CHAPTER 1

INTRODUCTION

Section 1.1 describes the development of safety management in industries.
Section 1.2 discusses safety management in Indian industries. A brief description on methods of measuring safety management is presented in Section 1.3. Section 1.4 contains the research issues followed by research objectives in Section 1.5. Research methodology adopted for this study is presented in Section 1.6. Section 1.7 describes the organization of the thesis.

1.1 DEVELOPMENT OF SAFETY MANAGEMENT

The Industrial Revolution that took place in the eighteenth century changed forever the methods of producing goods. The most important change was the substitution of machines for people. This resulted in organization of work into large units called “factories”, followed by direct supervision of the manufacturing process and efficient division of work among the labor. As the industrial revolution continued its rapid growth, unsafe production methods exacted a heavy toll on the workforce in terms of job-related injuries and deaths (Felton, 1986).

In the twentieth century, as technology grew by leaps and bounds, associated hazards also grew with it. This resulted in collective efforts and thinking in the direction of controlling work related hazards and accidents. A group of delegates including safety professionals, management leaders, public officials and insurance specialists who met in a national safety meeting in New York in the year 1913, had a desire to attack the problem of occupational health and safety which most people considered either unimportant or insoluble. This resulted in the birth of a voluntary organization, named “National Safety Council”, which helped to create the safety movement, as we know it today. Later, similar voluntary organizations such as International Labor Organization, British Safety Council etc. came up with support from industries in various parts of the world.
Early legal action in industrial safety took the form of laws to regulate and investigate industry working conditions, death and injury rates. The next phase was largely concerned with workers’ compensation payments. In subsequent years, governments gradually expanded their roles in regulating industry on safety matters.

In 1970, ‘Occupational Safety and Health Act, (OSHA)’ was passed in United States of America as a comprehensive national safety law. Safety took a new direction and meaning as a result of OSHA. Similar steps were followed by other countries, such as United Kingdom (Health and Safety at Work Act, 1974), Australia (Victoria Occupational Health and Safety Act, 1985) etc.

As a result of the above Acts, Safety and health of workers became a major concern and priority of management. In addition to the losses due to downtime, costs for workers’ compensation insurance, medical and administrative expenses resulting from disability, death and impaired productivity, they were liable to face serious monetary penalties and criminal sanctions from the government side, for non-compliance of law. Therefore, safety management became an important part of industrial management.

1.1.1 Safety management in industries

The systematic and planned top management driven activity that aims at controlling the health and safety hazards of its employees is called safety management (Booth and Lee, 1995). The primary aim of safety management is to intervene in the causation process that leads to accidents. This includes above all, the active recognition of both visible and latent hazards. However, safety management is more than just a hazard identification system. It is an overall system for ensuring that safety activities are properly planned, effectively implemented, and that follow up system is arranged. Typically, safety management includes activities such as risk analysis, arrangement of safety training, accident and near-miss investigation, safety promotion and assessment of human reliability. In an effective safety management system, these activities are assigned to all the different hierarchical levels of the organization (Booth and Lee, 1995; Grimaldi and Simmonds, 1975).
1.1.2 Traditional safety management

The form of safety management followed by most of the industries, called as ‘traditional safety management’, has the following characteristics (Smith, 1996; Weinstein, 1996; Hansen, 1993).

- Top/down communication.
- Minimal employee participation.
- Dependence on discipline to influence safety behaviour.
- Centered on technical requirements aiming at short-term results.
- Safety techniques are used after accident and injury.
- Safety programme is not integrated with the rest of the functions of an organization.
- Safety director is responsible for safety programme, but does not have the authority to make changes.

In spite of these efforts to promote health and safety of employees, some major industrial disasters took place between 1970 and 1990 in various parts of the world. Scientific investigations into these accidents by researchers pointed out some major deficiencies in the existing safety management system. Powell and Canter (1985) observed that “more than half of the industrial accidents are attributable to deficiencies in the human and management component than to unforeseeable weaknesses in the technical component”. These findings prompted further studies to improve safety management. After studying more than 200 companies, Dumas (1987) discovered that programmes of quality and programmes of safety have similar components. He concluded, “Safety is a dimension of quality, after everything, the elimination of defects includes the elimination of practices of unsafe work”. According to Minter (1991), “if one looks at safety as a consequence of making things well, then the programme will undoubtedly bear quality”.

1.1.3 Safety integrated with quality

Recognizing the need of ensuring quality in safety management, many companies started to deviate from traditional safety management to embrace a new system approach to
safety management in the 1990s. This method, according to Petersen (1994), with philosophies of quality in conjunction with safety, has the following salient features:

- Safety becomes a system, more than a programme.
- Progress is not measured by injury ratios.
- Statistical techniques drive the efforts of continuous improvement.
- Investigation of accidents and following up corrective actions.
- Technical principles and tools for statistical control of process are used.
- Emphasis is placed on improving the system.
- Benefits are provided for people who discover illegal situations.
- Participation of workers in problem solving and decision-making.
- Ergonomic well-being is projected inside the place of work.
- The traps within the system that cause human errors are eliminated.

Companies in developed countries have been practicing quality integrated safety management since two decades. Different safety management practices are followed voluntarily in those industries to improve health and safety of employees at workplace.

1.2 SAFETY MANAGEMENT IN INDIAN INDUSTRIES

In India, The Factories Act, 1948 (Central Act 63 of 1948) came into force on 1.4.1949 to ensure the healthier and safer work atmosphere for the workers, and for improving the general welfare of workers. The Act sets out the broad outline of the measures for achieving the object of protecting the workers from industrial and occupational hazards and for their welfare. Power is given to state governments to frame rules regarding the details of the measures for various types of factories so that the local conditions prevailing in the State are appropriately reflected in the enforcement.

Government of Kerala has framed various rules such as ‘Kerala Factories Rules, 1957’, ‘Kerala Factories (Welfare Officers) Rules, 1957’, ‘Control of Major Industrial Accident Hazard (Kerala) Rules, 1993’, etc to provide guidelines for the enforcing agencies.

National Safety Council was set up by Ministry of Labor, Govt. of India in 1966, as a non-profit making, non-political voluntary organization to generate, develop and sustain a
voluntary movement at the national level to promote awareness of safety, health and environment so as to supplement and strengthen government efforts in this field. They have local chapters in all states and offer consultancy services to industries in all areas of safety management.

Safety management attained significance in India only after the Bhopal gas tragedy in 1984. Gupta (2002) points out the major causes of this accident as, indifferent attitude of the management towards safety and lack of enforcement of existing regulations by regulatory bodies. Learning lessons from Bhopal disaster, most of the industrial organizations in India have made considerable investments in safety related infrastructure, equipment and training. Enforcement rules and regulations have also been made more stringent with a number of amendments in the Acts and Rules.

Many organizations from chemical/process, manufacturing, engineering and construction industries have gone for management system certifications such as ISO 9001, OHSAS 18001 and ISRS certifications. With globalization and opening up of our economy, Indian organizations from various sectors have started to take initiatives to get the above certifications to compete in the international market. OHSAS 18001 and ISRS are occupational health and safety management based where as ISO 9001 is based on quality management. Since "Safety" is a dimension of "Quality", when any attempt for quality management is made, it also ensures safe work environment for its employees (Carder and Ragan, 2003).

Every Indian organization is supposed to prepare a ‘Safety Manual’ based on ‘The Factories Act, 1948’ and state ‘Factory Rules’ to take care of the health and safety of its employees, covering the various manufacturing activities employed in the company. To what extent these are practised in reality depends on the commitment of the top management of the organization. Committed managements subsequently adopt various safety management practices to safe guard their employees from work related hazards whereas others try to manage safety of employees by encouraging them to work safely. A scientific investigation into this only can reveal what is happening inside the organization so that improvement methods can be suggested.
1.3 MEASURING SAFETY MANAGEMENT IN INDUSTRY

Different safety management practices are adopted in industries by managements in advanced countries to promote health and safety of workers. Not all of them are universally adaptable due to social and cultural factors prevailing in each country. However, levels of these safety management practices need to be assessed especially in high hazard industries. It can be argued that these are predictive measures enabling safety condition monitoring (Flin, 1998), which may reduce the need to wait for system to fail, in order to identify weaknesses and to take remedial actions. This can also be conceptualized as a switch from ‘feedback’ to ‘feed forward’ control (Falburch and Wilpert, 1999). This shift of focus has been driven by the awareness that organizational, managerial and human factors rather than purely technical failures are prime causes of accidents in high reliability industries (Weick et al., 1999).

Safety audit is widely accepted as a method of safety management measurement in industries (Kennedy and Kirwan, 1998). However, safety audits have inherent measurement biases at various levels, as it examines what is documented, but fails to reveal what is truly existing in practice (Mearns et al., 2003; Kirwan, 1998). Survey among the workforce using valid and reliable self-reporting questionnaire is reported to be the most effective method for measuring the level of safety management practices (Flin et al., 2000; Mearns et al., 2003). For a successful organization, these measurements need to have positive relationships with safety outcomes such as accident rate or injury rate.

1.4 RESEARCH ISSUES

Most of the studies in the area of industrial safety have been reported from developed countries. India, being a large country with high population and abundant skilled manpower, is a suitable place for safety related research. Review of literature reveals that there is not enough research evidence from India in the area of industrial safety.

Antecedents of safety performance (safety management practices) must be instrumental in enhancing the level of determinants of safety performance (safety knowledge and safety motivation), which are in turn related to components of safety performance (safety
compliance and safety participation). It appears that this area has not been examined rigorously, especially in India. The way by which these determinants and components of safety performance are related to personal attributes of employees is also worth investigating.

Since more and more organizations are embracing safety specific or other type of quality certification in India, the level of safety management practices and determinants and components of safety performance in those firms and their relationship with safety outcomes become an area of research interest. There is wide scope for safety climate studies in India in various industries to identify the underlying factors and also to verify the claim of Coyle et al. (1995), that safety climate factors are not universally stable but are culture and industry dependent. The diversity in language, literacy level and culture of Indian labour add further scope for such studies.

Another area of research potential is structural equation modelling of safety performance where complex relationships can be modeled and tested which are not possible by other multivariate techniques. There is very little evidence in literature on safety performance model building relating antecedents, determinants and components of safety performance.

1.5 RESEARCH OBJECTIVES

The research objectives considered in the current study are as follows:

- To identify critical safety management practices in industries;
- To develop and validate an instrument to measure critical safety management practices, by an empirical study in chemical/process industry;
- To find out the relationship between safety management practices and accident rates in industries;
- To explore the impact of system certification on safety management practices in industries;
- To identify and validate determinants and components of safety performance;
- To explore the predictive capacity of safety management practices on determinants of safety performance;
• To explore the predictive capacity of determinants of safety performance on components of safety performance;

• To study the impact of accident rates, system certification and personal attributes such as qualification, age, tenure, job category and accident history on determinants and components of safety performance;

• To propose a model for safety performance connecting management practices, determinants of safety performance and components of safety performance;

• To explore the underlying factors in safety climate and its empirical validation;

• To study the impact of accident rates and system certification on safety climate factors;

• To test the validity of safety climate factors obtained in chemical/process industry with engineering and construction industries and to find safety climate factors in engineering and construction industries if necessary.

1.6 RESEARCH METHODOLOGY

The first part of research work presented in this thesis is the development of an instrument for measuring safety management practices, determinants of safety performance and components of safety performance. From review of related literature and safety management theory, and interactions with safety professionals and management experts, six critical safety management practices, two determinants of safety performance and two components of safety performance were identified. Initially, a draft questionnaire containing eighty two items, covering the above dimensions and safety of work environment was prepared. This was subsequently fine tuned to a sixty two item instrument after conducting a preliminary survey and discussions with safety professionals and management experts. Responses to these items were solicited on five point Likert scale from “Strongly disagree” to “Strongly agree”. Ten demographic questions were also included for use in various analyses.

Main part of the survey using this instrument was carried out in eight large major accident hazard chemical/process industrial units in Kerala in the year 2002. Responses were collected from workmen and first line supervisory staff from various departments.
1806 completed questionnaires were received with a response rate of 71%. This data were used for the analysis to achieve the objectives of this research. Finally, the same instrument was used for survey in construction and engineering industries as a part of cross validation. Employees from ten building sites belonging to three construction companies, and two engineering industrial units took part in this survey.

1.7 ORGANIZATION OF THE THESIS

The thesis is presented in eight chapters. The remaining seven chapters are organized as follows:

In Chapter 2, a review of literature on safety climate, safety culture and safety management in different industries is presented. Observations from the literature review and motivation for the present study are also discussed here.

The critical safety management practices in industries are identified and discussed in Chapter 3. This is followed by a discussion on the development of an instrument for measuring the level of safety management practices. Validation of the instrument using the data collected through survey using questionnaire among eight major chemical/process industrial units in Kerala is also presented in this chapter.

The relationship between safety management practices and accident rate in industries is presented in Chapter 4. This is followed by a discussion on system certification in industry and an investigation on the relationship between safety management practices and system certification.

In Chapter 5, the determinants and components of safety performance are identified and validated. This is followed by investigation on the relationship between safety management practices and determinants and components of safety performance. Impact of personal attributes of employees, system certification and accident rate on determinants and components of safety performance is explored here and the findings are reported. Finally, a safety performance model is proposed and the test results are presented at the end of this chapter.
The underlying factors in safety climate are explored and presented in Chapter 6. The predictive validity of safety climate factors and their relationship with accidents and system certification is also investigated and presented here.

Chapter 7 deals with the fit of safety climate model developed for chemical/process industry in construction and engineering industries followed by determination of safety climate factors for the latter two.

A summary of the results and findings of the research are presented in Chapter 8. The limitations of this research work and scope for future research are also presented here along with the conclusions of the researcher.