CHAPTER 2
LITERATURE SURVEY

Section 2.1 explains the concept of safety culture and safety climate. Section 2.2 describes the research works done on safety culture/climate in various industries. Section 2.3 critically examines the literature on safety management. In section 2.4, the gaps in literature are discussed and the motivation and objectives of the present study are explained.

In the past, industry has concentrated its efforts on reducing injuries by focusing on physical conditions such as the guarding of equipment or other factors that exposed employees to energy sources (Heinrich, 1959; Kohn et al., 1996). Industry has also focused on addressing primarily those issues that OSHA and other agencies regulate and are likely to check during an inspection at a facility (Smith, 1979; Weil, 1994).

Exhaustive inquiries into the major disasters of recent years, e.g. the escape of gas at Bhopal, the King’s Cross Underground Station fire, the sinking of the Herald of Free Enterprise, the Clapham Junction rail accident, the Chernobyl nuclear accident, the Piper Alpha oil rig fire etc. came to the same conclusion that, despite the adoption of the full range of engineering and technical safe guards, complex systems broke down calamitously because the people running them failed to do what they were supposed to do (Lee, 1998). On the other hand, in research works on occupational health and safety, the need to recognize the importance of worker behavior was commented on extensively by Margolis (1973), who found that engineering solutions to accidents were in themselves insufficient in the prevention of accidents. Similar observation was made by Saari (1990) also, who suggested that, after a certain point, technology cannot achieve further improvements in safety but organizational and cultural factors become important.

Margolis (1973) stressed that the individual attitudes of employees towards safety were directly related to managerial attitudes towards safety. Beck and Feldman (1983) reached similar conclusions arguing that the implementation of safe work practices is dependent on the expectations of employees. Yet, very little work has been undertaken to
systematically measure expectations and attitudes of workers towards occupational health and safety at various levels of organizations. For that matter, there has been little research aimed at determining whether identifying attitudinal problem areas within an organization will be of any benefit as far as occupational health and safety is concerned. This is where the concepts of safety climate and safety culture come in to picture, as they represent the work environment and underlying perceptions, attitudes, and habitual practices of the workforce at all its various levels (Kennedy and Kirwan, 1998).

2.1 CONCEPT OF SAFETY CULTURE/CLIMATE

The concept of 'safety culture' has largely developed since the OECD Nuclear Agency (1987) observed that the errors and violations of operating procedures occurring prior to the Chernobyl disaster were evidence of a poor safety culture at the plant (Pidgeon and O'Leary, 2000). Safety Culture has been defined as "that assembly of characteristics and attitudes in organizations and individuals, which establishes that, as an overriding priority, plant safety issues receive the attention warranted by their significance" (International Atomic Energy Authority (IAEA), 1986). Safety culture is important because it forms the context within which individual safety attitudes develop and persist and safety behaviors are promoted (Zohar, 1980). Safety culture is a stable and enduring feature of the organization and is a sub-element of the overall organizational culture (Kennedy and Kirwan, 1998).

Safety climate is regarded as a manifestation of safety culture in the behavior and expressed attitude of employees (Cox and Flin, 1998), and is a more tangible expression of the safety culture in the form of symbolic and political aspects of the organization (Kennedy and Kirwan, 1998). Safety climate is best considered a subset of organizational climate. Safety climate factors will characterize and influence the deployment and effectiveness of the safety management resources, policies, practices and procedures. It has been suggested that safety climate surveys are a much better predictor of an organizational safety performance as it overcomes many of the limitations of traditional safety measures such as reporting biases and after-the-fact measurement.
Assessments of safety climate are used as an indicator of overall safety culture in an organization. Culture in general, and safety culture in particular, is often characterized as an enduring aspect of the organization with trait-like properties and not easily changed. Climate, on the other hand, can be conceived as a manifestation of organizational culture (Schein, 1985) exhibiting more state-like properties. The nature of culture and climate and their relationship has also been related to the concepts of personality and mood (Cox and Flin, 1998), where culture represents the more trait-like properties of personality and climate the more state-like properties of mood. For the purpose of this discussion climate is viewed as a temporal manifestation of culture, which is reflected in the shared perceptions of the organization at a discrete point in time (Cox and Cheyne, 1999).

Reviewing 16 studies that proffered definitions of safety climate/culture, Guldenmund (2000) observed that perceptions are more likely to be associated with climate measures, whereas attitudes are considered to be part of culture. However, researches have often failed to make the distinction between these two concepts of safety management and these terms are often used interchangeably. Hence literatures on both safety climate and safety culture are discussed in this section.

One way to make the safety culture more visible is through the use of employee perception surveys, which have been valuable tools for detecting differences in employee attitudes concerning several management practices. Ojanen et al. (1988) suggested that safety performance should be measured on multiple levels, one of them being safety attitudes, in order to determine the real safety level of an organization. They claimed that measuring safety climate can indicate changes in organizational safety behavior and would therefore be useful for evaluating safety programs and suggested that safety climate questionnaire is the only way to measure safety climate in an organization.

### 2.2 RESEARCH ON SAFETY CULTURE/CLIMATE

In the early 1950s, aspects of psychological climate were found to relate to accident causation in an automotive plant (Keenan et al., 1951). The researchers argued that inter-departmental differences in accident rate might be attributable to differences in psychological climate. The dynamics of group processes have also been considered, and
found to influence attitudes towards safety (Lewin, 1958; Likert, 1967). Additionally, a series of Japanese studies over the last 30 years has related the importance of group decision-making to safety and accident reduction in a variety of organizations ranging from a bus company to a shipyard (Misumi, 1989). Brian (1988) placed considerable emphasis on the ways in which attention to attitudinal factors has lead to improvements in the safety performance of a number of US chemical companies; reductions in lost-time injuries were found to be directly attributable to the positive management of safety.

Green (1980) had demonstrated how attitudes towards accidents are influenced by previous experience. He found that frequency of accidents and knowledge of the ways in which accidents happen contribute to the attitude towards them, and may also be instrumental in affecting attitude change. Recognition of potential hazard derives from a safety climate where members of the organization are responsive to safety implementations. A study of 24 US nuclear power plants showed that attitudes, which facilitate pro-active safety interventions, relate not only to improved safety performance but also to higher productivity (Marcus, 1988). Plants in which all employees share attitudes towards safety which permit them to retain control and responsibility for accident prevention have a good safety record and three times fewer human error events than plants in which employees do not share such attitudes.

One of the clearest demonstrations of the relationship between safety attitudes/climate and accident rates was demonstrated in a study carried out at British Steel (Canter and Olearnik, 1989). In this study, all accidents and lost-time accidents at 16 plants of one British Steel site were correlated with attitudes towards various aspects of safety, as measured by a safety attitude question set. Answers to the safety attitude questions were found to predict the level of accidents in any given plant. This showed not only the close links between accidents and attitudes, but also demonstrated the possibility of producing reliable measurement instruments.

Following the work in British Steel, Donald and Canter (1993) attempted to identify the basic constituents of safety attitude using a short question set, and to develop scales from them to demonstrate their relationship to safety performance, in chemical industry. This study revealed 3 facets of safety attitude: people or the organizational roles which make
up the safety climate, attitude behavior or aspects of an individual’s safety behavior and safety activity or type of safety behavior. The scale was found to have good reliability (above 0.8). The results demonstrated that all the scales except ‘safety representatives scale’ are negatively correlated to self-reported accident rate at ‘p < 0.05’ significance level.

In another study, Bailey (1989) used Minnesota Safety Perception Survey to identify factors that positively contributed to injury reduction within the railroad industry. Both the original study and its extension, which include other industries (Bailey, 1997), showed that in plants that had low injury rates, the employees’ perception of management commitment to safety was highly positive. On the other hand, in plants where injury rates were high, the employees’ perception of management commitment to safety was low and the major focus of management’s safety efforts was on compliance of rules and procedures with limited employee involvement practices. Employees’ perception of management’s commitment to safety, of fellow employees’ participation in safety, and of the effectiveness of education and training on the part of the management have demonstrated a positive impact on safety outcomes (Bailey, 1997).

Simonds and Shafafi-Sahrai (1977) analyzed the relationship between injury frequency rates and factors thought to influence injury rates, such as management involvement in the safety effort, workforce characteristics, and physical conditions. They gathered data on the management system of companies, some with high injury rates and others with low injury rates. In studying these matched pairs of companies, the researchers found that in companies where top management is involved in safety, there were lower injury frequency rates.

In a similar study, Cohen (1977) examined critical determinants of a successful industrial safety program and found that, in firms that experienced low injury rates, certain common factors were present. These factors were, strong management commitment to safety as reflected by management’s knowledge of the problems, their convictions that high safety standards were attainable and their demonstrated work toward those ends. In addition, Cohen identified extensive formal and informal contacts between workers and management on safety issues and well-established safety training process as factors
contributing to low accident rates. In a follow-up study, Smith et al. (1978) found that
management’s commitment to the safety process was an important factor at low injury
rate plants.

In another research, Schneider (1975) studied organizational climates and found that
workers formed different “climate” perceptions of their environment. Further research
into this area by Payne et al. (1976) suggested that organizational climate would be better
used to describe the attitudes and performance of individuals and measuring
organizational climate provides a useful tool for managing/changing behavior of
employees and organizations.

Zohar (1980) developed the first measure, based on an Israeli sample in 1980 using a 40-
item questionnaire covering metal fabrication, chemical, textile and food processing
industries. After factor analysis, his final model included 8 dimensions with workers’
perceptions of: the importance of safety training, management attitude towards safety,
effects of safe conduct on promotion, level of risk at workplace, effects of work pace on
safety, status of safety officer, effects of safe conduct on social status and status of safety
committee. Analysis of the data in this study supported both hypotheses, namely: (a)
Safety climate can be regarded as a characteristic of industrial organizations, and (b)
safety climate is related to the general safety level in these organizations.

Brown and Holmes (1986) tried to replicate this factor structure in an American sample
using confirmatory factor analysis and found that it is not supported. They arrived at a
new set of 3 factors: employees’ perceptions of management concern about their well-
being, management activity in responding to problems with their well being and their
own physical risk. Dedobbeleer and Beland (1991) tested this 3 factor model in
construction workers in Canada and found that it was supported by their data, but a 2
factor solution was found superior. The 2 factors were interpreted to be management
commitment to safety and workers’ involvement in safety.

Glennon (1982) developed a questionnaire on an Australian workforce and found nine
climate dimensions, slightly expanding on Zohar’s original eight dimensions. He found
that determination of an organization’s safety climate was dependent on a number of
complex issues and there could never be any absolute external standards, as indicated by Zohar (1980). Seppala (1992) studied the safety climate in Finnish plywood industry, shipyards, factory and building construction industries and indicated that the safety climate was dependent on 4 factors: organizational responsibility, workers' concern about safety, workers' indifference with regard to safety and the level of safety precautions in the company. Cox and Cox (1991) studied the employees' attitude in organizations, which manufactured industrial gas across Europe. Factor analysis of the data collected suggested 5 factors: personal skepticism, individual responsibility, the safeness of work environment, the effectiveness of arrangements for safety and personal immunity. In both cases, the scales were found to be reliable and valid.

The study of Niskanen (1994) on road construction workers in Finland found two separate 4 factor solutions for workmen and for supervisors from factor analysis. For workmen the factors obtained were: attitude towards safety in organization, changes in the work demands, safety as part of productive work and appreciation of the work. For supervisors, the first 3 factors remained the same and the fourth was value of work. Neither the reliability nor the validity of the questionnaire was tested in this study and hence this is considered as an exploratory one only.

Coyle et al. (1995) in their study on two different health care and social service organizations revealed two different factor sets and claimed that safety climate factors are not stable across organizations. Only factor analysis was attempted in this study and no statistical tests were conducted for examine reliability or relationship with safety performance.

Williamson et al. (1997) studied the safety climate in a wide variety of types of jobs in Australia by measuring attitudes, perceptions and awareness of safety and revealed 5 factors: personal motivation for safe behavior, positive safety practice, fatalism, risk justification and optimism. Validity of the factor structure of the scale was examined using responses to two of the additional questions in the original item pool. Even though reliability was not assessed and validation was insufficient, items covering both
attitudinal and employees’ perceptions of workplace characteristics resulted in a broader factor structure compared with those identified in a number of studies (e.g. Zohar, 1980; Brown and Holmes, 1986; Dedobbeleer and Beland, 1991).

Diaz and Cabrera (1997) conducted a survey in three airport companies in Spain using an instrument designed from previous studies and obtained six factors on exploratory factor analysis (Company policies towards safety, Emphasis on productivity versus safety, Group attitudes towards safety, Specific strategies of prevention, Safety level perceived in the airport and Safety level perceived on the job). The reliability of the instrument was found high and the factors together explained 61% of the total variance. Analysis revealed significant differences in the safety level in the companies and was found to discriminate between high and low accident rate organizations. Various analysis were also conducted to determine the possible relationships between the independent variables such as, hierarchical position, education level, time in the company, age and whether working on a ramp or not.

Varonen and Mattila (2000) studied the structure of safety climate in wood processing industries in Finland and found that organizational responsibility, workers’ safety attitudes, safety supervision and company safety precautions accounted for 40% of the total variance. The factors were found to be reliable and showed negative correlation with accident rates.

Cox and Cheyne (2000) formulated a safety assessment questionnaire for offshore environment, based on established common themes, comparison with instruments in other industrial sectors, and review of constructs identified in the focus group discussions. This consisted of 47 items covering areas of Management commitment, Communication, Priority of safety, Safety rules and procedures, Supportive environment, Involvement, Personal priorities and need for safety, Personal appreciation of risk and Work environment. Data collected from 350 employees from three offshore installations were subjected to a series of statistical tests including confirmatory factor analysis (CFA), internal-scale consistency and alternate forms reliability tests. Comparative Fit Index (CFI) obtained was 0.85, which is below the acceptable value of 0.9. Measures of internal reliability for each of the factors were found to be good with only “Personal appreciation
of risk” falling below 0.6. Overall, the instrument was found to be reasonably valid and reliable.

Glendon and Litherland (2001) studied the safety climate factor structure among road construction and maintenance workers in Australia. The instrument used was a modified version of “Safety Climate Questionnaire” developed by the same authors in a previous study. Principal component factor analysis yielded the following six factors, which explained 69.3% of the total variance: Communication and support, adequacy of procedures, work pressure, personal protective equipment, relationships and safety rules. Multiple regression analysis with behavioral measures (safety performance) as dependent variable and safety climate factors as independent variables did not show any positive relationship between them. This result contradicted the limited previous research on relationship between safety climate and safety performance (e.g. Zohar, 1980; Glennon, 1982; Lee and Harrison, 2000).

Meams et al. (2003) conducted a safety climate survey on 13 oil and gas installations in United Kingdom using “Offshore Safety Questionnaire-OSQ” developed from previous research (Rundmo, 1994,1997; Meams et al., 1997,1998). The measurement scales used were, Satisfaction with safety activities, Involvement in health and safety, Communication about health and safety, Perceived supervisor competence, Perceived management commitment to safety, Frequency of general unsafe behaviour, Frequency of unsafe behaviour under incentives, Safety policy knowledge, Job satisfaction, Written rules and procedures and Willingness to report accidents. Analysis of data revealed that supervisors provided more favourable scores than other respondents on most of the scales. Differences between installations in their accident rates were reflected in differences in safety climate scores for both accident and non-accident groups. Management commitment emerged as a key predictor of accident proportion in this study.

Carder and Ragan (2003) used modified version of “Minnesota Safety Perception Survey” questionnaire to study over 50 chemical plants in United States of America and obtained a 6 factor model after factor analysis. Interestingly, the factors appeared to be fundamental components (Management demonstration of commitment to safety,
Education and knowledge of the workforce, Effectiveness of the supervisory process, Employee involvement and commitment, Drugs and alcohol and Off-the-job safety). The instrument was found reliable and validation effort was successful. Those sites with higher survey scores were found to have lower accident rates.

Silva et al. (2004) designed an “Organizational Safety Climate Inventory” comprising of four dimensions (shared perceptions about safety values, norms, beliefs, practices and procedures) and 78 items and conducted a survey in 15 Portuguese organizations in different sectors (chemical industry, electricity industry, public administration, and health). Reliability was found to be good (above 0.77) for all scales and confirmatory factor analysis testified that the model fitted well the data. The scale scores correlated well with accident data proving its predictive validity.

2.3 RESEARCH ON SAFETY MANAGEMENT

The typically large number of accidents due to safety management failings (Kawka and Kirchsteiger, 1999; Reason, 1998) justifies the development of audit tools for ensuring effective safety management practices (Hurst et al., 1996; Hudson et al., 1994; Mitchison and Papadakis, 1999). Examination of safety management practices should be considered an adjunct to the assessment of safety climate within an organization. In hazardous environments, such as chemical/process industries, it is essential to audit safety climate as well as safety management practices.

Safety management may be seen as the process whereby “informed decisions are taken to meet accepted safety criteria” and thus, safety management could be regarded as “the management process to achieve a state of freedom from unacceptable risks or harm” (Cox and Tait, 1991). Safety management is carried out via the organization’s safety management system, including various safety management practices, which acts as a system of control over work activities and work methods (Kennedy and Kirwan, 1998). Safety management as an approach is relatively mature, and a number of guidelines on the implementation and operation of effective management systems for health and safety have been issued by regulating governmental agencies in developed countries. These have often been linked to pre-existing standards on quality systems and management. In
Developing countries, managements adopt various safety management practices voluntarily for ensuring health and safety of their employees.

Researches have revealed that favourable safety climate is essential for safe operation. What is less clear are which antecedent factors promote a favourable safety climate. The issue is important because of the implications of intervention strategies. Research has focused on supervisors as role models for instilling safety awareness and supporting safe behaviour (Fleming et al., 1996; Mattila et al., 1994). Involvement of the workforce in safety decision-making has also received attention (Simard and Marchand, 1994). Both of these concepts naturally lead to a consideration of the safety philosophy of upper management and the safety management system of the organization. Hofmann et al. (1995) label the individual attitudes and behaviours discernible in safety climate as the micro-elements of an organization, which themselves are determined by macro-elements of the safety management system and practices. In this sense management attitudes and behaviour toward safety permeate down through the organization to the workforce.

Safety management relates to the actual practices, roles and functions associated with remaining safe (Kirwan, 1998). It is therefore more than a ‘paper system’ of policies and procedures. An audit of the official safety management system may begin and end with an analysis of what is contained in the paperwork but it therefore says little about how the system is being enacted in the field. Such an analysis identifies what an organization should be doing to protect its workers, the public and environment from harm but it does not reveal what is actually happening in the worksite and whether or not people and environment are being protected and adverse events are not occurring.

There have been numerous attempts to isolate specific safety management practices that predict safety performance (i.e. accidents and incidents). Some of the earliest studies identified common features of companies with high safety performance, but failed to include controls with low performance. Cohen (1977) reviewed four such studies, and in at least three cases the following factors were common to the sample: safety officers held high rank; management showed personal involvement in safety activities; training was superior for new employees and conducted at regular intervals for existing employees; specially designed posters were used to identify potential hazards; there were well...
defined procedures for promotion and job placement; daily communication between workers and supervisors about health and safety was the norm and site inspections were frequent. In contrast, Shafai-Sahrai (1971) examined 11 matched pairs of companies conducting on-site interviews and site inspections at each. Organizations with lower accident rates were characterized by: the presence of upper managers who were personally involved in safety activities; prioritization of safety in meetings and in decisions concerning work practices; and thorough investigation of incidents.

Cohen et al. (1975) and Smith et al. (1975) examined 42 matched pairs of companies. Those with lower accident rates were characterized by: the presence of safety officers with high rank; the presence of upper managers who were personally involved in safety activities; training for new employees, with frequent retraining for existing employees; and more pervasive lines of informal communication between higher management and workers, e.g. daily communication between supervisors and their teams. Shannon et al. (1996) conducted a postal survey of over 400 manufacturing companies, each having at least 50 employees. The defining features of organizations with lower rates of lost time injury included: managers who perceived more participation in decision-making by the workforce and more harmonious management-worker relations; encouragement of long-term career commitment; provision of long and short term disability plans; definition of health and safety responsibilities in every manager’s job description; performance appraisals with topics related to health and safety; and more frequent attendance of senior managers at health and safety meetings.

Vredenburgh (2002) studied the level of safety management practices in hospital employees with the help of a questionnaire survey. Participants were risk managers from 62 hospitals located in several states in the United States. This study examined the degree to which six management practices frequently included in safety programmes (Management commitment, Rewards, Communication and feedback, Hiring practices, Training and Participation) contributed to safe work environment for hospital employees. The dependent variable was injury rates collected from the hospital records. Linear multiple regression analysis was used to assess the predictive capacity of management
practices of injury rates. The only management practice that individually predicted injury rates was ‘Hiring practices’. This was in tune with the findings of Eckhardt (1996) and Turner (1991) who observed that, consideration of safety performance in selection of employees helps to reduce injury rates.

An exploratory factor analysis was conducted to verify that the management practices items (predictors) loaded into the expected subscales (six safety management practices). Even though six factors were obtained, explaining 69% of the variance in the data, the items in the factors did not correspond to those in the six safety management practices.

Mearns et al. (2003) devised an audit tool, “Safety Management Questionnaire -SMQ” to assess safety management practices in 8 oil and gas installations in UK. The following indicators suitable for offshore environment were selected from previous studies (Fuller, 1999; Miller and Cox, 1997; Blackmore, 1997; HSE, 1997): Health and safety policy, Organizing for health and safety, Management commitment, Workforce involvement, Health promotion and surveillance and Health and safety auditing. This data on safety management practices were collected from senior management in two successive years. Favourable total SMQ scores were found to be associated with lower rates of lost time injuries in each year.

Some researchers have tried to explore the mechanisms by which safety management practices influence safety behaviours of individuals in organizations. Smith-Crowe et al. (2003) found that safety management practices, especially safety training, moderate the relationship between safety knowledge and safety performance. Neal et al. (2000) studied the relationships between antecedents, determinants and components of safety performance using structural equation modelling procedures among Australian hospital workers and revealed that, safety knowledge and safety motivation individually predict both safety compliance and safety participation. Safety management practices were found to predict both safety knowledge and safety motivation. The mediating effect of safety knowledge and safety motivation on the relationship between safety management practices and safety performance were also observed in this study.
In a large-scale study in 13 companies operating in the manufacturing sector in the United Kingdom using questionnaires and interviews, Cox et al. (1998) attempted to model commitment to safety in terms of management actions for safety, quality of safety training and personal actions for safety. Structural model showed that ‘management actions for safety’ and ‘quality of safety training’ predicted ‘appraisal of commitment to safety’ while ‘personal actions for safety’ did not. However, the effect of ‘management actions for safety’ was much greater than that of ‘quality of safety training’. ‘Management actions for safety’ predicted ‘personal actions for safety’, while there was a reciprocal relationship between ‘management actions for safety’ and ‘quality of safety training’. ‘Personal actions for safety’ did not, in part, mediate the relationship between ‘management actions for safety’ and ‘quality of safety training’ on one hand and ‘appraisal of commitment to safety’ on the other.

2.4 OBSERVATIONS FROM LITERATURE REVIEW AND MOTIVATION FOR CURRENT RESEARCH WORK

2.4.1 Observations from literature review

From the literature review presented above, it is evident that the research literature on safety culture/climate leaves scope for a lot of additional research. Many researchers have studied different types of industries and factor analysis techniques have been used to determine the factors. Reliability of the factors obtained and the relationship between these factors and accident rates by correlation analysis has also been presented in some of the researches. However, the following aspects are worth noting from these studies:

- Although most of the researches reported are conducted according to the well-accepted methodology of social scientific research, little consensus has been reached on the different aspects commonly associated with safety culture/climate within this scientific discipline. Researchers have used different questionnaires resulting in different factor structures. Questionnaires that have been used were naturally influenced by the authors’ perceptions of what questions were “important”;
While the importance of the concept of safety climate or culture is stressed by most authors, very few have attempted to support their claim by reporting an indication of its construct validity, unidimensionality or predictive validity. Most efforts have not progressed beyond the stage of face validity;

- It is found that “Management actions for safety” emerged as the principal factor in many studies. Since this factor contains the various safety management practices adopted by the managements, assessment of level or deficiencies in each safety management practice become difficult from these studies;

- Most of the studies in safety culture/climate have been reported from developed countries where different safety management practices are already implemented in industries. There is no sufficient research evidence from developing countries like India where safety management has gained attention only recently.

A thorough survey of the literature review presented in the previous sections reveals that only a few studies have been carried out with respect to the implementation of safety management practices in industries. Most of the studies are either theoretical in nature or case studies. Proper identification of the critical safety management practices is essential for successful implementation of safety management and this is not reported in any of the studies. However, researchers have studied the difference in level of different safety management practices in high and low accident rate companies to explore their characteristics. The predictive capacity of safety management practices on safety outcomes was investigated by Vredenburgh (2002), but the safety management practices chosen was not empirically validated.

Neal et al. (2000) explored the relationship between safety management practices and determinants (safety knowledge and safety motivation) and components (safety compliance and safety participation) of safety performance using structural equation modelling. Since this study was carried out using summated score of safety management practices, individual effects of various safety management practices on determinants and components of safety performance still remain unexplored.
There is no research evidence examining the predictive capacity of safety management practices on determinants of safety performance and also, determinants of safety performance on components of safety performance. Comparison of level of safety management practices, determinants and components of safety performance in industries classified on the basis of management system certifications such as ISO 9001, OHSAS 18001 and ISRS was not found in literature review. Another research area that was found unexplored was related to the investigation of relationship between personal attributes of employees (such as age, qualification, years of experience, accident history and job category) and determinants and components of safety performance.

Since Indian industries were adopting traditional safety management techniques till recently, safety climate studies to determine the underlying factors and their effects on safety performance outcomes in all types of industries are yet to begin. This attempt in that direction is expected to contribute toward filling that huge gap in literature.

2.4.2 Motivating factors for the present research

While considerable research has been reported on the topic of safety management in industries from various parts of the world, there is scarcity of literature from India. The survey of literature on safety management reveals that the implementation of various safety management practices can contribute towards reducing accidents and injuries, thereby improving overall performance of an organization. However, empirical research on this topic seems to be meagre in the case of Indian industries. Therefore, it is expected that a clear understanding of the critical safety management practices would help in the implementation of safety management systems.

It appears that an empirical investigation of the relationship between the safety management practices and the determinants and components of safety performance is necessary, since the decision makers need to have evidence and scientific explanations to support their decisions. Literature review revealed that enough such studies have not been reported not only from India, but also from developed countries.

Investigation into the level of safety management practices in organizations with low, medium and high accident rates can reveal which safety management practice contributes
more in accident prevention. Similar study in organizations with different management system certifications can answer the question: "Which management system certification is best suited in Indian industries for better safety performance?".

Study on the relationship among personal attributes of employees and determinants and components of safety performance may reveal "whom to target" while designing improvement strategies and programmes. Structural equation modelling of safety performance using management practices, determinants and components of safety performance can reveal the strengths of their relationships which can finally help the decision makers in designing proper safety intervention programmes.

Measuring safety climate can be referred as taking the "safety temperature" of an organization since it comprise a summary of employee perceptions of a range of safety issues. Hence, it would be appropriate to understand the safety climate factors in various organizations and their relationships with accidents and management system certifications. It will also be beneficial to compare the safety climate structure in different types of industries to design most appropriate safety intervention programmes. It is evident from literature review that such attempts have not been done so far in Indian industries, and hence an attempt in this direction would be highly instrumental in motivating employees and demonstrating the commitment of management for the health and safety of employees.