CHAPTER II

LITERATURE REVIEW

This chapter provides the basic knowledge and theory about the supervisor behavior on safety action in construction project. It begins with the review of safety management in construction industry. The first section explains about the concept of safety, safety in construction and safety management research. Then, second section review the safety climate of construction site and describes their dimension. The third section focuses on supervisor role in safety action and their current status performance in safety management system. After that, the fourth section mentions about safety behavior concept and general factors influencing safety behaviors which lead to proposed model. Finally, a research framework is established to achieve the research objectives.

2.1 Safety Management in Construction Industry

2.1.1 Safety Concept

"Safety" is a natural concept, nobody know when it appeared as well as no-one can give an accurate definition of "safety". Generally the "safety" concept had been occurred when the people had awareness to protect themselves about 2,500 BC. According to dictionary, "***Safety*** *is the state of being "safe" (from French sauf), the condition of being protected against physical, social, spiritual, financial, political, emotional, occupational, psychological, educational or other types or consequences of failure, damage, error, accidents, harm or any other event which could be considered non-desirable*". However, it should be pointed that there is no state of "absolute safety" because human may have a chance to do something wrong. Thus, human may face with unsafe state at the general operational work. Our best is trying to reduce it as much as possible. As the result, we should focus on this problem more and more even though there are so many research studies. In addition, safety must be continuous and incessantly improved.

2.1.2 Safety in Construction Industry

Comparing with other industries, construction industry faces with several hazards environment. It also shows the highest record accident because of its characteristics as mention in chapter 1. Moreover the consequences from construction accident are uncountable. It causes human tragedies, adversely affects other workers and breaks the goals of project such as cost overrun, project delay and low productivity. It can ruin

reputation of the construction company (Mohamed, 1999). Thus, safety research in construction is always concerned by researcher, research institutes, and company such as Stanford Construction Institute, Executive Committee of the Construction Safety and Health Program. Developed and developing countries from around the world are showing an interest in the concept of construction safety management. Therefore, many construction organizations attempt to reduce the accident rate and achieve a zero-injury objective.

2.1.3 Safety Management Research

Table 2.1 Previous researches on safety management (Rowlinson, 2004)

Areas	Items	Relative researches
People's role	Role of leaders	Hakkinen (1995); Koehn, Kothari and Pan (1995); Levitt and Parker (1976); Tam and Fung (1998); Wentz (1998)
Organization management	Worker's behavior Training	Hinze (1981); Yu (1990) Gun (1993); Hakkinen (1995); Hale (1984); Krause (1993); Tam and Fung (1998)
Safety systems	Safety systems	Hale, *et al.* (1997); Hale and Hovden (1998); Hinze (1981); Jaselskis, Anderson and Russell (1996); Tam, Fung and Chan (2001)
Apparatus and	Equipment	Jaselskis and Suazo (1994); Krause (1993); Larsson and Field (2002)
Technology	Technology control	Blank, Laflamme and Anderson (1997); Lingard and Holmes (2001); Jannadi and Assaf (1998)
Industrial relationship	Market	Hinze and Raboud (1988); Kartam, Flood and Koushki (2000)
Safety regulations	Safety regulations	Gun (1993); Seppala (1995)

A large amount of researches was investigated on the safety issues in construction. They tried to explore all problems related to safety management system. According to Levitt and Samelson (1987), Lance William deStwolinski conducted the first safety research program in 1969, Jimmie Hinze made the first base in role of middle management, Michal Roger Robinson developed the accident cost accounting system, and James

Edward Koch investigated liability. Many previous researchers discuss about root causes of safety problems and performance. These research reports are classified into different groups as shown in the Table 2.1 above.

The main influence on free injury under construction environment belongs to the government. One reason is that construction managers often believe that safety causes increasing budget and reducing productivity, so they always try to avoid its cost as more as possible (Leather, 1987). From this reason, it is necessary to establish and enforce the legislations on construction safety, such as Construction Law, Inspection Standards for Construction Safety and Inspection Standards for Labor Protection in Construction Enterprises. In general, the Ministry of Construction takes a main responsibility for regulating construction safety, implementing new strategies and policies, and monitoring and controlling accidents in construction site (Rowlinson, 2004). The government hierarchies are described in Figure 2.1 below.

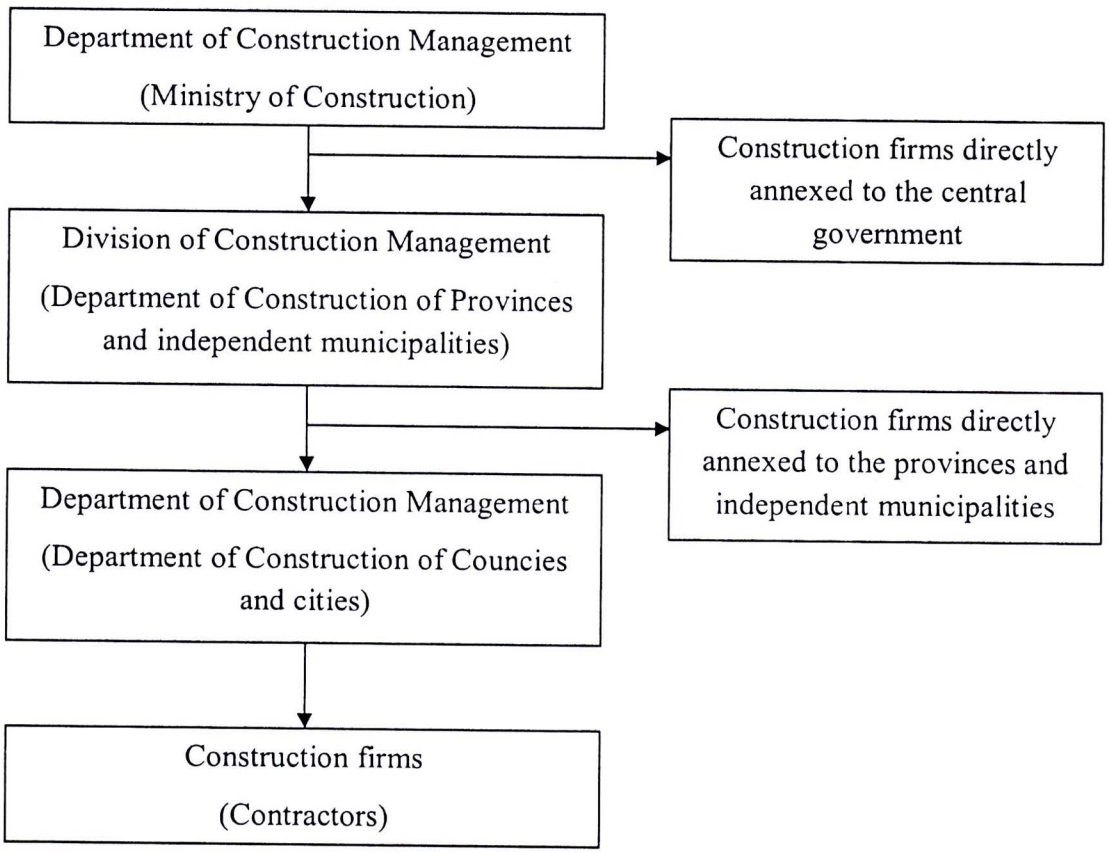


Figure 2.1 Government hierarchy for construction safety management (Rowlinson, 2004)

Currently, construction companies attempt to achieve compliance with health and safety regulation. It requires a commitment from several parties such as government, company policies, workplace culture and individual. Many researchers compared between low and high accident rate in construction companies and explored factors that associated with good safety management (Zohar, 1980; Chew, 1988). The key success factors of safety management includes policy, organization, planning and implementing, measuring and reviewing and auditing performance (Holt, 2001). Other key success factors related to safety are control of site hazards and working conditions, safety training, safety responsibility of employees (Jannadi, 1996). It also found that roles and functions of safety management system, or safety management system to control risk can be essential factors. Finally, policies and procedures of safety are also founded as important factors. For example, Mearns (2003) found that organization policies and procedures can protect their workers from hazard workplace and reduce hazard in workplace.

When the company realized the importance of safety investment in construction site, it is essential to explore management, tools or techniques that can reduce unsafe environment. Ladders, scaffoldings and operating machinery are also found to be associated with accidents. Operators believe that lack of training and skill in using machinery are the main cause of accidents. Based on the nature of work, the Ergonomic nailing System (ENS) was designed and tested in the field. The ENS is a technical system applied to reduce hazards in one of the highest risk operation in construction – process of nailing sub-floors. In construction, the worker frequent has problems to lift material and they usually cause fatal accidents. HSE 1998 establishes issue to avoid people injuries in lifting materials, make sure all equipment used for lifting in good condition and workers must be trained before doing the job. In recent time, together with technology development, some authors studied in the use of virtual reality or visualization for improve construction site safety. Hadikusumo and Rowlinson (2003) applied virtual reality to establish the Design-for-Safety-Process to assist reducing construction site safety and safety analysis. Furthermore the development of robotics and artificial intelligence contribute a significant role in reducing risk in performance dangerous activities on site (Committee on Army, Artificial et al., 1984; Bradley, Seward et al., 1993). Many innovative technological solutions are discussed but their application is still not popular because of the limitations in economic and knowledge to understand the processes. However, we can believe it will be commoned in future with more flexible. In results of Sawacha (1999), the most significant variables in the technical factor were awareness of the hazardous materials rather than their handling.

One of the most important influences on construction site safety is education and safety training. Training construction safety aims to improve workers' knowledge, skills and awareness in order to perform their job at the basic safety level. According to Anderson and John (1999), lack of education and training is one of seven factor that cause high rate of construction accident in UK. Therefore, three levels of training are needed to improve safety in construction industry such as craft and skills training, training by employer to new employees upon joining, and training on-site induction process. It is also found that three conditions for successful safety training are the active commitment, support and interest of management, necessary finance and organization provide the opportunities to learn. However, it should keep in mind that training cannot substitute for implementing safe and healthy working conditions and good design and planning (Holt, 2001). The humans are fallible, so management function can lessen opportunities for making mistake and unsafe behavior.

2.2 Safety Climate

2.2.1 Safety Climate Definition

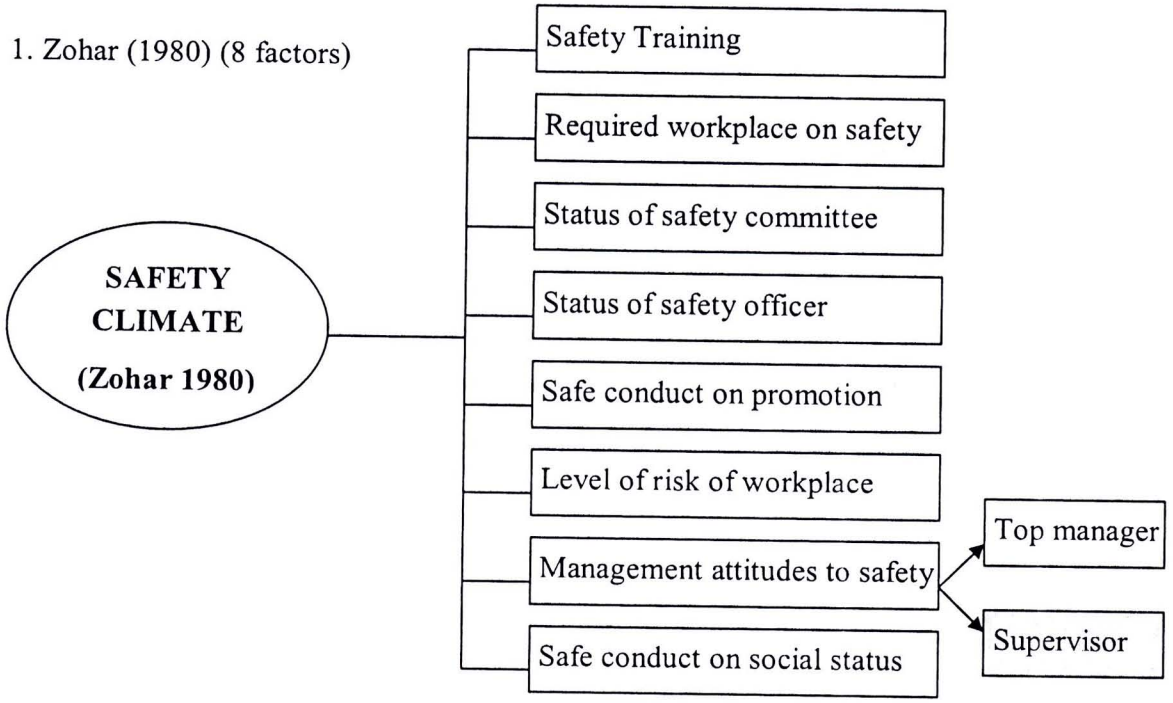
Unlike others, construction industry has some special characteristics such as decentralization, mobility, uniqueness and work complexity. In addition, construction projects are affected by several uncertainties such as weather conditions, labor skill and site conditions. These make the industry more risk and more difficult to achieve continuous improvement on safety performance. Especially, safety performance in construction industry is more related to human factors (Fang, Chen et al., 2006). So it is important for a construction company to improve its safety climate to achieve better safety performance (Mearns, Whitaker et al., 2003; Xie, 2003). According to Guldenmund (2000), the earliest paper on safety climate is Keenan 1951. Until now, there are a lot of definitions on safety climate; they can be explicit or implicit. Zohar (1980) defined "*safety climate as a summary of molar perceptions that employees share about their work environments*", while Williamsona (1997) defined that "*safety climate is a summary concept describing the safety ethic in an organization or workplace which is reflected in employees' beliefs about safety*". In other research, Cox and Cox (1991) described that "*safety cultures reflect the attitudes, beliefs, perceptions, and values that employees share in relation to safety*". Therefore, safety climate can influence on safety performance.

2.2.2 Dimensions of Safety Climate

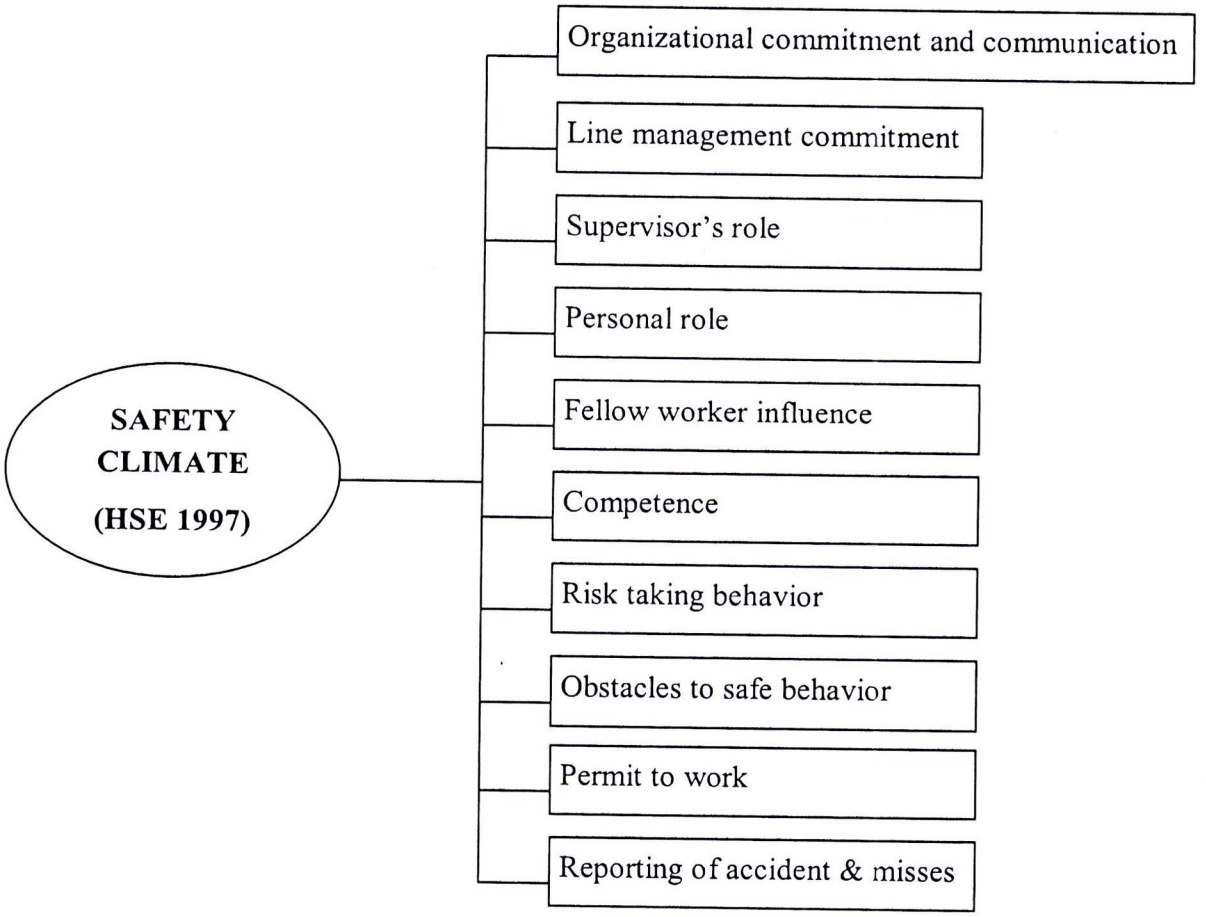
A number of studies have been made to describe and construct the dimension of safety climate. Each author has a different way to represent this concept. Zohar (1980) was the first researcher who explored dimensions of safety climate in construction. The finding from factor analysis shows eight factors related to safety climate that described below (Zohar, 1980). In 1997, Health and Safety Executive of the United Kingdom (HSE) developed and published a Health and Safety Climate Survey Tool (HSCST) found ten factors influencing safety climate. These factors are organizational commitment and communication, line management commitment, supervisor's role, personal role, fellow worker influence, competence, risk taking behavior and some contributory influences, some obstacles to safe behavior, permit-to-work, and reporting of accidents and near misses. In other studies, the top five important issues associated with onsite safety climate are management talk on safety; provision of safety booklets; provision of safety equipment; providing safety environment and appointing a trained safety representative on site (Sawacha, Naoum et al., 1999). Flin (2000) reports several dimensions influencing safety climate, which are management, safety system, risk, work pressure, competence, and procedures. The similar findings were found by Guldenmund (2000). These criteria are management, risk, safety arrangements, procedures, training, and work pressure. Later, Glendon and Litherland (2001) investigated the safety climate in a road construction organization. Their analysis highlighted six factors related to safety climate. These factors are communication and support, adequacy of procedures, work pressure, personal protective equipment, relationships, and safety rules.

These are some models to describe about safety climate.

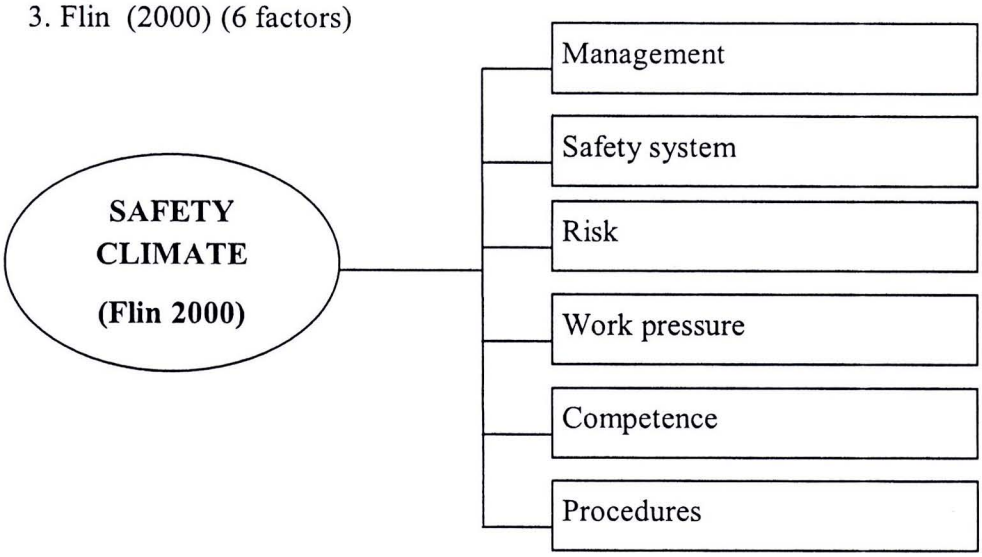
1. Zohar (1980) (8 factors)



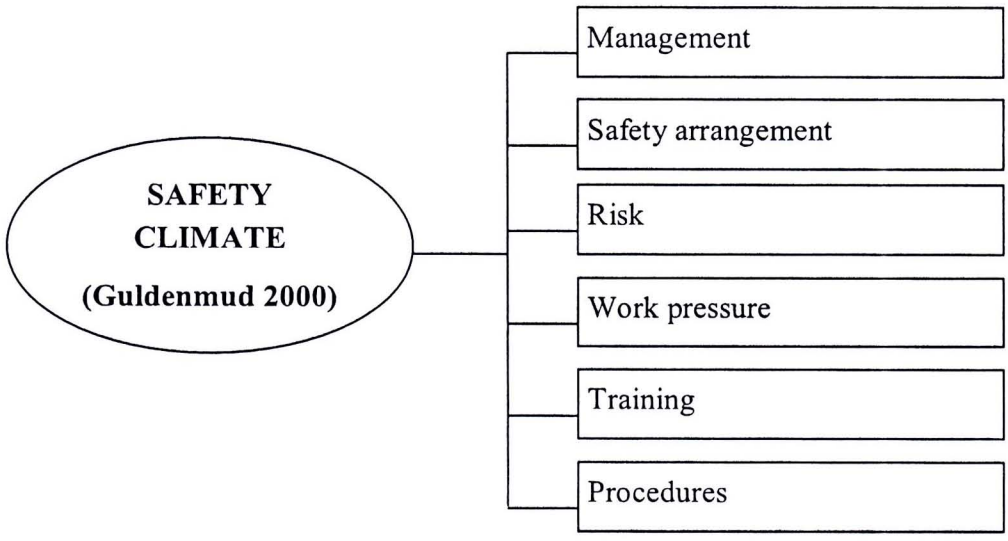
2. Health and Safety Executive of the United Kingdom (HSE 1997) (10 factors)



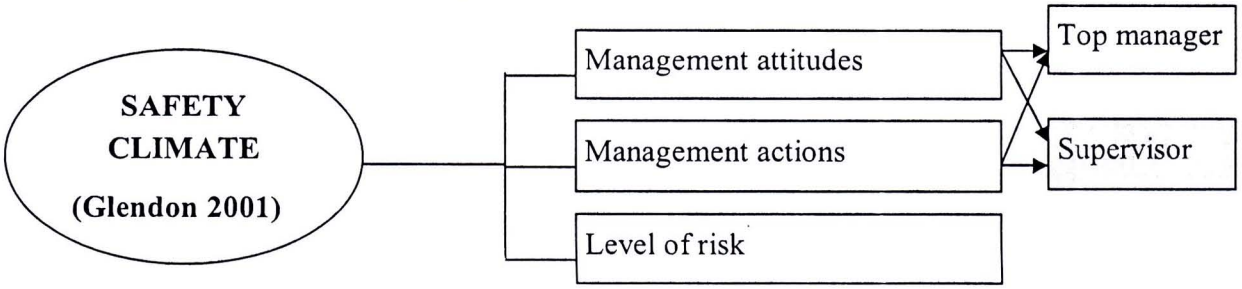
3. Flin (2000) (6 factors)



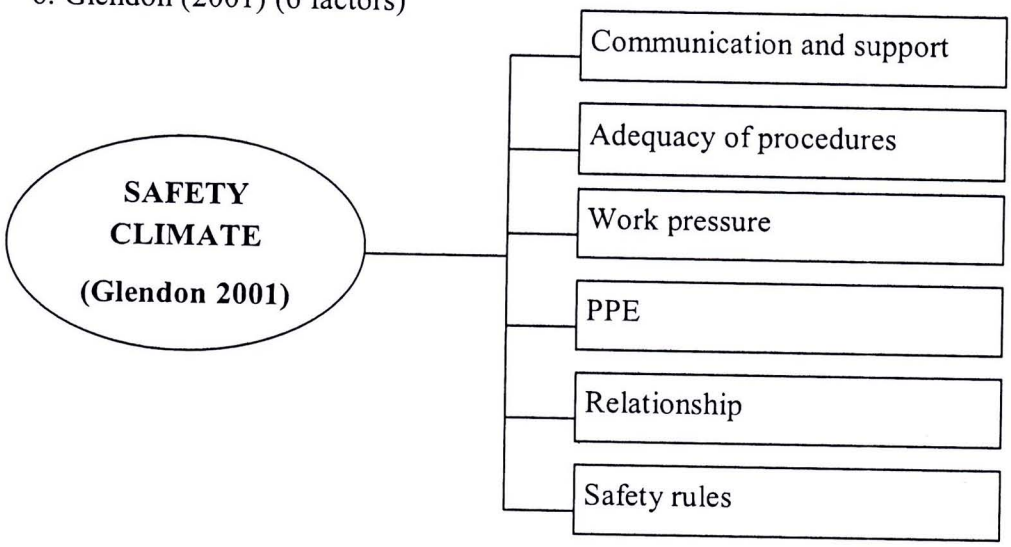
4. Guldenmud (2000) (6 factors)



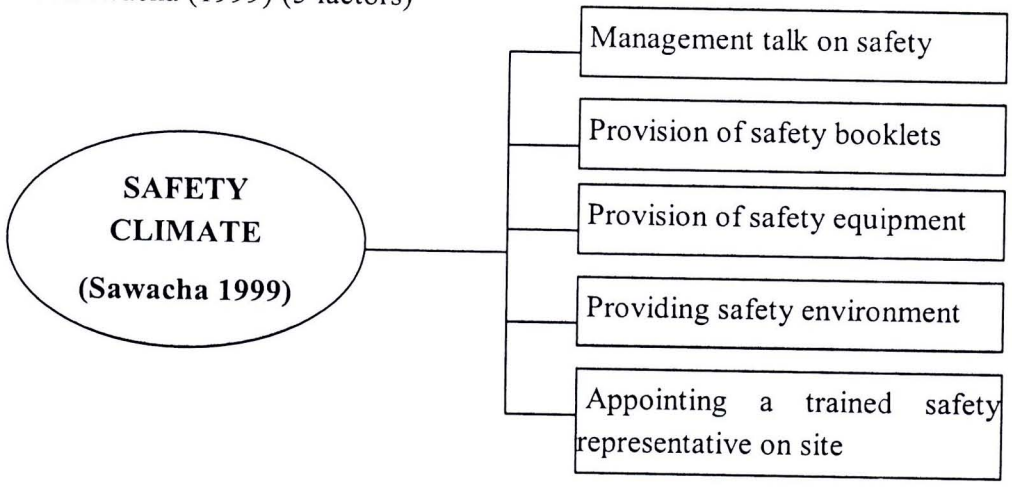
5. Glendon and Litherland (2001) (3 factors)



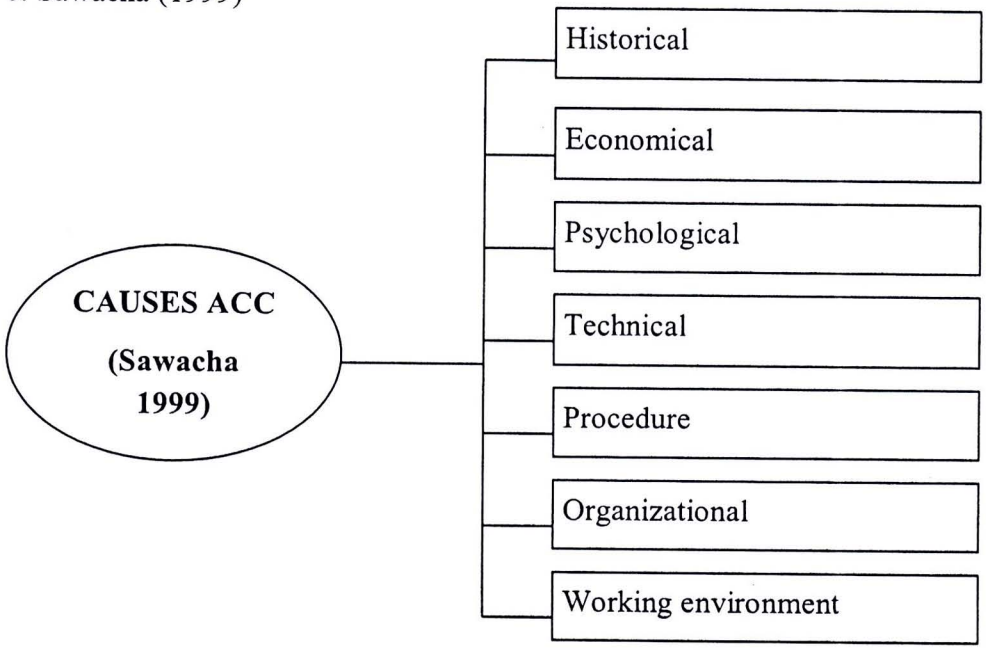
6. Glendon (2001) (6 factors)



7. Sawacha (1999) (5 factors)



8. Sawacha (1999)



Many researches explored about safety climate in construction industry. They tried to describe factors influencing safety climate and factors affecting accident in construction. Although there are some differences in concepts, dimensions and factors impacting to the safety climate in each model, but generally no one can disclaim the role of management factor and supervisor is one of the significant factor in every models.

2.3 Supervisor's Role in Safety

2.3.1 Safety Supervision and Supervisor

Supervision is the most important process in company management system to accomplishing the objectives and company targets (Rue and Byars, 1996). Based on information from Donald C. Lhotka, cited by Rue and Byars (1996), safety supervision is a coordinated work to ensuring safety status for workers and production process to achieve an organization's loss prevention and loss control objectives.

Supervisor is the one representative of management who has daily contact with the employees. Supervisor has the main role in supporting and ensuring the accomplishment of work (Ludden and Capozzoli, 2000). The job of supervisor is a complex combination from planning, organizing, directing and controlling. Supervisor not only is required a good knowledge to realize and avoid hazards for their worker but also need to have a control capability to convince their worker of obey their instruction. Almost company

commends safety at the construction site to supervisor. Dan Petersen pointed that "*Safety excellence only occurs when supervisors, managers and executives demonstrate their values through actions, and their credibility by asking hourly workers to improve the system*".

2.3.2 Supervisor's Safety Role in Construction Site

Supervisors or foremen have key role in implementing policy and ensuring safety in construction site. It is necessary to emphasized that all levels of management are important in safety supervision, and each level keeps a different responsibility. Top manager takes responsibility for providing a guideline and leadership about safety policy of companies. Supervisor's missions are enforcing this policy and ensuring safety condition for their worker and working conditions. Therefore, there is no doubt about the important role of safety supervisor (Rue and Byars, 1996).

Similar to the above review of safety climate models, Table 2.2 highlights factors affecting construction site safety. Although previous research studies tried to describe the relationship between factors and safety climate in different dimensions, there is no doubt that supervisor's role is one of the most significant factors that affect the safety climate in construction site, this factor is presented in almost all models.

A research done by Rinefort and Fleet (1993) concluded that accident rate was influenced by type of company safety supervision. The strong correlation portrayed that accident rate can be control with a better safety supervision level. This research also suggested some methods and technique for improving safety supervisor such as escape their crews from stress, separate workers in different groups for easy handle and training and so forth.

Because of its importance, some countries have begun adopting "Construction Supervisor Scheme" since the late 1980s, and nowadays developing countries such as Thailand and Vietnam also adopt safety scheme. Supervisors are responsible for the safety of their employees. So their role is to enhance construction supervision by introducing checks and controls at various construction stages on behalf of the clients. Supervisors' duties are to ensure construction works in compliance with the construction regulations, to supervise execution of the work, to monitor construction safety, to prepare supervision plans and to notify the government in case of any violation of the relevant statutory legislations.

Table 2.2 Relative importance index of factors affecting construction site safety (Rowlinson, 2004)

Ranking	Factors affecting site safety	Relative Importance Index
1	Poor safety awareness of firm's top leaders	0.93
2	Lack of training	0.90
3	Poor safety awareness of project managers	0.89
4	Reluctant safety	0.86
5	Reckless operation	0.86
6	Lack of certified skilled labor	0.84
7	Poor equipment	0.82
8	Lack of first aid measures	0.81
9	Lack of rigorous enforcement of safety regulations	0.74
10	Lack of organizational commitment	0.71
11	Low education level of workers	0.68
12	Poor safety conscientiousness of workers	0.65
13	Lack of personal protective equipment	0.62
14	Ineffective operation of safety regulation	0.59
15	Lack of technical guidance	0.55
16	Lack of strict operational procedures	0.55
17	Lack of experienced project managers	0.54
18	Shortfall of safety regulations	0.53
19	Lack of protection in material transportation	0.53
20	Lack of protection in material storage	0.51
21	Lack of teamwork spirits	0.50
22	Excessive overtime work for labor	0.49
23	Shortage of safety management manual	0.48
24	Lack of innovation technology	0.43
25	Poor information flow	0.40

2.3.3 Supervisors' Role on Accidents Prevention

The supervisor can do several specific things to prevent accidents (Rue and Byars, 1996; Ludden and Capozzoli, 2000):

- Make the work interesting.
- Be familiar with organizational policies that relate to safety. Make sure that the appropriate policies are conveyed to employees.
- Be familiar with the proper procedures for safely accomplishing the work. See that each employee knows the proper method for doing the job.
- Know what safety devices and personal protective equipment should be used on each job. Ensure that the respective jobholders use the proper safety devices and wear the proper protective equipment.
- Know what safety-related reports and records are required (such as accident reports and investigation reports). Be sure that these reports are completed and processed on a timely basis.
- Get to know the employees.
- Know when and where to make safety inspections.
- Learn to take the advice of the safety director and safety committee.
- Know what to do in case of an accident. Be familiar with basic first aid. Know how to contact the doctor, emergency services, and the hospital.
- Know the proper procedures for investigating an accident and determining how it could have been prevented.
- Always set a good example with regard to safety. Remember, employees are always watching the supervisor.

Supervisor's safety performance in controlling unsafe activities and unsafe conditions was described in the process in Figure 2.2 below.

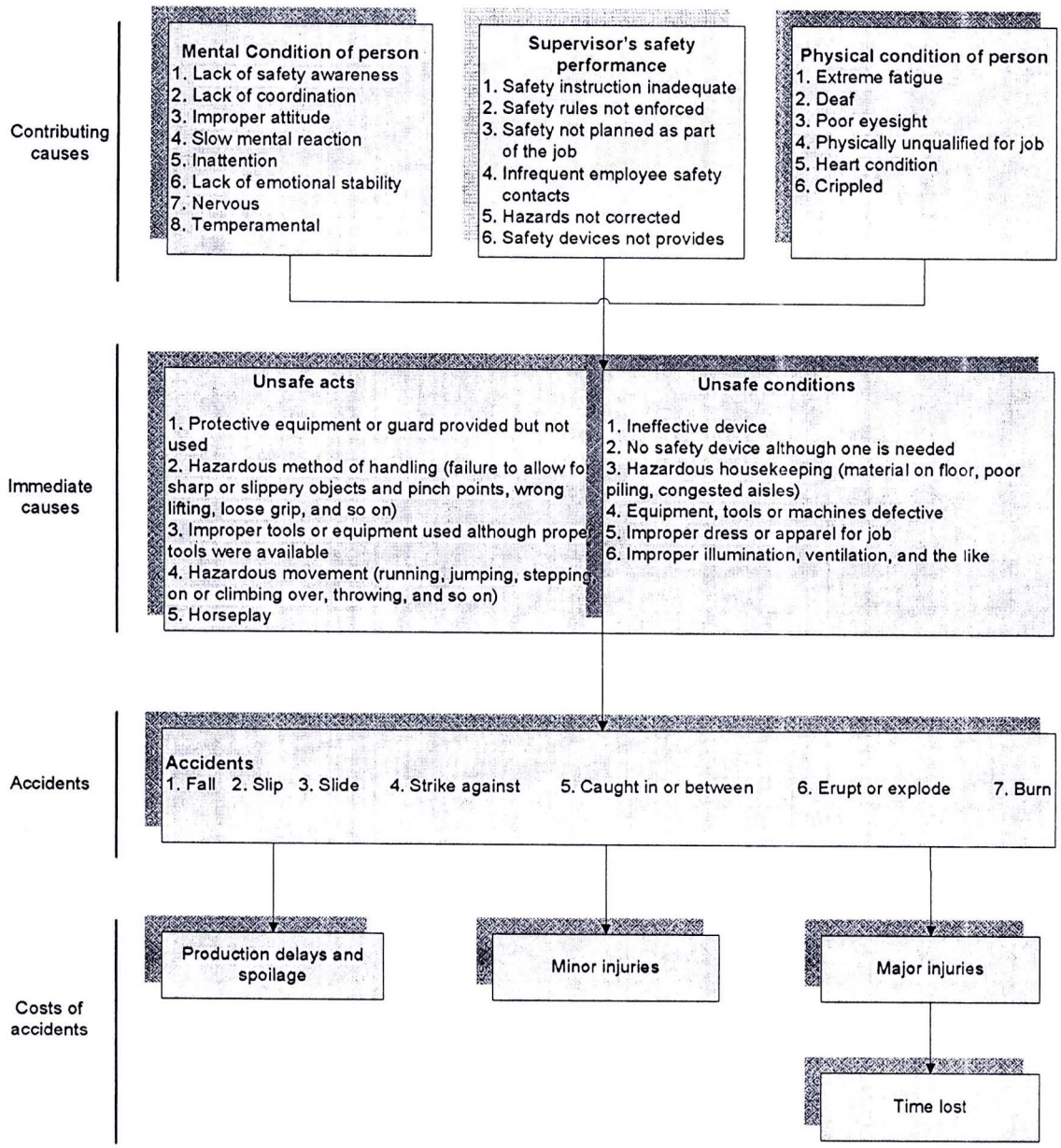


Figure 2.2 Essentials of Management for First-Line Supervisors

2.3.4 Current Status of Supervisor's Performance in Safety Management

There is an actual situation that construction managers often view safety as a cost that conflicts with production and budget. This situation makes little direct interest in safety, end rely on the site supervisor to manage safety (Leather, 1987). So the supervisor directly influences the workers by monitoring their behavior, give support and mediates goals and visions from higher level. The supervisor is the middle level in safety progress

that pays a very important place. Therefore, supervisor's behavior is the most significant factor that decides the successful safety progress. A question comes up is "Do they fulfill their responsibilities in keep safety on construction site". From the practice which was listed in the common responses below we can realize supervisor not pay attention enough for their role – protect worker out of risk. Sometime they are turning a blind-eye in worker unsafe activities, or encouraging employees to take a short-cut for the sake production.

Table 2.3 The most common responses of supervisors to questions on safety practice (Holt, 2001)

Issues	Responses
1. Resource limitations	There are not enough staff on site to do the job properly and my attention has to go to production
2. Safety tasks seen as outside the boundaries of their duties	It's not my job to spot other people's mistakes
3. Acceptance of hazards as inevitable	Construction work is dangerous, so people have to look out for themselves
4. Influences of the social climate on site	I don't want to become unpopular by going on about safety – I'd always be complaining and we wouldn't get the job done
5. Industry tradition	We've always done it that way though I know it's wrong
6. Lack of technical competence	I don't know what the safe way is to do that
7. Incompatible demarks upon their time	I don't have enough time to do my job property
8. Reliance upon the worker to take care	It's up to the men to look after themselves, not my job to nurse them
9. Lack of authority	I can't stop them doing that, because the progress of work would suffer
10. Lack of information	I thought it was dangerous, but I didn't know for sure

Another research was conducted by Lam (1994) about the status of supervisors in Hong Kong. Author concluded that foremen do not know exactly their responsibility and authority in supervisor tasks, and foremen do not have enough necessary knowledge and experience for ensuring safety as their responsibility. The general assessing for safety supervisory performance overall is poor.

The causes that affect their unsafe behavior may come from many reasons, the policy not strict enough; their company has never noticed about safety, some may come from themselves, experience, capacity and others (Lam, 1994; Holt, 2001). In fact, the supervisors should take responsibility for employees' safety. Supervisors can prevent accidents if they really want to do so (deStwolinski, 1969). Therefore it's necessary to explore the factors that affect supervisor's safety behavior. The findings can help us to understand more on their behavior. In addition, these can help project managers to encourage supervisor to fulfill their safety responsibilities in construction site.

Like others, Vietnam construction industry has begun adopting "Construction Supervisor Scheme" from 1990s. The position of supervisor is emphasized as the Professional Certificate for Construction Supervision has been issued. However, Vietnam construction industry did not have any researches about safety supervision. Consequently this research is carried out to find how supervisor behavior performs their safety supervision, what affect their behavior to fulfill his obligations in reducing accident rate in construction site.

2.4 Safety Behavior

2.4.1 Conceptual of Behavior

Behavior is what people action because behavior involves a person's actions, it is described with action verbs. Behavior is not a static characteristic of the person (Miltenberger, 2008). In the limitation of this research, the concept Safety Behavior means what people do and say in safe state and condition. Supervisor safety behavior is any type of supervisor's action regarding to safety condition for his employees, as the results of planning, organizing, staffing, leading and controlling.

Behaviors have one or more dimensions that can be measured such as frequency, duration, and intensity. The frequency of a behavior can be measured by counting the number of times a behavior occurs. Other dimensions as the duration of a behavior, the intensity of a behavior, or the physical force involved in the behavior also can be measured.

Behaviors can be observed, described, and recorded by others or by the person engaging in the behavior. Because a behavior is an action, its occurrence can be observed.

Behaviors have an impact on the environment in which it occurs, including the physical or the social environment (other people and ourselves) in some way, regardless of whether we are aware of its impact.

Behavior is lawful, systematically influenced by environmental events. Once we understand the environmental events that cause behaviors to occur, we can change the events in the environment to alter behavior.

Behaviors may be overt or covert. Some behavior that we can observe or record through their action, these are over behavior. But some cover behavior we can not observe, they can be observed only by the person engaging in the behavior.

2.4.2 Quantified of Behavior

There are two types of behavioral observation: direct and indirect (Cozby, 2007; Miltenberger, 2008).

2.4.2.1 Direct observation

1. Direct observation. This is an observation which the person was told that he will be observed. This type of observation will lead to artifact results.

2. Naturalistic observation. This is an observation in case the person does not know this fact. This type of observation will lead to accurate results.

2.4.2.2 Indirect observation

Indirect observation involves using interviews, questionnaires, and rating scales to obtain information on the target behavior from the person exhibiting the behavior or from others.

1. Interview. This is a method in which the person is asked to response the questions of the study. An interview will lead to numerous information, the results may be not obtain if the responder insincerely.

2. Questionnaire. This method can be applied for predict the trend of behaviors. The respondents are required to finish all questions according to their personal opinion. This method seems easier than others.

3. Recording. This type of research requires the person to make their own record, such as diary. The targets of this study normally about person habits, health and so forth.

Direct observation usually is more accurate than indirect assessment. This is because in direct observation, the observer is trained specifically to observe the target behavior and record its occurrence immediately. In indirect observation, information on the target behavior depends on people's memories. In addition, the people providing information

may not have been trained to observe the target behavior and may not have noticed all the occurrences of the behavior. This study used indirect observation involves using interviews, questionnaires and rating scales to obtain information on the safety behavior from supervisor.

2.4.3 Needs of Safety Behavior

From the literature review, almost construction companies have improved safety management system such as safety policy, safety regulation, safety training, and applying techniques to reduce the accident rate. Over a long period, these efforts tend to reduce dramatically in accident rates. However, these rates are considered too high and caused many unfortunate consequences. Another reason is unsafe behavior which can explain the high rate of construction accident. Approximately 80 – 95 percent of all accidents are triggered by deeply ingrained unsafe behavior (Cooper, 1998).

Unsafe behavior was suggested to focus rather than accident rates index of safety performance because of two reasons. Firstly, unsafe behavior is an initial cause of accident, so if unsafe behavior can be controlled, the accident rate can be reduced. Secondly, unsafe behavior can be measured and assessed in daily performance, so it is easier to realize unusual behavior quickly and correct it. In the past, company usually used accident rate as a signal that something wrong in the safety system. However, it maybe too late because they only noticed if accident rate is risen dramatically. On the other hand, safety behavior can be formed as a unit of measurement, a critical sets of safe or unsafe behavior was identify to control safety system effectively daily "Safety Behavior Inventories" (Cooper, 1998). Because of its useful, safety behavior is used more and more to improve or measure safety system.

According to Cooper (1998), there are some factors that often affect personal behavior unsafe. The first is the reinforced behavior tends to be repeated. People have never hurt before when doing the job in an unsafe way, "I've always done the job this way". The second cause comes from actual workflow process which reinforces peoples' unsafe behavior. The third sometimes causes from line managers turning a blind-eye or encouraging employees to take a short-cut to do the job. So the role of construction managers, especially supervisor, is very important to aware their workers to perform the work in safe behavior.

2.4.4 Factors Affect Safety Behavior

According to original concept of safety climate, there is an assumption that safety climate acts a frame of reference that guides behavior (Zohar, 1980). In addition, Williamson

(1997) pointed that safety climate describes everything effect workers' beliefs about safety and the way workers behave for safety in workplace. Thus, it is quite clear about positive relationship between safety climate and safety behavior in construction site.

Another survey was made from 222 employees of a chemical plant located in the Midwest by Hofmann and Stetzer (1996). They focused on three group-level factors and one individual-level factor as a hypothesis to influence the unsafe behaviors and accidents. The results pointed out that over workload, group process, safety climate, and approach intention have relationship to unsafe behaviors.

Under surveying of 525 employees from a 32 work groups in a large Australia hospital, Neal (2000) tested a model examining the effects of general organizational climate on safety climate and safety performance (see Figure 2.3). Organizational climate measured aspects of the work environment such as leadership, professional interaction, decision making processes, and role clarity. These factors were found to have a significant impact on safety climate, that is, perceptions of safety within the hospital environment such as management values, communication, training, and safety systems.

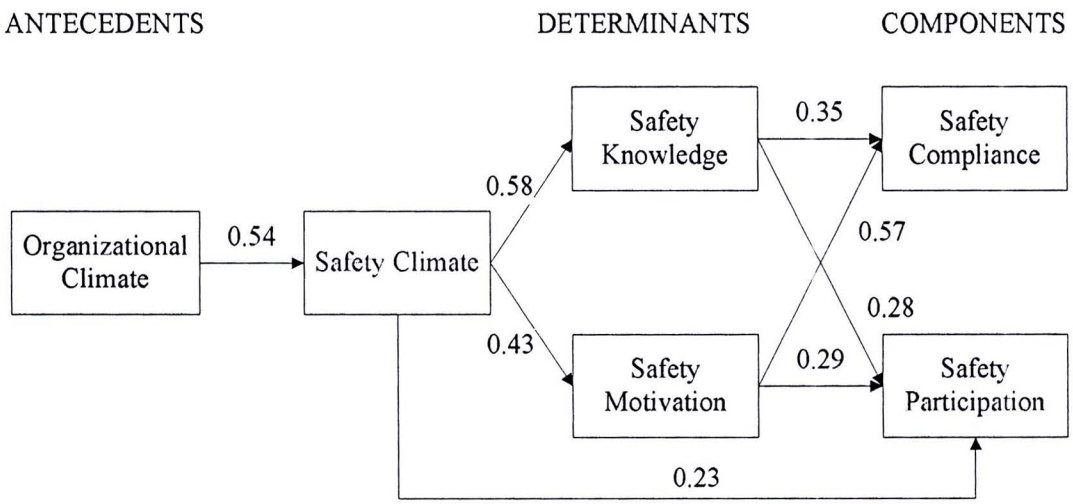


Figure 2.3 Neal et al. (2000) Model

The relationship between safety climate and safety work behavior also was examined by Mohamed (2002) when he tried to describe the safety climate in Australia construction site and a model linking are shown below.

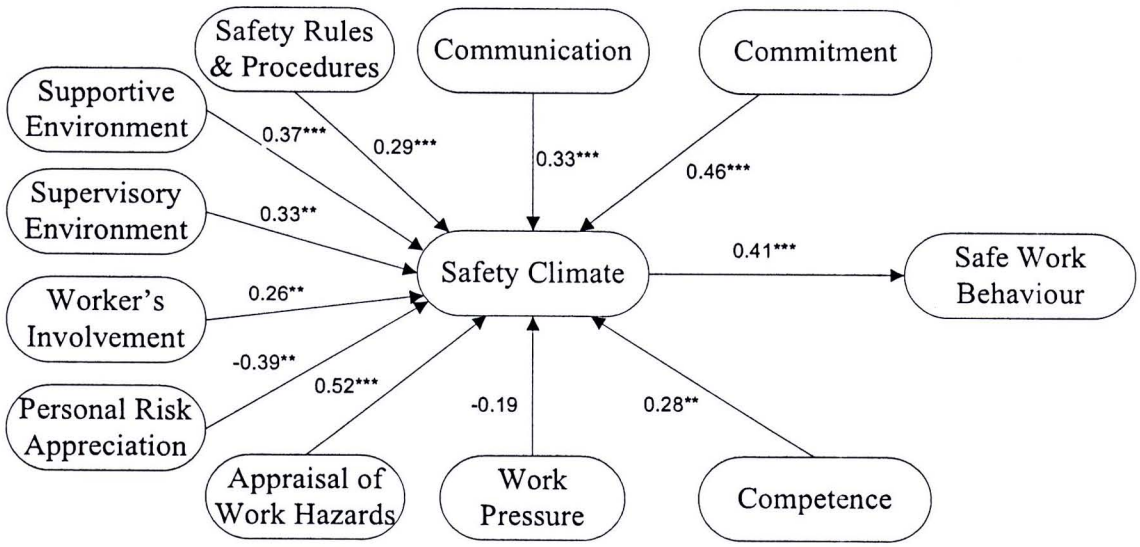


Figure 2.4 Research model linking safety climate determinants to safety work behavior (Mohamed, 2002)

A number of studies have been found that behaviors and attitudes are significantly associated. Decisions of top manger can be influenced by their attitudes which have strongly affect conditions that employees take place their job. Consequently, their attitudes may affect company policy about safety, so can direct or indirect influence on employees' attitudes and behavior.

Prussia (2003) also used modeling to predict safe work behaviors in a steel plant in the US. The research aims to determine the extent to which managers and employees agreed on safety issues (see Figure 2.5). Their model included the organizational variables: safety hazards, management's influence on workplace safety, and pressure for expediency over safety. Results suggested that managers and employees agreed on these system-level factors influencing individual-level factors (cavalier attitude towards safety behavior and safety efficacy, that is, belief in one's ability to work safely), which in turn impacted on safe workplace behavior.

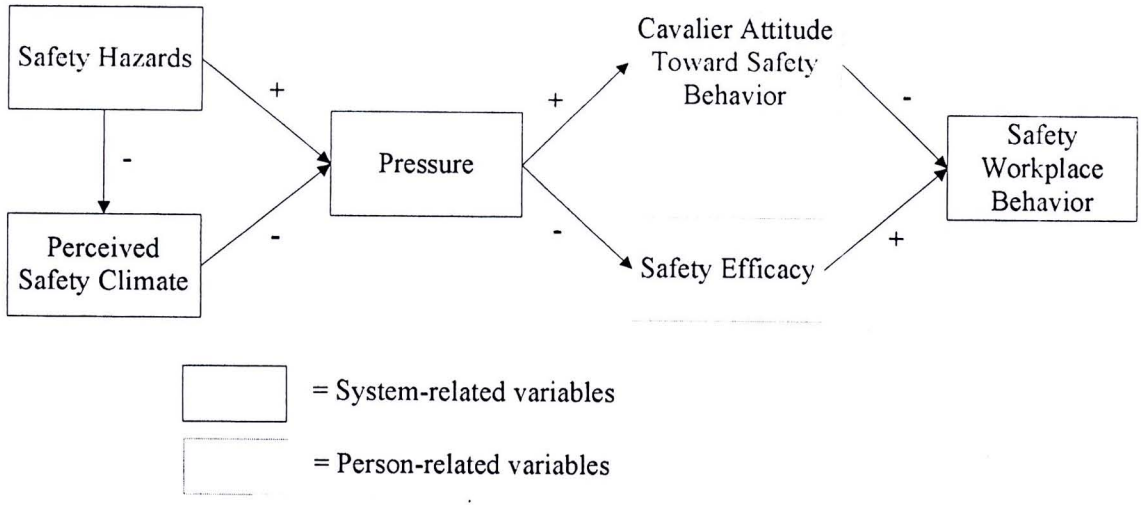


Figure 2.5 Safety workplace behavior (Prussia, Brownb et al., 2003)

Recently, Zhou and group (2008) made a survey from 4700 employees at a large construction firm to establish a Bayesian network (BN) among causal factors that have influences on human behavior (see Figure 2.6). Factors were separately considered in two main groups which are safety climate and personal experience. Safety climate includes safety management systems and procedures, management commitments, safety attitudes, workmate's influences and employee's involvement. Additionally, personal experience factor focus on safety knowledge, education experience, work experience and drinking habits. It was found that safety behavior was more sensitive to safety climates factor such as management commitment and workmate's influences. However, only two questions in questionnaire are established to evaluate safety behavior, so it quite difficult to exactly determine how their actual behavior. On the other hand, various project stakeholders in construction project such as employer, contractor, engineer and workers can affect safety behavior differently because each of them has their own goal focusing in project. Therefore, this study is expected to establish a model that explains supervisor behavior on safety action.

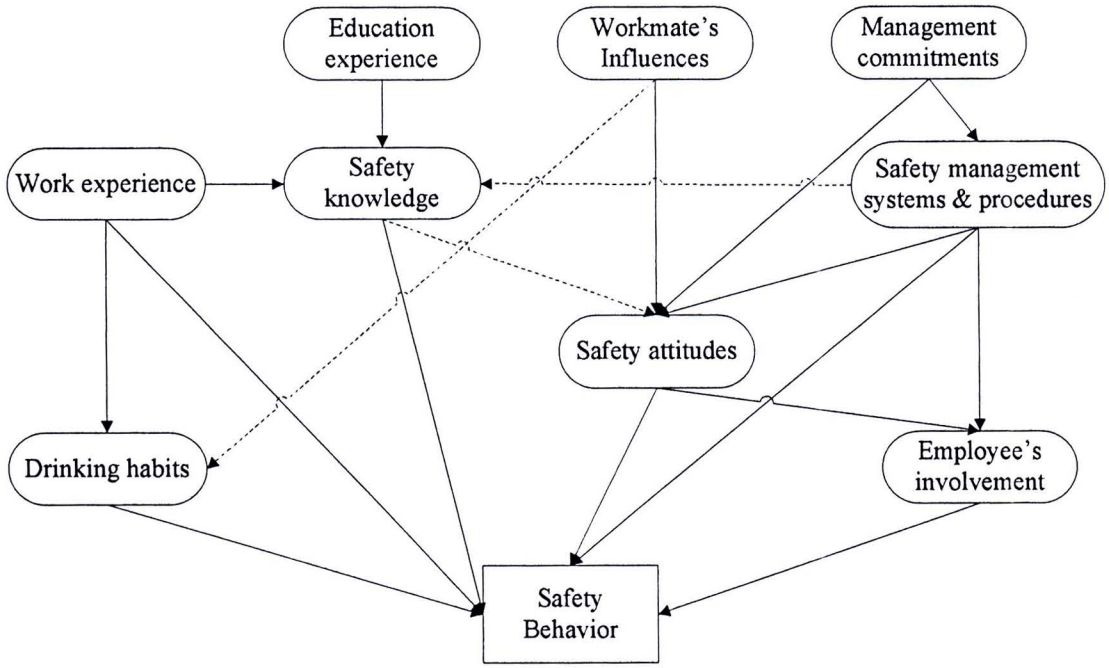


Figure 2.6 A BN of safety behavior (Zhou, Fang et al., 2008)

In summary, many researches focus on safety behavior, safety climate, safety culture and safety performance. They tried to describe their relationship and reciprocal influence. Although many techniques and processes are proposed for safety but the accident rate is still high. The main reason comes from the human behaviors. So there are many researchers focusing on Safety Behavior. Safety behavior concept is considered as one of the significant causes that affect safety performance in construction site. About the object of safety behavior, there are three levels that we should be invested such as Top Manager, Supervisor/Foreman and Worker level. From many reviewed papers, previous research studies did not clearly describe on what factors and how these factors influencing supervisor behavior, they only focused on behavior at worker level. Worker have clearly impacted to safety behavior was studied in a lot of papers. The top level and specially the middle level, supervisor who is strongly impact the safety process, seldom to be concerned. Understanding about significant of safety behavior and the role of supervisor and also the actual statement of their performance in construction site safety, this research expected to find the key factors that affect supervisor's behavior in safety action. It helps the company know how to impact supervisor effectively to improve their influence in keeping construction site safety.

2.5 Theories of Behavior

This research tends to supervisor' current behavior on safety and the influence of factors may impact their behavior. It is necessary to underline that our research is not a theory testing, so the theories discussed below should be viewed as a foundation for developing proposed model. Theory of Reasoned Action (Fishbein and Ajzen, 1975) and Theory of Planned Behavior (Ajzen, 1991) is most commonly adapted. These theories are now discussed.

2.5.1 Theory of Reasoned Action (TRA)

The theory of reasoned action (TRA) was one of the first theories to explain person's actual behavior. It was developed by Martin Fishbein and Icek Ajzen (1975). According to this theory, the actual behavior is seem as a results of behavioral intention which influenced by person's attitudes and subjective norms. Figure 2.7 below shows the relationships among constructs in TRA.

In the simple way, this theory can be explained that what people intend to behave will be influence by a combination of their attitude regarding to that behavior and other people judgments about that behavior. And then, this behavioral intention can be directly influence on what they actual behave. In addition, TRA also explains about the meaning of attitude and subjective norms in details. People's attitudes toward a specific behavior are formed by their own perceptions. More complex than attitude, subjective norms of one person is his perceptions of what other people want him to do and motivation to comply their expectations.

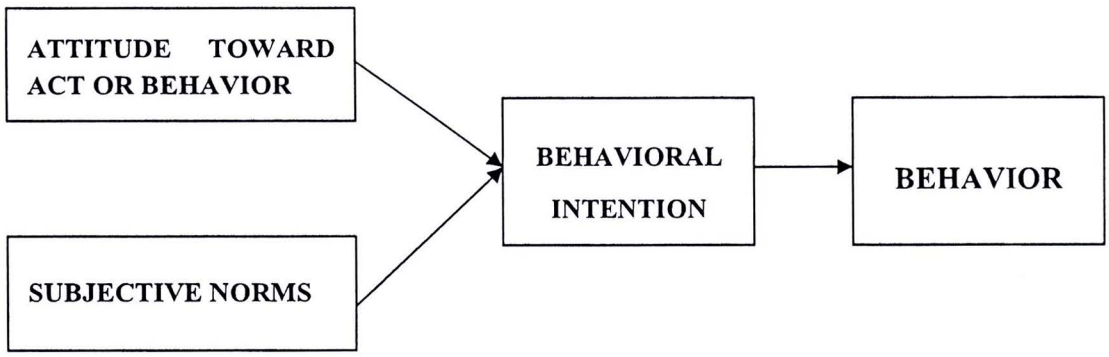


Figure 2.7 Theory of Reason Action (Fishbein and Ajzen, 1975)

TRA theory provides a foundation in developing conceptual model in this research. It supplies a knowledge background about constructs of person's behavior. As mentioned before, this research studies about supervisors' behavior, so it is necessary to explore

their behavioral intention as a predictor of their behavior. In addition, from this theory suggestion the factors influencing behavior through behavioral intention are more important to achieve a deeply understand their behavior.

These are some definition of each components of the theory:

- Attitudes: the sum of beliefs about a particular behavior weighted by evaluations of these beliefs.
- Subjective norms: looks at the influence of people in one's social environment on his/her behavioral intentions, the beliefs of people, weighted by the importance one attributes to each of their opinions, will influence one's behavioral intention.
- Behavioral intention: a function of both attitudes toward a behavior and subjective norms toward that behavior, which has been found to predict actual behavior.

2.5.2 Theory of Planned Behavior (TPB)

The theory of planned behavior (TPB) has been proposed as an extension of the theory of reasoned action by Ajzen (1991). TPB provides a supplementary construct, perceived behavior control, which reflects the level of people can control his behavior. This theory has been a foundation for a lot of studies and had a great contribution since 1985. It provides a completely theoretical explanation and a fully guideline for changing person behavior.

According to TPB theory, person's behavior is influenced by three constructs which are attitudes, subjective norms, and perceived behavior control as described in Figure 2.8 below. The concept of attitudes and subjective norms are not different comparing with TRA theory. Additional concept of perceived behavioral control is factors that may facilitate or impede person's behavior (influence of control beliefs) weight by the how he perceives about the power influence of these factors (control beliefs).

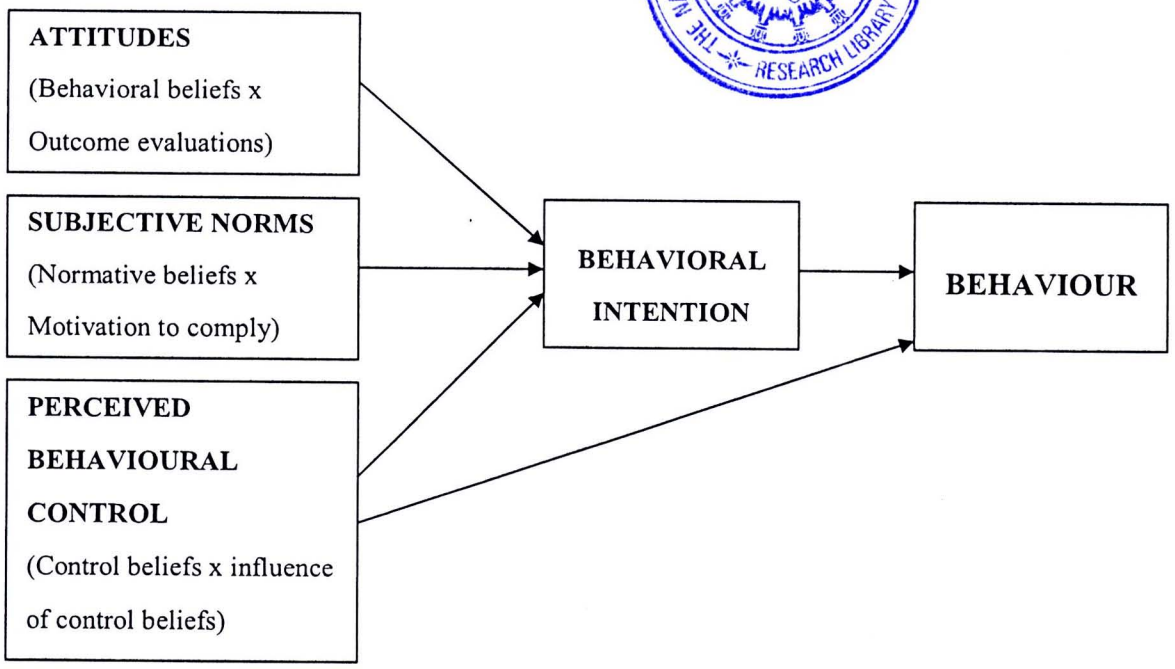


Figure 2.8 The Theory of Planned Behavior (Ajzen, 1991)

Some simple explanations of key words are:

- Behavior: the things that a person does
- Behavioral Intentions: a verbal indication on typical behavioral tendency of an individual
- Attitude: Whether the person is in *favor* of doing it
- Subjective norm: How much the person feels *social pressure* to do it
- Perceived behavior control: Whether the person feels in control of the action in question

Based on TPB theory, by changing these three "predictors", we can adjust the behavioral intention and thence can adjust the expected tendency of person's behavior. As mention above, this research do not purpose for theory testing, so this theory is seemed as a foundation in developing proposed model. In this study, we expect to find what factors strongly impact the supervisor's behavior on safety action. So if they can change those factors in positive way, they can increase the chance of supervisor actually behave safety to reduce the accident in the construction site.

2.6 Proposed Model

From previous literature review, the supervisor behavior on safety is needed to improving safety at construction site. Although several research studies mention about the importance of supervisor behaviors, few research studies are focused on factors influencing supervisor's behavior on safety action. So, this research aims to develop models to explain the relationships between factors influencing and supervisor's behavior on safety action based on their own perception and practice. A proposed model of factors affect supervisor's behavior in safety action is developed base on literature review and theories of behavior. It should be reminded this research is not a theory testing, theories of behavior could be viewed as empirical building blocks to explore the proposed model. The proposed model of supervisor's behavior in safety action is described in Figure 2.9 below.

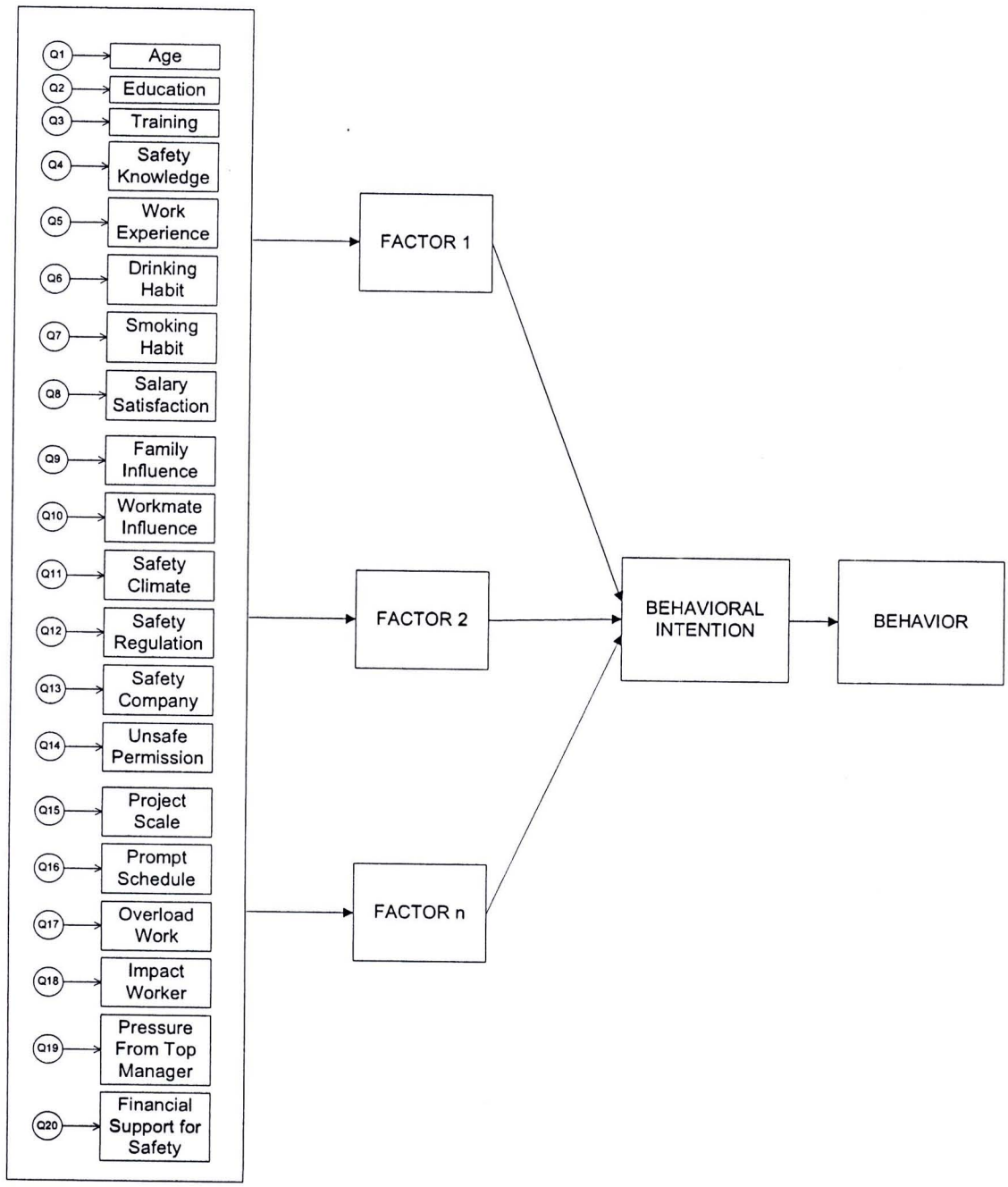


Figure 2.9 Proposed model of factors influencing supervisor's behavior in safety actions