

CURRENT PRACTICES AND TRENDS OF INDUSTRIAL
SAFETY IN THE GREATER HOUSTON AREA

A Thesis

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Master of Arts

by
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A THESIS

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ABSTRACT

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Purpose

The purposes of this study were to ascertain the following in the Greater Houston area: (1) the degree to which safety education was employed; (2) the emphasis placed by industry on selected safety practices; (3) the extent to which vital safety components were utilized. These components include: training and education, inspection, safety engineering and vocational hygiene.

Methods

The methods used to obtain data for this study were (1) an investigation was made of pertinent literature; (2) a representative group of industrial firms were selected; (3) survey form was prepared; (4) questionnaire analyzed by advisory board; (5) questionnaire mailed to industrial representatives and results were tabulated; and (6) recommendations and summations.

Findings

1. Industries showed adequate utilization of safety practices;
2. Insignificant interest was expressed in

initiation of certain safety programs
in the future;

3. Definite trend as to months in which
accident rates are highest and lowest;
4. Insignificant pressure on industry is
exerted by state legal safety require-
ments.

Dr. Stephen Randel
Supervising Professor

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R.E.W.

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Chapter 1

INTRODUCTION

Statement of the Problem

Many industrial workers are either disabled or killed yearly as a result of unsafe practices or unsafe conditions in industry. Quite frequently these unsafe practices and unsafe conditions could have been avoided if both the worker and employer had cooperated in protecting against industrial hazards. A common belief is that accidents are caused by

carelessness. While the human element contributes largely to accident causation, the practice of attributing accidents entirely to carelessness results in an impasse as far as constructive preventive action is concerned. Preventing the "deadlock attitude" toward further safety training is the constant battle of the industrial safety department.

It is generally agreed that safety in industry is a management function. The field representatives of lower level management-supervisors or foremen may sometimes handle the task of carrying out safety instructions or safety meetings to their respective workers, but the actual initiation of some form of safety indoctrination is the eventual responsibility of the Safety Engineer echelon of management.

Though genuinely concerned with accident prevention, employee welfare and the humanitarian aspects of safety, "management" must concern itself with the direct and indirect costs of industrial accidents.

Direct costs are recognized generally as an expense item which is subject to control. That indirect costs also are noteworthy is borne out by the independent findings of H. W. Heinrich, Travelers Insurance Company, and the Division of Labor Standards, U. S. Department of Labor. These findings indicate that on the average, the "indirect costs" of an industrial accident are "four times" the direct costs.¹

Definition of Terms

Terms used generally throughout the report are defined in this section as follows:

The term "accident" refers to an event in which (a) the contact of a person with an object, substance or another person, or (b) the exposure of a person to objects, substances, other persons or conditions, or (c) the movement of a person causes personal injury or suggests the probability of such injury.²

The term "education" refers to meetings and talks, personal contacts with authorities or teachers, the use of bulletins and posters and other reading matter, stereoptician

¹National Safety Council, Accident Prevention Manual for Industrial Operations (3d ed.; Chicago: National Safety Council, 1955).

²H. W. Heinrich, Industrial Accident Prevention (2d ed.; New York: McGraw-Hill Book Company, Inc., 1941), p. 15.

slides and motion pictures, first-aid instruction and any oral or written instruction in avoiding hazards and cultivating safe methods of doing work.³ For the purposes of this study, the writer believes this definition will suffice for the term "training and education".

"Inspection" refers to a part of an accident-prevention program which is intended to serve as a check on the diligence of the plant personnel, both management and workers, in regard to the removal of unsafe working practices and unsafe working conditions.

"Vocational hygiene" refers to the science of maintaining and enjoying good health physically, mentally, and morally while at work. Briefly, it is that "field in medical science which aims to conserve the health of the worker and increase his productivity."⁴ This usually comes through the health service department of the industrial plant.

Limitations of the Study

The main problem for consideration in this study concerns the practices and procedures used by industry in combating accidents. The selection of industries and the scope of the questionnaire included in this study were limited by certain factors.

³Ibid., p. 345.

⁴Daniel Caplin and S. G. Ocean, Vocational Hygiene and Safety (rev. ed.; New York: Globe Book Company, 1939), p. 1.

First, the study was limited to a sampling of safety department policies of industries from one geographic area-- the greater Houston, Texas area.

Although almost all types of industries are represented, the study is primarily concerned with manufacturing and construction industries.

The study was further limited to the industries which employed at least 399 employees. Establishment with fewer employees were considered highly unlikely to maintain a staffed safety department. The study was further divided into companies with employees ranging from 399 to 999 and companies with employees ranging from 1000 or more.

It was necessary to collect the bulk of the data through the use of a survey, and not all of these surveys were returned. The study is limited, of course, to the accuracy to which the individuals completed the questionnaire and the true representation of their safety practices, comments and opinions.

Procedure

- I. An investigation was made of pertinent literature.
- II. A representative group of industrial firms was selected for the survey.
- III. The questionnaire was constructed.
- IV. The questionnaire was evaluated by an advisory board; suggested revisions were made.
- V. The questionnaire was mailed to selected industrial personnel.

VI. After final analysis of returned forms, results were tabulated.

VII. The thesis was prepared and submitted for approval.

Related Studies

Several studies have been made that indicate a concern for furthering the cause of safety in industry. Investigation of the literature has revealed certain studies which relate to portions and components of this study.

An early study pertaining to safety and vocational hygiene was conducted in 1939 by Daniel Caplin and S. G. Ocean titled, "Vocational Hygiene and Safety".¹ The basic considerations were given to occupational hazards and first-aid.

A study closely related to the present study is "A Proposed Safety Training Program for Industrial Supervisors" by A. Loveless.² This study's primary interest was the safety programs used by industries in educating its supervisors.

A study by Heinrich was made to determine methods by which industrial accidents may be prevented.³ He relates to and delineates between a safety program and accident prevention.

¹Daniel Caplin and S. G. Ocean, Vocational Hygiene and Safety (rev. ed.; New York: Globe Book Company, 1939).

²A. Loveless, "A Proposed Safety Training Program For Industrial Supervisors," Unpublished Master's Thesis, Texas A & M University.

³H. W. Heinrich, Industrial Accident Prevention (4th ed.; New York: McGraw Hill Book Company, 1959).

Chapter II

TRAINING AND EDUCATION

It is the purpose of this chapter to present data concerning training and educational practices used in safety departments of Houston area industries. A major factor to be considered in the administration of industrial safety programs is the training and education of all ranks of supervision and workers in the application of safety principles to their daily jobs. To determine the extent to which a given industry utilizes training and safety education, one must first delineate what constitutes the term. All effort made to prevent accidents:

Whether or not it be educationally intended, is nevertheless educational in its effect upon the individual employee whom it necessarily involves. It is the employee who suffers the injury, and it is the employee who must be made to carry on his work safely, in order that our industries may be reasonably free from accidents. That this is true is clearly indicated by evidence that intelligent and careful men may avoid injury on dangerous work and that careless men may be injured under the safest possible conditions. Education is an important factor in accident prevention, whether employers demand as their right that employees conduct their work safely or merely teach safety to the best of their ability and depend on the employee for personal initiative.¹

¹H. W. Heinrich, Industrial Accident Prevention (2d ed.; New York: McGraw-Hill Book Company, Inc., 1941), p. 345.

Much responsibility is placed on the supervisor or foreman. Regardless of the form that safety education takes, it should be kept in mind that it is the foreman or immediate superior who is in the best position to convey its message to the individual worker and to interpret it for the worker in "shop" language.

Safety in industry is good business. Any individual who has served in a supervisory capacity would probably attest to this fact. The supervisor in working through lower echelons of industry would recognize and verify the statement through his personal experiences. The supervisor, by definition and in fact, is in a better position to know the situation on a more personalized basis. Therefore, the supervisor, not the safety engineer, is in a better position to advance the cause of safety. The supervisor because he is responsible for controlling men, machines and working conditions on a daily, full-time basis can see the overt and actual responses of industrial accidents on the same plane as his men. The significant loss of morale, the remorse for injury or death of a fellow worker, the new man to take his place, the installation of a new machine, guarding machines to prevent a similar accident--this is the view of the supervisor in relation to safety--its existence and its application.

A safety committee or a group which represents the workers in the area of safety will be found in most industries. The specific function of the safety committee is to offer a

forum from which workers and committeemen can discuss the major accident-producing conditions and circumstances and the practical corrective action to eliminate the hazards. The extent to which the industries utilize the safe practices is shown in Table 1.

A comparison was made of the respondents from the firms with over 1000 employees, as to what extent each utilized the safety committee. It was found that sixty-two percent used the committee "extensively". Firms with less than 1000 employees used the committee slightly less than thirty-eight percent for the same category. An average of the combined percentages reveal that twenty-five percent of

companies without a safety committee program plan such a program in the future. From Table 1 it can be seen that almost forty-three percent of the larger firms used a safety training program for supervisors "extensively" while fifty-two percent used the program "moderately". The smaller firms used a training program for supervisors, twenty-five percent "extensively" and fifty-six percent "moderately". The outlook for programs concerning supervisory training programs was approximately the same for both groups. Over eighty-four percent of the larger firms indicated the use of safety training programs for workers, while eighty-one percent of the smaller firms indicated the use of a training program for workers. An average of the combined percentages indicate

Table 1

A Comparison of Safety Training and Educational Programs
in Companies with Over 1000 Employees and
Companies with Under 1000 Employees

Aspect of the Safety Program Used Within the Companies Surveyed	Companies over 1000 Employees					
	Safe Practices Used			Future Program		
	Extensively	Moderately	Seldom	Never	Yes	No
Safety Committee	62.0%	23.8%	14.3%	0.0%	14.2%	4.7%
Safety Training Program (For Supervisors)	42.8%	52.4%	4.7%	0.0%	33.1%	0.0%
Safety Training Program (For Workers)	42.8%	42.8%	14.2%	0.0%	33.1%	0.0%
Bulletins, Fliers or Posters	61.9%	33.1%	4.7%	0.0%	23.8%	0.0%
Companies under 1000 Employees						
Safety Committee	37.4%	31.2%	12.5%	0.0%	37.4%	0.0%

Table 1 (continued)

A Comparison of Safety Training and Educational Programs
in Companies with Over 1000 Employees and
Companies with Under 1000 Employees

Aspect of the Safety Program Used Within the Companies Surveyed	Companies under 1000 Employees					
	Safe Practices Used			Future Program		
	Extensively	Moderately	Seldom	Never	Yes	No
Safety Training Program (For Supervisors)	25.0%	56.0%	6.3%	0.0%	43.7%	6.3%
Safety Training Program (For Workers)	37.4%	43.7%	12.5%	0.0%	37.4%	0.0%
Bulletins, Fliers or Posters	62.5%	31.2%	0.0%	0.0%	25.0%	6.3%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins, in the Greater Houston, Texas area, March 4, 1971 - April 4, 1971.

that over thirty-five percent of the firms plan to initiate a program of this type in the future.

A further addition to the training and education of the employees of an industry as to safe practices would be the use of bulletins or posters. The use of posting literature to that effect may be seen by referring to Table 1. From this table it can be seen that over sixty-two percent of all companies surveyed used posters "extensively" with both large and small firms balancing at sixty-two percent "extensively". The overall use of posters was marked by higher percentages--ninety-five percent of large firms using them either "extensively" or "moderately" while over ninety-three percent of smaller firms used them "extensively" or "moderately".¹

Respondent industries varied in the susceptibility to fire and consequently the instruction of fire-fighting techniques varied. Over fifty percent of the larger firms used fire drills in the first two categories while less than fourteen percent of the smaller firms used the fire drill for the same categories. Instruction of fire fighting techniques showed a proportionate usage with over sixty-one percent of

¹Posters may portray serious bodily injuries. They may show the loss of arms, legs, hands, fingers, eyes, the results of infection, hardships from the loss of income, and many other unfortunate circumstances, as reported by H. W. Heinrich, Industrial Accident Prevention (2d ed.; New York: McGraw-Hill Book Company, Inc., 1941), p. 75.

larger firms using the instruction "extensively" and "moderately", while the smaller firms showed a surprising seventy-five percent usage "extensively" and "moderately". (See Table 2)

Frequently thought of as one of the best methods of educating employees for prevention of unsafe practices and recognition of unsafe conditions is the use of slide films or movies. Respondents again were asked to ascertain to what degree they used slide films or movies in their training and education program. Respondents from over eighty-five percent of the larger firms indicated the use of slide films or movies "extensively" and "moderately" (thirty-eight and thirty-eight percent respectively). The smaller firms showed a seventy-five percent usage "extensively" and "moderately". The larger percentage being sixty-three percent "moderately".

Representatives of early industrial safety refer to safety contests as interest-producing activities. Whether or not it is applicable to this phase of the industrial age remains to be seen. Responses to the question concerning safety contests may be seen in Table 3. Slightly less than thirty-four percent of the firms with over 1000 employees used safety contests to any extent while twenty-five percent of the small firms were using contests.

These data would seem to indicate that the majority of industries believe that workers work safely for their own

Table 2

Usage of Instruction of Fire Fighting Techniques Through
the Use of Fire Drills, Slide Films or Movies

Instruction of Fire Fighting Techniques Employed by the Companies Surveyed	Companies over 1000 Employees					
	Safe Practices Used			Program in the Future		
	Extensively	Moderately	Seldom	Never	Yes	No
Fire Drills	23.8%	28.2%	28.2%	14.2%	19.0%	4.7%
Instruction of Fire Fighting Techniques	28.2%	33.1%	19.0%	28.2%	28.2%	0.0%
Slide Films or Movies	38.0%	47.6%	9.5%	4.7%	19.0%	4.7%
	Companies under 1000 Employees					
Fire Drills	12.5%	31.2%	6.3%	43.7%	18.7%	25.0%
Instruction of Fire Fighting Techniques	31.2%	43.7%	12.5%	6.3%	18.7%	6.3%

Table 2 (cont)

Usage of Instruction of Fire Fighting Techniques Through
the Use of Fire Drills, Slide Films or Movies

Instruction of Fire Fighting Techniques Employed by the Companies Surveyed	Companies under 1000 Employees				
	Safe Practices Used				Program in the Future
	Extensively	Moderately	Seldom	Never	
Slide Films or Movies	12.5%	62.5%	12.5%	6.3%	18.7% 6.3%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins in the Greater Houston, Texas area, March 4, 1971 - April 4, 1971.

physical well-being rather than making a game of injury-frequency rates. Although this may be the general consensus almost thirty percent of all firms surveyed indicate they planned initiation of contests in the future.

A comparison of the two types of firms studied showed that both types used protective clothing and equipment eighty-one percent "extensively". Table 3 indicates that the larger firms show a fourteen percent moderate usage. Both the smaller and larger industries indicate over twenty-three percent have future plans concerning increased use of protective clothing and equipment.

The practice of publishing a safety magazine in industry is used by only a few Houston area firms. Slightly over thirty-three of the larger firms utilized a safety magazine (fourteen percent "exclusively"; nineteen percent "moderately") while the smaller firms did not use a magazine at all. Over 93.7 percent of the smaller firms indicated that the safety magazine was never used and only twelve percent plan to initiate a magazine in the future. Several firms responded in comment that, safety practices were covered in the company magazine or a specific section was reserved for all information concerning safety (posters, tips, personnel injuries, etc.).

A comparison of respondents from large and small industries indicate little usage of employee opinion surveys. Slightly over twenty-three percent of the larger industries

Table 3

Industrial Accident Preventive Techniques Demonstrated
Through the Use of Safety Contests and
Protective Clothing and Equipment

Industrial Accident Preventive Techniques Used in Industry	Companies over 1000 Employees					
	Safe Practices Used					Program in the Future
	Extensively	Moderately	Seldom	Never	Yes	No
Safety Contests Protective Clothing and Equipment	19.0%	14.2%	23.8%	42.8%	14.2%	14.2%
	81.0%	14.2%	4.7%	9.0%	23.8%	4.7%
Safety Contests Protective Clothing and Equipment	Companies under 1000 Employees					
	6.3%	18.7%	43.7%	25.0%	25.0%	6.3%
	81.3%	0.0%	12.5%	0.0%	25.0%	0.0%

Source: Questionnaire Survey, conducted by Ronnie E. Wilkins, Greater Houston, Texas, area,
March 4, 1971 - April 4, 1971.

used surveys while less than thirteen percent of the smaller industries used surveys. As seen in Table 4, plans for using surveys in the future showed a proportionately small percentage, with larger firms reporting fourteen percent and smaller firms less than 6.5 percent.

The extent of utilization of coordination of public relations releases on safety may be more readily interpreted in the "seldom" and "never" categories of the smaller firms. The smaller firms indicated a thirty-seven percent and thirty-one percent usage respectively while the larger industries showed higher percentages in the "extensively" and moderate categories--twenty-four and thirty-three percent respectively.

Industrial workers generally do have an interest in safety and accident prevention. This is a natural manifestation of the law of preservation. The management of most industrial firms offer some type of safety training manuals from which the workers can actually learn and henceforth recognize the unsafe practices of his particular job. The majority of the industries, large and small indicated that they used safety training manuals. Over fifty-seven percent of the firms with over 1000 employees used safety manuals "extensively" as compared to thirty-seven percent of firms with 399-999 employees. Over thirty-seven percent of the respondents in smaller industries indicated they plan to initiate the use of safety training manuals in the future while

Table 4
Advertising Media--Employee Opinion Surveys
and Releases on Safety

Companies over 1000 Employees	Safe Practices Used				Program in the Future		
	Extensively	Moderately	Seldom	Never	Yes	No	
Employees' Opinion Surveys	9.5%	14.2%	33.1%	42.8%	14.2%	14.2%	
Coordinate Public Relations Safety Releases	23.8%	33.1%	19.0%	23.8%	14.2%	14.2%	
Companies under 1000 Employees	Extensively	Moderately	Seldom	Never	Yes	No	
Employees' Opinion Surveys	0.0%	12.0%	31.2%	50.0%	6.3%	0.0%	
Coordinate Public Relations Safety Releases	6.3%	12.5%	37.4%	31.2%	18.7%	25.0%	

Source: Questionnaire Survey conducted by Ronnie E. Wilkins in Houston, Texas, March 4, 1971 - April 4, 1971.

larger industries show slightly over twenty-eight percent for the same category. (See Table 5)

There seem to be indications that the mass approach to safety training may not be adequate.

Carefully conducted tests reveal that some mass training methods, including classroom training and films, apparently have little effect on the frequency of injuries especially in plants with good records.³

Group or mass training would seem to have a place in the complete safety program. However, accidents usually happen to people one at a time, so it would also appear to be a natural step to carry the accident-prevention program to the individual employee one at a time.

The advantages of teaching job safety on an individual basis are many. The job hazards vary from one job to another. Two different individuals because of individual differences may be confronted with different hazards. These individual differences can be considered when safety training is personalized. The individual basis provides for consideration of the workers interests, rate of learning, his natural ability and his physical limitations.

Personalized safety training can be specific. Group training must be general. The key to successful job safety training is telling the employee what the hazards are and how to avoid them. The evidence indicates that industry can cut total injury rates in half by using this personalized safety-training program approach.⁴

³Russell DeReamer, Modern Safety Practices (New York: John Wiley & Sons, Inc., 1958).

⁴Ibid., p. 47.

Table 5

Safety Training Manual as a Visual
Aid for Employees

	Companies over 1000 Employees				
	Safe Practices Used	Extensively	Moderately	Seldom	Never
				Yes	No
					Program in the Future
Develop and use safety training manuals	57.0%	28.2%	9.5%	0.0%	28.2%
					0.0%
	Companies under 1000 Employees				
Develop and use safety training manuals	37.4%	31.2%	18.7%	0.0%	37.4%
					0.0%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins, Greater Houston, Texas industries, March 4, 1971 - April 4, 1971.

The use of a personalized safety instruction program in industry seems to be of extreme importance. Respondents from the larger industries indicated an eighty-five percent usage of safety training on an individual basis ("extensively" fifty-seven percent; "moderately" twenty-eight percent). The smaller industries reported slightly over eighty-one percent utilization of personalized training (31.2%, "extensively" and 50% "moderately"). Twenty-five percent of the industries with less than 1000 employees indicated a program in the future to initiate safety training on an individual basis while nineteen percent of the industries with more than 1000 employees plan a program in the future.

Chapter III

INSPECTION

The purpose of this chapter is to present data concerning the inspection practices used in safety departments of Houston area industries. The safety inspection is one of the principal means of locating accident causes. Inspections assist in determining what actions of safeguarding are necessary to protect against hazards before accidents and personal injuries occur. Inspections which are planned as part of an accident-prevention program are intended to serve as a check on plant personnel and removal of unsafe working practices and unsafe working conditions. No matter how frequently inspections are made or how able and informed the inspectors are, they cannot be relied upon to detect every accident cause. Even those which are noted by the inspector and duly reported will remain in existence until the necessary corrective procedure can be placed in motion. The use of inspection is enhanced if one takes into account the proper supervisory and worker safety training programs as pointed out in Chapter II. Through this approach hazards can be eliminated when they first appear. The major purpose of the safety inspection should be to provide help in discovering conditions which, if corrected, will bring the particular

Take note

industry up to accepted and approved standards. The data gathered in this study do not indicate any serious problems with any state safety requirements being too rigid.

In preparing for an inspection, it is advisable to analyze all accidents for the past several years so that special attention can be given those conditions and those locations known to be accident producers. Safety inspections may be classified as follows:

1. Periodic inspections
2. Intermittant inspections
3. Continuous inspections
4. Special inspections¹

The effective inspections must contain techniques which yield a large amount of "relative" information. Such techniques would include (1) a check list of typical items to be observed, (2) instruction to inspectors indicating that the check list is only a guide and does not bar them from reporting any unsafe act or condition which they notice, (3) instructing them to suggest proper correction, and (4) review of the reports submitted and the delivery of constructive criticism.

In the writer's opinion, there are certain principles which should be followed in scheduling inspections and reporting the results of inspections. Most of these principles seem to be easily recognizable in that common sense dictates their usage. For instance, when an inspection is

¹National Safety Council, Accident Preventive Manual for Industrial Operations (3d ed.; Chicago, 1955), p. 219.

made, regardless of who makes it, the inspector should discuss the unsafe condition or unsafe practices with the supervisor before reporting them to the higher echelons. By informing the supervisor of his inspection status, corrective action can be taken immediately thus nullifying the need for a formal report. Inspections, if made and reported without consultation with the immediate supervisor, have an undermining effect on the supervisor's control over his men and respect due to his position.

The emphasis upon the phases of inspection varies among industries and departments within the industries. The purpose of this chapter is to present data concerning safety inspection practices used in industry.

Over sixty-one percent of the industries over 1000 employees indicated "extensive" use of personal and supervising inspections while thirty-eight percent of the industries with less than 1000 employees indicated "moderate" use in the same category, as shown in Table 6. Likewise, over sixty-two percent of the industries with less than 1000 employees indicated "extensive" use of inspections with twenty-five percent utilization in the "moderate" category. Both respondent categories projected at least a twenty-three percent increase of work in this area in the future.

Reports on the status of safety are used quite frequently in industry. Representatives of industries in the

Table 6

A Comparison of Personal and Supervising Inspections
Accompanied by Status Reports on Safety

	Companies over 1000 Employees						
To what extent do, you utilize:	Safe Practices Used				Program in the Future		
	Extensively	Moderately	Seldom	Never	Yes	No	
	Personal and super- vising inspections	61.9%	38.0%	0.0%	0.0%	23.8%	0.0%
Submitted reports on safety status	81.0%	19.0%	0.0%	0.0%	23.8%	0.0%	
	Companies under 1000 Employees						
Personal and super- vising inspections	62.5%	25.0%	6.3%	0.0%	25.0%	0.0%	
	Submitted reports on safety status	75.0%	6.3%	12.5%	0.0%	25.0%	0.0%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins, March 4, 1971 - April 4, 1971, Houston, Texas.

survey were asked to indicate to what extent they used submitted reports on the status of safety. (See Table 6)

The reports referred to could be on a daily, weekly or monthly basis. Industries of the larger personnel numbers indicated a combined ninety-nine percent usage while the smaller firms showed slightly over eighty-one percent usage. Respondents from both categories anticipated programs in the future concerning status reports.

*if such a use
not by
protection
why so many
add.*

Effective inspection is developed by providing inspectors with a check list of typical items to be observed. The best inspection check lists seem to be detailed enough to cover all phases which the worker must go through to accomplish his particular job. For example:

In a department where woodworking operations are carried on, the check list should list each machine, with appropriate provision for indicating whether the guards are in place and whether they are properly adjusted. In the interest of brevity and clarity it is best to prepare a separate list for each major department or group of departments where operations are similar.²

For the purposes of this study a checklist of unsafe practices will be defined as a list of unsafe practices for any or all departments of the industries surveyed, either general in description of a given phase or detailed to the operations within a certain department.

Forty-nine percent of the respondents from smaller firms used a check list of unsafe practices "extensively" and

²H. W. Heinrich, Industrial Accident Prevention (2d ed.; New York: McGraw-Hill Book Company, Inc., 1941), p. 55.

"moderately". The same factor was considered to be "extensively" used alone by over forty-seven percent of the larger firms while another thirty-three percent used checklists "moderately" in their operations. (See Table 7) Twenty-two percent of all companies surveyed planned to initiate a program of this nature in the future.

Many of the accidents caused by irregular maintenance of machinery, equipment and tools may be avoided through the use of two regular maintenance schedules. Well maintained equipment usually yields better work and decreases job dangers. Over ninety-three percent of the responses from all participating industries indicate either "extensive" or "moderate" use of a regular maintenance schedule on equipment with over fifty-eight percent using a schedule "extensively". Twenty-five percent of the smaller firms plan to use a schedule in the future while slightly less than twenty-four percent of the larger firms plan to initiate a program of scheduling maintenance later. Constant and periodic provisions for the inspection, repair and maintenance of equipment is an essential precautionary measure in the prevention of accidents.

In modern safety programs accident investigation is given high priority among the duties of the in-shop supervisor. By reason of his close contact with the worker, familiarity at the work area, his experience and knowledge of the machines and materials, the supervisor is in an advantageous position

Table 7
Safety Practices Exercised by Industry

Safety Practices Utilized in Industry	Companies over 1000 Employees					
	Safe Practices Used		Program in the Future			
	Extensively	Moderately	Seldom	Never	Yes	No
Checklist of unsafe practices	47.6%	33.1%	9.5%	9.5%	19.0%	4.7%
Regular maintenance schedule on equipment	66.7%	33.1%	0.0%	0.0%	23.8%	0.0%
Investigation of serious accidents	90.5%	0.0%	0.0%	0.0%	23.8%	0.0%
	Companies under 1000 Employees					
Checklist of unsafe practices	37.4%	12.5%	18.7%	25.0%	25.0%	18.7%
Regular maintenance schedule on equipment	50.0%	37.4%	6.3%	0.0%	25.0%	0.0%

Table 7 (continued)
Safety Practices Exercised by Industry

Safety Practices Utilized in Industry	Companies under 1000 Employees				
	Safe Practices Used	Program in the Future			
		Extensively	Moderately	Seldom	Never
Investigation of Serious Accidents	93.7%	0.0%	0.0%	0.0%	0.0%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins, March 4, 1971 - April 4, 1971, Houston, Texas area industries.

to conduct an accident investigation. The basic reason for making an accident investigation is to pinpoint the causes of the accident so immediate corrective action can be taken to alleviate the possibility of recurrence. The investigation although guided by a format can become involved in uncommon abstracts. The physical and mental condition of the injured worker at the time of the accident often reveals the prime reason for the mishap.

Assuming the results of this study are representative of all industries in the greater Houston area, it would appear that all firms in the surveyed area use some type of investigation for serious accidents. Over ninety percent of the larger industries use investigation "extensively" while almost ninety-four percent of the smaller firms utilize investigations "extensively". One-fourth of all industries plan to start a program of investigation in the future as shown in Table 7.

The worker in a modern industry places more reliance on sight than on any of the other senses. He relies heavily on his eyesight for protection against accidents. The eye, however, can relay to the brain only such impressions as are carried to it by light waves and if these light waves are insufficient because of poor illumination, the effect on an individual with normal eyesight is similar to that of a condition of partial blindness. Because of the long recognized importance of good illumination in industrial-accident prevention, illuminating engineering has long been one of the industrial

sciences. The number of accidents attributed to inadequate lighting is still, however, far greater than is justified by our scientific knowledge of current lighting principles and means of applying them.

Although inadequate illumination is known to be a constant source of industrial accidents, many specialists in the field of proper illumination feel that adequate illumination is neither considered to be relative enough or important for detail consideration.

There are millions of violations of the fundamentals of good illumination in our workshops--violations that endanger all workers, regardless of the character of their vision and millions of workers are laboring every day under the double handicap of poor lighting and sub-normal eyesight.³

One method of determining the adequacy of illumination within the plant is through the use of an illumination survey. Industries of both categories showed over twenty-five percent "moderate" and "extensive" usage of an illumination survey form. The larger firms showed a slight edge over smaller firms with a 28.5 percent usage. Findings of the study confirmed this writer's theory that few industries are genuinely involved with controlling or creating proper illumination. Based on the findings of the study, less than eighteen percent of all companies plan to start a program using illumination survey forms. The fact is, although preventive measures may be taken and inspections may be made regularly--the accident gives no warning of its presence. The time element thus comes into

³Ibid., p. 297.

play as an important segment of the entire sequence of an accident.

If the interval between the onset and the climax of an accident--creating a condition is half a second, and if the worker, because of poor illumination, requires half a second to see the danger, there is no time left to him for escaping it.⁴

In American industry there are thousands of workers who have been convinced that the testing and use of protective equipment is a good practice. The use of safety glasses provides an excellent example of personal protective equipment. The use of safety glasses seems to be partially determined and reinforced by the extra emotional fear of the loss of ones' eyesight. Of course, this is the philosophy behind all protective equipment, but there seems to be an extra dimension to the traumatic thought of blindness. Not only does the use of safety glasses prove to be wise on the part of the worker but the monetary loss due to an eye injury should be surprising to everyone.

But aside from his humanitarian consideration, the medical and compensation expense involved in the loss of one eye--\$2300 to \$14,536, depending upon state compensation laws--makes the eye-protection program economically sound.⁵

Although safety glasses are an important item of personal protective equipment, there are other types of protective equipment which are just as important to injury

⁴Ibid., p. 299.

⁵Russell DeReamer, Modern Safety Practices (New York: John Wiley & Sons, Inc., 1958), p. 182.

prevention. These would include: (1) all types of respiratory protective devices (selection and care of respirators is important), (2) hard hats, (3) protective caps, (4) gloves, (5) safety shoes, and (6) work clothing.

The acquisition and care of personal protective equipment has proven itself a valuable aid in maintaining employee welfare and morale. However, in order to insure the desired results from protective equipment, periodic testing would seem advisable. Respondents in industries included in the study held a variety of positions. Slightly over half of the industries with 399-999 employees used testing of protective equipment "extensively" and "moderately" while over three-fourths of the industries with 1000 or more employees used testing "extensively" and "moderately" (forty-two and thirty-three percent respectively). These data seem to indicate that respondents from both categories were fairly evenly divided. In initiating a program of testing protective equipment in the future, both reported over twenty-three percent probability of including testing of equipment in future operations. (See Table 8)

The follow-up studies of serious accidents in theory, are eventually linked with proper corrective action. The corrective action may come in a variety of forms. These might include: (a) recommendations to alleviate the unsafe practice, (b) approval of necessary expenditures, (c) the direction of concerned departments (purchasing, engineering or maintenance)

Table 8

An Analysis of the Practice of Using
Protective Equipment

Demonstrated Use of Protective Equipment	Companies over 1000 Employees					
	Safe Practices Used			Program in the Future		
	Extensively	Moderately	Seldom	Never	Yes	No
Test protective equipment	42.8%	33.0%	9.5%	4.7%	23.8%	0.0%
Test protective equipment	Companies under 1000 Employees					
	43.7%	12.5%	18.7%	18.7%	12.0%	25.0%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins, March 4, 1971 - April 4, 1971, in the greater Houston, Texas area.

to do necessary work and in some instances informing line supervisors as to corrective procedures. The data obtained in the study indicates that almost all of the industries use some form of a follow-up study of serious accidents.

Findings of the study confirmed the value of follow-up studies. One hundred percent of the larger firms indicated either extensive or moderate use of a follow-up. Ninety-three percent of the smaller firms used the follow-up either "extensively" or "moderately". Approximately twenty-five percent of all firms suggest future use.

Chapter IV

SAFETY ENGINEERING

The purpose of this chapter is to describe some of the practices included in a typical safety engineering department and to report tabulations concerning the practices used by Houston area industries. Information is given concerning departmental safety records, safety meetings, help or advice from State Labor Departments, help or advice from insurance companies, suggestion boxes, correlation of safety programs with union representatives and workers. Coordination of Safety and Purchasing Departments, coordination of Product and Plant Engineering on safety designs, analysis of safety standards of other companies, inspection of new equipment for mechanical or electrical hazards, coordination of traffic and other departments, screening candidates for jobs to isolate the so-called accident-prone individual are also discussed.

At the beginning of the twentieth century the role of the safety engineer, safety inspector or safety director was not yet defined. The profitable operation of a business had not yet been joined to the essential skills and specialized knowledge of the safety man. But, early in 1900 several large companies, especially in the steel, electrical, chemical and

railroad industries began to show increased interest in industrial safety. The industries began to employ safety inspectors to search out and correct hazards. The safety committee was conceived to give the workingman a representative who could put his ideas where it would do some good.

Much literature proclaims the responsibilities of the safety specialist but before the detailed representation of his duties can be given, a definition of the term seems applicable.

Safety engineering may be defined as the application of the arts and sciences of engineering and education for the prevention of accidents and the conservation of health, life and property.¹

Perhaps no one factor of a safety program can be singled out as most important, but constant recognition of the role of the line supervisor is mandatory where effective safety engineering is to be found. DeReamer emphasizes that if this concept (line supervisor role) is accepted, the responsibilities of the safety engineer become characterized accordingly. The safety engineer must teach, counsel, advise and assist line management to fulfill to the highest degree its responsibility for safety, provide for periodic safety appraisals, promote and maintain a continuing safety-education program, maintain and interpret accident and injury statistics and accident cost data, devise measurements and set standards, provide for the advancement and dissemination of fundamentals

¹Russell DeReamer, Modern Safety Practices (New York: John Wiley & Sons, Inc., 1958), p. 320.

of safety knowledge, conduct safety research and maintain liason with national, state and local safety councils. It also seems to be advantageous to the safety engineer to take an active part in the activities of such groups.

One of the main functions closely related with safety engineering is the maintenance of departmental safety records. The emphasis upon departmental safety records varies among larger industries and with smaller firms. Over ninety-five percent of the larger industries suggest an "extensive" and "moderate" usage of departmental safety records while seventy-five percent of the smaller industries imply usage for the same classifications, as shown in Table 9.

The participation of the employee in the safety program is an important factor in the development and retention of worker safety awareness. It is a cornerstone of the learning theory that people learn by doing and participation increases interest.

Employee participation in the accident-prevention program stimulates interest and enthusiasm for the various safety activities. Where safety participation is properly promoted, it becomes an X factor which produces outstanding results in the control of accidents and the improvement of employee attitude toward the supervisor and the company.²

Respondents from both groups of industries prescribed a strong usage of the safety meetings; larger industries reported 94.8 percent, as compared to 86.7 percent in the smaller industries. Table 10 shows the percentage of industries which suggest a program in the future.

²Ibid., p. 71.

Table 9

A Comparison of the Use of Departmental Safety Records
in Companies Over 1000 Employees and
Companies under 1000 Employees

To what extent do you use the following in your safety Program	Companies over 1000 Employees				
	Safe Practices Used				Future Program
	Extensively	Moderately	Seldom	Never	Yes No
Departmental safety records	81.0%	14.2%	4.7%	0.0%	19.0% 4.7%
Departmental safety records	Companies under 1000 Employees				
	50.0%	25.0%	63.0%	12.5%	18.7% 12.5%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins, March 4, 1971 - April 4, 1971
of the Houston, Texas area industries.

When respondents in industry were asked if they used "help or advice from State Labor Departments," a large percentage from the larger industries indicated moderate usage, as seen in Table 10. A larger percentage of respondents from smaller industries implied employment of such a program in the future.

Only 9.5 percent of the respondents from the over 1000 employee industries proclaim "help or advice" from insurance companies to be of extensive application. As seen in Table 10, almost forty-four percent of the 399-999 employee industries include "extensive" use of advice from insurance companies in their safety engineering operations.

Some respondents from industry suggested that the use of "suggestion boxes" could be a factor in curbing hazards. As seen in Table 10, the largest percentage of respondents, over half of the larger firms, included suggestion boxes in their plan for alleviating accidents.

Safety program implementation is certainly an activity over which there should be no labor-management disagreement. Everyone involved would acquire new attributes which would enhance the standing of their organization.

Management stands to gain through increased operating efficiency; employees, through the reduction of lost earnings resulting from injuries; and the employee's representatives, the unions, stand to gain in prestige by their ability to claim one more constructive measure which they have been able to obtain for their membership.³

³Frederick G. Lippert, Accident Prevention Administration (1st ed.; New York: McGraw-Hill Book Company, Inc.), p. 66.

Table 10

Integrated Safety Programs Utilizing Advice from
State Labor Departments-Insurance Companies
and Companies Suggestion Boxes

Integral Components of Safety Programs	Companies over 1000 Employees					
	Safe Practices Used			Program in the Future		
	Extensively	Moderately	Seldom	Never	Yes	No
Safety meetings Help or advice from State Labor Depts. Help or advice from insurance companies Suggestion boxes	71.5%	23.8%	4.7%	0.0%	23.8%	0.0%
	4.7%	28.2%	38.0%	23.8%	9.5%	9.5%
	9.5%	42.8%	38.0%	23.8%	14.2%	4.7%
	23.8%	28.2%	19.0%	28.2%	14.2%	9.5%
Safety meetings	Companies under 1000 Employees					
	68.7%	18.7%	12.5%	0.0%	25.0%	0.0%

Table 10 (continued)

Integrated Safety Programs Utilizing Advice from
State Labor Departments-Insurance Companies
and Companies Suggestion Boxes

Integral Components of Safety Programs	Companies under 1000 Employees				
	Extensively	Moderately	Seldom	Never	No
Help or advice from State Labor Depts.	12.5%	12.5%	50.0%	12.5%	18.7%
Help or advice from insurance companies	43.7%	37.4%	12.5%	0.0%	0.0%
Suggestion boxes	12.5%	25.0%	18.7%	37.4%	12.5%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins in the Greater Houston, Texas
area, March 4, 1971 - April 4, 1971.

According to Lippert, the mere desirability of labor-management cooperation does not "get the job done."

. . . in order to translate this expression of policy into a workable operating procedure it remains for the management of a concern to consider the specific ways in which the labor organizations with which it deals can participate in the accident prevention program and than to make a proposal, formal or informal, which embodies the details of this participation, to the union.⁴

Not all respondents in the survey considered the correlation of safety programs and measures with Union representatives and workers applicable to their firms. The data in Table 11 show that respondents from the smaller industries, when asked to record the extent to which they included correlation of safety programs with Union representatives and workers reported over forty-three percent "never" utilized this approach. Undoubtedly a large portion of this number included industries who used non-union workers. Over forty-seven percent of the larger industries utilized labor-management cooperation in carrying out safety programs and measures.

The practice of coordinating Safety and Purchasing Departments in achieving a more advantageous start to accident and hazard protection, was used by more than three-fourths of the respondents from major industries. Almost sixty-three percent of the respondents from minor industries rank the coordination as being either "extensive" or "moderate".

A larger percentage of respondents from major industries employed coordination of product and plant engineering on safety

⁴Ibid.

Table 11
Coordination of Safety Programs and Measures
in Industry--Large and Small

Correlated Programs for In-plant Safety for all Employees	Companies over 1000 Employees					
	Safe Practices Used					
	Extensively	Moderately	Seldom	Never	Yes	No
Correlate safety programs and measures with union representatives and workers Coordination of safety and purchasing departments Coordination of product and plant engineering on safety designs Analyze safety standards of other companies	14.2%	33.1%	0.0%	19.0%	4.7%	14.2%
	33.1%	47.6%	4.7%	0.0%	19.0%	0.0%
	38.0%	38.0%	9.5%	4.7%	23.8%	0.0%
	19.0%	57.0%	9.5%	14.2%	19.0%	9.5%

Table 11 (continued)

Coordination of Safety Programs and Measures
in Industry--Large and Small

Correlated Programs for In-Plant Safety for all Employees	Companies under 1000 Employees					
	Safe Practices Used			Program in the Future		
	Extensively	Moderately	Seldom	Never	Yes	No
Correlate safety programs and measures with union representatives and workers	12.5%	12.5%	25.0%	43.7%	12.5%	37.4%
Coordination of safety and purchasing depts.	25.0%	37.4%	6.3%	25.0%	18.7%	18.7%
Coordination of product and plant engineering on safety designs	25.0%	43.7%	6.3%	18.7%	18.7%	18.7%
Analyze safety standards of other companies	18.7%	25.0%	37.4%	12.5%	18.7%	18.7%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins of industries in the Greater Houston, Texas area, March 4, 1971 - April 4, 1971.

designs as a means of deferring industrial hazards within the plant. Major industries indicated a seventy-six percent inclusion whereas smaller industries indicated over sixty-eight percent "extensive" and "moderate" application.

A considerably larger percent of respondents from larger firms analyzed the safety standards of other companies in comparison with their own standards. The frequency with which respondents used analysis of other company standards is shown in Table 11. Slightly over forty-three percent of the respondents from smaller industries utilized other company standards, as compared to over seventy-six percent of the larger industries.

Most literature, studies and data designed to keep the safety man informed as to safety practices and accident prevention are based on the day-to-day operations of a plant. However, inspection of new equipment for electrical or mechanical hazards may entail an out-of-the ordinary sense of safety perception.

New equipment, machines and processes and all relocated or modified machines and equipment should be carefully checked for compliance with existing safety standards before being put into operation.⁵

Respondents from firms with fewer employees indicated a ninety-three percent "extensive" and "moderate" usage of inspection of new equipment as a safety policy. The data in

⁵Russell DeReamer, Modern Safety Practices (New York: John Wiley & Sons, Inc., 1958), p. 254.

Table 12 show over eighty percent of the larger industries utilized "inspections" of new equipment.

The practice of coordinating traffic and other departments to insure safe movement of vehicles and pedestrians, was used by over half of all industries surveyed. The smaller industries showed a slight edge in desire for a program of departmental coordination in the future.

Everyone is susceptible to accidents. The "traditional" accident occurs as a result of an unsafe act or unsafe condition. Yet in the past few decades there have been numerous studies centered around the so-called accident-prone group of people.

Usually "accident proneness" is described as a combination of human abilities which make:

A person highly proficient in bringing about accidents, regardless of his environment, at a rate higher than could be statistically expected by chance alone. Perhaps it will suffice to describe the accident-prone individual as a person who will have an abnormally high rate of injuries, regardless of his job, work, environment, age or length of service.⁶

Very little emphasis was placed on screening candidates for jobs to isolate the so-called accident-prone individual. As seen in Table 12; the largest combined category was "never". Assuming that the results of this study are representative of all industries in the Houston area, the possibility of industries initiating screening processes in the future is doubtful.

⁶Ibid., p. 29.

Table 12

Coordination of Departments in the Inspection of New
Equipment and Screening Candidates for Jobs
to Isolate Accident-Prone Situations

	Companies over 1000 Employees					
	Safe Practices Used				Program in the Future	
	Extensively	Moderately	Seldom	Never	Yes	No
Inspect new equipment for mechanical or electrical hazards Coordination of traffic and other departments Screen candidates for jobs to isolate the so-called accident-prone individual	57.0%	23.8%	14.2%	0.0%	23.8%	0.0%
	23.8%	28.2%	19.0%	4.7%	9.5%	4.7%
	28.2%	0.0%	23.8%	42.8%	9.5%	14.2%
	Companies under 1000 Employees					
Inspect new equipment for mechanical or electrical hazards	68.7%	25.0%	6.3%	0.0%	18.7%	6.3%

Table 12 (continued)

Coordination of Departments in the Inspection of New
Equipment and Screening Candidates for Jobs
to Isolate Accident-Prone Situations

	Companies under 1000 Employees				
	Safe Practices Used				Program in the Future
	Extensively	Moderately	Seldom	Never	
Coordination of traffic and other departments Screen candidates for jobs to isolate the so-called accident- prone individual	31.2%	25.0%	25.0%	12.5%	18.7%
	31.2%	25.0%	6.3%	25.0%	18.7%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins of Greater Houston, Texas
area industries, March 4, 1971 - April 4, 1971.

Chapter V

VOCATIONAL HYGIENE

A vocational hygiene program in the modern sense is an all inclusive health maintenance program patterned to check, test or verify by evidence or experiments the industrial environment and the workmen. The purpose of this chapter is to present data concerning industries' practices in providing a healthful and convenient place to work for its employees through an active vocational hygiene program. The implementation of such programs prove advantageous to labor and management. It is generally agreed that the healthy and happy worker will tend to produce both better and faster than will the worker who suffers from physical illness or unhappiness with his work. Management can realize the importance of better general health through production of goods with minimum expenditure of time and energy.

The data in the study seem to indicate the use of some form of "on-the-job medical aid" by over eighty-eight percent of all participating industries. As seen in Table 13, over ninety percent of these industries employing over 1000 employees indicated "extensive" and "moderate" application. Likewise, over seventy-five percent of the industries

Table 13

On-the-Job Medical Assistance in Industry Today

Companies over 1000 Employees	Safe Practices Used			Program in the Future	
	Extensively	Moderately	Seldom	Never	Yes No
On-the-job medical aid	71.5%	19.0%	0.0%	0.0%	19.0% 0.0%
Companies under 1000 Employees	Extensively	Moderately	Seldom	Never	Yes No
On-the-job medical aid	75.0%	12.5%	6.3%	0.0%	25.0% 0.0%

Source: Questionnaire Survey of the Houston, Texas industries conducted by Ronnie E. Wilkins, March 4, 1971 - April 4, 1971.

employing 399-999 employees utilized on-the-job medical aid "extensively". The susceptibility and mere exposure of individuals in industry to harmful or toxic substances deems an effective and well-informed vocational hygiene program necessary. The National Safety Council reports:

Occupational diseases are usually defined for compensation purposes, and also for general discussions as diseases arising out of and in the course of employment.¹

Occupational disease, unlike the traditional-accident-injury cycle may not exhibit the suddenness between the unsafe act or condition and a personal injury. Occupational disease is not so apparent nor does it immediately follow the exposure to the harmful substance.

Occupational health hazards must be very carefully evaluated, for they have a very insidious effect and are the factors which most frequently cause aggravation of a disability.²

Industry is making unbelievable progress in creating and developing new products. Consequently new methods are introduced which require appropriate control methods.

Progress is so rapid that at any given time no list of diseases caused by or incidental to industrial occupations or processes can be considered complete.³

Table 14 is an indicator of the scope of the occupational disease problem. The data in the study consign extensive

¹National Safety Council, Accident Prevention Manual for Industrial Operations (3d ed.; Chicago: National Safety Council, 1955), 33-38.

²Ibid., 39-1.

³H. W. Heinrich, Industrial Accident Prevention (2d ed.; New York: McGraw-Hill Book Company, Inc., 1941), p. 291.

Table 14

Occupational Diseases in Industry

Substance or source of occupational disease	Occupational disease associated	Typical industrial operations or uses
Acids (sulphuric, hydrochloric or hydrofluoric)	Poisoning or dermatitis	Acid manufacturing, chemical processing
Air (compressed)	Caisson disease	Tunneling
Alkaline compounds (lime, cement, caustics)	Dermatitis	Caustic manufacturing lime burning, cement
Anthrax	Anthrax	Handling of hides, wool, hair or bristles
Arsenic	Skin irritation, ulcers	Insecticide manufacture
Asbestos	Asbestos	Asbestos mining and milling, manufacture of asbestos products
Bacterium Mallei	Glanders	Care and handling of animals
Benzenes and certain derivatives	Benzol poisoning	Manufacture and use of solvents
Carbon bisulphide	Acute and chronic poisoning	Rayon industry, rubber, insecticides
Chromium	Chrome sores, ulcers	Electroplating, paint manufacturing, tanning

Table 14 (continued)
Occupational Diseases in Industry

Substance or source occupational disease	Occupational disease associated	Typical industrial operations or uses
Formaldehyde	Respiratory irritation	Plastic and disinfectant manufacturing
Halogenated hydrocarbons	Skin irritations, liver disorders	Metal degreasing, dry cleaning, refrigerants
Hydrogen sulphide	Respiratory irritation conjunctivitis	Rayon industry, metallurgy sewers
Lead	Lead poisoning	Handling and use of lead compounds, storage- battery and paint manu- facturing, mining and smelting of lead
Light (glare)	Cataract, eye affections	Manufacture of glass
Manganese	Liver ailments, nervous especially optic nerve	Anti-freeze solutions, varnish making, solvents
Nickel carbonyl	Irritation and edema of lungs, dermatitis	Anti-knock in motor fuel, metallic nickel
Nitrous fumes	Respiratory irritation and edema	Manufacture of nitrates, welding, nitric acid

Table 14 (continued)

Occupational Diseases in Industry

Substance or source of occupational disease	Occupational disease associated	Typical industrial operations or uses
Petroleum derivatives	Eye affections, dermatitis, respiratory disorders	Manufacture of nitrates solvents, dry cleaners, paints and varnishes
Phenols	Skin irritation	Manufacture and use of disinfectants and preservatives
Phosphorus	"Phossy jaw" or other bone deterioration	Manufacture of phosphorus and phosphoric acid
Pitch	Cancer or ulcer of skin, liver or eye	Roofing, waterproofing
Radium (or X-rays)	Radium poisoning, tumors	Manufacture of luminous paints, dials, radio-therapy
Silica	Silicosis	Granite, quarrying, foundaries, ore milling
Zinc	Zinc shakes	Zinc smelting, brass

Source: H. W. Heinrich, Industrial Accident Prevention 2d ed.; New York: McGraw-Hill Book Company, Inc., 1941, p. 195.

importance to informing employees of job related occupational diseases. The data in Table 15 show over seventy percent of the larger industries provide their employees with information regarding the vocational hygiene program. Respondents from smaller industries suggest over sixty-eight percent "extensive" and "moderate" utilization of the practice.

The basic reasons for noise control are similar to those innate to other occupational diseases. First, it may have a significant effect on production, reducing quality and quantity. Secondly, it may have adverse effects on the health of employees.

In recent years, with the advent and increased utilization of power and high speed equipment, noise levels have been proportionately affected. Management's concern was activated when consideration of possible financial responsibility for occupational deafness was to be determined. Several state workmen's compensation courts have accepted the assumption that exposure to high noise levels can damage the hearing of some people. Employees in one large company in New Jersey filed compensation claims totaling more than 5 million dollars and hearing loss claims have increased throughout the United States. Although there is little doubt that the employer holds financial responsibility for occupational deafness, there seem to be several important questions that demand prompt and fair answers. A few of these questions would include: How much noise is needed to produce occupational

Table 15

Communication with Employees in Regard to Job
Related Occupational Diseases

Companies Over 1000 Employees	Safe Practices Used				Program in the Future	
	Extensively	Moderately	Seldom	Never	Yes	No
Informing employees of job related occupa- diseases An industrial noise program Communication with industrial and State Board and Health Commissions	47.6%	23.8%	14.2%	9.5%	19.0%	9.5%
	57.0%	19.0%	9.5%	9.5%	14.2%	9.5%
	23.8%	33.1%	38.0%	4.7%	9.5%	9.5%
Companies Under 1000 Employees	Safe Practices Used				Program in the Future	
	Extensively	Moderately	Seldom	Never	Yes	No
Informing employees of job related occupa- tional diseases	43.7%	25.0%	6.3%	18.7%	12.5%	18.7%

Table 15 (continued)

Communication with Employees in Regard to Job
Related Occupational Diseases

Companies Under 1000 Employees	Safe Practices Used				Program in the Future	
	Extensively	Moderately	Seldom	Never	Yes	No
An industrial noise program	43.7%	12.5%	6.3%	31.2%	31.2%	12.5%
Communication with industrial and State Board of Health Commissions	25.0%	18.7%	37.4%	12.5%	18.7%	12.5%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins of Greater Houston, Texas
area industries, March 4, 1971 - April 4, 1971.

deafness? If the worker experiences no wage loss, should compensation still be paid? What degree of deafness can be attributed to old age? What determines the permanency of a hearing loss?

Once questions, such as these, designed to give specific numerical and judgmental data have been answered, then the backlog of claims and future hearings can be more rapidly adjudicated.

A comparison of industries advocating an industrial noise program may be seen in Table 15. A large majority of respondents from larger industries indicated use of a noise program. Almost one third (31.2%) of the smaller industries indicated the use of a noise program in future operations.

The safety engineer, by virtue of his position, must have a good working knowledge of state and territorial agencies which govern health and safety laws. Through association with proper agencies, divisions and boards within state labor departments, the safety engineer is equipped to direct inquiries, when discrepancies exist, to the proper channels.

The practice of using and maintaining communication with the industrial commission and State Board of Health by the industries in the study showed a combined frequency of slightly over fifty percent. As seen in Table 15, 18.7 percent of the smaller industries indicated a program in the future designed to increase the communication.

Reports showing safety performance and accident trends play an important role in the prevention of accidents. Although the individual accident investigation report is the basis for determining trends and form the crux of reports, confirmation of such as to future hazards and record of past experience depends on reproducible evidence of regular reports.⁴

As seen in Table 16, industries from both classifications report extensive interest in regular reports. Larger industries uniquely record 100 percent usage ("extensively" and "moderately") while smaller firms report over eighty-one percent utilization in the same category.

Closely related to and possibly a part of a successful general and specific educational program is the utilization of praise for outstanding safety practices. The praise may be in the form of verbal recognition, written commendations, or as was used in the study, buttons and awards. A comparison of industries designing safety programs by giving awards for exceptional safety practices into their safety programs can be seen in Table 16. Only fifty percent of the industries employing less than 1000 people showed "extensive" to "moderate" interest in recognition of safety practices through awards while fifty-seven percent of industries employing over 1000 used this system.

⁴Appendix D, Accident Rate in Industry on a Monthly Basis.

Table 16

In-Plant Safety Program

Companies Over 1000 Employees	Safe Practices Used				Program in the Future	
	Extensively	Moderately	Seldom	Never	Yes	No
Regular reports showing safety performance and accident trends Buttons and awards for exceptional safety practices	76.2%	23.8%	0.0%	0.0%	28.2%	0.0%
	19.0%	38.0%	14.2%	23.8%	23.8%	14.2%
Companies Under 1000 Employees	Extensively	Moderately	Seldom	Never	Yes	No
	62.5%	18.7%	12.5%	0.0%	18.7%	6.3%
Regular reports showing safety performance and accident trends Buttons and awards for exceptional safety practices	0.0%	50.0%	25.0%	18.7%	18.7%	6.3%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins of Greater Houston, Texas
area industries, March 4, 1971 - April 4, 1971.

In industry, the access of employees to stretchers and first-aid materials is nothing more than a common-sense principle. First-aid may be defined as:

The treatment of minor ills or injuries and the emergency treatment of major injuries pending the arrival of a physician. First-aid also involves administration of care and treatment in emergencies and sudden illness.⁵

Although medical services seem to be a humanitarian prerequisite to all forms of industry, qualified professional services are sometimes impractical. Many small organizations as well as field operation supervisors believe that on-the-job professional medical personnel is both idealistic and unjustifiable. Of course, in such cases, the preferred arrangement is a complete first-aid kit and an individual on-the-job trained in both kinds (emergency and common, which includes small cuts, scratches, etc.) of first-aid treatment.

Industrial provision of access to stretchers and first-aid varies. Table 17 indicates the interest of Houston area firms in emergency treatment. A major portion of respondents from both groups indicated extensive use. The data would seem to indicate that all concerned in business demand a high priority on fellow employee health and well being.

The practice of using fans, blowers and hoods for ventilation is shown in Table 17. A look at this table reveals that a large majority of both groups employ fans and blowers

⁵Daniel Caplin and S. G. Ocean, Vocational Hygiene and Safety (rev. ed.; New York: Globe Book Company), p. 55.

Table 17

The Interest of Houston Area Firms in Emergency Medical Treatment

Companies Over 1000 Employees	Safe Practices Used				Program in the Future	
	Extensively	Moderately	Seldom	Never	Yes	No
Provide access to stretchers and first-aid	95.3%	0.0%	0.0%	0.0%	23.8%	0.0%
Fans, blowers and hoods for ventilation	85.7%	9.5%	0.0%	4.7%	23.8%	0.0%
Companies Under 1000 Employees	Extensively	Moderately	Seldom	Never	Yes	No
Provide access to stretchers and first-aid	75.0%	0.0%	12.5%	0.0%	25.0%	0.0%
Fans, blowers, and hoods for ventilation	81.3%	12.5%	0.0%	0.0%	25.0%	0.0%

Source: Questionnaire Survey conducted by Ronnie E. Wilkins of Greater Houston, Texas
area industries, March 4, 1971 - April 4, 1971.

"extensively". One-fourth of the industries employing 399-1000 intend to adopt a program of better ventilation, in the future, and likewise, 23.8 percent of the larger firms plan to initiate a program in the future.

Chapter VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to compare and ascertain to what degree safety education and practices are employed by selected industries in the Greater Houston area.

Through this research, an attempt was made to assess the need of a more intensive safety program. Also, through the use of a questionnaire, a basis was developed through which vital safety components were measured. These components included:

1. Training and education
2. Inspection
3. Safety engineering
4. Vocational hygiene

Sixty questionnaires were mailed to a representative number of Houston area industries, primarily in the fields of refinery, manufacturing and construction. Out of sixty questionnaires, forty-one responses were received from which the data was synthesized and tabulated.

Conclusions

insofar as the facts obtained and the opinions

expressed are accurate and representative of the total industrial population concerned the following conclusions may be drawn as of the time this study was made:

Respondents from a large majority of the industries did not answer the "Program in the Future" column indicating few, if any, plan to initiate any viable safety practices in the future. It would appear to this writer that, in some industries, there may be unenthusiastic and non-interested safety attitudes prevalent in management.

Items which appeared overall and through comments to be almost insignificant in an effective safety program were items such as: publish a safety magazine; conduct employee opinion surveys and coordinate public relations releases on safety. In this writer's opinion items such as these are "the coming thing!" The individual worker's personality is formed and shaped by everything and everyone in his environment. The worker carries this personality with him into the shop, the refinery or wherever his occupation demands. Consequently, if industry desires a complete safety-oriented individual, the aforementioned tactics must be applied. Items of this nature would reach into the employee's home. They would influence his family, thereby exposing them to "safe living" attitudes.

Another aspect of great importance was the response of industry to the question, "In your opinion, are State Safety Requirements governing your company too rigid?" (See Appendix E) Over eighty-five percent answered "No." This finding

indicates a vast possibility of improvement in all areas of industrial safety.

In reading the comments of safety directors, safety supervisors, and safety engineers, it was found that most were very well informed as to the problems of safety and procedures applicable to alleviating unsafe conditions or practices. However, the sincere desire to maintain safe operations by many personnel in the small industries seemed unduly threatened. This situation of course was not prevalent in the larger industries who maintained a complete staff of well-trained safety specialists.

Recommendations

In this writer's opinion, the major emphasis at this point is to convince the management echelons of the need for increased interest in industrial safety if it seems practical in the smaller industries. Future legislation that is concerned with health and safety can become a cornerstone in alleviating many complex human engineering problems associated with any change.

Also, coming into its own are the psychological aspects involved with worker attitudes, habits and influences thereon. The safety engineer of the future will be forced to deal with the ultra-modern equipment.

Although no mention was made in the study of the Federal Occupational Health and Safety Act, Public Law 91-595,

which becomes a law on April 29, 1971, this writer believes the following comment from a respondent appropriate:

I personally feel this law is the greatest thing ever to happen to the extent that it will make our jobs much easier. Instead of having to persuade, beg and spend time selling supervision on installation and repairs to make equipment safe, we will simply say "management must comply or be in violation of federal law."

Although most industries indicated that state requirements governing their firms were not too rigid--most companies, through the survey, displayed adequate safety indoctrination and utilization of safe practices accordingly.

In order to stay abreast of improvements and technical developments in all phases of safety, it is recommended that publication of the National Safety Council, the American Society of Safety Engineers, and other safety organizations be utilized to the fullest extent by industrial management.

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APPENDIXES

APPENDIX A

LETTER

March 4, 1971

Attention: Safety Department

Dear Sir: .

You are undoubtedly aware that in industry, safety is good business. Industrial accidents are responsible for over 8,000 deaths annually. Not only do industrial accidents account for remorse on the part of the families concerned, but they place a tremendous burden on the employer through direct and indirect costs as a result of accidents.

I am making a study to ascertain current practices concerning industrial safety. The results of this survey will be used initially for a master's thesis at Sam Houston State University in Huntsville, Texas.

The enclosed questionnaire will be used as a basis for developing statistical and informational data in the study. The information obtained through this survey will be held in strict confidence and no company or individual will be identified.

Will you please take a few minutes of your time to answer the questions on the enclosed information form? Your response will provide a valuable contribution to the study. An enclosed envelope is provided for return of the form. An early reply from you will enable the study to proceed without delay and will be greatly appreciated.

Thank you for your cooperation.

Sincerely,

Ronnie E. Wilkins

Approved by: Dr. Stephen Randel
Chairman, Industrial Arts Department
Sam Houston State University
Huntsville, Texas 77340

APPENDIX B

QUESTIONNAIRE SURVEY

Appendix B

Information Form for Companies Concerning
Current Practices and Trends of Industrial Safety in
the Greater Houston Area

General Information

Name of Company	Date
Primary Industry	(Refinery, Machine Mfg., Construction, Etc.)
Approximate Number of Employees	

Directions: Indicate by checking () under Column I below the extent to which you are using the following safe practices. In Column II, indicate if you plan to initiate any type of program pertaining to the question.

Key: E - Extensively
M - Moderately
S - Seldom
N - Never

PART I - TRAINING AND EDUCATION:

		COLUMN I				COLUMN II	
		Safe Practices Used				Program In Future	
		E	M	S	N	YES	NO
1.	The safety committee.....	()	()	()	()	()	()
2.	Safety training program.....	()	()	()	()	()	()
3.	Safety training program..... (for workers)	()	()	()	()	()	()
4.	Bulletins, fliers, or posters.....	()	()	()	()	()	()
5.	Fire Drills.....	()	()	()	()	()	()
6.	Instruction of fire fighting techniques.....	()	()	()	()	()	()
7.	Slide film or movies.....	()	()	()	()	()	()
8.	Safety contests.....	()	()	()	()	()	()
9.	Protective clothing and equipment.....	()	()	()	()	()	()
10.	Publish a safety magazine.....	()	()	()	()	()	()
11.	Conduct employee opinion surveys.....	()	()	()	()	()	()
12.	Coordinate public relations releases on safety.....	()	()	()	()	()	()
13.	Develop and use safety training manuals. . .	()	()	()	()	()	()
14.	Teach job safety on an individual basis.....	()	()	()	()	()	()

PART II - INSPECTION:

1.	Personal and supervising inspections.....	()	()	()	()	()	()
2.	Submitted reports on status of safety..... (Daily, weekly, or monthly)	()	()	()	()	()	()
3.	A checklist of unsafe practices.....	()	()	()	()	()	()

PART II - INSPECTION:

	COLUMN I			COLUMN II		
	Safe Practices Used			Program In Future		
	E	M	S	N	YES	NO

To what extent do you utilize:

4. A regular maintenance schedule on equipment.....
5. Investigation of serious accidents.....
6. Use of illumination survey forms.....
7. Test protective equipment.....
8. Follow-up studies of serious accidents.....

PART III - SAFETY ENGINEERING:

	E	M	S	N	YES	NO
--	---	---	---	---	-----	----

1. Departmental safety records.....	()	()	()	()	()	()
2. Safety meetings.....	()	()	()	()	()	()
3. Help or advice from State Labor Depts.....	()	()	()	()	()	()
4. Help or advice from insurance companies.....	()	()	()	()	()	()
5. Suggestion boxes.....	()	()	()	()	()	()
6. Correlate safety programs and measures with Union representatives and workers.....	()	()	()	()	()	()
7. Coordination of Safety & Purchasing Depts.....	()	()	()	()	()	()
8. Coordination of Product & Plant Engineer- ing on safety designs.....	()	()	()	()	()	()
9. Analyze safety standards of other companies...	()	()	()	()	()	()
10. Inspect new equipment for mechanical or electrical hazards.....	()	()	()	()	()	()
11. Coordination of Traffic and other depts.....	()	()	()	()	()	()
12. Screen candidates for jobs to isolate the so-called accident-prone individual.....	()	()	()	()	()	()

PART IV - VOCATIONAL HYGIENE:

	COLUMN I				COLUMN II	
	Safe Practices Used				Program In Future	
	E	M	S	N	YES	NO
1. On-the-job medical aid.....	()	()	()	()	()	()
2. Informing employees of job related occupational diseases.....	()	()	()	()	()	()
3. An industrial noise program.....	()	()	()	()	()	()
4. Communication with industrial commission and State Board of Health.....	()	()	()	()	()	()
5. Regular reports showing safety performance and accident trends.....	()	()	()	()	()	()
6. Buttons and awards for exceptional safety practices.....	()	()	()	()	()	()
7. Provide access to stretchers & first-aid....	()	()	()	()	()	()
8. Fans, blowers, and hoods for ventilation....	()	()	()	()	()	()

PART V:

In your opinion, are state safety requirements governing your company too rigid? Yes ()
No ()

Comment: _____

Appendix (continued)

PART V:

In your company, do males () or females () have more accidents?

Comment: _____

During what month(s) is your accident rate highest?

_____, _____, _____, _____, _____, _____,

Comment: _____

During what month(s) is your accident rate lowest?

_____, _____, _____, _____, _____, _____,

Comment: _____

Any comments you might have concerning a specific question or questions on this form are welcomed.

Question Number

Comment

Return to: Mr. Ronnie E. Wilkins
8110 Findlay
Houston, Texas 77017

APPENDIX C

DESCRIPTION OF PARTICIPATING COMPANIES

Appendix C
Description of Participating Companies

Company	Classification
American Can Company	Manufacturer Metal Containers
Atlantic Richfield Company	Petroleum
Arco Chemical Company	Petro-chemical Manufacturer
Armco Steel Corporation	Steel
W. S. Bellow Construction Corp.	Industrial Construction
Big Three Industries, Inc.	Oil and Gas Manufacturer Industrial Machinery
Brown & Root, Inc.	Construction and Engineering
Cameron Iron Works	Manufacturer Oil Tool Products
Chevron Oil, Texas Gulf Coast Division	Petroleum
Continental Can Company, Inc.	Manufacturer Metal Containers
Continental Oil Company	Manufacturer Petroleum Products
Crown Central Petroleum Corp.	Refinery
Dow Chemical Company	Chemical
E. I. duPont de Nemours	Chemical
Ethyl Corporation	Petroleum
Fluor Corp., Ltd.	Engineering
General Electric Co.	Aerospace support to M.S.C.

Appendix C (continued)

Description of Participating Companies

Getty Oil Company	Petroleum
Goodyear Tire & Rubber Company	Manufacturer of Synthetic Rubber
Gulf Oil Corporation	Petroleum
Houston Belt & Terminal Railway Co.	Railroad Transportation
Houston Lighting & Power Co.	Electric Power
Houston Natural Gas Corp.	Natural Gas Products
Hughes Tool Company	Metal Fabricators - Oil Tools
Humble Oil & Refining Co.	Petroleum
Ling-Tempo-Vought, Inc.	Construction
Linbeck Construction Corp.	Construction
Lockheed Aircraft Corp.	Aerospace
M & J Valve Company	Machine Manufacturing
Walter M. Mischer Company	Construction
Monsanto Co., Hydrocarbon & Polymers Division	Petrochemical Manufacturer
Mosher Steel Company	Fabrication
Peden Iron & Steel	Manufacturer Steel Products
Petro-Tex Chemical Corp.	Chemical
Philco-Ford Corporation	Aerospace
Phillips Petroleum Co.	Petroleum
Rohm & Haas Company	Chemical Manufacturer
Shell Chemical Company	Chemical Manufacturer

Appendix C (continued)

Description of Participating Companies

Shell Oil Company	Petroleum
S.I.P., Inc.	Engineering & Construction
Signal Oil & Gas Company	Refinery
Southland Paper Mills, Inc.	Paper Products
Southwestern Bell Telephone Company	Communication
Stran-Steel Corporation	Industrial Products
Tenneco, Inc.	Petroleum
Texaco, Inc.	Petroleum Integrated
Todd Shipyards Corporation	Ship Building
Texas Electric Steel Casting Company	Machinery
U. S. Steel Corporation	Steel
United Gas Corp.	Gas Products
Union Carbide Corporation	Chemical
W-K-M Valve, Div. of ACF Industries, Inc.	Machine Shop and Iron and Steel Foundry
E. N. Wolcott	Design and Construction of Process Plants

Source: Respondents in Questionnaire Survey conducted by
Ronnie E. Wilkins, March 4, 1971 - April 4, 1971.

APPENDIX D

ACCIDENT RATE IN INDUSTRY

Appendix D
Accident Rate in Industry

Companies with over 1000 Employees		
Accident Rate Highest		Accident Rate Lowest
14.2%	January	33.1%
4.7%	February	33.1%
4.7%	March	33.1%
0.0%	April	14.2%
14.2%	May	4.7%
23.8%	June	4.7%
38.0%	July	4.7%
47.6%	August	0.0%
28.0%	September	9.5%
19.0%	October	14.2%
14.2%	November	19.0%
9.5%	December	38.0%

Companies with under 1000 Employees		
6.3%	January	31.2%
0.0%	February	31.2%
18.7%	March	18.7%
18.7%	April	6.3%
25.0%	May	18.7%
50.0%	June	12.5%

Appendix D (continued)
Accident Rate in Industry

Companies with under 1000 Employees			
Accident Rate Highest		Accident Rate Lowest	
43.7%	July	12.5%	
37.4%	August	12.5%	
12.5%	September	18.7%	
25.0%	October	12.5%	
6.3%	November	25.0%	
18.7%	December	31.2%	

Source: Respondents Statistics according to the Questionnaire Survey mailed to Houston, Texas area industries.

APPENDIX E

STATE SAFETY REQUIREMENTS

Appendix E

Industries Concensus as to State
Safety Requirements

Companies Over 1000 Employees

81.5%	Indicated State safety requirements governing their industry were not too rigid
9.5%	Indicated State safety requirements governing their industry were too rigid

Companies Under 1000 Employees

81.3%	Indicated State safety requirements governing their industry were not too rigid
12.5%	Indicated State safety requirements governing their industry were too rigid

Source: Tabulated results of responses from questionnaire survey conducted by Ronnie E. Wilkins, March 4, 1971 to April 4, 1971.