function was concentrated in the personnel departments which were observed by this writer to be clearly overwhelmed by routine personnel problems as well as other activities. Also, in some cases a member of the personnel department was introduced as the person in charge of safety or as the safety director, but further questions revealed that safety was only a sub-function and not their main responsibility.

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TABLE IV-6

ORGANIZATIONAL UNITS RESPONSIBLE FOR SAFETY OF THE COMPANIES

Industry Code	Firms with LOW Accident Fr. Rates			Firms with HIGH Accident Fr. Rates		
	Safety Org. Yes	Safety Org. No	Responsibility Center	Safety Org. Yes	Safety Org. No	Responsibility Center
201		X	Industrial Rel.		X	Personnel
202		X	No specific unit		X	Personnel
203		X	Plant Management		X	Plant Management
251		X	Personnel		X	Personnel
265	X		Safety Branch		X	Production
332		X	Employee Relation		X	Personnel
335		X	Plant Engineer		X	Personnel
339		X	Personnel		X	Personnel
346		X	Personnel		X	Industrial Rel.
354		X	Personnel		X	No specif unit
371		X	Personnel		X	Employee Rel.
Total	1	10		-	11	

For this reason they were not considered as representing an independent or separate functional unit in the organizational structure. Among 22 firms only one had a safety organization which was staffed and operated on a full time basis within the personnel department.

By virtue of the fact that a great majority of smaller size firms have serious work accidents, this writer's

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contention would be that the establishment of a safety organization should be given more emphasis by practitioners and experts in the area of small business administration. Further, its size, structure and relations with other functional areas must be determined by considering the extent of operations, type of business and extent of safety problems prevailing in each business concern.

Testing of the Hypotheses

For the analysis of data collected for testing of hypotheses of this study the Wilcoxon matched-pairs signed rank test was primarily employed. In some cases where data type was not amenable to evaluation by that test, the sign test was used.[3] Instances where the latter was employed will be mentioned in the text of reporting results of hypothesis testing. For all hypotheses where no such specification is made, the former test has been used.

Hypothesis #1: In the firms with lower work injury frequency and severity rates, top management is highly interested and involved in the company's overall safety programs and actively participates in and supports safety activity.

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[3]For explanation of the nature of these tests see: Appendix E.

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The results of testing this hypothesis provided a positive and strong support for confirmation since a significance level of ($\alpha = 0.05$) was obtained. Table IV-7 shows, in summary, how top management's support and involvement in safety differed in firms with low accident rates compared to firms with high accident rates. Although differences exist in most of the activities listed in the table, three areas represent the largest difference. It appears that top management in the firms with better safety records, puts more emphasis on personal audit and inspection than does top management of the firms with relatively poor safety records. Also, not only does top management of the firms' with better safety performance show more interest in plans for achieving certain safety objectives but it also holds review and analysis sessions to ascertain that those plans are being carried out properly and according to projected objectives. Obviously, this practice enables top management to take timely and constructive corrective measures. In the firms with relatively high accident rates this practice is not being given much emphasis and, as it is shown in Table IV-7, considerable difference exists between firms with low and high accident rates in this matter. The third large difference is in the area of including safety reports, figures, and achievements on the agenda of board

TABLE IV-7

TOP MANAGEMENT'S SUPPORT AND INTEREST IN SAFETY AND HOW IT DIFFERS IN FIRMS WITH LOW AND HIGH ACCIDENT RATES

Description of Top Management's Activity with Regards to Safety	Firms With LOW Accident Fr. Rates (N=11)		Firms With HIGH Accident Fr. Rates N=11)	
	Yes	No	Yes	No
1. Does he attend any safety meetings in the company?	8	3	6	5
2. Does he chair any of these meetings?	3	8	2	9
3. Does he regularly receive safety reports?	11	0	11	0
4. Does he personally conduct any safety audit or inspection	9	2	4	7
5. Is he a member of any safety organization?	0	11	0	11
6. Does he regularly attend any safety meetings or conference outside the company?	2	9	0	11
7. Does he emphasize plans for achieving certain safety objectives?	10	1	8	3
8. Does he actively participate in execution of safety plans?	10	1	7	4
9. Does he hold review and analysis sessions in order to compare the results of carrying out safety plans with projected objectives?	9	2	3	8
10. Are safety figures, reports, achievements included on the agenda of company board meetings?	8	3	3	8
Total Score	70	40	44	66

meetings. This is being practiced in the firms with better safety records to a greater extent than in the firms with poor safety records. It appears that improvement in the above three areas may contribute to fill the gap which exists between firms with markedly different work injury rates.

Table IV-8 shows how matched-pairs of firms in different industry groups differed in "score"[4] with regard to top management's support and involvement in safety. These are actual scores which were used to test the hypothesis and determine its significance level. The most interesting and important observation in this table is that where great differences exist between firms with respect to their score of top management's support and involvement in safety, a great difference is also observable in their respective accident frequency rates. This point can be clearly observed when firms in industries 201, 265, 346, 354 and 371 in the above table are scrutinized. When scores are close, the respective frequency rates also tend to be close.

In brief, not only did statistical testing of this hypothesis show a very strong significance level, but a

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[4]In determining these scores, a total of 10 questions were formulated and asked. For each question an answer of "Yes" (with value of 1) or "No" (with value of zero) was required. These scores represent total of "Yes" answers. See Appendix C for the nature of questions asked.

TABLE IV-8

THE TOTAL SCORE OF THE FIRMS ON TOP MANAGEMENT'S SUPPORT AND INVOLVEMENT IN SAFETY

Industry Code		Firms with LOW Accident Fr. Rates		Firms with HIGH Accident Fr. Rates	
		Score	Fr. Rate	Score	Fr. Rate
201		7	12.0	2	51.7
202		9	25.2	7	37.0
203		2	18.8	2	61.9
261		4	25.2	4	89.4
265		7	14.5	2	45.1
332		6	15.5	5	69.67
335		4	34.1	6	45.0
339		8	41.7	7	71.1
346		7	16.0	4	65.2
354		9	44.2	1	173.0
371		7	51.6	4	128.0
	Total	70		44	
		(Mean = 6.3)		(Mean = 4)	

comparison of firms' scores while considering their accident frequency rates provide evidence that leads strongly to belief that top management's earnest support and involvement in company's safety is undoubtedly one of the determinate factors in achievement of good safety performance records. Where this support and involvement is missing, f

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firms tend to suffer greatly from high work accident rates.

<u>Hypothesis #2. In the firm's with lower injury frequency and severity rates, workers have higher average attainment of formal education than in the firms with relatively poor work injury records</u>.

The results obtained from statistical testing of this hypothesis are inconclusive. By using the sign test, it was revealed that the educational level of workers <u>is not significantly</u> related to accident rates of the firms included in this study. Thus the hypothesis was not confirmed. Table IV-9 shows the average educational level of the workers in the companies studied. Although firms have markedly different accident rates, educational level of their workers in most cases are ties. In industries 251 and 354, firms with higher accident rates have also the highest educational level of workers among all 22 firms. It is interesting to note that most of the workers in the firm having high accident rates in industry 251 are college students, since that firm is owned by a university. Thus, average age of the workers which is in 18-23 bracket seems to be affecting accident rates along with other variables -- to be discussed in remaining parts of this chapter -- rather than the educational level.

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TABLE IV-9

AVERAGE EDUCATIONAL LEVEL OF THE WORKERS IN THE FIRMS STUDIED

Industry Code	Firms with LOW Accident Fr. Rates	Firms with HIGH Accident Fr. Rates
201	10-12 Grade	10-12 Grade
202	10-12 "	10-12 "
203	10-12 "	10-12 "
251	10-12 "	13 & over "
265	10-12 "	10-12 "
332	10-12 "	10-12 "
335	10-12 "	7-9 "
339	10-12 "	10-12 "
346	10-12 "	7-9 "
354	10-12 "	13 & over "
371	10-12 "	10-12 "
	(Mdn = 10-12)	(Mdn = 10-12)

It must be noted that this is not, by any means, to generalize that the educational level of the worker is not a significant factor in any situation. It may be a determinant variable where differences in educational level of workers vary greatly which is subject to further research. But as far as the firms included in this study are referred to, the educational level of the workers did not prove to be a significant variable affecting accident rates of the firms.

<u>Hypothesis #3. In the firms with better safety records, average age of the employees is higher than in the firms having relatively high accident rates</u>.

By a significance level of ($\alpha = 0.01$) this hypothesis was confirmed as a result of statistical testing. Based on the evidences provided by findings of this study, age of the employees is significantly related to the occupational accident rates of the companies. In most industries of this study, where accident frequency rates of the companies vary considerably, the average age of the employees also more or less follows the same pattern. Table IV-10 is an illustration of the average age of workers. This can be clearly observed by considering firms in industries 201, 251, 339, 346, 354 and 371. This correlation between age and accident rates may stem from the fact that normally, lower age is associated with a lesser degree of experience. It may also result from the attitude of young men in regard to risk taking. The younger worker's voluntary involvement or arbitrary assignment to more hazardous tasks in the companies could possibly explain the nature of the relationship existing between age and accident rates.

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TABLE IV-10

THE AVERAGE AGE OF EMPLOYEES IN THE COMPANIES STUDIED

Industry Code	Firms with LOW Accident Fr. Rates		Firms with HIGH Accident Fr. Rates	
	Average Age Bracket	Fr. Rate	Average Age Bracket	Fr. Rate
201	35-40 years	12.0	29-34 years	51.7
202	41-46	25.2	41-46	37.0
203	35-40	18.8	35-40	61.9
251	35-40	25.2	18-23	89.4
262	35-40	14.5	29-34	45.1
332	35-40	15.5	35-40	69.67
335	35-40	21.6	35-40	45.0
339	41-46	41.7	35-40	71.1
346	41-46	16.0	29-34	65.2
354	41-46	44.2	29-34	173.0
371	35-40	51.6	29-34	128.0
	(Mdn = 35-40) or 37.5		(Mdn = 29-34) or 31.5	

Hypothesis #4. Firms with better safety records have provided recreational programs and facilities for the employees, and by doing so, have helped to bring employees together.

Statistical analysis of data collected for this hypothesis showed a considerably strong significance level of (α = 0.01). Table IV-11 summarizes how firms in eleven different industries scored in connection with the questions raised about recreational programs and facilities that they provide for their employees. In industries 201, 251, 339, 346, 354 and 371 where firms in each pair have considerably different accident frequency rates, the difference between their scores shown in the Table IV-11 also varies markedly.

There are two possible explanations for such a high level of significance of the hypothesis. Firstly, while providing recreational facilities and programs apparently do not seem to have anything to do with accident prevention or safety performance of the company, it is important to note that such provision is definitely indicative of a company's interest in its employees. Where a company cares about recreation of its employees, it is logical to deduce that the safety of those employees will not be ignored nor would its importance be underestimated. The second possible explanation would be that recreational programs and facilities help to bring employees together which in turn may lead to creation of a friendly relationship among workers. It is not an exaggeration nor irrational to say that a friendly work environment where workers care about each other, will be less conducive to work accidents than will an indifferent or hostile environment.

TABLE IV-11

COMPANY SCORES ON PROVIDING RECREATIONAL PROGRAMS AND FACILITIES FOR THEIR EMPLOYEES

Industry Code	Firms with LOW Accident Fr. Rates		Firms with HIGH Accident Fr. Rates	
	Score[5]	Fr. Rate	Score[5]	Fr. Rate
201	6	12.0	1	51.7
202	0	25.2	1	37.0
203	3	18.8	2	61.9
251	6	25.2	2	89.4
262	4	14.5	3	45.1
332	5	15.5	5	69.67
335	2	21.6	2	45.0
339	4	41.7	1	71.1
346	4	16.0	1	65.2
354	6	44.2	4	173.0
371	4	51.6	2	128.0
	(Mean = 4) (Mdn = 4)		(Mean = 2.1) (Median = 2)	

[5]These scores were determined through seven major questions asked and a value of 1 was given to a "Yes" answer and zero to a "No" answer. See Appendix C for the nature of these questions.

<u>Hypothesis #5. Firms with low injury records have tried to promote employee's safety interest through their families</u>.

The results of testing this hypothesis are inconclusive. Although differences were not statistically significant in this study, before any generalizations can be made, further and extensive studies are suggested to examine the effects of safety promotion through employee families. The reason for this need is that a great majority of the firms, as shown in Table IV-12, scored low in this practice not because they thought it was not an effective means of promoting safety but because they were not familiar with it. Most of the interviewees while saying that they had heard about this for the first time from this writer, contended that it was "a pretty good idea" and they were going to try it.

It is interesting to note that the interviewee of the firm with high accident rates in industry 332 claimed that for 1970, the firm has been very successful in reducing accident rates. He mentioned the promotion of safety through worker families as one of the most effective means utilized by the company in its recent safety performance achievement.

TABLE IV-12

COMPANY SCORES ON PROMOTING SAFETY THROUGH EMPLOYEE'S FAMILY

Industry Code	Firms with LOW Accident Fr. Rates	Firms with HIGH Accident Fr. Rates
201	1	3
202	3	1
203	0	1
251	3	0
265	4	1
332	1	5
335	1	1
339	1	1
346	1	1
354	1	1
371	1	1
	(Mean = 1.54) (Mdn = 1)	(Mean = 1.45) (Mdn = 1)

Hypothesis #6. Firms with low work injury experience have established comprehensive safety rules covering all operations, have made sure that all employees understand them, and have consistently enforced them.

It is interesting to note that even though 7 out of the eleven firms with relatively low accident rates

scored[6] higher with respect to safety rules, than did their complement in the matched pair with high accident rates, this hypothesis was not supported statistically and a significance level of $\alpha = 0.05$ was not obtained. This is partially due to zero scores of the two firms with low accident rates in industries 339 and 346 and to a lesser extent to the lower score of the firm with better safety records in industry 332. Those firms with zero score did not have any safety rules. Table IV-13 shows the score of companies studied with respect to their safety rules.

If those firms with a zero score as well as their complement are eliminated from the analysis and the number of matched-pairs is then reduced to 9, a strong significance level could be obtained by the remaining data to support the hypothesis. This would suggest that with different sets of companies in other studies the findings could be markedly different with respect to the effect of safety rules in safety performance. The findings of this study, however, do not show significant support for this hypothesis.

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[6] In determining these scores, a total of 16 questions were formulated and asked. Some of the questions required only Yes or No answer with value of (1) and (0) accordingly and some were determined with a 3 point continuum. See Appendix C for the nature of the questions.

TABLE IV-13

COMPANY SCORES WITH REGARD TO THEIR SAFETY RULES

Industry Code	Firms with LOW Accident Fr. Rates	Firms with HIGH Accident Fr. Rates
201	12	7
202	9	9
203	10	8
251	11	4
265	11	6
332	14	10
335	4	7
339	0	7
346	0	7
354	14	4
371	11	5
	(Mean = 8.7) (Mdn = 11)	(Mean = 6.7) (Mdn = 7)

<u>Hypothesis #7. Average number of married employees is higher in the firms with better safety records than in firms with poor safety records</u>.

This hypothesis was strongly supported by the findings of this study with a significance level of ($\alpha = 0.01$). This simply indicates that the higher the number of married employees, the better will be safety performance experience

of the firm. As it is shown in Table IV-14, where firms differ greatly in the percent of their total employees who are married, their accident frequency rates also vary to a great extent. Why married employees tend to behave safety at work is a function of changes in their social status and role. As a husband or father, the married employee carries different sets of responsibilities which influence his behavior to be more consistent and dictates to him to stabilize his career. Love and concern for the family reminds the married employee of the unaffordable consequences of getting injured and temporary or permanent unemployment. The married worker is normally more restricted in his geographical movements and when he settles down in a company, it is normally a pre-planned and well-thought move. On the other hand, single workers are normally on the search for another organization which will provide them more prestige and monetary gains plus other important considerations. This attitude toward a job held presently by a worker, effects safety behavior of the workers.

TABLE IV-14

PERCENT OF THE TOTAL EMPLOYEES WHO WERE MARRIED IN THE FIRMS STUDIED

Industry Code	Firms with LOW Accident Fr. Rates: % of Employees Married	Firms with LOW Accident Fr. Rates: Fr. Rates	Firms with HIGH Accident Fr. Rates: % of Employees Married	Firms with HIGH Accident Fr. Rates: Fr. Rates
201	85%	12.0	80%	51.7
202	95	25.2	95	37.0
203	95	18.8	90	61.9
251	85	25.2	32	89.4
262	90	14.5	65	45.1
332	95	15.5	91	69.67
335	91	21.6	85	45.0
339	90.2	41.7	35	71.1
346	90	16.0	75	65.2
354	98	44.2	82	173.0
371	95	51.6	90	128.0
	(Mean = 83.6%) (Mdn = 91%)		(Mean = 74.5%) (Mdn = 85%)	

Hypothesis #8. Average number of years spent with the company is higher for employees in the firms with low work injury records than for employees in the firms with high work accident records.

The results of testing this hypothesis are

conclusive and a significance level of (α = .05) was found. The evidence strongly leads to belief that length of employees service in a company is positively correlated with low accident rates. Higher length of service means lower turnover rates or a more stable employment situation in a company. Higher turnover rate is associated with a higher number of new employees coming to organization. And number of accident occurring to or caused by new employees account for a great portion of total accidents. This presumably has to do with the lack of experience which was discussed in detail in Chapter III. Thus it is not surprising to observe that in all the companies with good safety records -- with one exception -- average length of employee's service is higher than in companies with relatively high accident rates. Table IV-15 illustrates this point.

TABLE IV-15

THE AVERAGE LENGTH OF EMPLOYEES' SERVICE IN THE COMPANIES STUDIED

Industry Code	Firms with LOW Accident Rates		Firms with HIGH Accident Rates	
	Average Length of Service (Years)	Fr. Rate	Average Length of Service (Years)	Fr. Rate
201	16 and over	12.0	1-3	51.7
202	13-15	25.2	13-15	37.0
203	4-6	18.8	1-3	61.9
251	10-12	25.2	1-3	89.4
262	13-15	14.5	4-6	45.1
332	7-9	15.5	4-6	69.6
335	13-15	21.6	13-15	45.0
339	16 and over	41.7	16 and over	71.1
346	13-15	16.0	10-12	65.2
354	10-12	44.2	7-9	173.0
371	7-9	51.6	13-15	128.0
	(Mdn = 13-15)		(Mdn = 7-9)	

<u>Hypothesis #9. Older companies have lower work injury frequency and severity rates than do relatively newly established companies</u>.

This hypothesis was neither supported nor refuted by this study. The main reason for formulating this hypothesis was that newly established companies normally try to identify their position in the competitive market and are to a certain extent aggressive to get as large a market share as they can. A newly established company's survival, in most cases, depends upon the success of this struggle for finding a foothold in the market. When the company is fighting for a greater cause such as survival, then safety, per se. may not represent an urgent problem for these companies. Another reason for formulation of this hypothesis was that normally, older companies through experience have developed fairly good knowledge of the operations or machinery and equipment that are hazardous and they may have installed safety devices or have provided specific personnel protective equipment in order to reduce their accident rates, whereas this kind of knowledge normally would not be available for a newly established firm. Despite the reasons given, the findings of this study indicated that at least for the firms included in this study, age of the company is not a significant factor. Table IV-16 shows the establishment date of those companies.

TABLE IV-16

ESTABLISHMENT DATE OF THE COMPANIES STUDIED

Industry Code	When Established	
	Firms with <u>LOW</u> Accident Fr. Rates	Firms with <u>HIGH</u> Accident Fr. Rates
201	1880	1962
202	1934	1938
203	1934	1938
251	1945	1934
262	1925	1961
332	1925	1886
335	1947	1938
339	1906	1917
346	1936	1912
354	1937	1951
371	1945	1909

<u>Hypothesis #10. Occupational accident record keeping systems in the firms with better safety records are considerably more comprehensive and efficient than in firms with poor safety records</u>.

The results obtained from testing of this hypothesis are conclusive. The hypothesis was statistically supported at a significance level of (α = .01). The record keeping system appears to be much better in companies with the better safety performance. This does not prove that the better records are a major factor in assisting companies to reduce their accident rates, but it strongly suggests that either it is an important causative agent or that it is closely related to other factors, which, together, help control accidents.

All of the companies visited kept some kind of accident records, but the main difference was found in the content of those records and how current they were. Most of the companies with low accident rates regularly make periodical reports from their accident records and issue them to the authorities who are most directly involved in the company's safety as well as those who are in positions to make decisions in the matter. Sheer collection of data and keeping of accident records will be wasteful effort unless they are properly and regularly analyzed so that accurate reports can and are made for timely decision making purposes. The type of data collected appears to be an extremely important aspect of the record keeping system. More specifically, as it is shown in Table IV-17, in <u>63.6%</u> or <u>seven out of eleven</u> firms with low accident rates, the record keeping system included and showed the <u>cost of accidents</u> whereas in only <u>18.1%</u> or <u>two out of eleven</u> with relatively high accident rates was such information included.

TABLE IV-17

ACCIDENT COSTS INCLUDED IN THE COMPANY ACCIDENT RECORD KEEPING SYSTEM

Industry Code	Firms with LOW Accident Fr. Rates		Firms with HIGH Accident Fr. Rates	
	Yes	No	Yes	No
201	X	-	-	X
202	X	-	-	X
203	X	-	X	-
251	X	-	-	X
265	-	X	-	X
332	-	X	-	X
335	X		X	-
339	X		-	X
346	-	X	-	X
354	X		-	X
371	-	X	-	-
Total	7 - Yes	4 - No	2 - Yes	8 - No
% of firms	63.6%	36.4%	18.1%	81.9%
	(N=11)	(N=11)	(N=11)	(N=11)

This writer was told by some interviewees that accident cost figures are the best means of stimulating top management's support for safety. And in some cases it was specified that the cost figures are computed by using the standard method of estimating accident costs developed by

Professor Simonds.[7]

It should also be pointed out that the frequency of report making from the company accident records must be given close attention. Where this report is made only once a year or semi-annually -- which is the case in most of the firms with high accident rates -- it normally arrives too late to use that information effectively and to take corrective measures in preventing or reducing accidents.

It appears that establishment of a comprehensive and effective accident record keeping and reporting system is related to the degree of top management's support, interest and involvement in safety. Obviously, it can be argued that if the executives of companies do not care and ask for the accident reports and figures, their subordinates can not or will not impose that information unilaterally. This is because a rational man will not attempt to render services that are not recognized and considered to be necessary and important by the higher echelons in the organizational hierarchy. Table IV-18 may be used as evidence for this discussion for it shows that in most cases where the score of companies with respect to the interest and

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[7]For detailed description of this method see: Rollin H. Simonds, Estimating Costs of Industrial Accidents, U.S. Department of Labor (Washington, D.C., Government Printing Office, 1955).

TABLE IV-18

THE COMPANIES' SCORES[8] ON ACCIDENT RECORD KEEPING SYSTEM AND TOP MANAGEMENT'S INVOLVEMENT IN SAFETY

Industry Code	Firms with LOW Accident Fr. Rates		Firms with HIGH Accident Fr. Rates	
	Top Management's Involvement	Record Keeping	Top Management's Involvement	Record Keeping
201	7	11	2	6
202	9	11	7	10
203	2	11	2	11
251	4	11	4	4
265	7	11	2	9
332	6	11	5	10
335	4	11	6	11
339	8	11	7	9
346	7	11	4	9
354	9	11	1	5
371	7	11	4	10

support of its top management is high, the score on accident record keeping also tends to be higher.

It is no exaggeration to say that one of the fastest and perhaps cheapest but most effective means of

[8]A total of 5 major questions were formulated and asked with respect to this variable. Two of the questions required "Yes" or "No" answers with a value of 1 or zero and 3 other questions were measured through a 5 and 6 points continuum. See Appendix C for the nature of questions asked.

improving the occupational safety picture, especially in small size firms, is the development of a comprehensive accident record keeping and reporting system.

Hypothesis #11. Relative span of control for every first line supervisor is wider in the firms with high work injury records than in the firms with low work injury records.

Statistical testing of this hypothesis resulted in a significance level of ($\alpha = .05$). It was strongly supported that the wider the span of control of the first line supervisor, the higher would be the accident rates.

Of course it is recognized that in different industries because of complexity and nature of tasks involved, the number of people that can be effectively supervised is markedly different. But when two companies of the same size, in the same industry are compared, it appears that where a supervisor has wider span of supervision, the accident rates tend to be higher accordingly. This stems mainly from the fact that as far as safety is concerned, a foreman not only has to supervise individual workers but also the interaction among individuals and groups. If the number of workers exceed the abilities of the foreman, then practice of supervision can not be claimed to be as efficient as it could be with a more appropriate number of workers. Another dimension to this concept is that, with fewer people assigned to each first line supervisor, he can devote more time to each employee and he may even be able to notice and observe any changes in worker's attitude conducive to work accident and take any corrective measures possible to prevent highly probable accidents. Table IV-19 indicates the actual span of supervision of the first line supervisors in twenty-two firms studied. Although different industries show different spans of supervision, if we look at the median of eleven firms with better safety records, it is between 16-20 workers whereas for the eleven firms with high accident rates the median is 21-25 workers. Also, if the mean score of each group of firms is multiplied by 5, then for the firms with high accident rates the average score (average number of people under each first line supervisor) is 22.5 and the score for the group of eleven firms with relatively better safety performance is 16.0. This analysis clearly indicates that at least for the group of firms included in this study, the relative span of supervision of the first line supervisors was a significant factor as far as the safety performance of their respective companies is concerned.

TABLE IV-19

THE AVERAGE NUMBER OF EMPLOYEES UNDER DIRECT SUPERVISION OF EACH FIRST LINE SUPERVISOR

Industry Code	Firms with LOW Accident Fr. Rates		Firms with HIGH Accident Fr. Rates	
	No. of Workers	Score*	No. of Workers	Score*
201	16-20	4	25-30	6
202	6-12	2	16-20	4
203	16-20	4	11-15	3
251	6-10	2	25-30	6
265	11-15	3	11-15	3
332	11-15	3	16-20	4
335	21-25	5	16-20	4
339	16-20	4	21-25	5
346	16-20	4	21-25	5
354	21-25	5	36-40	8
371	11-15	3	11-15	3
	(Mdn=16-20)	(Mean=3.2)	(Mdn=21-25)	(Mean=4.5)

*In determining the number of workers under each first line supervisor an interval scale was developed in the following order: 1-5; 6-10; 11-15 ..... 36-40; 41 and over. In order to test statistically, the first interval was given the number 1, second interval 2 and so on. These scores refer to those numbers given to each interval.

Hypothesis #12. Firms with newer machinery and equipment experience lower work injury frequency and severity rates than firms with older machinery and equipment.

Data obtainable proved inadequate to test this hypothesis. Originally, for collection of data with respect to this hypothesis a major question was asked from interviewees. The question was: the "last time that major production machinery were replaced by newer ones was" 1-3; 4-5; .... over 15 years ago. Except in two cases all interviewees responded: 1-3 years ago. This researcher had no other means of securing more specific data on this matter and the information provided by interviewees did not enable me to determine the significance level statistically. It should also be pointed out that one of those two companies which responded differently was from the group of companies with low accident rates, and the other belonged to the group of firms with relatively poor safety records. This hypothesis still remains a potential ground for further investigation.

Hypothesis #13. In the firms with good occupational safety records, physical working conditions such as relative roominess, lighting, visibility, and ventilation are better than in firms with poor safety records.

As a result of testing of this hypothesis, evidence was provided that led strongly to the belief that physical conditions of workplace is one of the most significant factors in occupation accidents. This hypothesis was clearly confirmed by findings of this study, and a significance of (α = .01) was found. In order to collect data for testing this hypothesis, a total of 18 factors were observed by this writer and evaluated in a 5 point continuum created for each factor. Observation was carried out by a comprehensive tour in the plant area and evaluation took place immediately upon leaving the company. Table IV-20 shows the total score of each firm with regard to physical conditions in actual plant and work areas. These were 18 factors each having 5 points which ideally would set the highest score at 90 points. But as can be seen in the table, none of the twenty-two firms could obtain that score. The lowest score for firms with better records was 53 and the low score for the firms with high accident record was 42. The mean score for former group was found to be 62, the latter group had a mean score of 53. Physical workshop conditions have been the subject of many other studies some of which were reviewed in Chapter III. The purpose of this hypothesis was not to measure and determine the significance of physical workplace conditions for it is a relatively well confirmed concept. But the main objective of formulating this hypothesis was to see whether or not it is one of the major factors responsible for vast differences existing among small but similar size firms in the same industry. The results obtained are

TABLE IV-20

TOTAL SCORE[9] OF THE FIRMS WITH RESPECT TO PHYSICAL WORK SHOP CONDITIONS

Industry Code	Firms with <u>LOW</u> Accident Fr. Rates	Firms with <u>HIGH</u> Accident Fr. Rates
201	63	45
202	64	56
203	59	57
251	61	52
265	64	53
332	54	48
335	68	64
339	53	43
346	57	42
354	75	53
371	63	62
	(Mean=62)	(Mean=53)

conclusive and physical working environment is an important factor that a concern can not afford to ignore.

<u>Hypothesis #14. There are more and better safety controls and devices on machinery in the firms with better safety records than in the firms with poor safety records</u>.

This hypothesis was strongly supported by this study,

[9]See Appendix C for the nature of factors included in determining the score of physical work place conditions.

and statistically a significance level of (α = .025) was obtained. This writer's belief is that no explanation is needed here, since the truth of the hypothesis seems self-evident. However, the test was needed because occasionally the "obvious" is not supported by the facts. Of course, as was mentioned earlier, partial guarding might give a worker over-confidence and he then might be less careful, but if remaining hazards are emphasized, installment of safety devices and controls would reduce worker's exposure to imminent danger and consequently would reduce accidents. Machine guarding and safety devices and controls were evaluated through observation of machinery in actual work-shops and were measured on a 5 point continuum. Table IV-21 indicates actual scores[10] of the companies with regard to the quality and quantity of company's machine guarding, safety devices and controls. The highest and lowest obtainable values were 5 and 0. The mean score for all eleven firms with good safety records was 3.6 and it was 2.8 for eleven firms with relatively high accident rates.

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[10]Highest number (5) represents more safety devices and properly guarded machinery whereas lowest number (zero) represents lack of safety devices and improperly guarded machinery.

TABLE IV-21

ACTUAL POINTS RECEIVED BY THE FIRMS WITH RESPECT TO MACHINE GUARDING, SAFETY DEVICES AND CONTROLS

Industry Code	Firms with LOW Accident Fr. Rates	Firms with HIGH Accident Fr. Rates
201	3	3
202	5	3
203	3	3
251	4	1
265	4	3
332	3	2
335	3	3
339	3	3
346	4	3
354	4	3
371	4	4
	(Mean=3.6)	(Mean=2.8)

Hypothesis #15. Firms with better safety records have established safety committees through which unions and/or employees aid and advise management on matters of worker safety, whereas in the firms with poor safety records such committees have not been established.

The results of testing this hypothesis are inconclusive. The evidence provided by this analysis strongly suggests that, at least for the companies included in this study, safety committees did not play a significant role, as far as accident rates are concerned. Out of eleven firms with low accident rates three did not have any kind of safety committee, and, also, four firms out of eleven with relatively high accident rates were in this category. One of the major questions asked of the companies dealt with the possible changes in accident rates of the firm which might have taken place after safety committees were established. Table IV-22 summarizes responses received from the companies in this matter.

TABLE IV-22

WORK ACCIDENT EXPERIENCE OF THE FIRMS AFTER SAFETY COMMITTEES WERE ESTABLISHED

	Firms with LOW Accident Fr. Rates	Firms with HIGH Accident Fr. Rates
Considerably improved	1	1
Improved little	5	3
No change	2	3
Worsened	-	-
Considerably worsened	-	-
Total	8	7

The content of this table is self explanatory and needs no elaboration. It should also be reported that most of the interviewees contended that if there is effective communication and understanding between management and employees, even without committees any necessary actions will be taken to provide the safest working conditions for the employees. And if such an understanding or trusting communication does not exist, then safety committees too would be of little or no help. Most interviewees believed in worker participation but preferred employee suggestion systems or employee opinion surveys to other types of participation such as committees. Their reasoning centered in the contention that those two preferred methods involve all of the employees and enable them to participate rather than merely a few people as a so-called "random group". It should be emphasized at this point that all of the firms included in this study were small size firms where personal contact and communication is possible and often exercised. However, in the large firms where such personal contact and participation of the entire workforce is impractical, the findings with regard to the effectiveness of the committees may be considerably different from those of this study. Such a possibility should be empirically investigated by more specific and further research. Table IV-23 shows how

TABLE IV-23

HOW FIRMS SCORED WITH REGARDS TO SAFETY COMMITTEES

Industry Code	Firms with LOW Accident Fr. Rates	Firms with HIGH Accident Fr. Rates
201	0	0
202	3	3
203	2	2
251	0	0
265	3	3
332	3	3
335	0	3
339	2	4
346	4	0
354	3	0
371	3	2
Total	23	20
	(Mean=2.09)	(Mean=1.8)

the firms scored with respect to the safety committees. A zero score in the table represents the firms without a safety committee.[11] Four main types of safety committees were identified and included in the interview guide. Also,

[11]See Appendix C for the nature of questions formulated with regards to safety committees and value assigned to each answer.

the frequency of these committee meetings was considered in this evaluation. Those four types of safety committees were:

Type 1. Central Safety Committee -
Consists of top management with department heads,

Type 2. Departmental Safety Committee -
Consists of department heads, supervisors and the foremen,

Type 3. Foreman's Safety Committee -
Includes foremen and all his men,

Type 4. Union - Management Committee -
Includes top management or his representative(s), union member(s), and employee representative(s).

The above order of listing of the different types of safety committees is not intended to represent any rank or significance. Table IV-24 is an illustration of types of committees existing in the firms studied. In some of the firms with "no safety committee", more specifically in the firms with low accident rates in industries 251, and 201, the interviewees revealed that those firms have had safety committees in the past which were discontinued later due to their insignificant results. It should be kept in mind that findings of this particular study can not be used to reject the concept of "participation" in general, and establishment of committees in particular. However, it provides an evidence to reject the idea that sheer establishment of a safety committee under any conditions will guarantee the advantages

TABLE IV-24

TYPE OF THE SAFETY COMMITTEES
IN THE FIRMS STUDIED

Industry Code	Firms with LOW Accident Fr. Rate	Firms with HIGH Accident Fr. Rate
201	No Committee	No Committee
202	Type 1	Type 4
203	Type 4	Type 4
251	No Committee	No Committee
265	Type 2	Type 2
332	Type 4	Type 3
335	No Committee	Types 1 and 2
339	Type 4	Type 3
346	Type 2	No Committee
354	Type 4	No Committee
371	Type 1	Type 4

assumed and expected from genuine and purposeful participation. There are certain prerequisites that must be present before any participation can effectively take place. These prerequisites are discussed in detail in Chapter III of this work under "worker participation and occupational safety" and are not repeated here. But before this section is terminated, this writer would like to add that today occupational safety is extremely complex in nature and a highly specialized and professionalized field of human studies which involves several scientific disciplines such as psychology, law, physiology, statistics, engineering, social psychology, anthropometry and medicine. And relatively recent genesis of the discipline of "Ergonomics" which embodies most of these disciplines was the consequence of the recognition of this fact. Unless the members of a safety committee have at least a general knowledge and understanding of the content of those above areas, a continuous and positive contribution cannot and should not be expected from these committees. And if there is any failure, it should not be attributed to the concept of "participation" or to a specific technique of it such as "Committees" if, in fact, prerequisites were not met.

OTHER FINDINGS OF THE STUDY

The information provided in this following section was not included in the hypotheses of this study nor was it statistically tested. It does represent, however, a systematic collection of opinions, suggestions, actual safety practices and so forth which not only assist further understanding of the occupational accident picture in the firms studied but also provide an excellent ground for future research. It is also a brief and primary step in empirical investigation of prevailing concepts, hypotheses and recommended practices in the field of safety. The first concept has to do with the "employee unsafe act" which in the literature is discussed as the cause of a considerably high percent of work accidents. The possible reasons for employees' unsafe acts were classified into four types as follows:

a) Physical inadequacies - (including poor eye-sight, defective hearing, muscular weakness, heart, circulatory or other organic weakness.)

b) Mental inadequacies - (including slow mental reaction, lack of coordination and nervous instability.)

c) Faulty attitude - (including indifference, inattention, indolence, arrogance, recklessness, hostility.)

d) Lack of knowledge or skill - (including ignorance of correct methods, faulty work habits and insufficient experiences.)

Each principal interviewee was then asked to rank the types in order of their importance in causing unsafe employee acts.

It is interesting to note that as summarized in Table IV-25, all of the twenty-two firms ranked the "faulty attitude" as the number one cause of unsafe employee acts. "Lack of knowledge or skill" was ranked as number 2 by majority of both categories of firms. Mental inadequacies ranked as the number 3 cause of unsafe acts, and, finally, physical inadequacies ranked as number four or least

TABLE IV-25

RANKING OF THE CAUSES OF UNSAFE EMPLOYEE ACTS

Cause of Unsafe Acts	Firms with LOW Accident Fr. Rates				Firms with HIGH Accident Fr. Rates			
	#1	#2	#3	#4	#1	#2	#3	#4
Physical inadequacies	-	-	2	9	-	-	1	10
Mental inadequacies	-	3	9	2	-	3	7	1
Faulty attitude	11	-	-	-	11	-	-	-
Lack of knowledge	-	8	-	-	-	8	3	-
Total	11	11	11	11	11	11	11	11

important among all four causes. This analysis tends to suggest that further psychological and socio-psychological research may make tremendous contributions to the field of occupational safety, for at the present time it is the only way that faulty attitude can be scrutinized and possibly corrected. Unsafe acts have been blamed for from 70 to 90 work accidents. A word of caution is needed here lest the unsafe act be overemphasized. Simonds and Grimaldi comment, "... "unsafe act" is a relative term. Often the unsafe act may be made impossible by improved physical conditions."[12]

Faulty attitude in this observation appears to be the major stimulant of unsafe acts, which if corrected will

[12]Simonds and Grimaldi, op. cit., p. 197.

result in considerable reduction in the work accident rate. The second area for major improvement seems to be safety education to provide workers with adequate knowledge and/or skills since lack of these essentials was ranked as the number two cause of unsafe acts. These observations may be used in formulating workable hypotheses subject to empirical investigation. Companies were also asked about frequency of occurrence of seven <u>major types of unsafe acts</u> in work accident cases, listed as follows:

a) Making safety devices inoperative

b) Using unsafe equipment

c) Unsafe loading, mixing, or placing

d) Unsafe position or posture

e) Failure to use safe clothing or personal protective devices

f) Operating equipment at unsafe speeds

g) Distracting, teasing, or abusing other workers.

The frequency of occurrence was measured in a four points continuum from very high to very low as shown in Table IV-26. This table reveals that in both the group of firms with high and with low accident rates unsafe position or posture is the most frequent occurrence. It follows that improvement in this area may result in considerable reduction in the number of accidents occurring as a result

TABLE IV-26

FREQUENCY OF OCCURRENCE OF DIFFERENT TYPES OF UNSAFE ACTS

Types of Unsafe Acts	Firms with LOW Accident Fr. Rates				Firms with HIGH Accident Fr. Rates			
	Very High	High	Low	Very Low	Very High	High	Low	Very Low
a	-	2	3	6	-	1	2	8
b	1	1	5	4	1	1	7	2
c	-	1	10	-	1	1	5	4
d	3	5	3	-	1	6	3	1
e	-	3	6	2	-	2	4	5
f	-	3	3	5	-	2	4	5
g	1	-	9	1	2	-	5	4

of unsafe acts. Other areas to be concentrated on are enforcement of the use of safe clothing or equipment and personal protective devices and also prevention of the operation of equipment at unsafe speeds. The use of unsafe equipment and distribution or teasing of other workers must then be prevented.

Another finding to be reported in this section has to do with safety promotion and propaganda. Interviewees were asked to show the degree of emphasis put on each of the factors listed in Table IV-27 when their respective companies practice promotion of employees' safety interests.

TABLE IV-27

FACTORS BEING LEAST AND MOST EMPHASIZED IN PROMOTING SAFETY

Subject of Emphasis	Firms with LOW Accident Fr. Rates					Firms with HIGH Accident Fr. Rates				
	1*	2	3	4	5**	1*	2	3	4	5**
1. Fear of personal injury	-	-	2	3	5	-	-	-	1	9
2. Fear of economic loss		1	1	3	5	-	-	3	4	3
3. Desire for reward	8	1	1	-	-	6	1	3	-	-
4. Desire for leadership	6	2	2	-	-	6	2	2	-	-
5. Desire to excel and be outstanding	4	2	3	1	-	5	-	3	1	1
6. Protection of others	-	1	3	1	5	-	-	2	2	6
7. Creating a favorable impression	3	3	2	2	-	2	3	3	-	2

*Number one represents least emphasized.
**Number five represents most emphasized.

Two companies did not have any safety promotion programs, one from the group of firms with high accident rates and one from companies with relatively better safety records. Responses received from interviewees are more or less similar but some differences in emphasis are noticeable between the two groups of firms with different accident rates. Among the firms with high rates, 9 firms emphasize most "fear of personal injury whereas only 5 firms with low rates is this factor most emphasized. "Fear of economic loss" is most emphasized in 5 firms with better safety records and 3 firms with poor safety records. Both groups of firms least emphasize desire for rewards, desire for leadership and desire to excel and to be outstanding, but the same groups of firms put relatively strong emphasis on the protection of others. Over-all observation of the table does not indicate any considerable difference between the groups.

Company safety inspections were also considered to be of importance to safety performance, and interviewees were consequently asked to evaluate the effect of safety inspections in preventing work accidents in their firms. Table IV-28 is an illustration of interviewees' evaluation. As is shown in the table, 54.5% of the firms with good safety records evaluated safety inspections as <u>very effective</u> in preventing work accidents whereas only 27.2% of the firms with relatively poor safety records evaluated safety inspection as very effective. This different degree of orientation towards safety inspections between two groups of firms with low and high accident rates appears to be much more serious than can be accounted for by sheer chance and calls for attention and extensive investigation.

TABLE IV-28

INTERVIEWEES' EVALUATION OF THE EFFECT OF SAFETY INSPECTION ON ACCIDENT PREVENTION

Industry Code	Firms with <u>LOW</u> Accident Fr. Rates				Firms with <u>HIGH</u> Accident Fr. Rates			
	Very Effective	Somewhat Effective	No Effect at All	Negative Effect	Very Effective	Somewhat Effective	No Effect at All	Negative Effect
201	X					X		
202	X				X			
203	X				X			
251		X					X	
265	X					X		
332		X				X		
335		X				X		
339		X			X			
346	X					X		
354	X					X		
371		X				X		
Total	6	5	-	-	3	7	1	-
	54.5%	46.5%			27.2%	63.6%	9%	
	(N=11)	(N=11)			(N=11)	(N=11)	(N=11)	

Summary

In this chapter some specific background data and statistics such as number of employees in the companies studied, firms' accident frequency and severity rates and firms' membership in safety organization were first reported. The second major section of the chapter dealt with reporting of the results of testing the hypotheses of this study. Finally, additional information of importance to safety performance of companies, collected in the course of study were reported.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

About every 8 minutes, the following estimates turn to actual work accident statistics in the United States: one fatality, 148 disabling injuries and at least 500 less serious injuries. Occupational accidents annually claim more than 14,000 human lives and cause over 2,000,000 disabling injuries. Some industries because of the nature of tasks, amount of risks involved, or degree to which they recognize safety as a problem, contribute more to these figures than do other industries. Not only do different industries demonstrate markedly different work accident rates, however, but existing knowledge further reveals that most of the smaller size (under 500 employees) firms experience much higher accident rates than larger companies within the same industry, though some small size firms have excellent safety performance records.

This study was an attempt to investigate empirically those factors that could possibly provide an explanation for differences in accident experience and rates of similar size firms in the same industry. The literature on, and related to, occupational safety was extensively reviewed in order to identify those possible factors. A total of fifteen factors were selected with respect to this endeavor, these factors were: 1) top management's support and involvement in safety; 2) formal educational level of workers; 3) age of the employees; 4) company recreational programs; 5) promoting safety through employee's family; 6) safety rules of the firms; 7) marital status of the workers; 8) worker's length of service in a company; 9) company age; 10) accident record keeping system; 11) first line supervisor's relative span of control; 12) relative age of production machinery and equipment; 13) physical workplace conditions; 14) safety devices and controls on machinery; and 15) safety committees. Then fifteen hypothesis were formulated concerning each factor mentioned above.

The next major step in the study was sampling. The sample had to be a number of matched-pairs of industrial concerns, each pair comprising firms of similar size in the same industry, but with one of the two having considerably more work injuries than the other. Eleven different industries were randomly selected. Then within each selected industry two firms of similar size but markedly different accident rates were selected. All of the twenty-two firms included in the sample of this study were in the State of Michigan and were spread around in 16 different locations throughout the state. For the collection of data all companies were visited their facilities inspected, and members of management interviewed. Also, some statistical data were obtained from the Michigan Safety Bureau after specific authorization from the several companies. A questionnaire was developed as the interview guide to insure that the same questions in the same order would be asked of all the interviewees. The interview was highly structured but after all questions listed in the interview guide were discussed, the interviewees were asked to feel free and express their viewpoints not covered in the structured phase of the interview. A tour in the actual workshops and plants constituted the second phase of the visit.

For the analysis of data collected and testing of hypotheses the Wilcoxon matched-pairs signed rank test was primarily employed. In some cases where data type was not amenable to evaluation by that test, the sign test was used. In reporting the limitations of this study two factors may be pointed out. As far as accuracy of data is concerned, the writer had to depend on the data provided by the companies except for his personal inspections. Of course, twenty-two firms is a limited sample. Nevertheless twenty-two should not be considered a small sample for this type of investigation.

The third chapter dealt with review of the literature with respect to variables included in this study. The present status of occupational accident research was then discussed and appraised.

Chapter IV constituted the reporting of study findings and was composed of three major sections. In the first section specific background data and statistics such as number of employees, company accident frequency and severity rates and firms' membership in safety organization were reported. The second section dealt with the results of testing the hypotheses of this study. Major findings of the study can be summarized as follows:

1. This study strongly supported the hypothesis that in the firms with better safety records, top management is highly interested and involved in the company's safety performance.
2. Formal educational level of the workers in the firms included in this study did not correlate with accident rates of these companies.
3. Employees' age was found to be significantly

related to the firms' accident rates. The higher the age of employees on the average, the lower their work accident experience tends to be.

4. Where a company provided recreational programs and facilities for its employees, work accident rates tended to be lower. The discussion noted that where a company cares about the recreation of its employees, their health and safety will hardly be ignored.
5. The hypothesis that firms with better safety records have tried to promote safety through the employee's family was not supported by this study. This is not to say that this technique of promoting safety is insignificant, but most of the firms studied did not use it because they did not have a knowledge of it.
6. Safety rules were not found to be a significant factor affecting firms' safety records.
7. In the firms with more married employees on the average, work accident rates were considerably lower.
8. This study supported the hypothesis that a positive correlation exists between low accident

rates and higher average employee length of service with a company. This implies lower turnover rates and a more stable employment situation which, in turn, tends to minimize the number of new employees to be hired.

9. The hypothesis that older companies tend to have better safety records was not confirmed by this study.

10. Among the companies included in this study, those with better accident record keeping systems were found to have considerably lower work accident rates.

11. In the companies where the first-line supervisor on the average has a wider span of control -- namely more men to supervise -- accident rates tend to be higher.

12. Data obtained proved inadequate to test the hypothesis that relative age of the production machinery and equipment is correlated to accident rates.

13. Physical workplace conditions were found to be significantly related to occupational accident rates. Firms with more desirable temperature, ventilation, lighting, noise level, roominess,

and cleanliness tend to have considerably lower work accident rates.

14. The hypothesis that better and more numerous safety devices on machinery contribute to attainment of better safety performance records of the companies, was strongly confirmed by this study.

15. This study did not support the hypothesis that firms with better safety records have established safety committees through which union and/or employees aid and advise management on matters of employees' safety at work. This does not show that employee participation is not a significant factor. Safety committees are only one form of participation, one which might perhaps be most useful in the larger companies where personal contact between management and employees is difficult. In the firms included in this study other types of participation such as employee opinion surveys, suggestion systems and personal contacts, which enable all of the workers to participate in safety issues, appear to be as significant as committees if not more so.

Some Conclusions

Good work accident experience is not a chance occurrence. It results from an organized movement directed toward accident control. It appears from this study that a safety movement must be initiated and led by top management of a firm.

Top management's support and involvement was one of the major factors included in this study and was found to be significantly correlated with the work accident rates of the firms. When other significant factors of the study are considered, it appears that they are also direct results of top management's interest and support. If the first factor does not exist in a firm, it is hard to believe that most of the other features such as good record keeping, orderly and safe working conditions, recreational programs, safety devices and so on will exist. Let us look at employee length of service with the company, as another example. It does not appear to be closely related to top management's support of safety programs. Even in this case there is probably a relationship between these two factors. Workers will be less inclined to stay long with a company where its management is careless about their safety. This is likely to be particularly true of most of the married and older workers, who want more security at the job, and who commonly have

the best safety records. If top management does not show its continuous and strong interest in adequate physical conditions of the workshop, this significant ingredient of good safety performance will hardly be added to the company's operations. Accident cost figures at least should motivate top management of companies toward accident control efforts even where they might otherwise hesitate to devote adequate effort and money to the prevention of unnecessary accidents and the saving of human lives. In most of the companies studied the actual cost figures except for insurance premiums are not known to top management. The Simonds method of cost analysis (now in use in the educational program of the Michigan Bureau of Safety) is another potential motivator and basis for managerial decision making.

Small size companies do not necessarily have to suffer from high work accident rates. This study included eleven small size firms with relatively low accident rates, and empirical investigation revealed that whenever these rates were low, top management's involvement, interest and support of the firm's occupational safety was higher.

Occupational safety is like a wheelbarrow that without constant pushing will not move. One of the prime responsibilities of top management must be to provide that needed push.

Some Recommendations

The following suggestions occur to the writer as a result of the experience of conducting the research, but are not actual findings of the study. Unless facts on occupational safety are collected, integrated and analyzed, is not likely that effective measures can be taken to reduce or minimize work accidents at the state level, industry level or in a single firm. It is in recognition of this important fact that this writer would recommend enforcement of the provisions of Section 15 of the Michigan Occupational Safety Standard Act (Act 282). While preparing and submitting required reports of work accidents to the State Department of Labor, company managements will necessarily become somewhat acquainted with their overall safety picture. Availability of such tangible information may motivate a more serious consideration for safety in the companies. At the same time analysis of accident reports will enable the State Department of Labor to direct and concentrate its occupational safety efforts to the types of accidents which appear to occur more often and also to identify industries and firms within each industry that are in need of more attention.

As appears evident from the findings of this and other studies, the young and new employees tend to have considerably more work accidents than older employees with experience. This being the case, it is recommended that safety training be emphasized in the later years of high school so that before a prospective employee starts a career, he is well aware of work hazards. Most of the firms studied claimed that they could not afford an extensive safety training program for a newly hired employee before he starts working. Some firms added that they conducted such formal safety training programs but upon termination of the training, most of the trainees left the firm, leaving only some cost figures for the company. If safety training takes place in the high schools, then it does not matter where the workers will be ultimately settled for working. Of course, this would be a joint effort and would require cooperation of educational institutions, the State Department of Labor, mass media, business organizations, the State Department of Public Health and any other individuals or organizations interested in the matter.

A suggestion is also made for application in government procurement, particularly cost-plus contracts. In determining the producer's cost his accident experience could be taken into account. When his record of injuries

significantly exceeded a reasonable figure for the kind of industry, a calculation of his excess costs resulting from the excessive accidents could be made, using the Simonds method. Then these unnecessary excess costs could be subtracted from his cost figures that were to be paid by the government agency.

Further investigation is recommended in the following areas.

There were fifteen variables or factors included in this study. Certainly there are other factors that might have a considerable impact on occupational accidents of the firms. Two specific variables are recommended for empirical investigation. The first variable is the _actual plant location_. In the course of this study it was noticed that firms located in small towns and townships where the majority of workers were from the same small, quiet and friendly community and generally were relatives or acquaintances, tend to have much lower accident rates than do firms in dissimilar conditions. This observation provides an excellent ground for a hypothesis to be empirically tested in the future.

Another variable recommended to be scrutinized is _the nature of workforce composition_ in the firms with respect to race, national origin and religion.

This writer's observation in the twenty-two firms studied opens ground for suggestion that racial composition of the firm's workforce might correlate with safety performance. In particular, those companies employing larger numbers of negroes revealed a marked tendency toward higher accident rates. Such an observation requires further empirical investigation as well as a major caveat. That is, the obvious coincidence of certain racial and environmental factors could easily result in a spurious correlation between racial variables and safety factors.

It is also recommended that this same study be conducted in different states with different sets of industries and also in different cultural environments. If the findings of this and the recommended studies coincide, it will be possible to make more universally applicable generalizations.

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APPENDICES

APPENDIX A

Letter Sent to the Director of
Bureau of Safety Regulation
Michigan State Department of Labor

MICHIGAN STATE UNIVERSITY EAST LANSING • MICHIGAN 48823

COLLEGE OF BUSINESS

DEPARTMENT OF MANAGEMENT • EPPLEY CENTER

June 16, 1970

Mr. Marshall Fiordelis
Director, Bureau of Safety and Regulation
Michigan Department of Labor
300 E. Michigan Avenue
Lansing, Michigan 48913

Dear Mr. Fiordelis:

One of our doctoral candidates, Mr. Yaghoub Shafai from Persia, expects to write his dissertation in the field of industrial safety under my direction. His current plans call for selecting eleven pairs of companies, each pair being composed of two concerns similar in size in the same industry but with one having much higher frequency and severity rates than the other. Then he would secure permission from the companies to gather information that might shed light on why the accident experience in one was better than in the other.

We thought someone in your organization might be able to suggest such companies. If you have the actual injury rates, this would be helpful, but not necessary. It will be his job with my assistance to obtain permission from the companies. He will probably need more than twenty names to start because some will likely not find it convenient to let him get the information. Incidentally, he will not be interested in the "touchy" data such as sales, profits, wages, etc.

Mr. Shafai will contact the Bureau. If it is not practical for your office to give him names of suitable companies, he will probably have to select at random and hope to get companies with markedly differing injury rates. If you are able to give him some suitable names, we shall appreciate it. If you have other suggestions to offer, please feel free to do so.

Sincerely,

Rollin Simonds

Rollin Simonds
Professor of Management

cc: Mr. Yaghoub Shafai
Professor Penfield
Professor Kruger

APPENDIX B

Letter Sent to the Companies as the Initial and First Contact

MICHIGAN STATE UNIVERSITY EAST LANSING · MICHIGAN 48823

COLLEGE OF BUSINESS

DEPARTMENT OF MANAGEMENT · EPPLEY CENTER

Date

Company Name

(Company President)

I am writing to you in connection with a research study to be conducted at Michigan State University. The purpose of the research is to find out what are some of the key factors that cause apparently similar business concerns to have markedly different accident experience. Higher work injury frequency and severity rates, of course, mean both employee hardship and loss of profit. All business concerns would naturally prefer to keep such control of their operations as to minimize accidents. It is possible, however, that we may not appreciate the part some factors play in this.

In hope of shedding further light on this, I have selected eleven pairs of industrial concerns, each pair comprising firms of similar size in the same industry, but with one of the two having considerably more injuries than the other. Yours is one of these selected companies. I hope to secure permission to visit these companies and compare them in terms of many factors to see if some correlate with high injury frequency and others with low. I shall not be concerned with costs or profits or wages and shall not reveal the names of the companies studied, although I shall make a summary of my findings available to the companies cooperating.

I would appreciate it very much if you would permit me to visit your company and talk with a few of you people to get the information I need. I shall conduct this study as a Ph.D. dissertation under the supervision of Professor Rollin Simonds of the Graduate School of Business, who is one of the internationally known experts in the field of safety.

I shall telephone your office in a few days hopefully to receive your permission and to answer any questions you may have in connection with the study.

Sincerely,

Y. Shafai

Yaghoub Shafai
Doctoral Candidate

APPENDIX C

Questionnaire Used as Interview Guide

DATE____________________________ CODE NO.________

INTERVIEW GUIDE

I. GENERAL INFORMATION

A. Company

1. Name of Company____

2. When established____

3. Type of ownership____

4. Address____

5. Telephone number____

6. Distance from Lansing____

7. Type of Business____

8. Industry____

9. Average number of employees____

10. Is company member of any safety organization? Yes______ No______

11. If yes, names of such organization____

____

12. Name of insurance company or actuary____

Agent____

B. Interviewee

1. Name of the interviewee____

2. Title and position of the interviewee____

3. Number of years in this position____

4. Number of years spent with the company____

CODE NO.________

5. Is he specifically responsible for company's safety? Yes____ No____

6. Does he have regular education and/or training in safety?

   Yes________ No________

7. Age of the interviewee: 18-23______ 24-28______ 29-34______

   35-40______ 41-46______ 47 and over______

8. Is he a member of any safety organization? Yes_______ No_______

   If yes, name of such organization________________________________

9. Do you attend any safety meetings and conferences? Yes____ No____

10. If yes, specify which meetings and conferences?__________________

    ____

11. If no, do you have a desire to be a member of a safety organization?

    Yes________ No________

C. Top Management

	Yes (1)	No (0)
1. Does he attend any safety committee meetings in the company?	______	______
2. Does he chair any of these meetings	______	______
3. Does he regularly receive safety reports?	______	______
4. Does he personally conduct any safety audit or inspection?	______	______
5. Is he a member of any safety organization?	______	______
6. Does he regularly attend any safety meetings or conferences outside the company?	______	______
7. Does he emphasize plans for achieving certain safety objectives?	______	______
8. Does he actively participate in execution of safety plans?	______	______
9. Does he hold review and analysis sessions in order to compare the results of carrying out safety plans with projected objectives?	______	______

CODE NO.________

10. Is safety figures, reports, achievements included on the agenda of board meetings? ______ ______

D. Employees

1. Average number of employees________________

Male____________

Female__________

2. Average number of years of regular education? 1-3______

4-6______ 7-9______ 10-12______ 13 and over______

3. Average age of the employees: 18-23______ 24-28______

29-34______ 35-40______ 41-46______ 46 and over______

4. Average number of married employees_________ % of total emp.______

Male _________ ______

Female _________ ______

5. Number of employees with higher regular education than average? _____________

6. Number of employees with lower regular education than average? _____________

7. Average number of years spent with company: 1-3______

4-6______ 7-9______ 10-12______ 13-15______ 16 and over_______

8. Nature of racial composition? Black % or No.__________________

White % or No.__________________

Other % or No.__________________

(Specify) __________________

9. Nature of religious composition:

Catholic % or No.__________________

Protestant % or No.__________________

Other % or No.__________________

(Specify) __________________

CODE NO.________

10. Nature of Nationality origin composition: %________ or No.________

%________ or No.________

%________ or No.________

%________ or No.________

11. Nature of birth place and residence composition:

Local: %___________ or No.________

non-Local: %___________ or No.________

12. Do you have handicapped employees? Yes_______ No_______ No.______

E. Supervisors (first line)

1. Average no. of the supervisors: Total______ Male______ Female______

2. Average no. of employees under direction of each supervisor:

1-5______ 6-10______ 11-15______ 16-20______ 21-25______

26-30______ 31-35______ 36-40______ 41 and over__________

3. Average age of first line supervisors: 18-22______ 23-27______

28-32______ 33-27______ 38-42______ 43-47______ 48-52______

53 and over______

4. Average number of years spent with the company? 1-3______

4-6______ 7-9______ 10-12______ 13-15______ 16-18______

19-21______ 22 and over______

F. Machinery and Equipment

1. What % of production is automated: 0-10%______ 10-20%______

21-30%______ 31-40%______ 41-50%______ 51-60%______

61-70%______ 71-80%______ 81-90%______ 91-100%______

2. Last time that major production machinery were replaced by newer ones was: (check how many years ago)

1-3_____ 4-6_____ 7-9_____ 10-12_____ 13-15_____ over 15_____

CODE NO.________

3. Do you provide at no cost, safety equipment to the employees?

   Yes__________ No__________

II. SAFETY

A. Safety Organization

1. Do you have a separate organizational unit responsible for safety of the company? Yes__________ No__________

2. If yes, how many people are full-time in this unit?______________

3. Where is this unit located in the firm's organization structure compared to other functions?______________________________

4. To whom does it report directly? Pres.________ Vice-Pres.________

   Plant Mgr.________ Personnel Mgr.________ Other________________

5. If answer is No for Question 1 above, which organizational unit is basically responsible for company safety?____________________

6. Why has this unit been given safety responsibility______________

   ____

B. Safety Policies and Procedures

1. Do you have written safety policies? Yes__________ No__________

2. Who has initiated these policies? Top management________________

   Safety Dept.__________ Personnel Dept.__________ Other____________

3. Have there been any changes in these policies in the past 5 years?

   Yes__________ No__________

4. Do you have an established communication channel for reporting, analysis of these reports and decision making on the subject matters pertaining to safety? Yes__________ No__________

5. Are employees or their representatives consulted in making these policies and procedures? Yes (1)__________ No(0)__________

CODE NO.________

C. Accident Record Keeping

1. Do you have a written accident record keeping procedures?

   Yes (1)________ No. (0)________

2. Does this record keeping system show cause______ place______

   time______ cost______ reason______ people involved______

   in the accidents? 1 2 3 4 5 6 (each Yes=(1) No=(0))

3. Is any periodical report made from these records?

   Yes (1)______ No (0)______

4. If yes, how often? monthly______ bi-monthly______

   quarterly______ semi-annually______ annually______ 1 2 3 4 5

5. Who receives these reports? 1 2 3 4 5

   Why?____

D. Safety Rules

	Yes (1)	No (0)
1. Do you have written safety rules for all operations?	______	______
2. Were employees or their representatives, involved in making these rules?	______	______
3. Were first line supervisors involved in making these rules?	______	______
4. Have there been any changes in these rules in the past 5 years?	______	______

5. What was the reason for these changes?______ 1 2 3 ______

   ____

6. How do you make sure that all employees have complete knowledge of

   these rules?________________ 1 2 3 ______

7. Who is responsible for enforcement of these rules?___ 1 2 3 ___

8. Are penalties resulting from violation of these rules publicized?

   Yes________ No______

CODE NO.________

9. If yes, how?____

10. Penalties for violation of rules varies from____________________

_____________ to____

11. Are these rules adopted from another source or organization?

Yes__________ No__________

12. If yes, what is the name of that source?____________________

13. What kind of organization is this source? Business______________

educational_________ governmental_________ other (specify_______

14. If rules are not adopted and are made specifically for the company, was job analysis used as a basis for making these rules?

Yes (1)__________ No(0)__________

15. Do you have any knowledge of safety rules in other firms in this industry? Yes (1)__________ No (0)__________

16. If yes, how would you compare yours with theirs? better (3)______

same (2)___________ other (specify) (1)__________________________

E. <u>Safety Programs and Practices</u>

1. Safety training

   a. Do you have safety training programs? Yes________ No________

   b. Who is responsible for administration of these programs?

   ____

   c. Do you have safety training for all new employees before they start work? Yes__________ No__________

   d. Do you have specific training programs for individual employees, who need personalized training in order to overcome their individual deficiencies? Yes_______ No_______

CODE NO.________

e. Do you seek assistance from other organizations for safety training? Yes__________ No__________

f. If yes, from which organizations:

______government	federal_______ state_________ local_________	_______insurance companys
		_______educational institutions
______national safety council		
		__________other (specify)
______unions		____________________________

g. In which one of the following cases do you think employees need a safety training and in which cases actually do you provide such a training?

	Training Needed	Training Conducted
New employees	________	________
Changed job	________	________
Expanded/Different responsibilities	________	________
New machinery	________	________
New equipment	________	________
New process	________	________
Changed layout or physical condition	________	________
Occurrence of an accident	________	________

h. Do you have special safety training programs for first line supervisors? Yes__________ No__________

i. Where does your safety training program take place?

	Yes	No
In the company	________	________
By company personnel	________	________
By other than company personnel	________	________
By both	________	________
Outside the Company	________	________
Both in and outside the company	________	________

CODE NO.________

j. Which of the following training techniques are used for safety training?

	Most Effective Technique	Techniques Actually used
Lecture	________	________
Conference	________	________
Lecture-Conference	________	________
Case study	________	________
Film	________	________
Role playing	________	________

2. Safety Committee

a. Do you have established a safety committee(s)?

Yes (1)______ No (0)______

b. If yes, in which of the following levels?

1) Central Safety Committee--Consist of top management with department heads? Yes (1)______ No (0)______

If yes, how often____________________________

2) Departmental safety committee--consisting of department heads, supervisors and the foremen? Yes (1)_____ No (0)_____

If yes, how often?____________________________

3) Foremen's safety committee--include all men?

Yes (1)______ No (0)______

If yes, how often?____________________________

4) Union-Management committee--consist of top management or his representative(s), union member(s), and employee representative(s)? Yes (1)_______ No (0)_______

If yes, how often?____________________________

c. When was this committee established?__________________________

d. Work accident experience in the company, after safety committee(s) were established has:

considerably improved_______ improved little_______

no change___________ worsened____________

considerably worsened____________________

CODE NO.________

3. Safety Inspections

a. Do you have regularly conducted safety inspections?

Yes__________ No__________

b. If yes, whose responsibility is it to make inspections?

____

c. How often are these inspections conducted?____________________

d. Who receives reports of the results of these inspections?______

____

e. Which one of the following ratings explain best the effect of safety inspections in preventing work injury in your company?

very effective________ somewhat effective________

no effect at all_______ negative effect__________

4. Safety Promotion and Propaganda

a. Do you practice promoting employees' safety interest?

Yes__________ No__________

b. Which of the following are most or least emphasized in this practice? (in order to influence the actions of employees?)

	1	2	3	4	5
1) Fear of personal injury	___	___	___	___	___
2) Fear of economic loss	___	___	___	___	___
3) Desire for reward	___	___	___	___	___
4) Desire for leadership	___	___	___	___	___
5) Desire to excel and be outstanding	___	___	___	___	___
6) Protection of others	___	___	___	___	___
7) Creating a favorable impression	___	___	___	___	___

CODE NO.________

c. Which one of the following methods do you use least or most in promoting safety interest:

	least 1	2	3	4	Most 5
1) Safety meetings--general and "stand-up"	___	___	___	___	___
2) Safety contest	___	___	___	___	___
3) Demonstrations	___	___	___	___	___
4) Displays and exhibits	___	___	___	___	___
5) Posters, signs, slogans	___	___	___	___	___
6) Publications	___	___	___	___	___

Manuals____ rule books____ payroll inserts____

Periodicals______ Handouts______

7) Promoting through employee families	___	___	___	___	___

III. OTHER PROGRAMS

A. Recreational Facilities and Programs

	Yes(1)	No (0)
1. Have you provided recreational facilities for employees?	______	______
2. Are employee families authorized to use these recreational facilities?	______	______
3. Is there athletic teams in the company?	______	______
4. Does the company encourage these teams to participate in games and competitions with other teams?	______	______
5. Have company teams ever won a championship position?	______	______
6. Do you believe that friendly relationships among workers will help to create a favorable work environment in which employees may be more safety conscious?	______	______
7. Do you have company sponsored social gatherings for employees, management and their families?	______	______

8. If yes, how often__________ and what is the nature of these gatherings?______________________________________

CODE NO.________

9. What % of employees and their families utilize recreational facilities and participate in these programs?

Employees: under 25%____ 25%____ 50%____ 75%____ over 75%____

Employee Families: under 25%____ 25%____ 50%____ 75%____ over 75%____

10. What have you done to create this friendly relationship among employees?____

____

B. <u>Medical Provisions</u>

1. Do you have the following medical personnel and facilities in the company?

			Full-time	Part-time	Number	Not in company but arranged
Doctor	Yes(1)____	No(0)____	____	____	____	____
Nurse	____	____	____	____	____	____
Hospital	____	____	____	____	____	____
Dispensary	____	____	____	____	____	____
Ambulance	____	____	____	____	____	____

2. Do you have first aid facilities? Yes (1)______ No (0)______

3. Have you provided first aid training for:

all employees Yes (1)______ No (0)______
first line supervisors Yes (1)______ No (0)______
other (specify)________________________

4. Do you have regular medical examinations for employees?

If yes, how often?____________________ Where?________________

IV. COMPANY'S SPECIFIC WORK INJURY INFORMATION AND STATISTICS

A. <u>Frequency and Severity Rates</u>

1. Are you familiar with work injury frequency and severity rates?

Yes__________ No__________

2. Do you know how they are figured out? Yes__________ No__________

CODE NO.________

3. Do you know your company's frequency and severity rates?

   Yes__________ No__________

4. Do you know industry's average frequency and severity rates?

   Yes__________ No__________

5. Total hours worked in 1968__________ 1969__________

6. Total number of disabling injuries in 1968__________ 1969_________

   Total number of compensable injuries in 1968________ 1969_________

   Reported to the government in 1968________ 1969_________

   Over seven days 1968________ 1969_________

7. Total days lost in 1968____________ 1969____________

   Total days lost (compensable only) 1968________ 1969________

8. Number of fatalities (if any) in 1968)___________ 1969________

9. Which year do you consider as the best for the company's safety record?_________________________

10. If 1969 safety record is different than best year, what are the factors that this difference can be attributed to?________________

____

B. <u>Causes of Accidents</u>

1. How would you rate the following with regard to their effect in causing unsafe employee acts which result in work accidents in your firm?

   ( ) a. <u>Physical inadequacies</u> (includes poor eyesight, defective hearing, muscular weakness, heart, circulatory, or other organic weakness.)

   ( ) b. <u>Mental inadequacies</u> (includes slow mental reaction, lack of coordination and nervous instability.)

   ( ) c. <u>Faulty attitude</u> (includes indifference, inattention, indolence, arrogance, recklessness, hostility.)

CODE NO.________

( ) d. Lack of knowledge or skill (includes ignorance of correct methods, faulty work habits and insufficient experience.)

2. How would you rate the following unsafe actions with regards to their frequency of happening in work accident cases of your company?

	very high	high	low	very low
a. Making safety devices inoperative	____	____	____	____
b. Using unsafe equipment	____	____	____	____
c. Unsafe loading, mixing, or placing	____	____	____	____
d. Unsafe position or posture	____	____	____	____
e. Failure to use safe clothing or personal protective devices	____	____	____	____
f. Operating equipment at unsafe speeds	____	____	____	____
g. Distracting, teasing, or abusing other workers	____	____	____	____

V. OBSERVATIONS (to be filled out immediately upon leaving company)

Physical Plant Layout and Conditions

1. Passage ways were: Obstructed 1 2 3 4 5 Clear

2. Passage ways were: Unmarked 1 2 3 4 5 Clearly marked

3. Overall plant layout was: cluttered 1 2 3 4 5 clean & roomy

4. Proper places for tools were: not provided 1 2 3 4 5 provided

5. Tools were: not properly placed 1 2 3 4 5 were properly placed

6. Machinery were: ungarded 1 2 3 4 5 properly guarded

7. Working surfaces were: oily, slippery and not clear 1 2 3 4 5 clean & dry

   Working surfaces were: uneven 1 2 3 4 5 even

8. Overall lighting of the plant was: insufficient 1 2 3 4 5 sufficient

9. Temperature was: uncomfortable 1 2 3 4 5 just right

10. Ventilation was: inadequate 1 2 3 4 5 adequate

CODE NO.________

11.	Noise in the plant was:	high	1	2	3	4	5	low
12.	Sanitary facilities were:	poor	1	2	3	4	5	very clean
13.	Visibility in the working area was:	poor	1	2	3	4	5	very good
14.	Suitable containers for spilled and leaking oil:	were not placed	1	2	3	4	5	were placed

under the barrels containing lubricating oil in engine rooms.

15.	Emergency exit signs were:	not easily seen	1	2	3	4	5	were easily seen
16.	Fire extinguishing equipment was:	not available	1	2	3	4	5	available
17.	Fire alarm system was:	not installed	1	2	3	4	5	installed

C.	Interest in Safety and this Project	out-standing	fair	poor	very poor
1.	Degree of their cooperation was:	______	____	____	____
2.	Company's interest in safety is:	______	____	____	____
3.	Company's safety practices seemed:	______	____	____	____

APPENDIX D

Letter of Authorization Obtained from Companies

Mr. Marshall Fiordelis
Michigan State Department of Labor
Bureau of Safety Regulation
Lansing, Michigan

Dear Mr. Fiordelis:

We are participating with Michigan State University and Mr. Yaghoub Shafai on a safety research project in industrial firms.

We hereby authorize him to have access to our safety figures and records.

Sincerely,

(Company)

APPENDIX E

Statistical Tests Used For The Analysis of Data

The Sign Test

The sign test is one of the non-parametric methods which is used to test the significance of the difference between two means in a paired experiment. It is particularly useful for research in which quantitative measurement is impossible or infeasible, but in which it is possible to rank with respect to each other the two members of the pair.[1]

The null hypothesis tested by this method is that:

$$P(X_A > X_B) \;=\; P(X_A < X_B) \;=\; \tfrac{1}{2}$$

Where X_A is the score of one member of the pair and X_B is the score of the other member in a matched-pair. The above equation implies that mean difference of two scores of the matched-pair is zero.

In the sign test, as implied by its name, only the sign of the difference between the paired variates is used and attention is focussed on the direction of the differences noting whether the sign of difference is plus or minus. If the difference between scores of matched-pair is zero thereby that pair is dropped from the analysis and N (the number of pairs) is reduced.

The number of fewer signs (X) is determined by counting. Then, by referring to a table, the probability level is found for respective number of observations with differing scores.

---

[1] Sidney Siegel, Non-parametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Company, 1956), pp. 68-75.

The sign test may be useful, if many of the differences are ties.[2] If the number of occurrences of the less numerous of the two signs is (S) and the total number of signs -- that is, the number of pairs of observations less the number in which the difference was zero -- is N, then by using the following formula

$$K = \frac{2S + 1}{\sqrt{n}} - \sqrt{n}$$

the value of K is determined. By subsequent referent to a related table the probability level can be determined.

The Wilcoxon Matched-pairs Signed-Ranks Test

The sign test discussed takes into consideration the direction of differences between mean scores of two members in a matched-pair but does not show the magnitude of difference. The Wilcoxon matched-pairs signed-ranks test not only utilizes the direction of differences, but it also gives more weight to a pair showing a large difference between the two members than to a pair showing a small difference.

It has been suggested that the Wilcoxon test is a most useful test for the behavioral scientists.[3] With the data of behavioral nature, the researcher can identify the member of a pair which is greater than the other member namely the direction of difference between the two. He can also rank the differences in order of absolute size. The procedure for using this test as follows:

1. List the score of each member in a pair.
2. Determine (di) the difference between scores of the two members.

---

[2] Allen Wallis and Harry V. Roberts, Statistics - A New Approach (Glenco, Illinois: The Free Press 1956), p. 598.

[3] Siegel, *op. cit.*, p. 75.

3. Rank the resulting differences in order of size, disregarding sign.

4. Affix the sign of the original difference to the corresponding rank.

5. Obtain T, the value of smaller of the sums of the like-signed ranks.

6. Then number of di's (differences with a sign) "N" is determined by counting.

7. If the two scores of any pair are equal, and the difference is thus zero, these pairs are dropped from analysis.

8. If the difference between two scores of the two or more pairs are the same size, the rank assigned will be the average of the ranks which would have been assigned if the d's had differed slightly.

9. If the number of pairs is 25 or less -- as it was in this study, a table of critical values of T is given for various sizes on N. For "N" larger than 25 that table cannot be used and the following formuls should be employed.

$$Z = \frac{T - \pi T}{\partial T} = \frac{T - \frac{N(N+1)}{4}}{\sqrt{\frac{N(N+1)(2N+1)}{24}}}$$

where πT = Mean and ∂T = standard deviation.