ปัจจัยที่มีอิทธิพลต่อพฤติกรรมการปฏิบัติงานของผู้ควบคุมงาน
ด้านความปลอดภัยที่หน่วยงานก่อสร้างในเวียดนาม

นางเงียนอันห์ ทู

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
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FACTORS INFLUENCING SUPERVISOR'S BEHAVIOR ON SAFETY ACTIONS AT CONSTRUCTION SITES IN VIETNAM

Mrs. Thu Anh Nguyen

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering Program in Civil Engineering
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เงียน อันห์ ทู: ปัจจัยที่มีอิทธิพลต่อพฤติกรรมการปฏิบัติงานของผู้ควบคุมงานด้านความปลอดภัยที่หน่วยงานก่อสร้างในเวียดนาม. (FACTORS INFLUENCING SUPERVISOR'S BEHAVIOR ON SAFETY ACTIONS AT CONSTRUCTION SITES IN VIETNAM) อ.ที่ปรึกษาวิทยานิพนธ์หลัก : ผศ.ดร.วัชระ เพียรสุภาพ, 194 หน้า.

ผู้ควบคุมงานมีบทบาทที่สำคัญในการควบคุมความปลอดภัยในโครงการก่อสร้างเช่น การให้คำแนะนำเกี่ยวกับแนวทางปฏิบัติที่ปลอดภัย และการตรวจสอบการทำงานของเครื่องจักร เป็นต้น การขาดความระมัดระวังของผู้ควบคุมงานอาจนำมาสู่การเกิดอุบัติเหตุได้ ดังนั้น การป้องกันอุบัติเหตุวิธีหนึ่งคือ การกระตุ้นให้ผู้ควบคุมงานมีพฤติกรรมการปฏิบัติงานด้านความปลอดภัยที่มีประสิทธิภาพ แม้ว่างานวิจัยที่ผ่านมาจะมีการศึกษาถึงความสำคัญของพฤติกรรมของผู้ควบคุมงาน แต่การวิจัยดังกล่าวยังขาดการศึกษาถึงปัจจัยที่มีผลกระทบต่อพฤติกรรมด้านความปลอดภัยของผู้ควบคุมงาน งานวิจัยนี้มีวัตถุประสงค์เพื่อสำรวจพฤติกรรมด้านความปลอดภัยของผู้ควบคุมงานในปัจจุบัน โดยการสำรวจปัจจัยที่มีผลกระทบต่อพฤติกรรมของผู้ควบคุมงาน ตลอดจนการพัฒนาแบบจำลองเพื่ออธิบายความสัมพันธ์ระหว่างปัจจัยดังกล่าวกับพฤติกรรมด้านความปลอดภัยของผู้ควบคุมงานโดยการวิเคราะห์เชิงแนวคิดและเชิงแนวปฏิบัติ ทั้งนี้แบบสอบถามพัฒนาขึ้นจากงานวิจัยในอดีตที่เกี่ยวข้องกับปัจจัยที่มีผลกระทบต่อพฤติกรรมด้านความปลอดภัยและพฤติกรรมด้านความปลอดภัยของผู้ควบคุมงาน โดยงานวิจัยสำรวจกลุ่มตัวอย่าง 434 ราย ในประเทศเวียดนามระหว่างเดือนมีนาคมและเดือนเมษายน พ.ศ. 2553 ผลจากการสำรวจพบกลุ่มตัวอย่างจำนวน 403 ราย ที่สามารถนำข้อมูลมาวิเคราะห์หาปัจจัย และมีกลุ่มตัวอย่างเพียง 214 ราย ที่สามารถนำข้อมูลมาสร้างโมเดลสมการโครงสร้าง (SEM) ได้

ผลการสำรวจพบว่า ผู้ควบคุมงานที่หน่วยงานก่อสร้างมีพฤติกรรมการปฏิบัติงานด้านความปลอดภัยอยู่ในระดับปานกลาง จากผลการวิเคราะห์ข้อมูลเชิงแนวคิดพบว่ามี 6 ปัจจัยที่ส่งผลกระทบต่อพฤติกรรมด้านความปลอดภัยของผู้ควบคุมงาน ในขณะที่การวิเคราะห์ข้อมูลเชิงแนวปฏิบัติมี 8 ปัจจัย นอกจากนี้งานวิจัยยังได้พัฒนาแบบจำลอง 2 แบบ โดยแบบจำลองเชิงแนวคิดและแบบจำลองเชิงแนวปฏิบัติ ซึ่งแบบจำลองเชิงแนวคิดทำให้ทราบถึงแนวคิดของผู้ควบคุมงานต่อปัจจัยที่กระทบต่อพฤติกรรมด้านความปลอดภัย และแบบจำลองเชิงแนวปฏิบัติจะช่วยให้เข้าใจถึงปัจจัยที่เกี่ยวข้องกับการปฏิบัติงานจริงต่อพฤติกรรมของผู้ควบคุมงาน

ภาควิชา วิศวกรรมโยธา ลายมือชื่อนิสิต Rlla

สาขาวิชา วิศวกรรมโยธา ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก Vachara Peansupap

ปีการศึกษา 2553

5170732721 : MAJOR IN CIVIL ENGINEERING
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THU ANH NGUYEN : FACTORS INFLUENCING SUPERVISOR'S BEHAVIOR ON SAFETY ACTIONS AT CONSTRUCTION SITES IN VIETNAM. THESIS ADVISOR : ASST. PROF. VACHARA PEANSUPAP, 194 pp.

Supervisors play a significant role in controlling safety in construction project. They provide good advice on safety practices and check the safety condition of equipment. The carelessness of supervisors may cause several accidents. Therefore, accident prevention is required the encouragement of supervisor to have good behavior on safety action. 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. This research aims to explore current supervisor's behavior on safety action, identify factors influencing their behavior and develop a model to explain the relationships between these factors and supervisor's behavior on safety action based on both perception and practice. The questionnaire is developed from literature related to factors influencing safety behavior and issues represented supervisors' behavior on safety. The survey is performed within two months March and April 2010 in Vietnam. Finally, 434 respondents are collected and 403 data are used for factor analysis, only 214 respondents are used to adopt structural equation modeling (SEM).

The statistical results demonstrate the current issue of construction accident, site supervisors have moderately accomplished their safety obligation. From perception data, six factors influencing supervisor's behavior on safety are explored from factor analysis technique. Meanwhile, eight factors are explored from practice data. Furthermore, two models for explaining supervisors' behavior were developed by SEM, one is based on their perception and another is based on actual practice on safety issue. The perception model can help to understand on what supervisor perceive on factor influencing safety behavior. On the other hand, the practice model helps researcher understand how actual practice influencing supervisor's behavior.

Department : Civil Engineering Student's Signature

Field of Study : Civil Engineering Advisor's Signature

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CHAPTER I

INTRODUCTION

1.1 Background

The construction is one of the most important industries both economically and socially. It contributes to Gross Domestic Product (GDP) and impacts on the working population in almost countries, from industrialized as United State, United Kingdom, Australia to developing countries as Thailand, Vietnam. The construction industry contribute to GDP in several countries such as 10% in United State (2008), 7.4% in United Kingdom , 7% in Australia (2007), 10% in Thailand (2003) and 9% in Vietnam . In the United State, the construction industry employed 7 million workers in October 2008, provided jobs for crowded worker. In Vietnam, construction industry is being break out developing stage, contributes 9% of GDP and attracts a great investment achieve US$ 3 billion in 2004. Vietnam is considered as the most potentiality developing market.

Despite of dramatic growth of the construction industry in recent decades, the industry encounters with several problems related to unsafe workplaces and has the highest accident records, includes 38.7% of total fatal accidents in general industry (Figure 1.1). The number of accidents was increased as the growth of the construction industry. For example, the US construction industry in 1999 reported the largest number of workplace fatalities compared to any other industries, accounted for 1,190 deaths included 21% of total 5,461 deaths in all industries. In Australia, between 1989 and 1992, 256 people were fatally injured, 10.4 per 100,000 workers. The construction industry's rate of occupational injury and disease is 44.7 per 1,000 persons, which is nearly twice the all-industry rate. The same situation in UK, in 2005, 118 fatal injuries was happened, made up 8.6 per 100,000 workers while this value of all-industry was only 2.7 per 100,000 . In developing countries, accident problems in construction are more dangerous, the value of accident is higher than developed countries because of inexperience and poor quality in safety management. In Thailand, 2003-2005 rate of accident was constant around 29.18 per 1,000 while rate of death per 100,000 people increased 11.60 in 2004. Construction worker has 14% of total death and 24% of total permanent disability (Tapanawat, 2010). The similar condition with Thailand is Vietnam, the data from Bureau of Labor Statistics in Vietnam in 2007 shows that the number of accidents and fatal accident are increasing yearly, there were 536 cases accident and 76 fatally in juried, included 12% of all. In general, it's an evident truth that the number of occupational injury is increased go together with economic development. Therefore, the research topics related to safety is an urgent and should be put as the first mission.

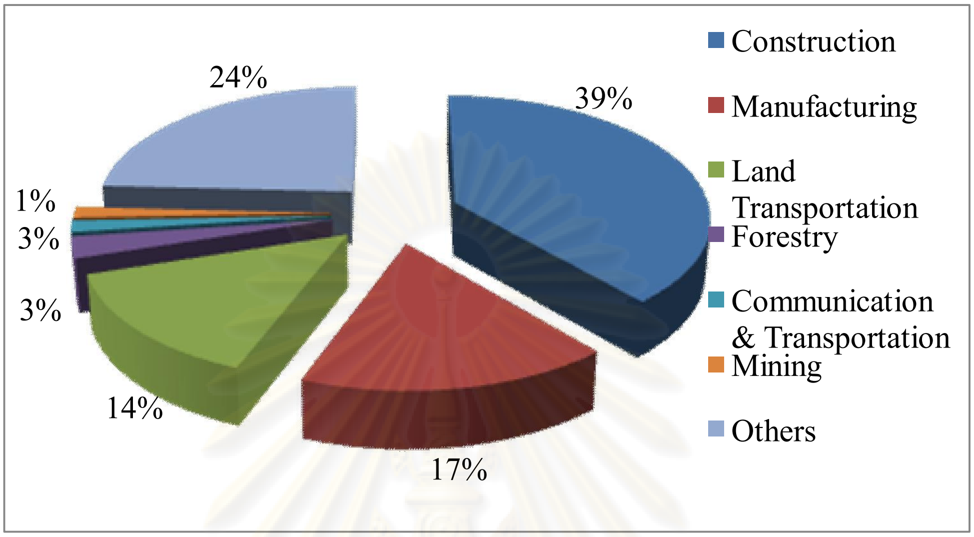


Figure 1.1 Fatal accidents by industry in year 2000 (2001)

The great number of accidents in construction has awakened those who concerned from owner, contractor, subcontractor, and designer. Accident damages are extra considerable, they include both direct and indirect damages such as project budget, time and especially human life, further impact to economic losses. Accident damages was studied and concluded that total costs for solving construction accidents was estimated from 7.9% to 15.0% of total project budget (Everett and Frank, 1996). Furthermore, amount of 3.5% of total project budget was used to pay for workers' compensation cause from construction accident (Coble, Hinze et al., 2000). However, there are other effects from accident in which contractors have not been concerned such as OSHA cost, decrease employee morale, less of future work etc. In US construction industry estimation, accident costs were at US$11.5 billion in 2002, including 15% of the total costs for accident in all industries. In Australia, accident and deaths cost $109 million a year and almost 50,000 weeks of lost working time. On the other sides, injuries of construction worker have an adverse impact on productivity in the industry. The impact is further felt when the injured worker's crew is less productive as a result of the injury. Furthermore, the accident may reduce the attractive competition of construction company, decrease of clients' interest and obliterate reputation of company.

Nowadays safety is found as a critical issue in managing construction projects. Many construction project attempts to improve construction operation by protecting welfare of employees, providing a safe work environment and controlling construction costs. Safety is one of the most important requirements which are considered in contract, bidding and the contractor selection.

Because of safety's importance, many researches have been carried out to explore the methods for improving the safety in construction site. These topics are very extensive explorations including overall fields in construction safety management such as occupational health, technology application, safety law, organizational safety culture, safety climate, safety performance, training, partner's attitude and behavior. These researches contributed an extra great part in reducing accident in construction. Although many research studies were explored, there are still much injuries occur every day in every country. It means that the future study of construction safety is still needed. Therefore, it's still an urgent and important mission to solve safety problem in construction site.

1.2 Statement of Problems

Many researchers and practitioners have explored various techniques to reduce construction accidents and deaths (Bentley, Hughes et al. 1995; Hadikusumo and Rowlinson 2003; Panagiotis, Tariq et al. 2005). Although they may be well developed but it is difficult to achieve continuous improvement on safety performance in construction industry. The main reason is that construction environment has many special characteristics such as decentralization, high mobility. It also depends on weather condition and uncertainty of work condition (Arditi, Lee et al. 2007; Chan and Au 2007). Another reason is that safety performance in construction is more relevant to human factors (Fang, Chen et al., 2006). Therefore, if a construction company expects to achieve higher level of safety performance, it needs consider improving safety culture or safety climate (Mearns, Whitaker et al., 2003; Xie, 2003). Understanding of safety climate can help us to control and decrease the unsafe workplace. The earliest paper on safety climate was conducted by Keenan in 1951 (Guldenmund, 2000). Until now, there are a lot of definitions of safety climate. Its meaning can be explicit or implicit. Safety climate was defined as a "*summary of molar perceptions that employees share about their work environments*" (Zohar, 1980). Another definition from Cox and Cox (1991) gave that "*safety cultures reflect the attitudes, beliefs, perceptions, and values that employees share in relation to safety*". A number of studies have been conducted to describe and construct the dimension of safety climate because of its major; each author has a different way to represent this concept. Zohar (1980) as the first person explored dimensions of safety climate. According to the result from factor analysis, eight factors related to safety climate dimensions included safety training, work pace on safety, safety committee, safety officer, safe conduct on promotion, level of risk at the work place, management attitudes to safety, and the safe conduct on social status (Zohar, 1980). Other researchers described the safety climate such as Sawacha (1999), Flin (2000), Glendon and Litherland (2001) and Guldenmund (2000). There are many research studies about safety climate in construction industry. Their previous studies may have some differences in concepts, models, and dimensions but generally no one can disclaim the role of management factor and supervisor is one of them.

Construction is classified as a cooperative environment. It needs coordinated closely by many parties as owner, contractor, sub-contractor, designer, consultant and project manager. To reduce and eliminate construction accidents, there are a lot of researches who explore their role and demonstrate parties' role. The contractor is the key player to control site safety (Levitt and Samelson, 1993; Hinze, 1997). Sub-contractor can be influenced by general contractor to implement the safety at construction site (Richard S. Baldwin, 2000; Jimmie and John, 2003). Designers also can reduce safety hazards in the working procedure if they notice it during the decision making stage such as choosing standard. The safety can be encouraged by the process of writing contract (Jimmie and Francis, 1992; Gambatese and Hinze, 1999). The owner is one of important party to manage and reduce the accident when they select the contractor, contractual safety requirement or participate in safety management during project execution (Gambatese and Hinze, 1999; Huang and Hinze, 2006). The role of project manager is considered in many papers, they are the most important party in construction safety (Levitt and Samelson, 1993; Huang, Chen et al., 2004; Clarke, 2006). In the construction site, three management levels can be directly impacted on the safety management. These three levels are top manager, supervisor/foreman and worker. It should be pointed that the top provide a vision and policy on safety while middle manager plays the essential role to serve the top management policy. Worker level is seen as the third level who has a main role and directly gets impact on safety in construction (Lingard, 1995; Brown, Willis et al., 2000). Previous studies about the causes affecting the safety management mentions about manager and worker however few mentions about the role of middle person–the supervisor. Therefore, the research about this middle level is necessary to explore the relationship with construction site safety.

When safety is more and more important in construction site, the role of supervisor is more and more appreciated. A successful safety program starts at the very top of the organization. All project stakeholders such as owners, top executives, and middle managers must be committed to safety. The supervisor is the key person of the program because they represent top manager and daily contact with the employees. Even when the construction project has a safety engineer or a safety director, the supervisor is still responsible for ensuring that safety directives are carried out. In addition, supervisor may shapes the employees' attitude toward safety (Ludden and Capozzoli, 2000). From supervisor practice, employees know what should do in safety status. A good behavior in safety supervisor is very important to the success of safety management.

The safety behavior is considered as one of the significant causes affecting safety performance in construction site. Cooper and Phillips (2004) took a safety climate measure in the manufacturing sector at the beginning of a behavioral safety initiative. After one year they found that employees perceived the importance of safety training that could be applied to predict the actual level of safety behavior. Zhou (2008) studied a method by applying the technique to give more insight into the influence of safety climate and personal experience factors on safety behavior, and identifying strategies to control the factors that have the most impact on safety behavior in complex construction scenarios. Some are studied about safety behavior such as Cox (2004), Lingard and Steve (1998), Duff, Robertson et al. (1994), Prussia, Brownb et al. (2003), DeJoy (1996). But these researches focused on worker level only, they tried to identify the factors can effect the worker behavior to change their behavior more positive safety as in Lingard (1995), Brown, Willis et al. (2000), Langford, Rowlinson et al. (2000).

Few studies were explored about supervisor related to safety behavior. Based on the study by Fang (2006), supervisor was mentioned as one of the employees in construction site. He explored the relationships between safety climate and safety behavior. Another study by Clarke (2006) also examined the relationship between safety attitudes and unsafe behavior and accidents. This study expected to examine all level in a car manufacturing plant from workers, supervisors and managers. However, the sampling was obtained only from workers and managers and didn't mention about supervisor. Huang (2004) examined the presumed benefits of safety policies and the roles of two organizational variables, supervisor safety support and employee safety control, on safety outcomes and satisfaction with the company. Supervisor is one of the managements that create a positive safety climate, directly through the interaction with the employees. The supervisor safety roles also was emphasized in general industry (Börjesson, 2008). Another study by Fung (2005) investigated the relationship between people's behaviors, attitudes and perceptions towards safety culture and to compare safety culture divergences among three levels of construction personnel: top management, supervisory staff and frontline worker by conducting safety culture survey. According to Dov Zohar

(2003), workers' safety behavior was significant influencing from supervisory safety-oriented and this influence may cause changing of safety climate scores.

Basing supervisor's activities and roles, there is no doubt about supervisor's importance in successful project, especially in reducing accident rate. Supervisor's behavior strongly impacts on the workplace safety at construction site. So if we understand what factors and know how factors affect their behavior in safety, the accidents in construction site can be obviously reduced. Therefore, a development model of factors influencing supervisor's behavior on safety action is necessary and important.

1.3 Research Objectives

From the above research problem, following research objectives will then be addressed:

- Explore the current supervisor's behavior on safety action at construction site
- Identify factors influencing supervisor's behavior on safety action
- Establish a model for explaining supervisor's behavior on safety action at construction site through the relationship between these factors, behavioral intention and behavior.

1.4 Research Scopes

This research is conducted under several scopes. At first this research only focuses on building projects in which it has some special characteristics comparing to infrastructure projects or industrial projects. Second, the sample will be collected in Vietnam construction site. It may be a case study of developing country in Southeast Asia only.

1.5 Research Methodology

The research methodology is designed to explore the factors that affect supervisor behavior and to develop model for explaining factors influencing supervisor behavior on safety action at construction site. Research methodology consists of several steps, which are:

- Systemization knowledge related to topic from literature review;
- Selection and design of data collection tools, questionnaires
- Data collection include pilot study and large-scale study
    - Selection of sites and samples; and
    - Data collection process

- Data analysis:
    - Descriptive analysis techniques are analyzed to explore respondents' characteristics and current behavior of supervisor in Chapter 4.
    - Factor analysis is used to explore initial factors influencing supervisor behavior on safety action. More details of factor analysis can be found in Chapter 5 and 6.
    - Structural Equation Modeling (SEM) technique is applied to analyze data and develop the explaining model. More details on SEM methods can be found in Chapter 5 and Chapter 6.

1.6 Research Outline

The thesis presents the whole research process and findings, and is organized as follows.

Chapter 1 provides a background of the research process and contributions, including the background to the research, the research problems, the research objectives, the research scopes and limitations, the methodology, and contributions.

Chapter 2 discusses the research issues, presents a literature review of safety, safety management, supervisor role and responsibility in safety, and safety behavior theories, and sets out the research questions.

Chapter 3 details the research method and the envisaged outcome for each stage of the research. Specifically, this chapter describes the utilized research instruments, data collection methods, data analysis techniques and desired research outcomes.

Chapter 4 presents a detailed discussion on the research methodology and findings. It includes the choice of research approaches and assumptions, the survey data collection methods, the analysis of current supervisor behavior, and the relationship between behavioral intention and behavior for assert the theories.

Chapter 5 focuses on data analysis that explores factors influencing supervisor's behavior on safety action. Then it presents the development of perception model for explaining relationship between these factors and their behavior by using SEM. All of factors explored in this chapter based on supervisor's perception.

Chapter 6 details the same methodology with chapter 5. It includes exploring factors from factor analysis and then develops model for explaining supervisors' behavior. But data collection for each factor is obtained from supervisors' practice such as supervisors themselves, real practice of construction company, construction site, characteristics of current working project.

Chapter 7 presents the research conclusions and implications, summaries the main findings of the research, explores the implications for theory, methodology and practice of the findings, addresses the research limitations and highlights the potential areas for the future study.

1.7 Research Benefits

The results show the current status of supervisor's behavior in safety action in construction site. It will help the project parties more understand about factors influencing supervisors' behavior. This study will also establish an explaining model for company who expects to improve their supervisor safety role. In addition, the explaining model from this research can support the company in selection suitable supervisor staff in conformable construction sites which are different characteristics and requirements. Furthermore, perception model and practice model are developed concurrently. It can help us not only understand what supervisors' perception but also how their current practice on safety at construction site.

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.

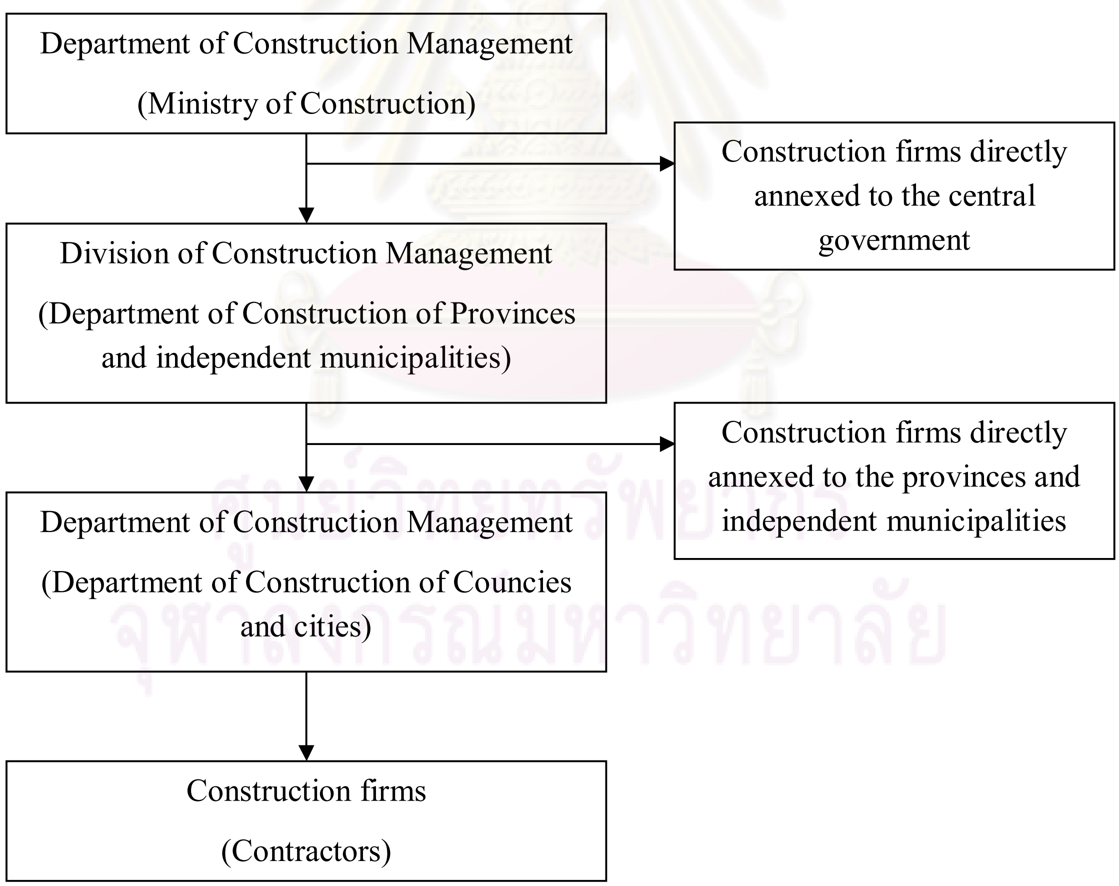


Figure 2.1 Government hierarchy for construction safety management (Rowlinson, 2004)

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.

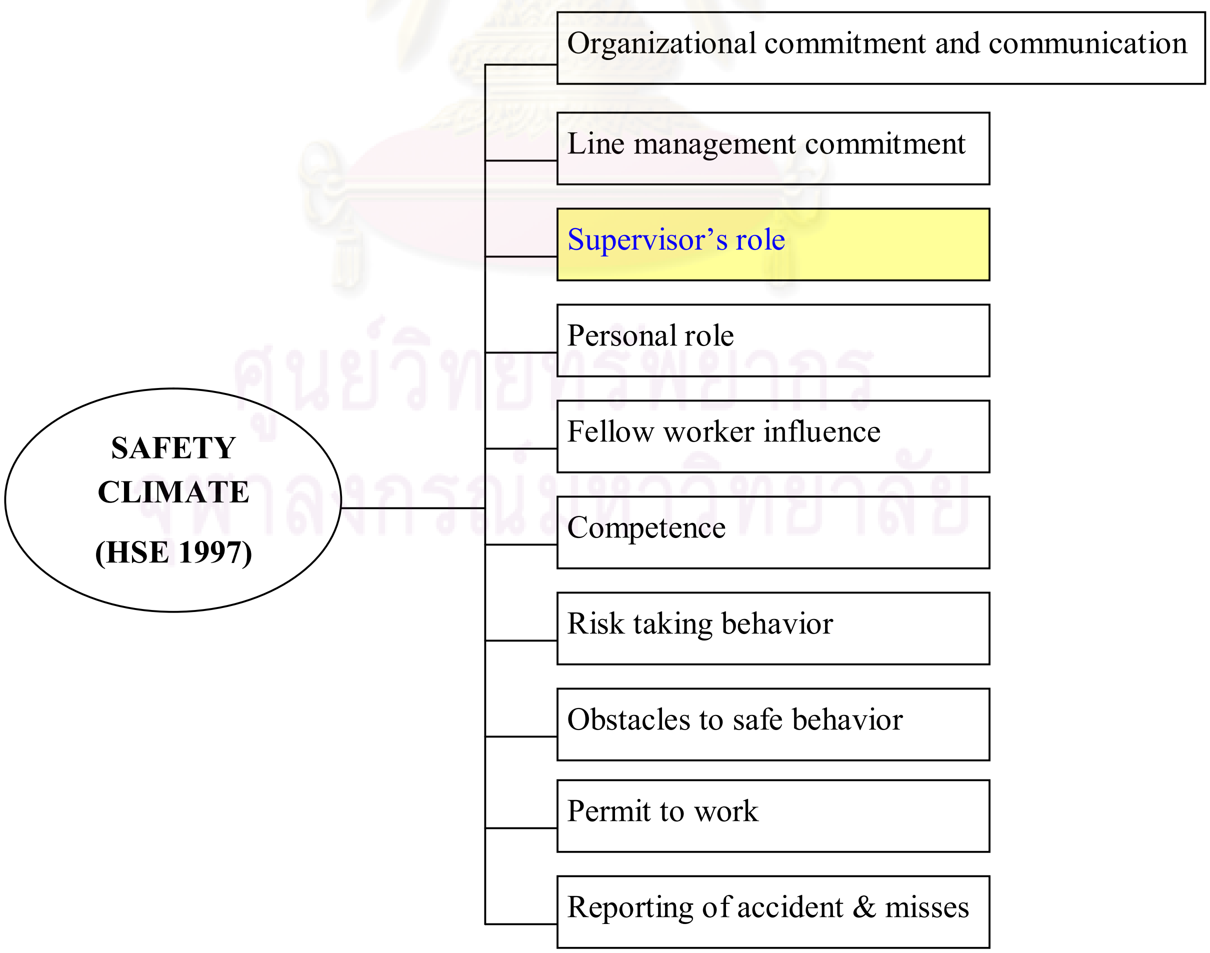
2.2.2 Dimensions of Safety Climate

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.

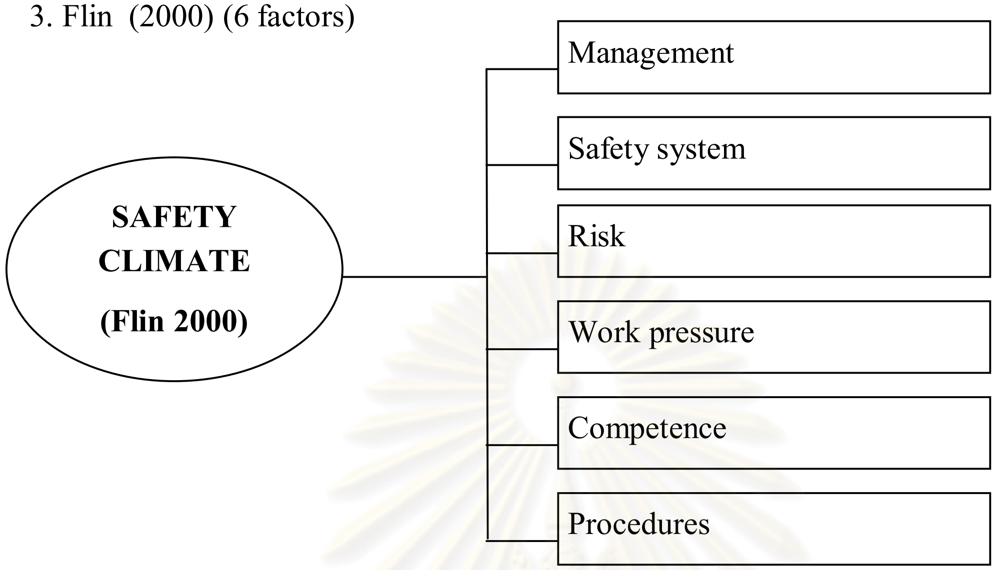
These are some models to describe about safety climate.

1. Zohar (1980) (8 factors)

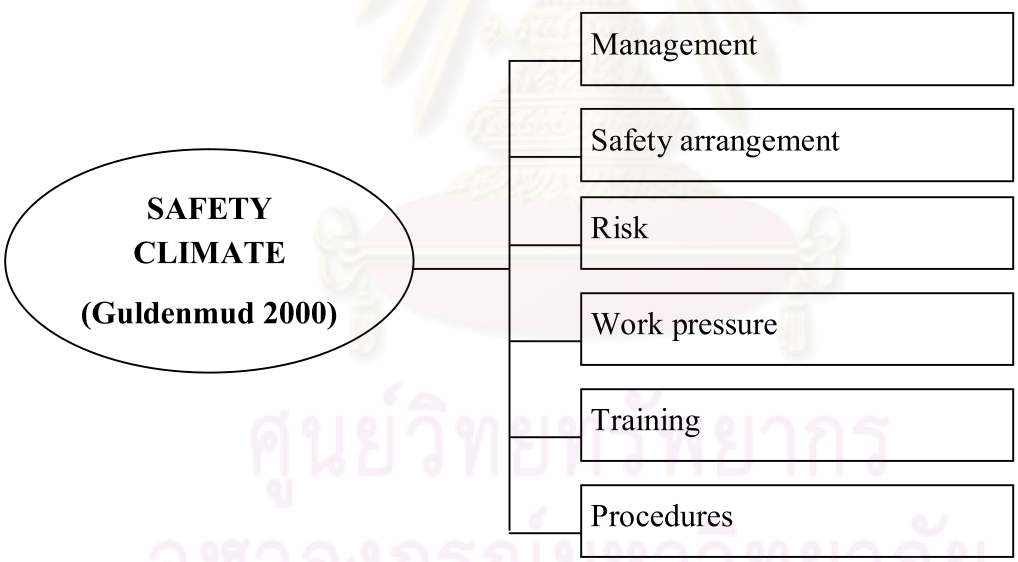
2. Health and Safety Executive of the United Kingdom (HSE 1997) (10 factors)



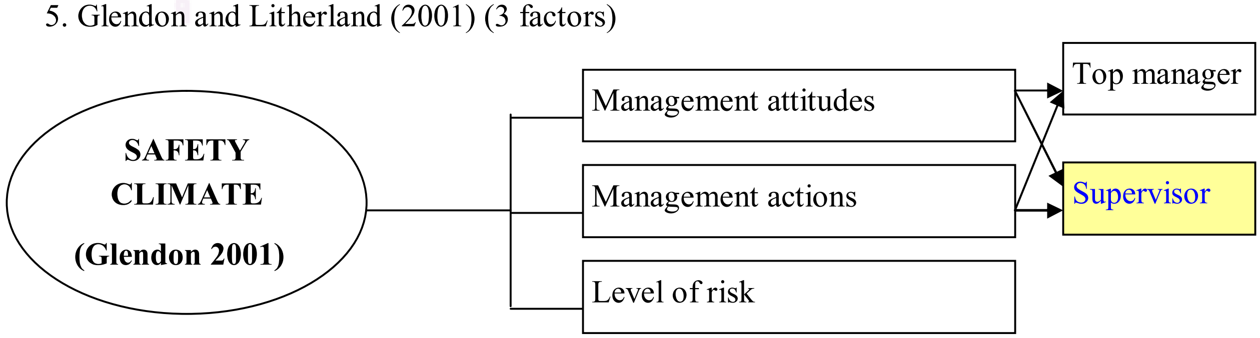
3. Flin (2000) (6 factors)



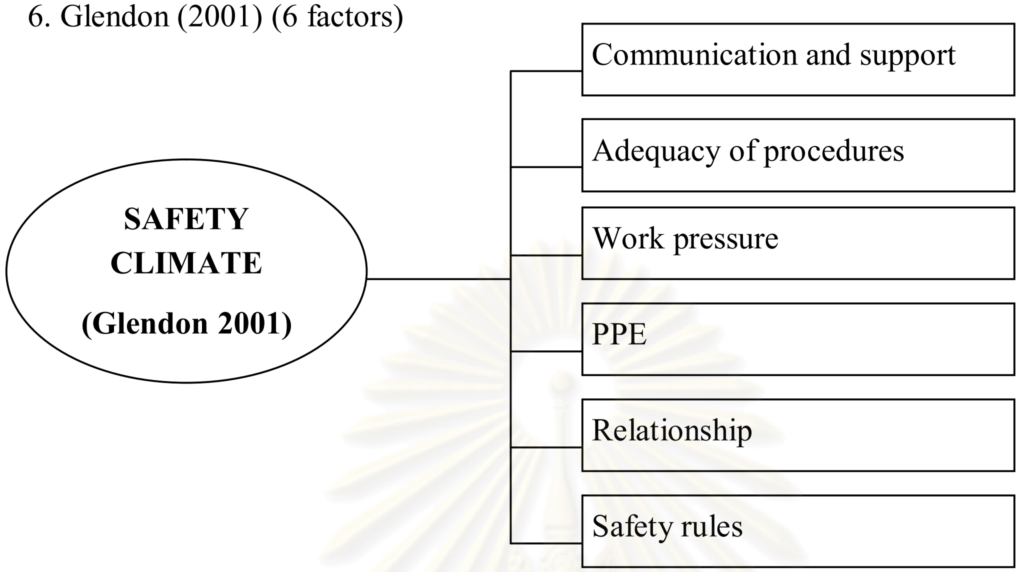
4. Guldenmud (2000) (6 factors)



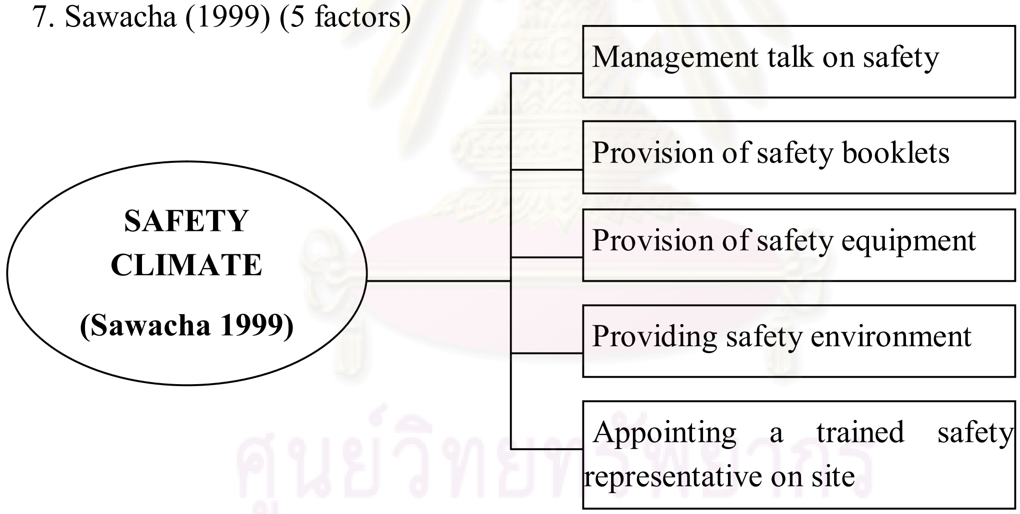
5. Glendon and Litherland (2001) (3 factors)



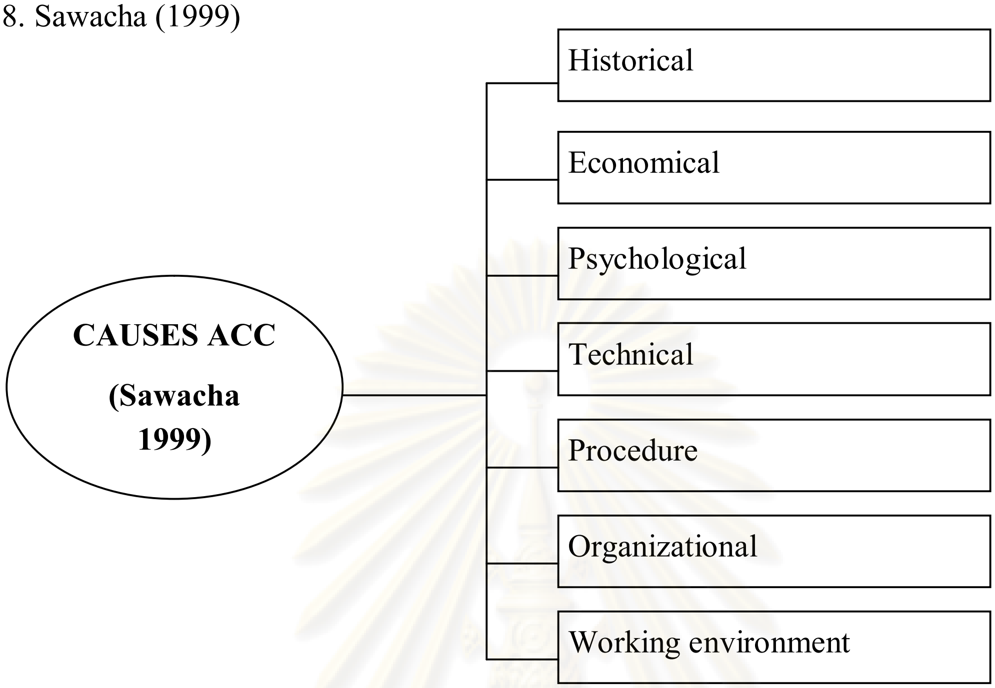
6. Glendon (2001) (6 factors)



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.

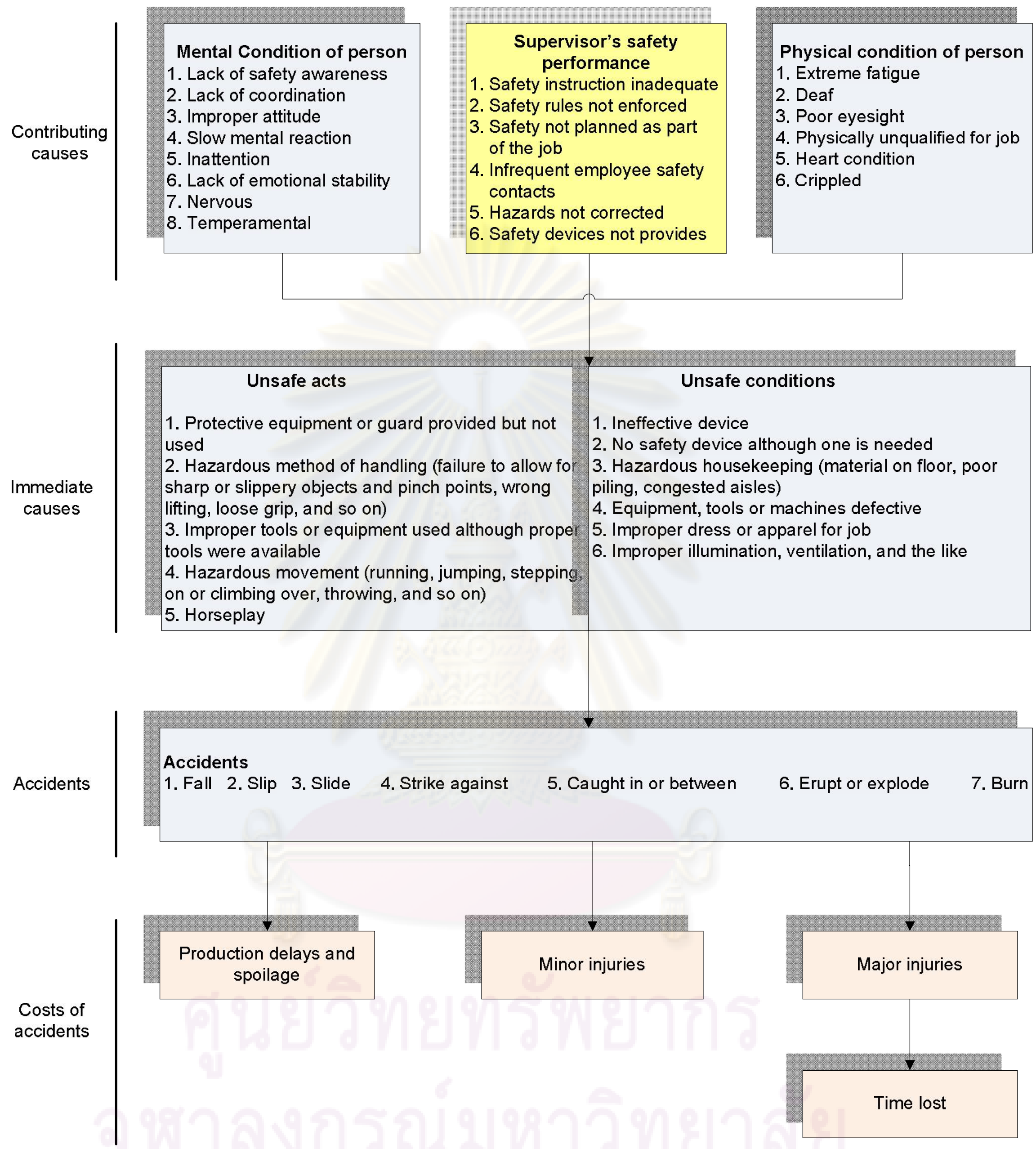


Figure 2.2 Essentials of Management for First-Line Supervisors

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.

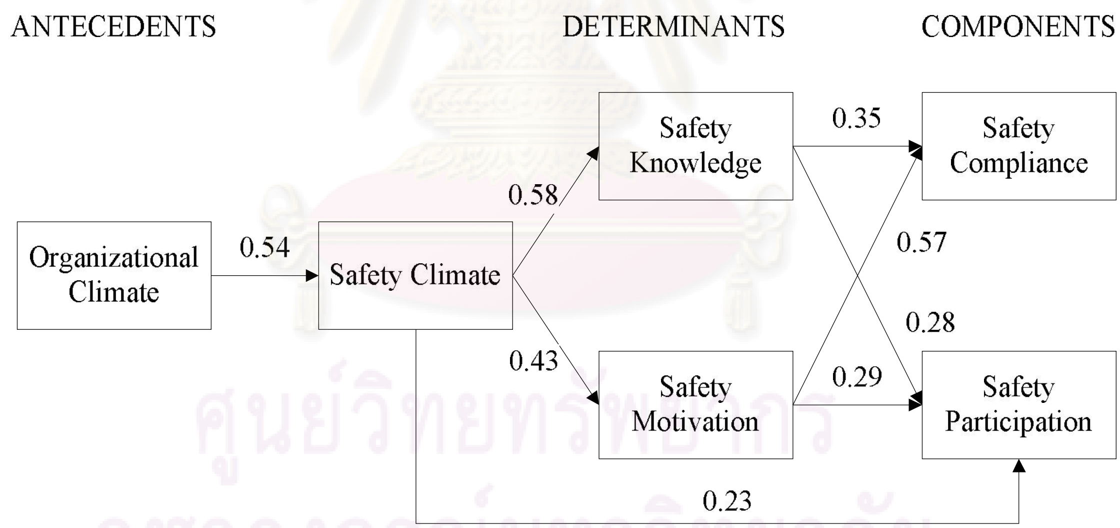


Figure 2.3 Neal et al. (2000) Model

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.

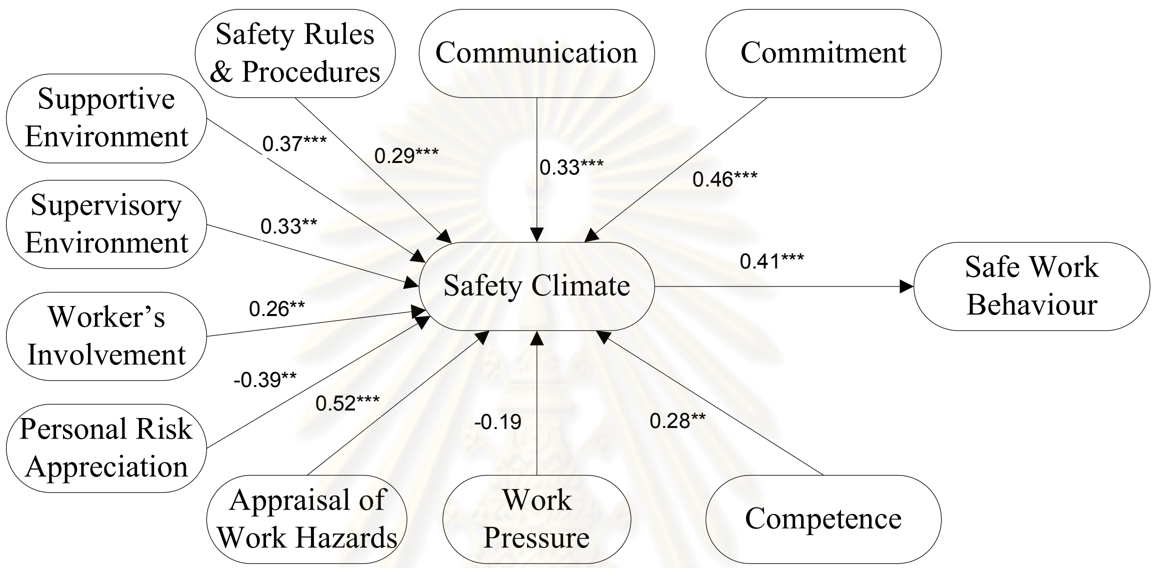


Figure 2.4 Research model linking safety climate determinants to safety work behavior (Mohamed, 2002)

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.

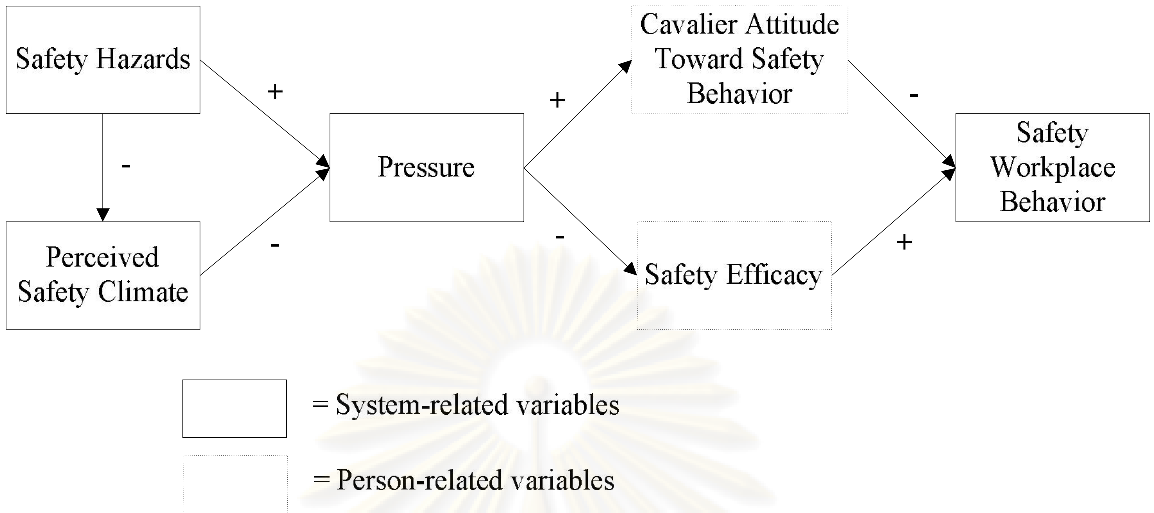


Figure 2.5 Safety workplace behavior (Prussia, Brownb et al., 2003)

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.

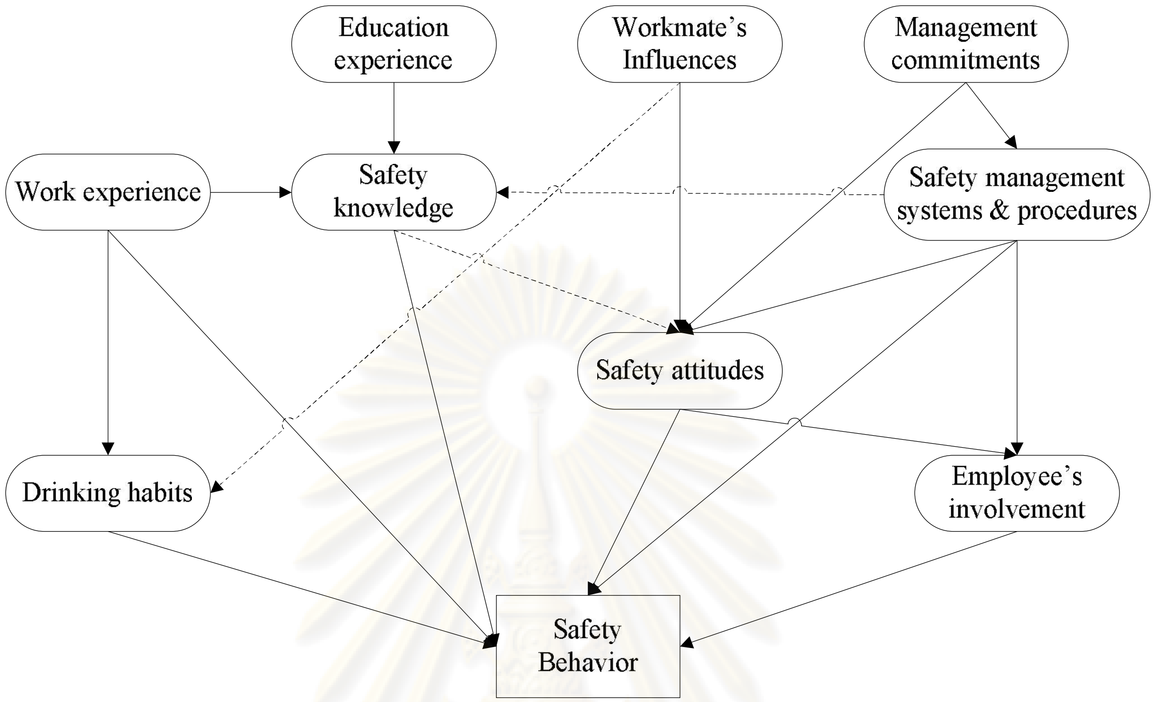


Figure 2.6 A BN of safety behavior (Zhou, Fang et al., 2008)

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.

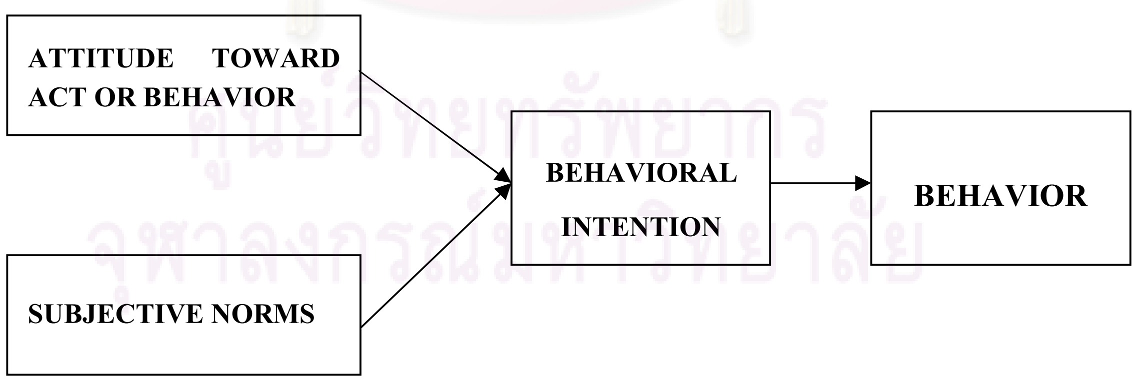


Figure 2.7 Theory of Reason Action (Fishbein and Ajzen, 1975)

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).

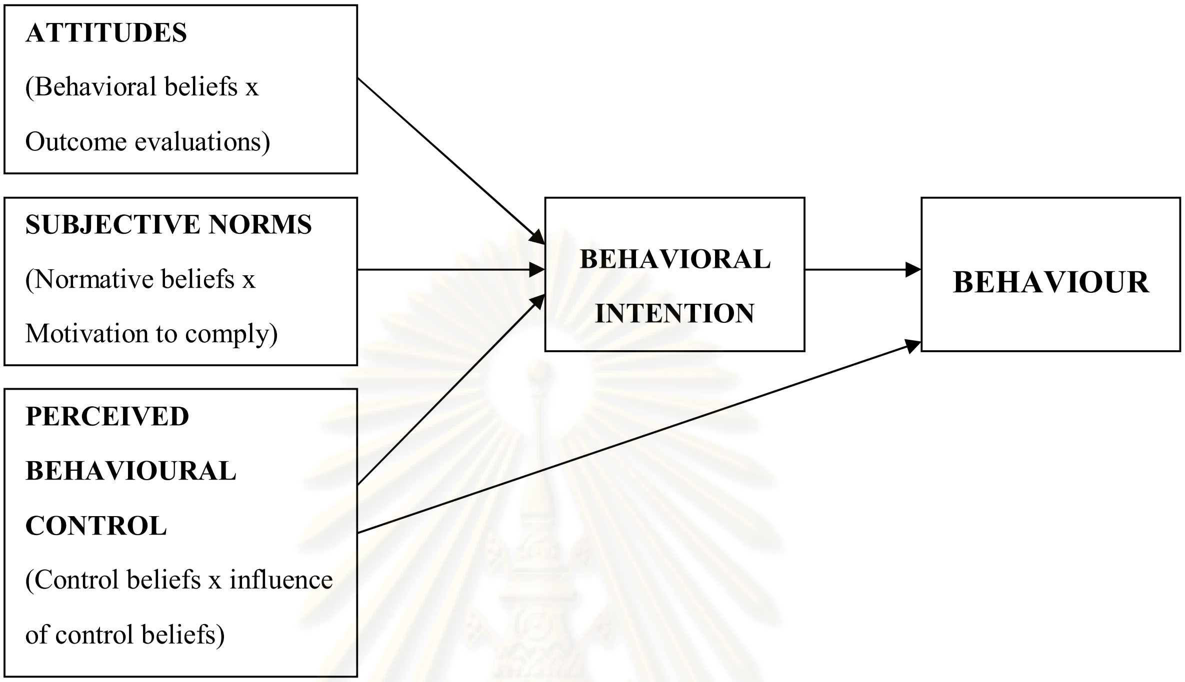


Figure 2.8 The Theory of Planned Behavior (Ajzen, 1991)

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.

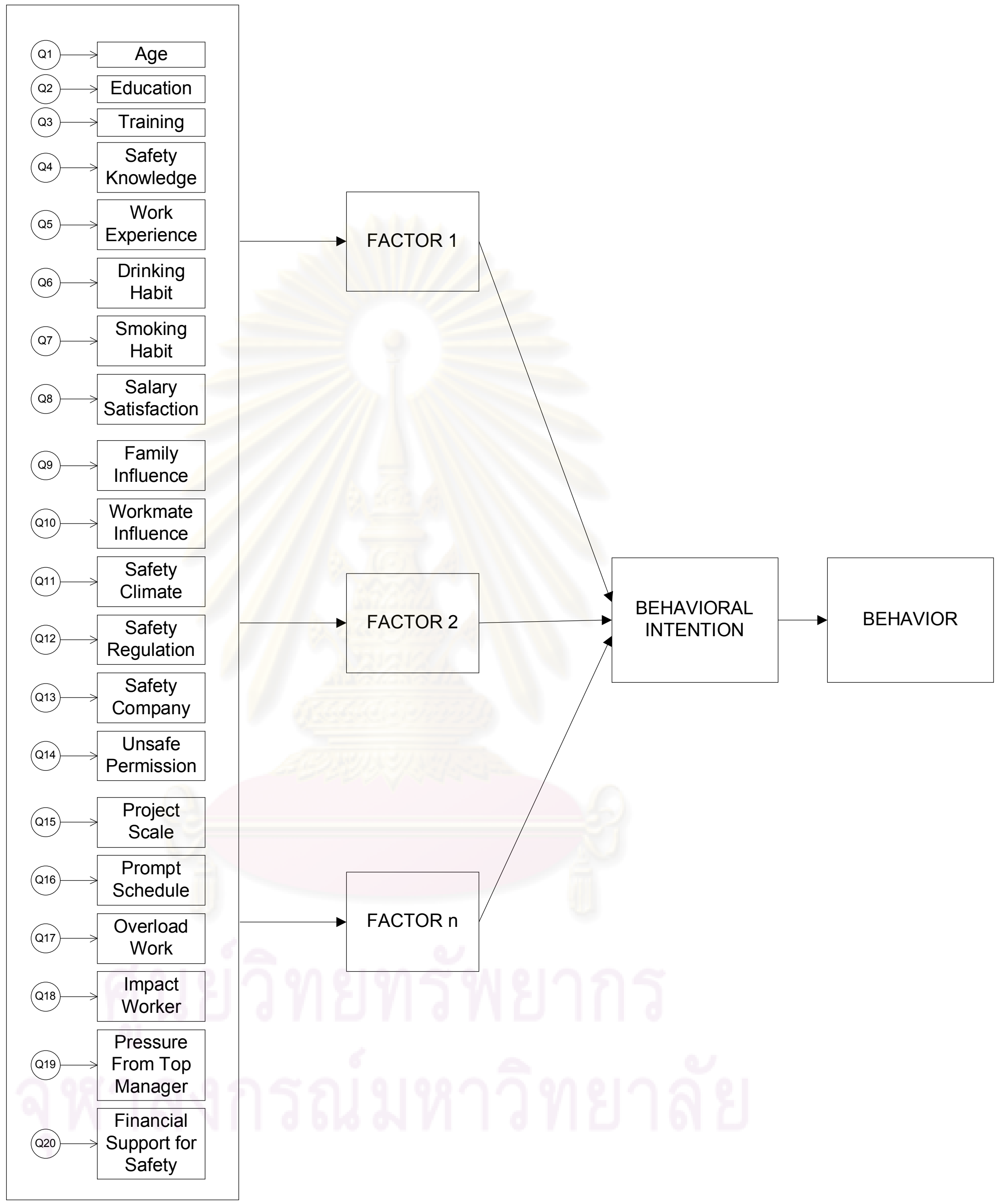


Figure 2.9 Proposed model of factors influencing supervisor's behavior in safety actions

CHAPTER III

RESEARCH METHODOLOGY

This chapter describes the proposed research method for evaluating supervisor's behavior on safety actions, refining the conceptual model and developing the final model for explaining factors affect their behavior in safety action at construction site. Moreover, the envisaged quantitative analysis methods required to achieve the research objectives are described. This chapter starts with section 3.1, summarize of research methodology. A schematic representation of the research activities and their expected output are described in Figure 3.1 below. The discussion then moves to data collection methods in section 3.2. Questionnaires design is described in section 3.3. After that, pilot study process is detailed in section 3.4. Finally, large scale study is discussed in section 3.5.

3.1 Research Methodology

Research methodology is designed in other to achieve the research objectives that set up at the beginning. It is a guideline with clear process and objectives of each process according to the conditions such as time, money, and research quality. The methodology adopted for carrying out this research is described below:

- Systemized the knowledge from literature review; and
- Design of data collection tools (instruments);
- Data collection:
    - Selection of target population, sample size, sampling technique; and
    - Data collection process;
- Data analysis:
    - Phase 1: Evaluating the supervisor behavior on safety through descriptive analysis.
    - Phase 2: Extracting factors affect supervisor's behavior on safety action through undertaking factor analysis.
    - Phase 3: Describing the relationship between factors in phase 2 and Supervisor behavioral intention and his behavior in safety action in phase 1.

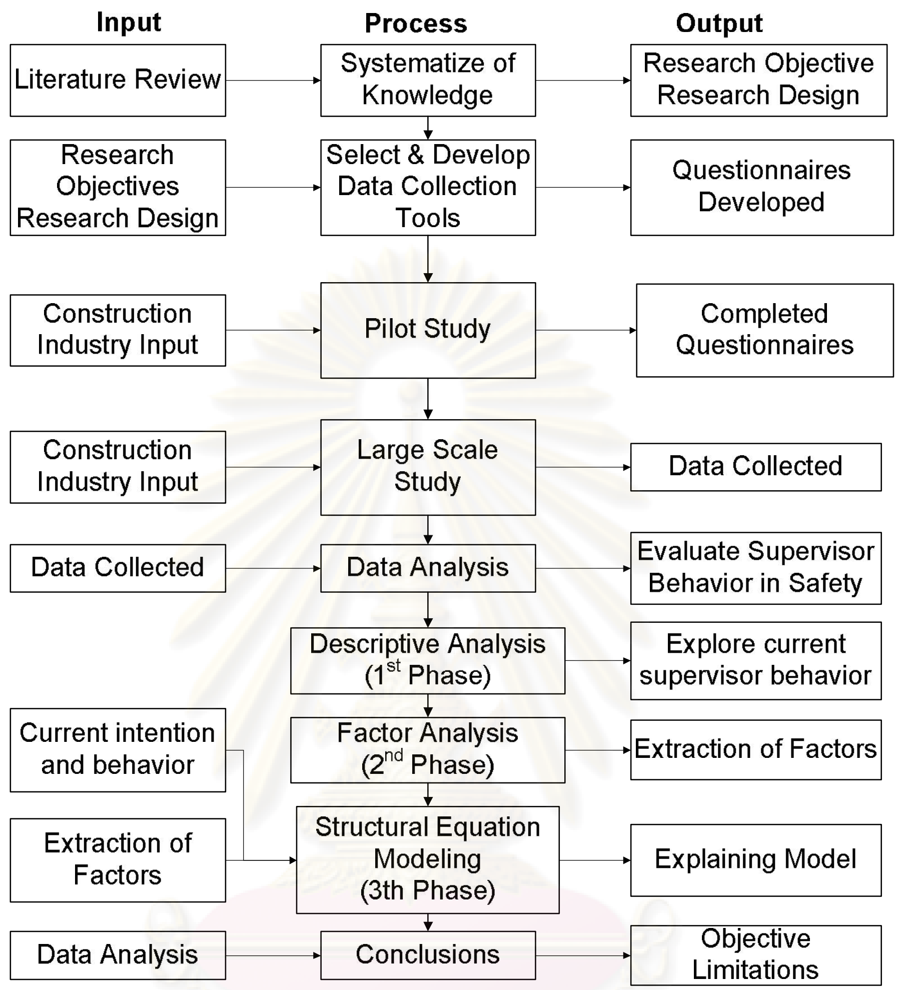


Figure 3.1 Research methodology

The research methodology process in Figure 3.1 is a master plan of procedures that we should follow to achieve the research objectives within economical budget. This process is classified into three categories based on the purpose of the research project, including (1) conceptual model development; (2) pilot study; (3) large scale study. Figure 3.1 illustrates the steps undertaken to achieve research objectives.

Stage I (Conceptual Model Development) – is used to systemize the relevant knowledge to define the research gaps, clarify the problem stamens, set up a clear objective to explore the new topic. The aim of this stage is to develop a conceptual model for explaining supervisor's behavior based on the literature review undertaken in Chapter 2.

Stage II (Pilot Study) – is used to test the validity of the questionnaire survey and uncover any gaps in the research.

Stage III (Large scale Study) – is purposed to collect all necessary data to determine the main factors of the conceptual model and the relationship between them and supervisor's behavior. A completed model for explaining supervisor's behavior is determined and evaluated.

3.2 Data Collection Method

3.2.1 Survey Research

Sample survey is considered to be appropriate for this research. Selecting the suitable data collection technique is very important in order to conduct a valid research (Tabachnick and Fidell, 2007). Sample survey is selected because of its advantages such as inexpensive, representative for large population, feasible in different location by mail, email or phone, flexibility and statistically significant. However, survey has some disadvantages should be considered carefully. The researcher must ensure the large sample to achieve statistically significant results. In addition, survey requires careful and complete questions to minimize the bias and misunderstand of the respondents, and requires accurate information about the population. Even though designing the good survey tools, the researcher can not control the quality of the respond because it depends on the participant of respondents.

Surveys are common and important method of behavior research. Related to human behavior, people was asked to provide information about themselves by using questionnaires and interview. From representative questions regarding to specific behavior, we can ask to understand person's attitudes, beliefs, behavioral intention and actual behavior.

3.2.2 Data Collection Method

Data collection method is a key step influencing the valid and reliability of survey research. The main purpose of data collection is gathering enough data from a smaller sample for analyzing the behavior of a general population. There are two ways to perform survey which are written questionnaire and interview (Cozby, 2007). With the questionnaire, respondents are asked to fulfill their own opinion, so it may take time for them to read and understand the question. This method is generally less costly and saving time than interview because it can be carried out by personal or group administration, mail or email, and internet survey. However, interview method usually provide higher respondent rate because people are more comfortable to participate to answer for a real person than a mailed questionnaire. There are three ways to conducting interview survey such as face-to-face interview, telephone interview, and focus group interview. Each of them has its own advantages and disadvantages, and the methods can be used alone or together depend on the scope and depth of data requirement. According to Fellows and Liu (2008), *"the choice is between a broad but shallow, study at one extreme, and a narrow but in-depth study at the other, and a study between these extremes*". Regarding to this research objectives, supervisors' behavior quite not easy to understand, so it requires a highly cooperate from the respondent to achieve valid results. Therefore, data collection instruments used in this research was questionnaire surveys associate with interview face-to-face.

3.2.3 Target Population

After clarifying method for data collection, target population is the next important issue needs to design. The better target population that we designed, we get the better representative for general population. Considering the main objectives of this research was to explore the supervisor's behavior in safety action in Vietnam construction site, so the subject of study will focus on supervisor working at construction site. In details, the target population of this study is defined as:

- Elements: Supervisors
- Sampling units: Supervisors who are currently working at construction sites
- Extent: Construction sites at Hochiminh city, Vietnam
- Time: 2010

3.2.4 Sampling Method

There are two main techniques of sampling from a target population: probability sampling and non-probability sampling (Cozby, 2007; Hair, Black et al., 2010). In probability sampling, each member of the population has a specifiable probability of being chosen. In other words, the list member of population is determined before sampling. In non-probability sampling, we don't know the probability of any particular member of the population. Non-probability sampling technique is quite arbitrary, difficult to ensure that the sample accurately represents the population. However, it is cheap and convenient comparing with probability sampling. So it is quite common and useful in many circumstances.

Under the probability concept, three main techniques can be applied to obtain sampling for data analysis. These three main sampling techniques are named as simple random sampling; stratified random sampling; and cluster sampling (Cozby, 2007; Hair, Black et al., 2010). The comparison between advantage and disadvantage of these probability sampling techniques are summarized in Table 3.1. Three types of non-probability sampling techniques are haphazard sampling, purposive sampling, and quota sampling. These techniques are summarized in Table 3.1.

Table 3.1 Description of sampling tools (Cozby, 2007)

Technique	Descriptions	Advantages	Disadvantages
Probability sampling			
Simple random sampling	Randomly choose a number of members of the population with an equal probability.	Representative of population	Expensive. Difficult to get full list of population.
Stratify random sampling	The population is divided into subgroups, and random sampling techniques are then used to select sample members from each stratum.	Representative of population	Expensive. Difficult to get full list of population.
Cluster sampling	Randomly choose some clusters from clusters list designed, and then random sampling techniques are used to select samples from chosen clusters.	Researcher doesn’t have to sample from lists of individuals in order to get a truly random sample.	Expensive and difficult to get full list of all members of any chosen cluster.
Non-probability sampling			
Haphazard sampling	Select a sample of population in convenience.	Inexpensive, efficient, convenient.	Bias into the sample, results may not generalize to intended population.
Purposive sampling	Obtain a sample of people who meet some pre-determined criterions.	Sample includes only purposed individuals are interested in.	Bias into the sample, results may not generalize to intended population.

Table 3.1 Description of sampling tools (Continued)

Technique	Descriptions	Advantages	Disadvantages
Non-probability sampling			
Quota sampling	Chooses a sample that reflects the numerical composition of various subgroups in the population.	Inexpensive, efficient, convenient, slightly more sophisticated than haphazard sampling.	Bias into the sample, results may not generalize to intended population; no method for choosing individuals in subgroups.

Because the sampling units are supervisors who are currently working at construction sites, it is difficult to get a complete list of target population. Besides, safety at construction site is delicate study so almost company refused cooperates. So, contacting and entering construction sites to interview supervisors are very complex without personal relations. In addition, this research is performed in a limited time and budget. From these reasons, purposive sampling is selected as a suitable tool for this research. A number of available construction sites at Hochiminh city are listed and contacted for interview permission before conducting the survey.

3.3 Questionnaire Design

Questionnaire is an efficient instrument for data collection. It contents a list of questions related to the research objectives that requires respondents provide their answers. A great deal of care is necessary to write the best question for a survey, researchers have to know exactly what their purposes of each question and the scale to measure the variables. With an efficient questionnaire, researcher can achieve their research objective faster and cheaper that other mechanism. However, it is not easy to get a good questionnaire.

There are three steps in designing a questionnaire, namely:

- Constructing questions to ask includes defining the research objectives and question wording.
- Responses to questions contents categorized, scaled and coded responses for analyzing after collected.
- Finalizing the questionnaire includes formatting the questionnaire and refining questions for more attractive and professional.

In developing the questions for this study, a number of suggestions relating to good question design were followed to. The principles for good question include:

- Avoid complexity,
- Avoid leading or loaded questions that lead to social desirability bias,
- Avoid emotional language and prestige bias,
- Avoid ambiguity,
- Avoid double-barreled words,
- Avoid making assumptions (ask respondents who do not have relevant knowledge),
- Avoid questions that seriously require the respondent's memory,
- Avoid implicit alternatives,
- Avoid estimates,
- Avoid double-barreled questions,
- Consider the frame of reference (the respondent's viewpoint in responding to questions),
- Determine the use of multiple questions or one question,
- Stimulate respondents to answer, and
- Avoid false premises.

By following these principles, a set of questionnaire was designed to take the views of supervisor on tasks in their safety supervision. The final version of the questionnaire for pilot study was developed and presented in Appendix A1. For this research study, four distinct questionnaire surveys were developed, included:

Table 3.2 Contents of survey questionnaire

Survey Questionnaire	Content	Expected Outcome
Section 1:	General Information of supervisor	Practical parameter of supervisor as personality, conditions of site and company in which they are working
Section 2:	Factors affect the supervisor's behavior	Assessing important level of factors that may influence supervisor's behavior
Section 3:	Measurement of Supervisor's safety behavioral intension	Supervisor's safety behavioral intention
Section 4:	Measurement of Supervisor's safety behavior	Supervisor's safety behavior

Section 1: General information related to safety issue

This section is designed to obtain data related to safety issues. This section includes supervisors' general information and their evaluation about current safety practice of construction company, construction project and project stakeholders.

Section 2: Factors affect the supervisor's behavior

As explained earlier in Chapter Two, the items for questionnaire survey were taken from a literature review and recent studies by Hofmann and Stetzer (1996), Cooper (1998), Neal (2000), Mohamed (2002), Prussia (2003), Zhou (2008), specially, Theory of Planned Behavior (Ajzen, 1991). Questionnaire comprised of twenty statements, which are considered factors that affect the Supervisor's behavior in safety, dealing with personalities, safety attitudes, subjective norms, perceives behavior control.

For each statement, supervisors were required to express their perception. Respondents indicated the strength of agreement or disagreement using a five point Likert scale, under categories of 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, and 5= strongly agree.

Section 3: Measurement of Supervisor's safety behavioral intension

Table 3.3 Safety accidents in the construction industry in 1999 (Rowlinson, 2004)

Accident category	Case of accidents	Fatality	Severe injury
Falling from height	466 (50)	524 (48)	133(44)
Electrocution	120 (13)	124 (11)	4 (1)
Hit by falling materials	115 (12)	116 (11)	45 (15)
Collapse of earthwork	87 (9)	148 (13)	36 (12)
Use of heavy machine	63 (7)	71 (6)	38 (13)
Lifting of weights	32 (3)	45 (4)	18 (6)
Toxic and suffocation	16 (2)	29 (3)	2 (1)
Use of motor	8 (1)	8 (1)	3 (1)
Fire and explosions	5 (1)	20 (2)	3 (1)
Others	11 (2)	12 (1)	17 (6)
Total	923 (100)	1097 (100)	299 (100)

The figure in parentheses indicates the percentage of the total

From literature review, falls from height and electrocution hazards are the most dangerous causes of fatal construction accidents. According to Report situation of occupational accidents for the first of 6 months of year 2008 in Vietnam, falling occupied 17,61% accidents and 19,81% fatality, electrocution occupied 26,70% accidents and 22,64% fatality. Rowlinson (2004) stated another report from China statistical yearbook of construction stated that falls from height and electrocution are the first and second subjective causes, details in Table 3.3.

According to research groups about constructing questionnaires based on theory of planned behavior (Francis, Eccles et al., 2004), behavioral intention can be measured by three methods which are Intentional performance, Generalized intention, and Intention simulation. For the purpose of this research, Intention simulation method is referred to use at the beginning questionnaire design. The instrument was developed to explore Supervisor behavioral intention by asking them questions regarding falling from height and electrocution hazards in ten scenarios. For each scenario, supervisor has two options to show their safety behavioral intention which are "Aware worker carefully or stop worker working until it be fixed" or "Let worker use it, don't say anything". Count the number of "Aware" answers. This number is the score for behavioral simulation. The higher the number, the stronger is the intention to perform the behavior. Ten situations are described below.

- *Regarding falling from height hazards are concerned with five situation*
  - *Situation 1:* Scaffold is not totally boarded
  - *Situation 2:* Ladders to climb up to a higher level is not tied or secured
  - *Situation 3:* There are many holes still not be shield when working at high level
  - *Situation 4:* Working at high level without edge protection and personal protections
  - *Situation 5:* Working at high level in bad weather such as windy, small rain
- *Regarding electrocution hazards are concerned with five situation*
  - *Situation 1:* Electric wire quality not satisfy the technique requirement
  - *Situation 2:* There is a part of jumper wire touch the water on the ground
  - *Situation 3:* Using handle electrical equipment without any personal protections as gloves, boots
  - *Situation 4:* Electrical equipment but don't have any circuit breaker, plug pin, safety box.
  - *Situation 5:* Electric line in your construction is very low and interlace

Section 4: Measurement of Supervisor's safety behavior by the activity method

The research questions were developed with the intent of exploring the current behavior in safety actions of supervisor at construction sites. Following Dan Petersen (1976) guidelines and Gary W. Hobson (1990) behavior measurement, interview questions allow supervisors to describe how often they perform their safety role. Their safety responsibilities are expressed by four main issues which are

- Investigating accidents to determine causes,
- Inspecting their area to identify hazards,
- Coaching their people to perform better, and
- Motivating their worker's aspiration to work safely.

Twelve questions related to main issues of safety are developed to assess supervisor current behavior. They represent important supervisor behaviors that build positive affect to workers. The respondents will be asked to choose one answer within three options for each question which will later be graded. They will be graded (1) point if the item rarely applies, (2) point if the item applies sometimes, (3) point if the item applies most of time.

3.4 Pilot Study

A pilot study is conducted to evaluate and checking the valid of questionnaire for improving in following study. Pilot study is conducted with a small sample similar to target population as designed before. The questionnaire is assessed in aspects of question objectives, question wording, questionnaire formatting to make sure its clarity, understandability and simplicity for respondents.

3.4.1 Questionnaire and Sampling

In pilot study, each respondent is interviewed face-to-face carefully and required to answer questionnaire. Interviews not only focus on the meaning of the responses but also gather their suggestion for each component of questionnaire and their difficulties when answering questionnaire. The subject firm for our study was supervisors working on construction site at Hochiminh city. The pilot study was undertaken in December 2009. The pilot study is conducted to collect data from 141 supervisors who are currently working at nine construction sites and one Cultivate Professional Supervisor course (45 supervisors from 9 construction sites, averaging 5 persons per site; and 96 supervisors at the course). The duration for each interview is approximately from 30 minutes to 45 minutes, depending on the amount of information that supervisors want to provide and cooperate.

The questionnaire survey for pilot testing issued to the respondents is shown in Appendix A1 in Vietnamese version. The questionnaire survey contained four sections. The first section examined general information of respondents, such as, position at construction site, education background, years of experience in civil field and experience as supervisor at site. This section was included to ensure that information was received from valid sources. Moreover, this section was necessary to test the classify respondents in each items, issues have a variance in their respondents were considered valid indicators in explaining model. The second section required supervisor provide perception about important factors which influencing their safety behavior. From five point Likert scale, twenty existing factors were checked whether they are factors influencing supervisor or not. In addition, respondents were asked to adding more factors that may change their safety behavior. The third and the four sections were pretested about the suitable of scale measure, clarity, understandability and simplicity, which can be answered by respondents. It should be noted that the questionnaire was translated into Vietnamese to ensure that all questionnaire items would be properly understood.

3.4.2 Results from Pilot Study

The pilot study is conducted to collect data from 141 supervisors who are currently involving at nine construction sites and one Cultivate Professional Supervision in Construction course. There are 112 respondents who are willing to participate in this survey and sufficiently complete, producing a usable response rate of 79% for the pilot study.

Survey introduction to managers conducted by one of the authors with supporting from company site office. Of those supervisors responding, the average age was 28 years and cover from 23 to 48 years old. All of them were male (100%) and had experiment as supervisor in construction site from 3 months to 10 years. Almost all responders have acceptable education background (91.1% graduated upper Bachelor degree) and at least 1 time attends the Supervisor Course (81.2%).

The pilot study helped refine the data collection procedure in preparation for the large scale study. Piloting is also vital to ensuring data provision by respondents is easy and the requirements clear. The primary concern of the pilot study was to ascertain the reliability and validity of the data. Reliability concerns the consistency of a measure, while validity concerns how effective a measure is for its purpose. From the results of pilot study, some conclusions are discussed below.

For the first questionnaire section, the questions were commented clear and easy to understand. However some responds should be adjusted to appropriate with real conditions. For example, Q6 and Q8 adjusted from 4 answers to 3 answers; Q12, Q17, Q19, Q20, Q21 change from "Yes/No" question to be 3 scale of frequency; Q14, Q15 and Q16 changed from stated percentage to be 3 scale of frequency. Detail of revised questionnaire is shown in Appendix A3 and A4 for both English and Vietnamese.

For the second questionnaire section, almost respondents agreed the importance of twenty existing items for factor influencing supervisor behavior. Table 3.4 show the mean value of them which were higher than 3. In addition, five point Likert scale was reliability for this questionnaire question providing Cronbach's alpha was 0.863 higher than threshold value 0.6. From respondents, all twenty question in second section clear and easy to understand. However, they also gave some suggestions about adding some items that may affect supervisor behavior in their perception. In summarized, five additional items were:

- Influence from worker safety behavior
- Influence from safety awareness of project owner
- Weather conditions at construction sites in which they are working
- Type of project owner
- Company's vision about safety issue

These five additional items were added in both first and section of questionnaire.

For the third questionnaire section, most supervisors recognized that 10 situations represented almost hazards at the construction sites. These 10 situations were the most important and frequently occurring. However, the two option responds "Aware worker carefully or stop worker working until it be fixed" or "Let worker use it, don't say anything" made respondents feel difficult to answer. Some respondents stated that "it is difficult to answer aware or not aware, it is depend on", others stated that "sometime I stop worker doing unsafe job but sometime not". From respondents' comments and suggestion, the third questionnaire was adjusted. Measuring behavioral intention changed from "Intention Simulation" to "Intention Performance" method (Francis, Eccles et al., 2004). Ten situations were kept but the scale changed from "Yes/No" answer to frequency answer. We asked them "Given each situation occur 10 times, how many time you aware worker carefully or stop them working if necessary", and the answer scale from 0 to 10. The number selected for each situation is the behavioral intention scores (Francis, Eccles et al., 2004). The total score of 10 situations was the representative score of behavioral intention.

For the fourth questionnaire section, more than half respondents agreed that twelve questions related to supervisor's role on safety issue were a good representative. They stated that "a good supervisor should fulfill all of twelve activities to achieve better safety", but they also asserted "performing all of them are very difficult and impossible because of limited resources". In addition, the three scale frequency of respond made respondent not easy to select, they need some middle level of frequency. Therefore, the answer of this section was change from three scale to five scale. Five scale include "Never", "Rarely", "Sometimes", "Usually", and "Always".

The finished revised questionnaire which was used for large scale study is shown in Appendix A3 in English version and A4 in Vietnamese version.

Table 3.4 Descriptive of factor influencing supervisor's behavior (Pilot Study, N=112)

Item	N	Minimum	Maximum	Mean	Std. Deviation
Age	112	1	5	3.70	1.038
Background	112	1	5	4.01	.973
Safety Training	112	1	5	4.16	.982
Safety Knowledge	110	1	5	4.35	.872
Work Experience	110	1	5	3.99	1.000
Drinking Habit	109	1	5	4.05	1.265
Smoking Habit	111	1	5	3.12	1.306
Salary Satisfaction	110	1	5	3.16	.982
Influence of family	111	1	5	3.46	.922
Influence of coworker	110	1	5	3.71	.881
Safety of Workplace	110	1	5	4.17	.844
Management safety practice	108	1	5	4.10	.976
Safety policy	109	1	5	3.78	.956
Community	109	1	5	3.40	.982
Project Scale	110	1	5	3.77	1.029
Project Schedule	108	1	5	4.10	.906
Work Assigned	110	1	5	4.10	.938
Control worker capacity	111	1	5	3.90	.924
Influence from Top Manager	111	1	5	3.88	.839
Financial Supporting from company	111	2	5	4.06	.866
Valid N (listwise)	95				

3.5 Large Scale Study

The objective of the large scale study was to collect valid and reliability data enough for achieve research objectives. Questionnaire, sampling technique, sample size and analysis method for large scale study are discussed in details below.

3.5.1 Questionnaire for Large Scale Study

The large scale study questionnaire was developed based on the literature review, lessons learnt from the pilot study and consultation with construction industry experts. In particular, the pilot study provided the impetus to refine the questionnaire layout, refine data collection plans, modify the questionnaire and gain an initial idea of the validity and reliability of the conceptual behavior model.

The large scale study questionnaire contented four main sections. Section 1 included 28 questions, 25 questions related to practical parameters may influencing supervisor behavior and 3 questions used to test the valid respondent. In this section, respondents were required to state their personality, evaluate current safety status of their project, construction site, and company safety vision, and give the comment on parties' safety awareness related project as owner, top manager, coworker, worker, community and so forth. Section 2 contented 25 questions which required respondent provide their perception. Respondents were asked in agreement five point Linkert scale about the important of 25 items influencing supervisor's behavior. Section 3 involved 10 hazard situations may occur at construction site to measure behavioral intention. Supposing each situation happened 10 times, respondents were asked how many time they "aware worker carefully or stop them working if necessary". Section 4 implied 12 questions related to supervisor's role on safety issue. They were asked to responds how often they perform each activity to measure their behavior on safety action. The fully questionnaire which was used for large scale study is shown in Appendix A3 in English version and A4 in Vietnamese version.

3.5.2 Sampling Technique and Sample Size

The large scale study questionnaire survey issued to the respondents is shown in Appendix A4. During March-April 2010, data collection for this study was undertaken with construction professionals in Vietnam, specific at Hochiminh city construction sites.

One of the main objectives in this research was to explore the safety behaviors of the construction supervisor. As we know, safety is a delicate study so it is hard to convincing construction company to participate. Further more, there is lack cooperation between construction companies and researchers in developing country and construction site has some special characteristic that rarely allow for survey without individual relationship. To overcome obstacles and difficulties, construction sites are contacts to facilitate access before survey and only number of site are allowed. For these reasons, convenience sampling is selected as a suitable tool for this research. A number of available construction sites at Hochiminh city are listed and contacted for interview permission before conducting the survey.

Sample size is next designed in careful because it directly influence on results accuracy (Tabachnick and Fidell, 2007; Fellows and Liu, 2008; Hair, Black et al., 2010). The sample size will be dependent on the accuracy required and the likely variation of the population characteristics being investigated, as well as the kind of analysis to be conducted on the data. The larger a sample size becomes the smaller the impact on accuracy so there is a cut-off point beyond which the increased costs are not justified by the (small) improvement in accuracy; a sample size of 1,000 is often referred to as a cut-off point beyond which the rate of improvement in accuracy slows. As this research will use factor analysis to explore factors influencing supervisor behavior and structural equation modeling (SEM) to develop model for explaining supervisor behavior, the sample size has to exceed 375 for this study. From the recommendation of SEM technique, the ratio should reach al least 15 sample for each independent variable (Bacon, 1997). So with 25 independent variables, we need sample size exceed 375 to minimize the error to achieve generalizability research results (Hair, Black et al., 2010). Analysis will be discussed in section 3.5.3.

The necessary actual sample is calculated by dividing the determined sample size (375) by the acceptable response rate (50%). This acceptable response rate was estimated from the pilot study (response rate was 79%) to ensure can collect all necessary data for statistically significant results in limit time and budget. This calculation resulted in achieving the total sample of 750. Finally, questionnaires were issued to all of these 800 respondents.

Within 800 questionnaires distributed, only 434 respondents were collected contribute response rate 54.25%. Other 366 questionnaires were not completed because respondents refused to provide information. There were many hiding reasons made them refuse to cooperate, the common reason are they must to perform some job, they don’t have time, the safety at construction site was good so they have no idea to suggest and so forth.

For the large scale survey, 434 questionnaires completed with highly cooperation from 39 construction projects and one Cultivate Professional Supervisor course (304 supervisors from 39 construction sites, averaging 7 persons per site; and 130 supervisors at the course). It is significant to provide more explanation about the Cultivate Professional Supervisor course. This course is obligatory according to the law in force for supervisor position at construction site. To work as a supervisor, they must to take this course every 5 year. Each respondent took from 30 minutes to 45 minutes approximately, depending on how much the supervisor wanted to say connected with the content.

3.5.3 Data Analysis

The data collected from the questionnaire surveys and interviews were analyzed with the support from Statistical Package for Social Sciences (SPSS) program. The analysis included: descriptive analysis, factor analysis, linear regression, and structural equation modeling (SEM). The data analysis and the results for the whole set of surveys are detailed in Chapter 4, 5, 6 and concluded in Chapter 7.

Descriptive statistics was the first technique applied. It was used to describe the characteristics of respondent sample; to check variables for any violation of the assumptions underlying the statistical techniques that will used, and to address specific research questions, current supervisor behavioral intention and behavior (Pallant, 2004). Descriptive statistics can be obtained a number of different ways, using Frequencies, Descriptive or Explore. Different procedures are depended on categorical or continuous variables.

Factor analysis was the second technique applied. For the objective of research to identify factors influencing supervisor behavior, explore factor analysis was carried out at the first step. Initial 25 items may influencing supervisor's behavior will be grouped in smaller set of factors before further analyze. And then, Cronbach's alpha is used to assess the validity and reliability of each factor (Hair, Black et al., 2010).

Linear regression was the third technique to achieve the research objectives addressed above. Linear regression analysis can be used to examine the relationship between a single dependent variable and several independent variables. However, this technique is restricted to examining a single relationship at a time. Therefore, linear regression is selected to explore the relationship between behavioral intention and behavior.

Structural equation model (SEM) was alternative technique for exploring the interrelationship among factors in multiple layers of linkages between variables. SEM proves effective statistical technique in develop the causal model for explaining a dependent variable with a high quality information (Tabachnick and Fidell, 2006; Hair, Black et al., 2010). Therefore, SEM is selected in developing models for explaining supervisor's behavior.

3.6 Summary

This chapter described the guideline to conduct this research. The components of questionnaire and interview survey were designed. Data collection method was described in details of target population, sampling technique and sample size. The study required two distinct research stages in order to develop the final model for explaining supervisor behavior on safety actions, namely, pilot study and large scale study. The pilot study tested the validity and reliability of the preliminary data obtained and enabled the refinement of the questionnaire survey for the large scale study. The large scale study refined, confirmed and established the explaining model. The data analysis and the results for the whole set of surveys are explained in Chapter 4, 5, 6 and concluded in Chapter 7.

CHAPTER IV

CURRENT SUPERVISORS' BEHAVIOR ON SAFETY ACTIONS AT CONSTRUCTION SITE

This chapter aims to explore the current practice of supervisor's behavior on safety action at construction site and test the hypothesis about the relationship between supervisors' behavioral intention and their current behavior. Chapter starts with section 4.1 which describes the characteristic of the survey and data which used to analyze in this chapter. Next section 4.2 describes the characteristics of respondents. Following section 4.3 expresses the current status of supervisor on safety actions through their behavior. Then section 4.4 describes supervisor behavioral intention base on simulated situations. Finally, linear regression is used to test the hypothesis in section 4.5.

4.1 Descriptive Survey Data

4.1.1 General Survey Details

The research questions were developed with the intent of achieving research objectives. The questionnaires contented four main sections as discussed in chapter 3, respondents were asked to complete at the same time. Data collection took place on March and April 2010 in Vietnam. Each respondent was interviewed in person to complete questionnaire. From the survey, 800 questionnaires were distributed to supervisors who were currently working at 39 construction sites and one Cultivate Professional Supervision in Construction course in Hochiminh city, one of the most developing cities in Vietnam. Finally, 434 respondents were completed and collected, ratio respond is 54.25 percent. In other to achieve high quality and cooperated responds, each supervisor was interviewed in person associating with questionnaire checklist. It took approximately fifteen to thirty minutes for each respondent who willing to contribute opinion.

4.1.2 Statistical Analysis

Data were screened using the complete sample (N = 434) prior to the main analyses to examine for accuracy of data entry, missing values, and fit between distributions and the assumptions of necessary analyze tools. After deleting unusable cases, 403 data are used in general purpose, however only 241 data are used for behavior and behavioral intention analyze.

4.1.3 Data Screening

Prior to analyses and using the usable sample (*N* = 403), it is important to check for mistake initially. So data were examined for accuracy of data entry, missing values. The data screening process involves a number of steps which are first step checking for error; second step finding the error in the data file and third step correcting the error in the data file. The accuracy of the data file was checked by proofreading a random sample of 100 of the original data against a computerized listing. In addition, the Frequencies and Descriptive statistic command in SPSS Version 17 was used to detect any out of range values. None were found.

4.2 Respondent Profile

4.2.1 Educational Background

Level of education is one factor that influences the level of safety behavior of supervisor at construction site. In this study, respondent's educational background is classified into three (3) groups. The results of the analysis are shown in Table 4.1 and Figure 4.1.

The data show that 36 people or 8.9% of the respondents have high school background, 352 people or 87.3% have undergraduate qualification and 15 people or 3.7% with post graduate education. Almost all respondents have acceptable education background so they can representative for supervisor level at construction site.

Table 4.1 Supervisor educational background (N=403)

Educational Background	Frequency	Percentage	Cumulative Percentage
Completed high school	36	8.9	8.9
Undergraduate	352	87.3	96.3
Graduate	15	3.7	100.0
Total	403	100.0	

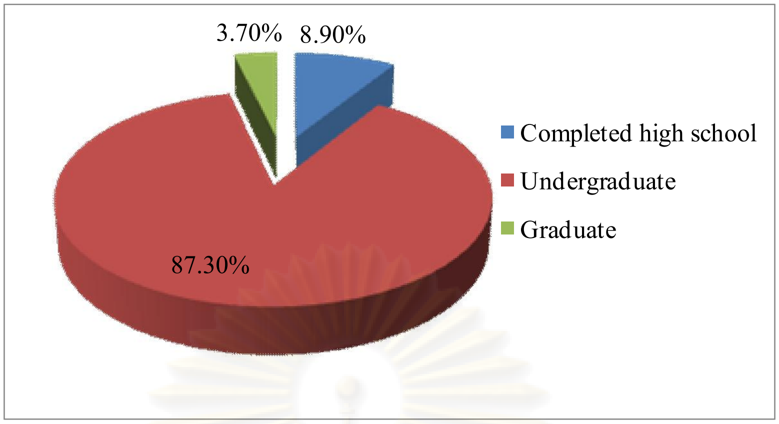


Figure 4.1 Supervisor Educational Background (N=403)

4.2.2 Respondent's Working Experience

Working experience is one important factor may influence the quality of safety behavior of supervisor. Personal experiences generally understand about their workplace in which they are working to avoid accident happen. For clearly understand about respondent's profile, this section covers respondent's working experience in two points of view including working experience in civil field, and experience as supervisor at construction site. In the research, respondents working experience arrange from 0 to 42 years in civil engineering field and from 0 to 30 for supervisor position. It is classified into three (3) groups. Result from the analysis shown in Table 4.2, Table 4.3, Figure 4.2, and Figure 4.3.

Respondents of supervisor whom participated in the research is regularly allocating in three groups. Related to experience in civil engineering field, 39.2% of respondents are having less than 2 years working experience, 31.3% of respondents having 2-5 years working experience while 29.5% having more than 5 years experience. Meanwhile rate of experience as supervisor of there groups in turn are 51.1%, 32.3% and 16.6%. In general, experience of respondents present the population of supervisor at construction site. Therefore, sampling data is available to use for further analyze.

Table 4.2 Respondent's experience in civil engineering field (N=403)

Experience in Civil	Frequency	Percentage	Cumulative Percentage
Less than 2 years	158	39.2	39.2
From 2 to 5 years	126	31.3	70.5
More than 5 years	119	29.5	100.0
Total	403	100.0	

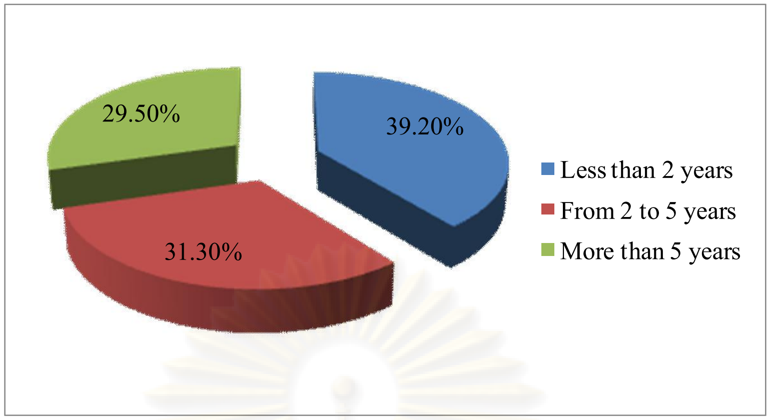


Figure 4.2 Respondent's experience in civil engineering field

Table 4.3 Respondent's experience as supervisor at site (N=403)

Experience As Supervisor	Frequency	Percentage	Cumulative Percentage
Less than 2 years	206	51.1	51.1
From 2 to 5 years	130	32.3	83.4
More than 5 years	67	16.6	100.0
Total	403	100.0	

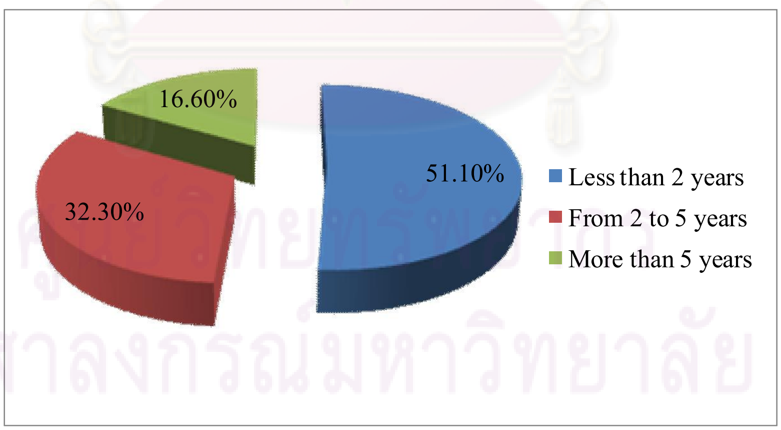


Figure 4.3 Respondent's experience as supervisor at site

4.2.3 Respondent's Safety Training

One important factor which influences the quality of safety behavior of supervisor is safety training as supervisor at construction site. It is observed from the respondent of the questionnaire, 21.8% of current supervisor at construction site have never attend any supervisor course. This characteristic should be considered for next step of analyze. Respondent predominantly attend one time in supervisor training, about 60.5% while 17.6% attend more than 1 time. Result from the analysis shown in Table 4.4 and Figure 4.4.

Table 4.4 Respondent's times attend safety training course (N=403)

Supervisor Safety Training	Frequency	Percentage	Cumulative Percentage
Never attend any course	88	21.8	21.8
Attend 1 time	244	60.5	82.4
Attend 2 times above	71	17.6	100.0
Total	403	100.0	

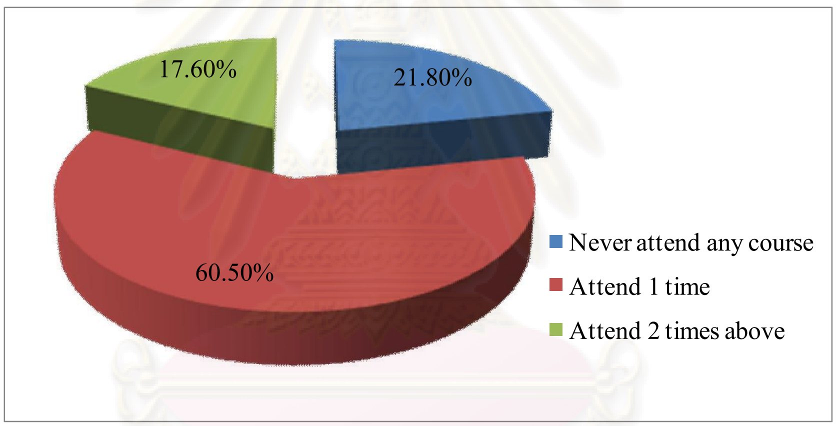


Figure 4.4 Respondent's times attend safety training course

4.2.4 Respondent's Safety Knowledge

Safety knowledge is a determining factor of supervisor safety behavior. It is a combination between personal experience, educational background and training supported from company. High level of safety knowledge can help supervisors to identify accident and avoid the damage not only for themselves but also others. In the research, respondents are required to judge themselves about their safety knowledge in three levels. The first level states that they have little knowledge about safety; second level states that they only have necessary safety information and knowledge; third level states that they can control or avoid all potential hazards at construction site. Result from the analysis is shown in Table 4.5 and Figure 4.5.

The result shows that 34% of the respondents are having little knowledge about safety. In addition, 46.2% have necessary safety information and knowledge and only 19.9% satisfy supervisor requirement, which can control or avoid all potential hazards. It is interesting to observe that most respondents are not satisfying knowledge which required for supervisor. It reflects an important feature of population characteristic, so they can representative for supervisor level at construction site.

Table 4.5 Respondent's safety knowledge

Safety Knowledge	Frequency	Percentage	Cumulative Percentage
Little knowledge about safety	137	34.0	34.0
Necessary safety information and knowledge	186	46.2	80.1
Can control or avoid all potential hazards	80	19.9	100.0
Total	403	100.0	

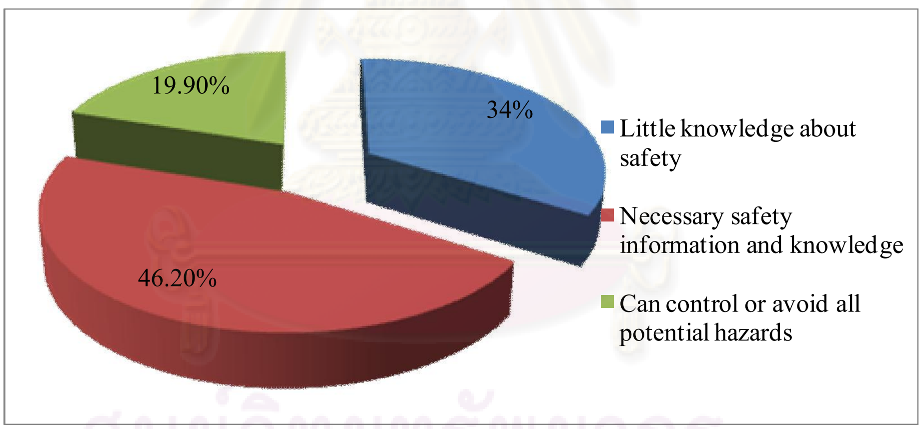


Figure 4.5 Respondent's safety knowledge

4.3 Analysis of Supervisors' Behavior in Safety Actions

4.3.1 Data Preparation for Behavior Analysis

This section describes the process of data preparation for behavior analysis. The survey data from the third and the fourth section of questionnaire are analyzed to find out the current behavior and behavioral intention of supervisor on safety actions at construction site. In addition, the relationship between them is observed. The main purpose of third section is exploring the behavioral intention though ten situations which related to working at height and electrocution hazard. The fourth section of questionnaire attempts to explain the current behavior of supervisor by evaluating four safety responsibilities which are investigating accidents to determine causes, inspecting their area to identify hazards, coaching their people to perform better and motivating worker's aspiration to work safely.

Questionnaires were distributed and completed by 434 respondents. Some are excluded due to incomplete and inappropriate respondent data. After cleaning data process, the sample size is reduced to 241. These data are used to present and analyze current behavior of supervisor. These 241 sufficiently complete included in data analysis, producing a usable response rate of 30.12% of total distributed questionnaires. The ratio of usable data was low because all of supervisor afraid to answer the questions which related their actions. Furthermore, all of four section of questionnaire was performed at the same time, thus it can not avoid respondents tired and lazy to fulfil carefully. Consequently, 241 usable responds which complete carefully with high cooperation was used for this chapter.

Of those 241 supervisors responding, the average age was 29.46 years and cover from 20 to 68 years old. All of them were male (100%) and had experience as supervisor in construction site from beginning to 22 years experience, average 3.54 years experience. Almost all responders have acceptable education background (89.2% undergraduate) and at least 1 time attends the Cultivate Professional Supervision in Construction Course (77.2%). The data show that 34% of the respondents are having little knowledge about safety, 49.4% have necessary safety information and knowledge and only 16.6% satisfy supervisor requirement that can control or avoid all potential hazards. The characteristics of respondents cover all possible expected, so they can representative for supervisor level at construction site.

4.3.2 Reliability Analysis of Scale

The research questions section three and four were developed with the intent of exploring the current behavior in safety actions of supervisor at construction sites. Supervisors were asked to describe how often they perform their safety role. Their safety responsibilities are expressed by four main issues which are investigating accidents to determine causes, inspecting their area to identify hazards, coaching their people to perform better and motivating worker's aspiration to work safely.

To ensure that the items comprising the behavior produced reliable scales, Cronbach's alpha coefficient of internal consistency was calculated for each scale. The results are shown in Table 4.6 below. Comparing with the acceptable value of Cronbach alpha of 0.60 (Hair, Black et al., 2010), this scale was considered to be reliability with the value of

Cronbach alpha 0.802. Values from the column "Alpha if item deleted" in Table 4.6 suggested that all of 12 items representative for supervisor behavior were valid and not removed from the analysis. All of these 12 items provided the most reliability scale for measuring supervisor's behavior on safety action.

Table 4.6 Cronbach's alpha for supervisor behavior scale (N = 241)

Cronbach's Alpha = 0.802 N of Items = 12	Cronbach's Alpha if Item Deleted
Investigating injuries causes	.789
Conducting an investigation on the causes of accidents immediately	.793
Finding the contributing causes for each accident as more as possible	.779
Correcting hazards if an accident has happened	.794
Giving recommendations to prevent a similar accident	.781
Carrying out inspections for worker realize hazards on the site	.779
Inspecting workers to correct hazards	.782
Setting up meetings to coach the group of employees	.786
Orienting new employees on site	.783
Contacting employees individually to inspect them working safely	.793
Using safety materials to motivate the worker working safely	.799
Operating some attitude activity to improve your worker safety behavior	.790

4.3.3 Supervisors' Current Behavior

The behavior is described using the frequency of performing in current practice. Due to the questionnaire is designed by 5 point scales (from 0 to 4) to describe the frequency, therefore, the average score of each issue which represent safety behavior was used in order to indicate level of frequency.

The mean score were categorized into interval as follows:

Mean Scores	Description
0.00 – 1.00	Seldom Apply
1.01 – 2.00	Rarely Apply
2.01 – 3.00	Sometimes Apply
3.01 – 4.00	Often Apply

Supervisors were asked to describe behavior on safety action by expressing frequency of safety performance. The initial results were shown in Table 4.7 and Table 4.8 shows the average score of supervisors' behavior on safety action and its interpretation. The analysis of supervisors' behavior can be grouped into four groups. The first group of supervisors' behavior is the investigation of accidents to determine causes. It is sometimes applied with the low mean score. They are not quite often investigate the incident causes (mean=2.56), the value of mean score just enough exceed the average score. Under case of supervisor investigation about the accident causes, they have a better trend to conduct it immediately (mean=2.74) and investigate accidents carefully (mean=2.70).

Next the second group of supervisors' behavior is positive in inspecting area and identifying hazards. They often correct the hazards which can cause the accident with the highest mean from 12 items (mean=3.00). The current status also shows that supervisors usually prefer to correct the hazards himself rather than give the recommendation about construction site safety (mean=2.79). They sometimes carry out the inspection and make worker realize the hazards (mean=2.64). It can be pointed that their practices can prevent worker's awareness in safety behavior.

The third group of supervisors' behavior is coaching the worker. It is sometimes found that supervisors take safety action in coaching the worker. The frequency supervisor perform coaching about safety is moderately low. They are more likely to conduct the safety orientation for new workers at construction sites (mean = 2.39). Supervisors are limited in establishing the meeting for coaching workers (mean=2.07). This weakness should be modified, because supervisor coaching function is very important. It can directly impact to change the worker's safety behavior. Lack of supervisors' practice on this safety action can lead to very dangerous and should be aware.

The fourth group of supervisors' behavior involves motivation worker's aspiration to work safely. Almost accidents are triggered by unsafe behaviors; workers in developing countries have less safety culture to protect themselves. Workers seldom require the safety supporting from the company. In other words, workers have a risk on unsafe events in construction works. Thus, motivating their aspiration to work safe is an urgent mission of supervisor. But the real practice is inversed. The items in this group have the lowest mean of frequency applied (Mean = 2.10, 1.71 and 1.76). This supervisor behavior should be changed to improve the positive impact in keeping safe for construction site.

Table 4.7 Percentages supervisor applying each issue related safety

Issues related to supervisors' behavior on safety actions at construction sites	Percentage of supervisor action (%) Never	Rarely	Some-times	Usually	Always	Total (%)
Investigating injuries causes	2.9	14.1	28.6	33.2	21.2	100
Conducting an investigation on the causes of accidents immediately	4.6	7.9	25.7	32.8	29.0	100
Finding the contributing causes for each accident as more as possible	3.3	8.3	28.2	35.3	24.9	100
Correcting hazards if an accident has happened	2.1	5.0	19.5	36.5	36.9	100
Giving recommendations to prevent a similar accident	1.2	7.9	24.1	44.0	22.8	100
Carrying out inspections for worker realize hazards on the site	1.7	8.7	31.1	41.1	17.4	100
Inspecting workers to correct hazards	1.2	12.4	34.0	42.3	10.0	100
Setting up meetings to coach the group of employees	7.5	20.7	39.8	21.6	10.4	100
Orienting new employees on site	5.8	14.1	29.5	36.1	14.5	100
Contacting employees individually to inspect them working safely	7.5	20.7	36.1	25.7	10.0	100
Using safety materials to motivate the worker working safely	17.0	21.2	39.0	19.5	3.3	100
Operating some attitude activity to improve your worker safety behavior	12.9	24.9	38.6	20.3	3.3	100

Table 4.8 Average score of each issue related to supervisors' behavior on safety action

Issues related to supervisors' behavior on safety actions at construction sites	Mean	SD.	Frequency
Investigating accidents to determine causes			
Investigating injuries causes	2.56	1.064	Sometimes Apply
Conducting an investigation on the causes of accidents immediately	2.74	1.100	Sometimes Apply
Finding the contributing causes for each accident as more as possible	2.70	1.038	Sometimes Apply
Inspecting their area to identify hazards			
Correcting hazards if an accident has happened	3.00	.977	Sometimes Apply
Giving recommendations to prevent a similar accident	2.79	.926	Sometimes Apply
Carrying out inspections for worker realize hazards on the site	2.64	.926	Sometimes Apply
Coaching their people to perform better			
Inspecting workers to correct hazards	2.47	.881	Sometimes Apply
Setting up meetings to coach the group of employees	2.07	1.066	Sometimes Apply
Orienting new employees on site	2.39	1.079	Sometimes Apply
Motivating worker's aspiration to work safely			
Contacting employees individually to inspect them working safely	2.10	1.076	Sometimes Apply
Using safety materials to motivate the worker working safely	1.71	1.068	Rarely Apply
Operating some attitude activity to improve worker safety behavior	1.76	1.024	Rarely Apply

Figure 4.6 shows gaps of current supervisors' behavior on safety action at construction site. The results show that the most practice of supervisors related to safety action is "Correcting hazards which can cause accident". The result shows that most of behavior has mean score above 2.00. It means that supervisors sometimes performed on safety action such as "Investigating causes of accident carefully in details", "Giving recommendations about construction site safety to prevent a similar accident" and "Orienting new employees on site". However, three lowest supervisor's behaviors have mean score nearly or less than 2.00. These are "Setting up meetings to coach the group of

employees", "Using safety materials to motivate the worker working safely" and "Operating some attitude activity to improve your worker safety behavior". These actions should be improved by supervisors in construction projects.

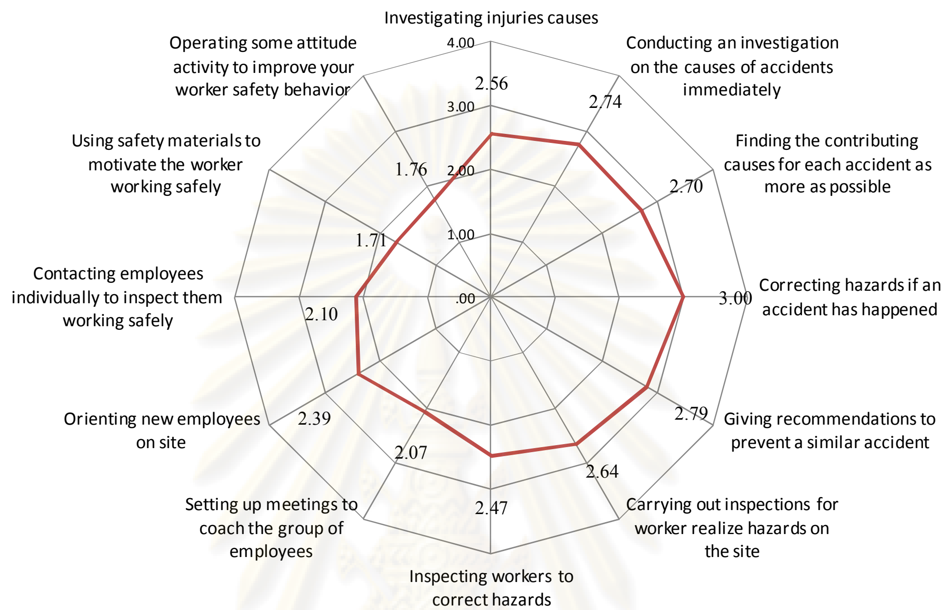


Figure 4.6 Gaps of supervisors' behavior on safety actions at construction sites

4.4 Analysis of Supervisors' Behavioral Intention on Safety Action

Behavioral intention is person's intention to perform a particular action. There should be a high relation between behavioral intention and actual performance of that behavior. Although this relationship does not always perfectly correlation but behavioral intention is the best single predictor of people's behavior. Therefore, this section is used to describe behavioral intention for explaining supervisor behavior and their relationship. This relationship is focused as a key point of the explaining model which will discussed in next chapter.

As discussing in the previous chapter, behavioral intention is measured by applying intention performance method using ten scenarios. By understanding how respondents decide in each situation given it occurring ten times, we can understand their tendency to perform that behavior. All the details of analysis are shown below.

4.4.1 Reliability Analysis of Scale

Table 4.9 Cronbach’s alpha for supervisor behavioral intention scale (N = 241)

Cronbach's Alpha = 0.924 N of Items = 10		Cronbach's Alpha if Item Deleted
Situation 1	Once one worker is ready to start his job, he climbs the scaffold up to the level he must work at but the scaffold is not totally boarded.	.917
Situation 2	Workers are ready to start his job which requires to use ladders to climb up to a higher level is not tied or secured or ladder not enough 1 meter above the landing place.	.924
Situation 3	When the workers ready to start their job on roof or high level but there are many holes still not be shield.	.916
Situation 4	Workers are working on roof or high level without edge protection and personal protections have not been provided.	.913
Situation 5	Workers are working on roof or high level in bad weather such as windy, small rain.	.915
Situation 6	Workers are using electrical equipment for their works but the electric wire quality not satisfy the technique requirement	.912
Situation 7	Workers are using electrical equipment for their works but there is a part of jumper wire touch the water on the ground.	.914
Situation 8	Workers are using handle electrical equipment for their works without any personal protections as gloves, boots.	.919
Situation 9	Workers are using electrical equipment but don’t have any circuit breaker, plug pin, safety box.	.915
Situation 10	Electric line in construction is very low and interlace and there is equipment inside construction such as concrete pump, truck.	.917

The behavioral intentions are measured by 10 situations. It is necessary to ensure that these items comprise of reliable measured scale. Cronbach’s alpha coefficient of internal consistency was calculated for scale. The results are shown in Table 4.9 below. In respect of the scale’s reliability, this scale was also found to be reliable with very high value of

Cronbach's alpha 0.924 and above the acceptable of 0.60 (Hair, Black et al., 2010). Values from the column "Alpha if item deleted" in Table 4.9 suggested that all of these 10 items provided the most reliability scale for measuring behavioral intention. So we should not remove any items of this scale for further analysis.

4.4.2 Supervisors' Behavioral Intention

In the behavioral intention questionnaire, supervisors were asked to state the frequency of times they warn or stop worker working if each situation occurs 10 times at the construction site. It means the scale of behavioral intention from 0 to 10. For each single item measurement, the number selected is the behavioral intention score. The average score of each situation are shown in Table 4.10. The total score of all ten situations indicates their general intention behavior in safety actions at site. Descriptive analysis results are shown in detail below.

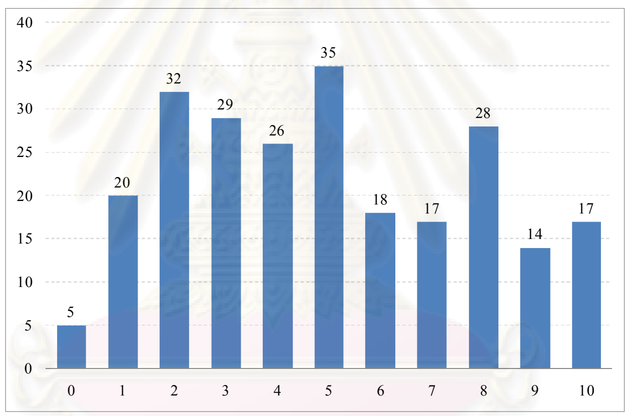


Figure 4.7 Frequency of times supervisor warn or stop worker from working at height when scaffold is not totally boarded, situation 1

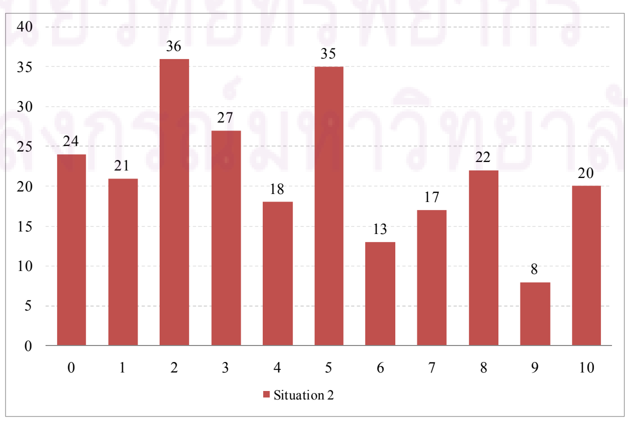


Figure 4.8 Frequency of times supervisor warn or stop worker from climbing up to a higher level with unsafe ladders, situation 2

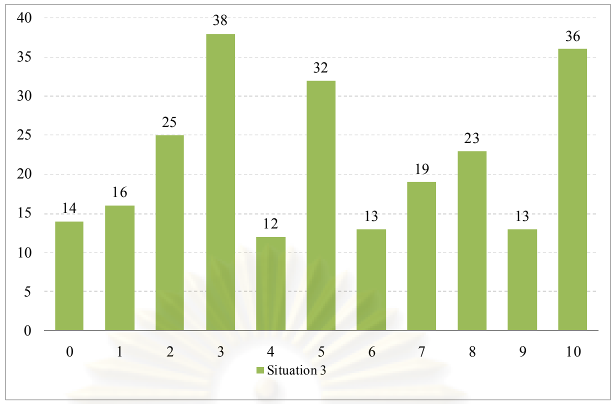


Figure 4.9 Frequency of times supervisor warn or stop worker from working on roof or high level with unsafe holes, situation 3

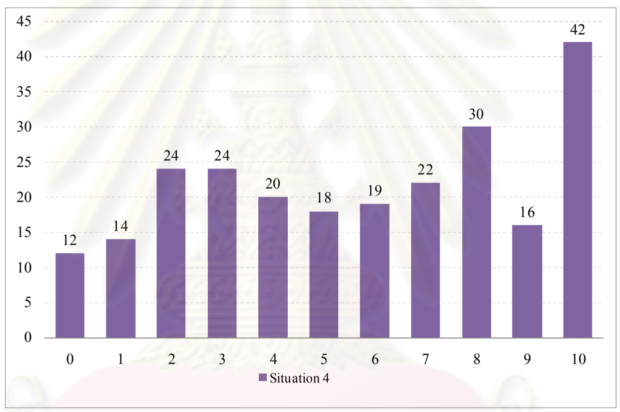


Figure 4.10 Frequency of times supervisor warn or stop worker from working on roof or high level without edge and personal protections, situation 4

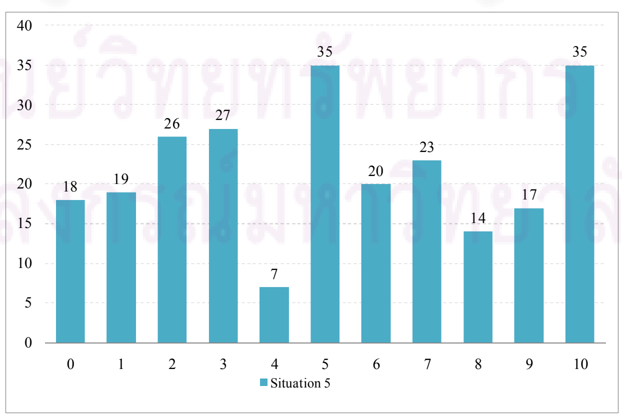


Figure 4.11 Frequency of times supervisor warn or stop worker from working on roof or high level in bad weather, situation 5

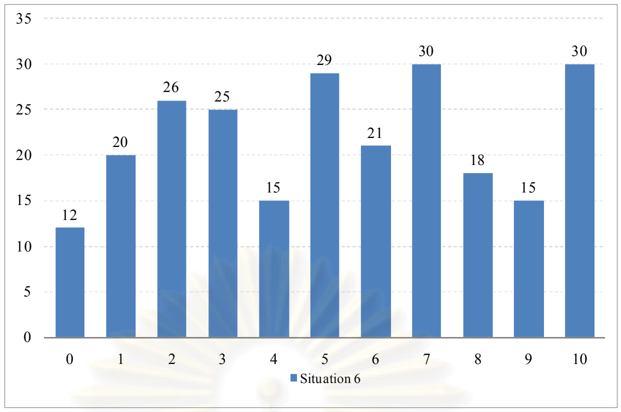


Figure 4.12 Frequency of times supervisor warn or stop worker from using unquality electric wire, situation 6

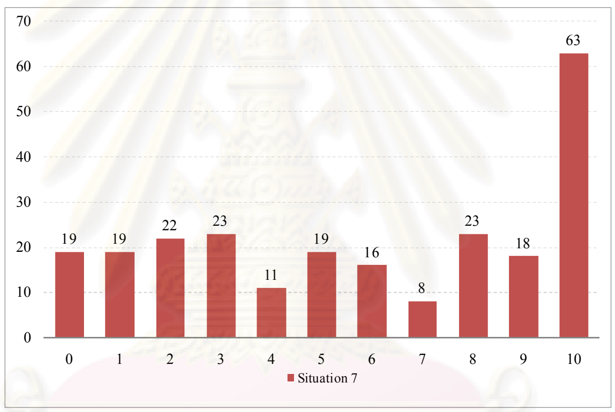


Figure 4.13 Frequency of times supervisor warn or stop worker from using electrical equipment with a part of jumper wire touch the water on the ground, situation 7

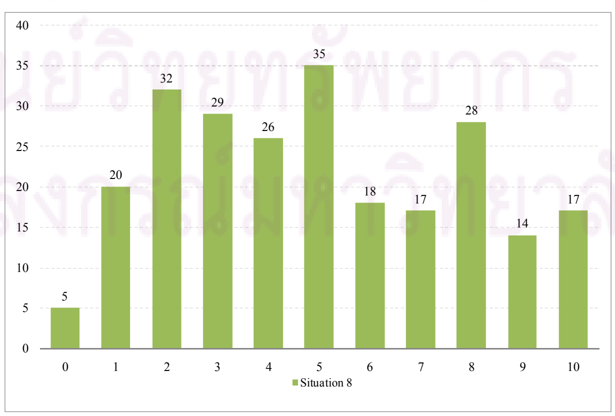


Figure 4.14 Frequency of times supervisor warn or stop worker from using handle electrical equipment without any personal protections, situation 8

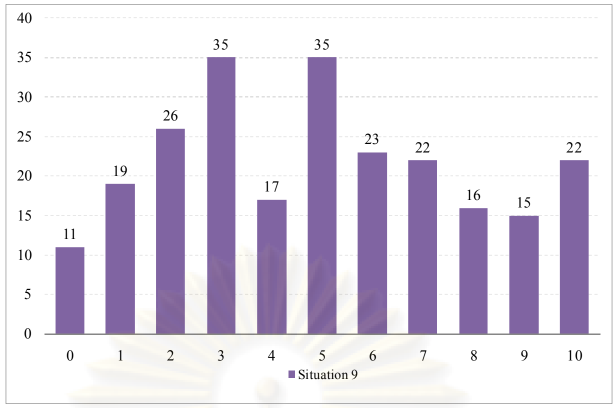


Figure 4.15 Frequency of times supervisor warn or stop worker from using electrical equipment but don't have any circuit breaker, plug pin, safety box, situation 9

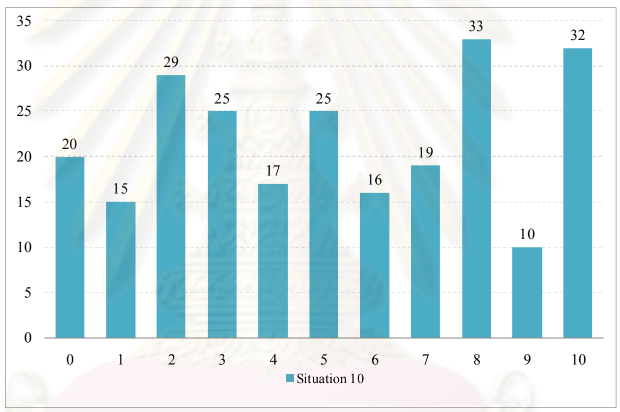


Figure 4.16 Frequency of times supervisor warn or stop worker when equipment enter construction site but electric line is very low and interlace, situation 10

According to descriptive results in Table 4.10, supervisor behavioral intention was average level. The average score of each situation ranges from 4.42 to 5.80. This score also indicated the risk perception of supervisor. The highest mean is 5.80 from situation 7, situation that worker using electrical equipment with a part of jumper wire touches the water on the ground. It pointed out this situation is the most dangerous from supervisor view. The most disregards situation from supervisor is situation 2 related to unsafe ladders when worker climbing. The average score of this situation is the lowest 4.42. From the results, the standard deviation of all situations dispersed widely (SD=2.785 – 3.214). Therefore, behavioral intention was a conformable variable in predicting the relationship between it and behavior.

Table 4.10 Average score of each situation related to behavioral intention (N=241)

Situation	Minimum	Maximum	Mean	SD.
Situation 1	0	10	5.16	3.005
Situation 2	0	10	4.42	3.036
Situation 3	0	10	5.23	3.153
Situation 4	0	10	5.71	3.174
Situation 5	0	10	5.19	3.214
Situation 6	0	10	5.26	3.059
Situation 7	0	10	5.80	3.560
Situation 8	0	10	4.97	2.785
Situation 9	0	10	4.95	2.897
Situation 10	0	10	5.16	3.202

4.5 Hypothesis Testing Positive Relationship Between Supervisors' Behavioral Intention and Their Behavior on Safety Action

Based on the literature review, there is a relationship between behavioral intention and behavior (Fishbein and Ajzen, 1975; Ajzen, 1991; Francis, Eccles et al., 2004). This section is analyzed to test the hypothesis about positive relationship between Supervisors' behavioral intention and their current behavior on safety action. This analysis is performed based on behavior score in section 4.3 and behavioral intention in section 4.4. The relationships are described through the linear regression analysis.

4.5.1 Data Preparation

From the analysis results of scale's reliability in section 4.3 and 4.4 above for measuring behavior and behavioral intention, 12 items were considered as an acceptable measurement for the supervisor behavior scale and 10 items situations for behavioral intention scale. Behavior score is the total score of these 12 items score, range from 0 to 48. The behavioral intention is described by summary score of ten situations, range from 0 to 100. The frequencies of them are shown in Figure 4.17 and Figure 4.18. From descriptive analysis, behavior score has mean=28.95, SD=6.867 and behavioral intention has mean=51.86, SD=24.005.

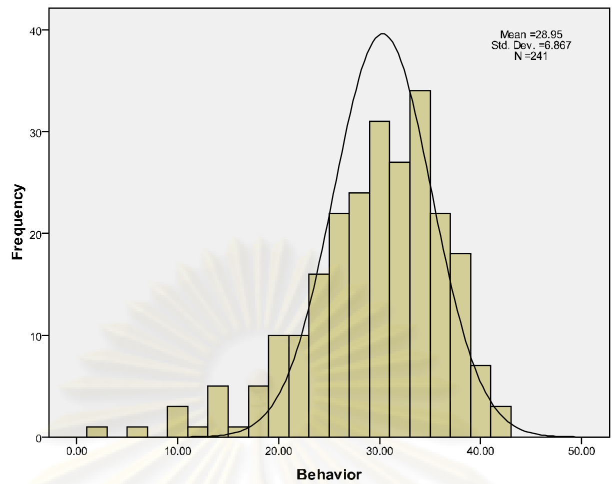


Figure 4.17 Frequency of Supervisor Behavior

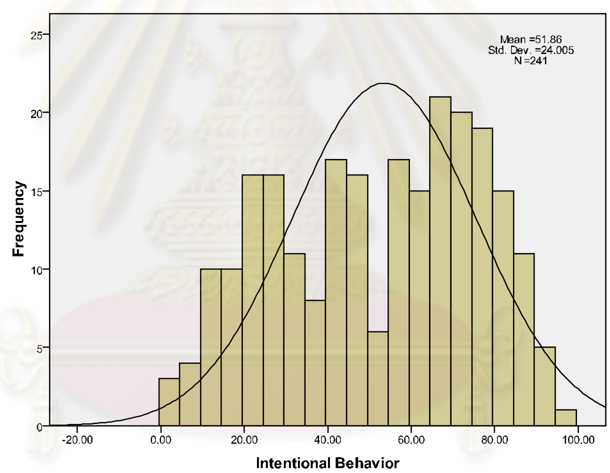


Figure 4.18. Frequency of Behavioral intention

4.5.2 Testing Hypothesis and Checking Assumptions of Linear Regression

For relationship testing between behavioral intention and behavior, linear regression is an appropriate technique. Linear regression analysis proves effective tool to exam the relationship between a single dependent variable and several independent variables (Hair, Black et al., 2010). One key important issue before using linear regression is assessing data appropriation to ensuring all key assumptions of regression models are satisfied. Any assumption violations may cause distorted and biased research results. These assumptions include *linearity, homoscedasticity, normality, multicollinearity,* and *independence of the error terms* (Hair, Black et al., 2010).

Regarding to this research, the third assumption about *multicollinearity* would not be tested because this hypothesis contents only one independent variable. The assumption regarding independence of the error terms was not considered to be relevant and it would not be tested in this thesis because this research has not used time series data or sequencing variables (Hair, Black et al., 2010).

The assumptions of *linearity, nonlinearity,* and *homoscedasticity* can be examined by using graphical tools such as scatter plots, or residual plots and/or statistical analyses which are discussed with the regression results. If no assumptions are violated, the residuals should be randomly distributed around their mean of zero (Hair, Black et al., 2010). In addition, normality was tested using normal probability plots. Normality is achieved when the graphs illustrate no tremendous departure from the diagonal line (Hair, Black et al., 2010). The results of these tests will be reported along with the results of the hypothesis testing, which are now discussed.

4.5.3 Results of Proposed Hypotheses Testing

As mentioned above, 241 respondents were sufficiently complete to be included in this analysis. The regression equations were conducted over the full sample for the proposed hypothesis to test the influence of supervisors' behavioral intention on their behavior. The results of the regression equations are reported along with the results of the test of assumptions in Table 4.11. Residual plots and normal probability plots of hypothesis are displayed in Appendices B. The discussion now turns to the results of the hypothesis testing commencing with those proposing to test the influence of supervisors' behavioral intention on their behavior.

The results summarized in Table 4.11, indicate that 6.4% of the variance in **supervisor's behavior** could be explained by their behavioral intention, this relationship was significant in this explanation at 1% significant. From the summarized results of ANOVA test, the model including this variable reaches statistical significance (Sig = .000, this really means $p<.01$). The data were then examined for whether they violated the assumptions of the regression models. The probability plots and residual plots presented in Appendices B do not indicate any serious violations. Statistically, this hypothesis was therefore accepted. **Behavioral intention** has a positive influence on **supervisors' behavior** in this sample.

Table 4.11 Linear regression analyze for hypothesis proposing the influence of behavioral intention on supervisors' behavior

	Unstandardized Coefficients		Standardized			Violations of Assumptions (Y=yes, N=no)		
	B	Std. Error	Beta	t	Sig.	Heteroscedasticity	Linear-ity	Norm-ality
Dependent Variable:						N	N	N
Safety Behavior								
Adjusted R square: 0.064								
F : 17.478								
Sig. F : 0.000								
Independent variable:								
Constant	25.073	1.020		24.572	.000			
Behavioral intention	0.075	.018	.261	4.181	.000			

4.6 Summary

This chapter has discussed about collected data in details and described respondent profile. Firstly, data were screened to ensure appropriate for proposed analysis tool. And then, the discussion then turned to descriptive statistics regarding the behavioral intention and behavior on safety action. The statistical results demonstrate the current issue of construction accident and site supervisors have not accomplished his safety obligation. The most frequently task performed is correcting hazards if the accident has happened (Mean=3.00). Some other tasks related to investigating accident for determining causes are sometimes applied. Site supervisors are not pay attention enough on coaching their worker to perform work safety or motivating worker's thirst for being safe (Mean <2.00).

One of factors influencing supervisors' behavior was explored, behavioral intention. Based on the results of the regression analysis, behavioral intention was found have a strong influence on Supervisors' behavior**.** As expected, this is positive relationship. It suggests that improving their behavioral intention may directly impact to change their behavior on safety action.

CHAPTER V

EXPLORING FACTORS INFLUENCING SUPERVISOR'S BEHAVIOR ON SAFETY ACTION BASED ON THEIR PERCEPTION

Chapter 5 explains the statistically analysis of collected data which were obtained from supervisors' surveys. This chapter aims to explore the group factors influencing supervisor's behavior in safety action at construction site. It begins with section 5.1 in other to give overview of collected data which used for this chapter. Next is the factor analysis process to explore the factors influencing supervisors' behavior on safety action, see details in section 5.2. Finally section 5.3 establishes a model to explain how these factors influencing supervisors' behavior using structural equation modeling. It is important to emphasize that all of information analyzed in this chapter based on Supervisors' opinion.

5.1 Descriptive Survey Data for Factor Analysis

5.1.1 General Survey Details

The research questions were developed with the intent of exploring factors influencing supervisor's behavior in safety action. The list of variables was asked in the second section among four section of questionnaire (see in Appendix A). It comprised twenty five statements, which are considered factors that affect the Supervisor's behavior in safety.

Data were screened using the complete sample (N = 434) prior to the main analyses to examine for accuracy of data entry, missing values, and fit between distributions and the assumptions of necessary analyze tools. After deleting unusable cases, 403 data are used for factor analyses. Exploratory factor analysis was used to examine the construct validity of the questionnaire. Reliability analyses (Cronbach's alpha) were conducted on the items remaining to test the internal consistency of the scales.

5.1.2 Data Screening

Prior to analyses and using the usable sample (N = 403) for factor analysis, it is important to check for mistake initially. So data were examined for accuracy of data entry, missing values. The data screening process involves a number of steps which are first step checking for error; second step finding the error in the data file and third step correcting the error in the data file. The accuracy of the data file was checked by proofreading a random sample of 100 of the original data against a computerized listing. In addition, the Frequencies and Descriptive statistic command in SPSS Version 17 was used to detect any out of range values. None were found.

5.1.3 Respondent Profile

The details of respondent profile were discussed in section 4.2 Respondent Profile of Chapter 4. In summarized, of those supervisors responding, the average age was 29.67 years and cover from 20 to 68 years old. All of them were male (100%) and had experience as supervisor in construction site from beginning to 30 years experience, average 3.49 years experience. Almost all responders have acceptable education background (91.0% undergraduate) and at least 1 time attends the Supervisor Course (78.2%). The data show that 34.0% of the respondents are having little knowledge about safety, 46.1% have necessary safety information and knowledge and only 19.9% satisfy supervisor requirement, can control or avoid all potential hazards. The characteristics of respondents cover all possible expected, so they can be representative for supervisor level at construction site.

5.2 Factor Analysis

As an early step in the data analysis, all questionnaire responses were checked to ensure completeness and readability before the data was processed using the Statistical Package for Social Sciences (SPSS) version 17. The questionnaire (Appendix B) comprised 25 variables dealing with supervisor's behavior on safety actions at construction site. The data gathered were factor-analyzed to examine the interrelationships among the 25 variables and to reduce this number of original variables into a smaller set of factors. It is important to remind this factor analysis is based on supervisors' perception on factors influencing their behavior.

The construct validity of the scales in sample (N = 403) was investigated by factor analyzing the items using the Maximum Likelihood (ML) technique with Varimax rotation. Although structural equation modeling was later used, factor analysis was used to help refine the measurement model.

5.2.1 Factor Analysis

Factor analysis, a multivariate statistical technique, is commonly used to identify a smaller number of relevant factors than the original number of individual variables. The application of this technique can reduce the data to a representative subset of variables or even create new variables as replacements for the original variables, while still retaining their original characteristics (Pallant, 2004).

5.2.2 Checks for Factor Analysis

Collected data is required to check whether it appropriates for performing factor analysis. Checking data contents three steps includes checking adequacy of sample size, assessing the factorability of the correlation matrix, and examining the anti-image correlation matrix.

The first step was checking adequacy of sample size. Factor analysis prefer sample size larger than 100 and at least five time of observations (Hair, Black et al., 2010). The sample size of the supervisor is 403, with the ratio of 16.12 cases to 1 variable, which satisfies the specified limit.

The second step was assessing the factorability of the correlation between observations via the correlation matrix of survey. Factor analysis requires a number of correlation which higher than 0.30 (Hair, Black et al., 2010). Result from correlation matrix among 25 observations in this research points out more than 20 percent of correlations greater than 0.30 at the 0.01 level of significance (see Appendix C1).

The third step was examining the anti-image correlation matrix, the diagonals on that specific matrix should have an overall Measure of Sampling Adequacy (MSA) of 0.50 or above (Hair, Black et al., 2010). The same criterion of MSA applies to the values of individual variables, which should be considered for elimination from further analysis if they are low on this measure (Hair, Black et al., 2010). After omitting the above variables, the MSA test was conducted again, to check the revised values for overall and individual MSA. The set of variables exhibited satisfactory values above 0.50 and therefore were deemed fit for further analysis. The checked data set of 25 variables resulted in a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.845, which is considered as meritorious. Another mode of determining the appropriateness of factor analysis is the Bartlett test of sphericity. The analysis of Bartlett test of sphericity reached statistical significance with chi-square 3807.97, degree of freedom 300 and significance level of 0.000. Therefore factor analysis was deemed appropriate.

5.2.3 Factor Analysis Process

Table 5.1 Pattern Matrix, Eigenvalues, Percentage of Variance explained for factor influencing supervisor's behavior on safety actions (N = 403)

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Safety management system	.816					
Safety regulations and procedures	.796					
Company vision about safety	.777					
Financial supports for safety	.740					
Workplace environment	.660					
Providing of safety training programs	.648					
Project schedule		.804				
Amount of work responsibility		.766				
Project scale		.752				
Type of project owner		.678				
Weather conditions		.484				
Project owner			.832			
Top manager			.804			
Community pressure			.665			
Workers			.507			
Safety knowledge				.706		
Working experience				.674		
Supervisor capability to control workers				.594		
Education background				.518		
Family					.720	
Coworkers					.629	
Age					.580	
Salary satisfaction					.495	
Smoking						.874
Drinking						.849
Eigenvalues	3.707	2.914	2.679	2.128	1.953	1.578
Percentage of Variance Explained	14.827	11.656	10.714	8.513	7.813	6.311

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

Factor analysis is used to explore factors influencing supervisor behavior on safety actions. The initial captures of these factors are extracted by using principal component analysis. The factor solution without rotation presents six (6) distinct factors with eigenvalues equal to or greater than unity (Tabachnick and Fidell, 2007). After that, varimax rotation is performed for easier interpret the factors structure and name the factors. The final results of factor analysis are shown in details in Table 5.1 above.

The use of varimax rotation technique makes result as easy as possible to identify each variable with a single factor. The six grouped factors accounted for 60 percent of the total variance. The factors were then examined to identify the number of items that loaded on each factor. The rotated pattern matrix for the remaining 25 items is presented in Table 5.1. The eigenvalues, percentage of variance explained are also displayed in this table. The correlation matrix of factor is displayed in Table 5.2. The results show the strength of the relationship among 6 factors is not high; only correlation between factor 1 and factor 3 is -0.326, factor 2 and factor 5 is 0.325 exceed 0.3. So the assumption underlying the use of varimax rotation is satisfied.

Table 5.2 Component Correlation Matrix

Factor	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Factor 1	1.000					
Factor 2	-.205	1.000				
Factor 3	-.326	.280	1.000			
Factor 4	.000	-.134	-.112	1.000		
Factor 5	-.040	.325	.182	-.116	1.000	
Factor 6	.216	-.118	-.269	.097	-.201	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

5.2.4 Reliability Analysis

To ensure that the items comprising the factors produced reliable scales, Cronbach's alpha coefficient of internal consistency was calculated for each scale. The results are shown in Table 5.3 below. The Cronbach's alpha ranged from 0.604 to 0.867, which are higher than standard value of 0.600, indicating adequate internal consistency (Pallant, 2004; Hair, Black et al., 2010).

Table 5.3 Cronbach's Alpha for each factor scale (N = 403)

Items of Scale	Cronbach's Alpha	Cronbach's Alpha if Item Deleted
Factor 1. Organizational and Management	0.867	
Safety management system		0.831
Safety regulations and procedures		0.838
Company vision about safety		0.846
Financial supports for safety		0.841
Workplace environment		0.853
Providing of safety training programs		0.856
Factor 2. Project Characteristics and Work Assignment	0.796	
Project schedule		0.727
Amount of work responsibility		0.735
Project scale		0.739
Type of project owner		0.767
Weather conditions		0.800
Factor 3. Project Stakeholder Influence	0.794	
Project owner		0.691
Top manager		0.685
Community pressure (government, law, neighbors)		0.777
Workers		0.800
Factor 4. Personal Background and Safety Knowledge	0.643	
Safety knowledge		0.520
Working experience		0.521
Supervisor capability to control workers		0.594
Education background		0.643
Factor 5. Social Influence	0.604	
Family		0.458
Coworkers		0.460
Age		0.604
Salary satisfaction		0.570
Factor 6. Supervisor Habits	0.708	
Smoking		-
Drinking		-

5.2.5 Factors Interpretation

From factor analysis present above, there are six factors may influencing supervisor's behavior from their won perception. Each of them contents a group of items which have a strongly correlation and provides amount of variance explained for the features. They are named in accordance with the meaning of all items that they representative. The following section will discuss about the meaning of each factor.

The first factor, "Organizational and Management Influence", accounts for 14.827% of the total variance and comprises 6 items. It includes Safety Practice, Safety Regulation, Financial Supporting, Control Capacity, and Commitment of Top Managers. It indicates the degree of supervisor's belief about organization role. Organizational management's safety responsibilities strongly influence their safety behavior. The majority of items enjoy relatively large factor loadings (>0.65). Loadings, however, suggest that the item "Providing of safety training programs" is relatively weakly associated with this factor. It is an interesting result, contrary to normal expectations; supervisor received less influence from safety training programs to their work. The highest factor loading item is "Safety management system" indicating the important role of management system. They recognize management as a safety associate. This result stresses the role of organization level in creating a safety environment in which their employers can work safely. This finding adds further support to earlier researches on health and safety about the role of organization and management such as Jannadi (1996), Holt (2001) and Mearns (2003). Holt (2001) pointed out the important role of policy, organizing, planning and implementing, measuring and auditing the performance in successful safety management system. Jannadi (1996) also found that roles and functions of safety management system, or safety management system to control risk can be essential factors. Mearns (2003) emphasized that organizational policies and procedures can protect their workers from hazard workplace and reduce hazard in workplace. This research give additional evidence about the way that organization impact on the worker safety through the middle level, supervisors who direct influence workers daily.

The second factor, "Project Characteristics and Work Assignment", contains five items and accounts for 11.656% of the total variance. This factor includes five items relating to properties of project, and the other to the weather influence. Collectively, this group of items demonstrates the supervisors' perception of the influence from project properties to their behavior in safety actions. The majority of items enjoy relatively large factor loadings (>0.65), except item "Weather conditions". The first and the second are "Project schedule" and "Amount of work responsibility". The tight project schedule and overload of work assignment maybe reinforces peoples' unsafe behavior. Supervisors sometimes are turning a blind-eye or encouraging employees to take a short-cut to do the job. They themselves also get the pressure to ensuring the project schedule rather than keeping safe workplace. Next are "Project scale" and "Type of project owner". Different scale and owner of project causes different interest of supervisor about safety. Real practices at small construction site demonstrate supervisors usually negligent and leave workers unsafe working. In the great scale or main important project in which the safety has a strong influence to their successful, the supervisors are remarked about their safety role. In that case their safety behavior is improved. The last item, weather conditions in which project was placed, weakly associated with this factor with the factor loading low. However, it also expresses the influence to supervisor behavior.

The third factor, "Project Stakeholder Influence", has four items and accounts for 10.714% of the total variance. Three of four items in this group factor are related to supervisors' pressure, namely project owner, top manager and community, impact supervisor behavior. Supervisors' behavior is influenced strongly by the community. Community conception believes that construction site accident is evident truth, there is no-site can get the zero-accident. The most common responses of supervisors to questions on safety practice is "Construction work is dangerous, so people have to look out for themselves" (Holt, 2001). This concept not only impacts on supervisors' behavior but also creates a fulcrum for unsafe behavior. Supervisor perception indicated project owner and top manager also have certain influence to them. The last item is an influence from workers. It shows moderately factor loading because workers normally have less influence on supervisors' behavior in term of command line. But workers can influence supervisors' behavior through their commitment on work safety.

The fourth factor, "Personal Background and Safety Knowledge", includes four items and accounts for 8.513% of the total variance. Factor includes "Safety knowledge", "Working experience", "Supervisor capability to control workers" and "Education background". This is one of the most important influences on construction site safety. According to Anderson and John (1999), lack of education and training is one of seven factors that cause existing high accident rate in construction industry. Among four items of this factor, "Safety knowledge" and "Working experience" have high factor loading. It demonstrates a high perception of supervisor about the important of safety knowledge to their job. The other two items have lower factor loading. All of the respondents may have moderately influenced by education background.

The fifth factor, "Social Influence", includes four items and accounts for 7.813% of the total variance. This factor includes the influence from family members, coworker, age and salary satisfaction. From the factor loading, the important from family members remind them working safely is pointed out. There is no doubt about family role in supervisors' behavior. Supervisor should keep safe for themselves and their worker because they are very important to their family. This concept is quite often used in the safety training in order to improve supervisors and workers behaviors. Another response of supervisors is "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" (Holt, 2001). Despite the violation of organization's safety policy, supervisors became socialized and accepted the unsafe practice as "normal" work behavior. They let worker perform work unsafely to avoid being teased or made fun of their co-worker, avoid to be a wimp in workers' eyes when he always remind about safety. Influence from co-worker is latent but very dangerous impact to supervisors' behavior in safety action. There is a relationship between age and personal behavior. Younger supervisor in many cases possess certain capabilities over older workers including increased strength, speed, and precision. However, they may lack to aware the hazard. Difference age can directly influence on their experience. Older supervisor may have some advantages in realizing and controlling hazards at the site through their experience. Under construction site environment, the older supervisor may present more competence than younger supervisor to give a command for work safety. Conversely, changing the unsafe behavior of older supervisor is quite difficult. Lastly the satisfaction of salary can influence on supervisors' behavior because supervisors who did not satisfy to their salary may not have organizational commitment. Therefore, they may neglect on safety practice while they supervised the construction work task.

The sixth and the last factor, "Supervisor Habits", combines two items which are "Drinking habit" and "Smoking habit" accounts for 6.311% of the total variance. All of items enjoy relatively large factor loadings (>0.80). Among 403 respondents were asked, more than 66% person respond have a habit of drinking and more than 24% have a habit of smoking. Although all of respondents are aware the extremely influence of these habits to their behavior on safety actions, they still keep their habits. This results should be consider in further analyze.

5.2.6 Descriptive Factors

The correlation matrix showing relationships among the various factors, together with the means, standard deviations and important index is presented in Table 5.4.

Table 5.4 Summary statistics and correlations for all factors (N = 403)

Factor	Mean	SD.	Index	F1	F2	F3	F4	F5	F6
F1	4.249	.725	5.864	1					
F2	3.654	.877	4.167	.334**	1				
F3	3.798	.894	4.250	.286**	.506**	1			
F4	4.211	.703	5.993	.516**	.296**	.298**	1		
F5	3.294	.869	3.789	.215**	.372**	.470**	.345**	1	
F6	3.676	1.261	2.916	.180**	.152**	.084	.188**	.125*	1

**. Correlation is significant at the 0.01 level; *. Correlation is significant at the 0.05 level (2-tailed).

Correlation matrix was used for communicating the pattern of relations among factors. These descriptive statistics were calculated using SPSS Version 17. Level of influence of six factors, Organizational and Managerial Influence, Project Characteristics and Work Assignment, Superiors Pressure and Workers Influence, Safety Knowledge and Learning, Social Influence and Supervisor Habits, on supervisor's behavior were all measured using a 5-point scale. All of mean responses to these factors were high, exceed 3.0, suggesting that all of these factor considerable impact to supervisor's behavior. However, the variance was high for all of these factors, all of them above 0.70, showing that the same portion numbers of respondents either agree or disagree. The highest responses pertained to the fourth and first factor, Safety Knowledge and Learning and Organizational and Managerial Influence, suggests that all of supervisors remarked the strong influence from these factors on their behavior on safety action. Mean responses of four remaining factor were not too high but above threshold of average 3.0. It proved that these four factors also affected supervisor behavior from themselves opinion. The influence rankings of each item in each factor are also presented in Table 5.5. From the important index, five most important items are Safety Knowledge, Safety Management System, Safety Regulation and Procedure, Supervisor Experience, and Company Safety Vision.

The correlation matrix indicated that all organizational factors were significantly related to each other with the exception of Superiors Pressure and Workers Influence and Supervisor Habits. Coefficients ranged from 0.125 to 0.516. All these coefficients were positive and significant at the .01 level.

Table 5.5 Descriptive and influence ranking of factors and their items (N=403)

Factor	Mean	SD.	Index	Influence Ranking
Factor 1. Organizational and Management	**4.249**	**.725**	**5.864**	**II**
Safety management system	4.397	0.865	5.086	2
Safety regulations and procedures	4.298	0.898	4.785	3
Company vision about safety	4.248	0.950	4.469	5
Financial supports for safety	4.206	0.972	4.327	7
Workplace environment	4.104	0.959	4.280	8
Providing of safety training programs	4.241	0.962	4.410	6
Factor 2. Project Characteristics and Work Assignment	**3.654**	**.877**	**4.167**	**IV**
Project schedule	3.918	1.124	3.484	11
Amount of work responsibility	3.692	1.199	3.080	16
Project scale	3.660	1.218	3.005	18
Type of project owner	3.382	1.211	2.794	20
Weather conditions	3.615	1.156	3.127	15
Factor 3. Project Stakeholder Influence	**3.798**	**.894**	**4.250**	**III**
Project owner	3.893	1.131	3.442	12
Top manager	3.940	1.084	3.634	10
Community pressure	3.742	1.147	3.261	13
Workers	3.618	1.181	3.062	17
Factor 4. Personal Background and Safety Knowledge	**4.211**	**.703**	**5.993**	**I**
Safety knowledge	4.591	0.837	5.486	1
Working experience	4.290	0.934	4.591	4
Supervisor capability to control workers	4.032	1.003	4.019	9
Education background	3.931	1.228	3.201	14
Factor 5. Social Influence	**3.294**	**.869**	**3.789**	**V**
Family	3.258	1.292	2.522	23
Coworkers	3.387	1.143	2.962	19
Age	3.166	1.419	2.231	25
Salary satisfaction	3.365	1.275	2.639	22
Factor 6. Supervisor Habits	**3.676**	**1.261**	**2.916**	**VI**
Smoking	3.355	1.357	2.472	24
Drinking	3.998	1.505	2.655	21

5.3 Structural Equation Modeling (SEM)

Structural equation modeling (SEM) is performed to establish the model for explaining supervisor's behavior. This technique is applied by using AMOS 16.0 software. Six independent variables which are Organizational and Management Influence, Project Characteristics and Work Assignment, Project Stakeholder Influence, Personal Background and Safety Knowledge, Social Influence, and Supervisor Habits are explored their influence on behavioral intention and actual behavior that were discussed on Chapter 4. With SEM technique, researchers can explore the complex relationship among several dependent variables and independent variable in multi layer of linkage at a time. This research expects to develop model for explaining complex relationship among factors, behavioral intention and behavior, so SEM is an appropriate technique to apply.

Sample size is a strict requirement in SEM in order to achieve a stability and reliability of the parameter estimates. In SEM, sample size has to exceed fifteen cases per measured variable (Bacon, 1997). Replication with multiple samples would demonstrate the stability of the results, but many times this is not feasible. For one sample analysis, there is no exact rule for the number of participants needed; but fifteen cases per estimated parameter appear to be the general consensus (Bacon 1997). Since factor analysis reduced the number of variables to six factors, combined with behavioral intention and behavior measured variable, a satisfactory ratio of 15:1 cases per measured variable was achieved. Moreover, the developed model needs to satisfy conditions for a number of statistic criteria. The reader is referred to Table 5.6 and Section 5.3.1 for a complete description of these and their threshold acceptance levels.

5.3.1 Goodness-of-fit Measures

Researcher typically uses the following criteria to obtain the statistical significant and substantive meaning of developed model. Table 5.6 provides a summary on the most common SEM model fit indexes. In reference to model fit, numerous goodness-of-fit indicators were used to assess the model (Tabachnick and Fidell, 2007; Hair, Black et al., 2010). The more criteria a model satisfy, the better its fit.

Table 5.6 Cutoff criteria for several fit indexes

Indexes	Short-hand	General rule for acceptable fit	Recommend
Absolute/predictive fit			
Chi-square	$\chi 2$	Ratio of $\chi 2$ to $df \leq 2$ or 3, useful for nested models/model trimming	Used
Akaike information criterion	AIC	Smaller the better; good for model comparison (nonnested), not a single model	
Browne–Cudeck criterion	BCC	Smaller the better; good for model comparison, not a single model	
Bayes information criterion	BIC	Smaller the better; good for model comparison (nonnested), not a single model	
Consistent AIC	CAIC	Smaller the better; good for model comparison (nonnested), not a single model	
Expected cross-validation index	ECVI	Smaller the better; good for model comparison (nonnested), not a single model	
Comparative fit		Comparison to a baseline (independence) or other model	
Normed fit index	NFI	>0.95 (Good); > 0.9 (Acceptable)	Used
Incremental fit index	IFI	>0.95 (Good); > 0.9 (Acceptable)	
Tucker–Lewis index	TLI	>0.95 (Good); > 0.9 (Acceptable)	Used
Comparative fit index	CFI	>0.95 (Good); > 0.9 (Acceptable)	Used
Relative noncentrality fit index	RNI	Similar to CFI but can be negative, therefore CFI better choice	
Parsimonious fit			
Parsimony-adjusted NFI	PNFI	Very sensitive to model size	
Parsimony-adjusted CFI	PCFI	Sensitive to model size	
Parsimony-adjusted GFI	PGFI	Closer to 1 the better, though typically lower than other indexes and sensitive to model size	

Table 5.6 Cutoff criteria for several fit indexes (Continued)

Indexes	Short-hand	General rule for acceptable fit	Recommend
Others			
Goodness-of-fit index	GFI	>0.95 (Good); > 0.9 (Adequate)	Used
Adjusted GFI	AGFI	>0.95 Performance poor in simulation studies	Used
Hoelter .05 index		Critical *N* largest sample size for accepting that model is correct	
Hoelter .01 index		Hoelter suggestion, *N* = 200, better for satisfactory fit	
Root mean square residual	RMR	Smaller, the better; 0 indicates perfect fit	
Standardized RMR	SRMR	<0.08	
Weighted root mean residual	WRMR	<0.9	
Root mean square error of approximation	RMSEA	< 0.06 to 0.08 with confidence interval	Used

Some common fit indexes, the Normed Fit Index (NFI), Non-Normed Fit Index (NNFI, also known as TLI), Incremental Fit Index (IFI), Comparative Fit Index (CFI), and root mean square error of approximation (RMSEA), will be used. The following section will report the fit indexes chosen for this study together with the justification for choosing those indexes.

The χ_2 statistic. This statistic is an absolute fit index indicating how well an analysis succeeded in minimizing the discrepancy between the hypothesized covariance matrix and the sample covariance matrix. The smaller the value of χ_2 the better the fit, with zero indicating perfect fit and a value with an associated probability greater than .05 indicating acceptable fit (Tabachnick and Fidell, 2007). However, a number of writers have raised concern about the use of this statistic as a test of model fit because of its sensitivity to data that are not multivariate normally distributed and its tendency to indicate misfit as sample size increases (because of power). Despite these reservations, it has been used here as it allows for comparisons between models, with the χ_2 statistic for the hypothesized model providing a baseline value against which all subsequent tests of invariance can be compared. Furthermore, in cross-validation analysis, the χ_2- difference test can be used whereby a non-significant difference between the χ_2 for the calibration sample and the χ^2 for the validation sample indicates no difference between the two models.

The χ^2 /DF ratio. Researchers have addressed some of the limitations of the χ^2 statistic by developing a number of alternative goodness-of-fit indices (Bacon, 1997; Tabachnick and Fidell, 2007). One of these indices is the χ^2 /degrees of freedom ratio (reported as CMIN/DF), an index that is designed to compensate for the tendency of the χ^2 test to reject models when sample sizes are large. As with the χ^2 statistic, this ratio provides an indication of the efficiency of the hypothetical model in reproducing the sample data. Values of 2 or less represent a good fit (Schreiber, Nora et al., 2006).

The Root Mean-Square Error of Approximation Index (RMSEA). The RMSEA takes into account the error of approximation in the population and relaxes the stringent requirement on χ^2 that the model holds exactly in the population. Values of .05 or less indicate the hypothetical model is a close fit to the sample data (Schreiber, Nora et al., 2006). However, some authors suggest that models with RMSEA values of .08 or less can be accepted (Tabachnick and Fidell, 2007; Hair, Black et al., 2010).

The Tucker-Lewis Index (TLI). This index is an incremental (or comparative) fit index which provides a measure of improvement in fit when the hypothesized model is compared with a more restricted baseline model. TLI is recommended when the maximum likelihood estimation method is used as was the case in this study. TLI should be greater than 0.95 although values greater than 0.9 indicate reasonable fit (Schreiber, Nora et al., 2006). This index can exceed a value of 1 (i.e., it is a non-normed fit index), however, this indicates a lack of parsimony.

The Confirmatory Fit Index (CFI). The CFI is also an incremental fit index and is recommended when data are not multivariate normally distributed, as the CFI shows minimum estimation bias when this is the case. This index is normed with values constrained to fall between 0 and 1. CFI should be greater than 0.95 although values greater than 0.9 indicate reasonable fit (Schreiber, Nora et al., 2006; Hair, Black et al., 2010).

The Goodness-of-fit index (GFI). The GFI is the goodness of fit index, which indicates the proportion of the observed covariances explained by the model-implied covariances. GFI varies from 0 to 1, but theoretically can yield meaningless negative values. By convention, GFI should be equal to or greater than 0.90 to accept the model (Schreiber, Nora et al., 2006).

The Adjusted GFI (AGFI). The AGFI is the adjusted goodness of fit index. This adjustment is to cater for the phenomenon of SEM, whereby more complex models fit the same data better than simpler models. The AGFI takes this accommodation into account by adjusting the GFI value downwards as the number of model parameters increases. AGFI varies from 0 to 1, but theoretically can yield meaningless negative values. AGFI should be at least 0.9 to accept the model (Schreiber, Nora et al., 2006).

The Normed fit index (NFI). The NFI indicates the proportion of improvement of the model relative to a null model that assumes the variables are uncorrelated. NFI ranges from 0 to 1, with value over 0.9 indicative of an acceptable fit of the model to the data, and values close to 1 indicating perfect fit (Schreiber, Nora et al., 2006).

5.3.2 Structural Equation Model for Supervisors' Behavior Based on Their Perceptions

Structural model was undertaken using the SEM technique to uncover the significant interrelationships between the factors retained from EFA in section 5.2. The conceptual model was described in Figure 5.1. Six constructs related to factor influencing supervisors' behavior which was explored from EFA, one construct represented for behavioral intention and one construct represented for current behavior were in this model. The details of each observed indicators were shown in Table 5.7.

The final significant model without link between errors was called middle model shown in Figure 5.2. In order to achieve a higher Goodness-of-Fit model, some links between errors were sequential added based on the result from Modification Indices (MI). The final model which was described in Figure 5.3 was the optimum model that achieved almost criteria for several fit indexes without too complex relationship.

Table 5.7 Observed indicators used in perception model explaining supervisors' behavior

Construct	Variable	Scale	Item
Organizational & Management Influence	Safety management system	1-5 (Disagree – Agree)	System
	Safety regulations and procedures	1-5 (Disagree – Agree)	Regu
	Company vision about safety	1-5 (Disagree – Agree)	Vision
	Company financial supports for safety issue	1-5 (Disagree – Agree)	Financial
	Workplace environment	1-5 (Disagree – Agree)	Envi
	Providing of safety training programs	1-5 (Disagree – Agree)	Train
Project Characteristics & Work Assignment	Project schedule	1-5 (Disagree – Agree)	Schedule
	Amount of work responsibility	1-5 (Disagree – Agree)	Load
	Project scale	1-5 (Disagree – Agree)	Scale
	Type of project owner	1-5 (Disagree – Agree)	Otype
	Weather conditions at construction site	1-5 (Disagree – Agree)	Weather
Project Stakeholder Influence	Project owner	1-5 (Disagree – Agree)	Owner
	Top manager	1-5 (Disagree – Agree)	Top Man
	Community pressure (government, law, neighbors)	1-5 (Disagree – Agree)	Social
	Workers	1-5 (Disagree – Agree)	Worker

Table 5.7 Observed indicators used in perception model explaining supervisors' behavior (Continued)

Construct	Variable	Scale	Item
Personal Background & Safety Knowledge	Safety knowledge	1-5 (Disagree – Agree)	Know
	Working experience	1-5 (Disagree – Agree)	Exp
	Supervisor capability to control workers	1-5 (Disagree – Agree)	Control
	Education background	1-5 (Disagree – Agree)	Edu
Social Influence	Family	1-5 (Disagree – Agree)	Family
	Coworker	1-5 (Disagree – Agree)	Coworker
	Age	1-5 (Disagree – Agree)	Age
	Salary satisfaction	1-5 (Disagree – Agree)	Salary
Habits	Drinking	1-5 (Disagree – Agree)	Drinking
	Smoking	1-5 (Disagree – Agree)	Smoking
Behavioral intention	The situations include 2 main parts which related to falling from height hazard and electrocution hazard	0-10 (Frequency)	S1 – S10
Behavior	Performances include 4 main responsibility related to safety role	0-4 (Never - Always)	P1 - P12

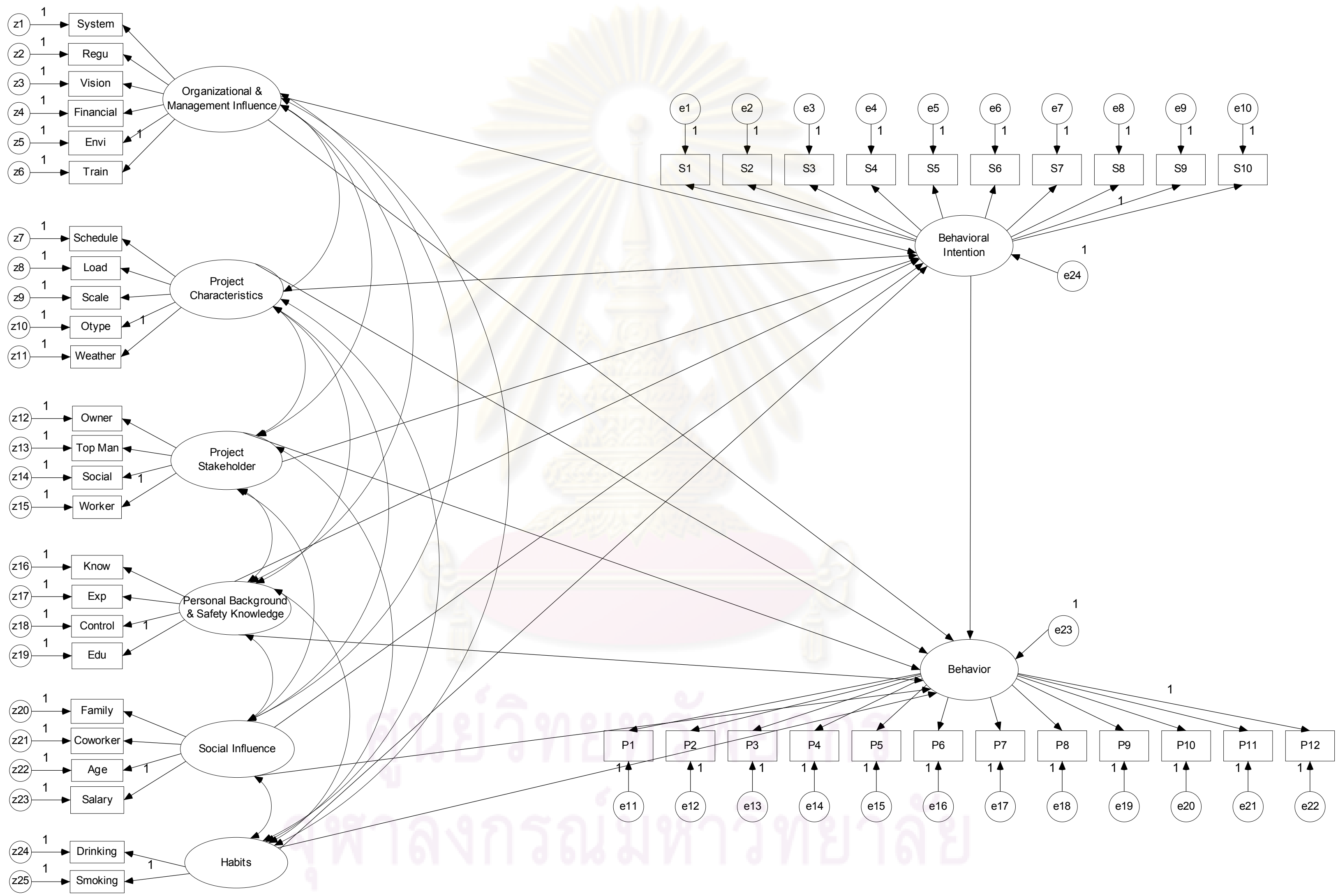


Figure 5.1 Conceptual perception model for explaining supervisors' behavior

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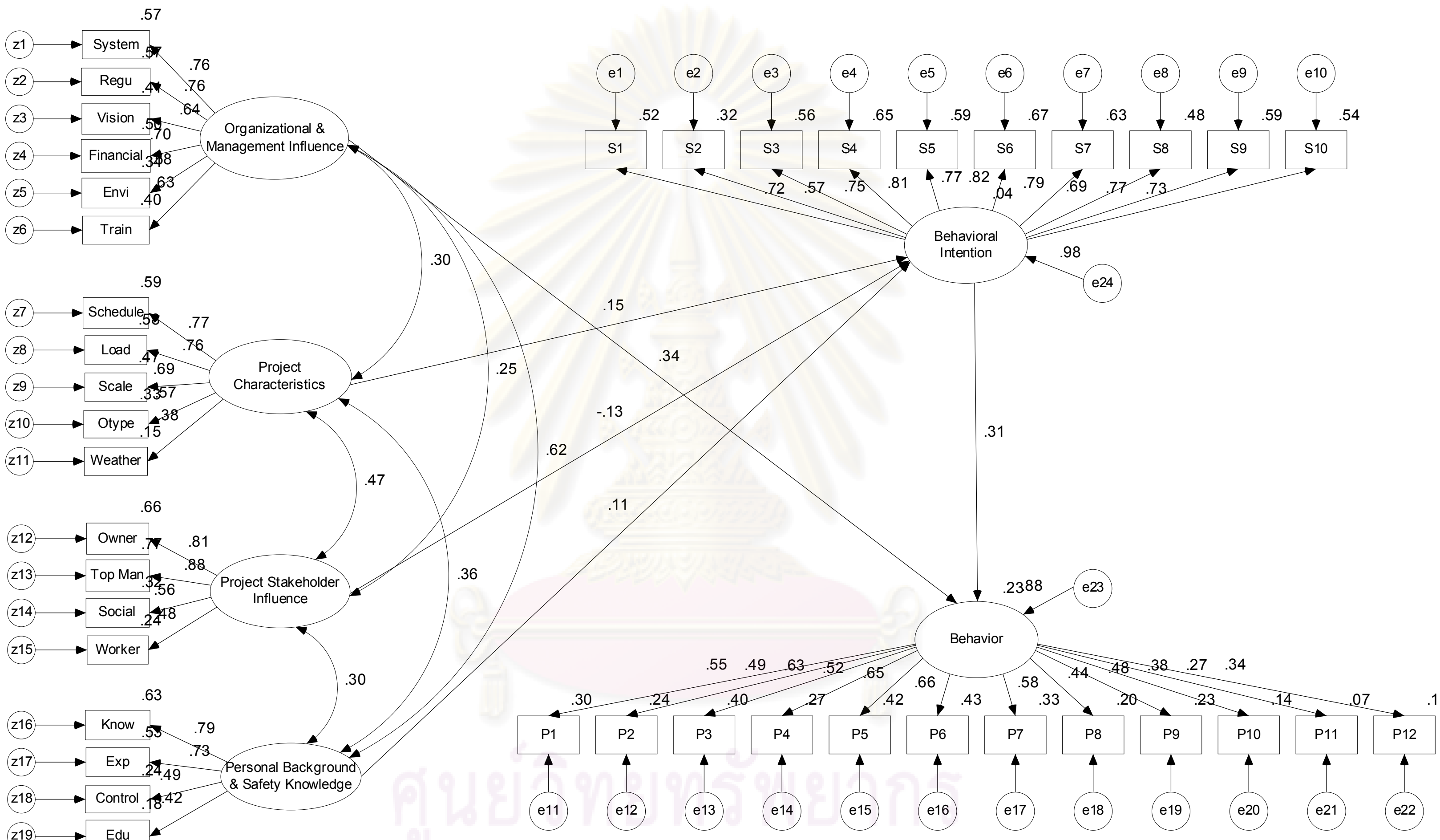

Chi-square=1477.605;df=768;P=.000;
Chi-square/df=1.924;
GFI=.765;TLI=.808;CFI=.820;
RMSEA=.062

Figure 5.2 Perception model for explaining supervisors' behavior (before add link between errors)

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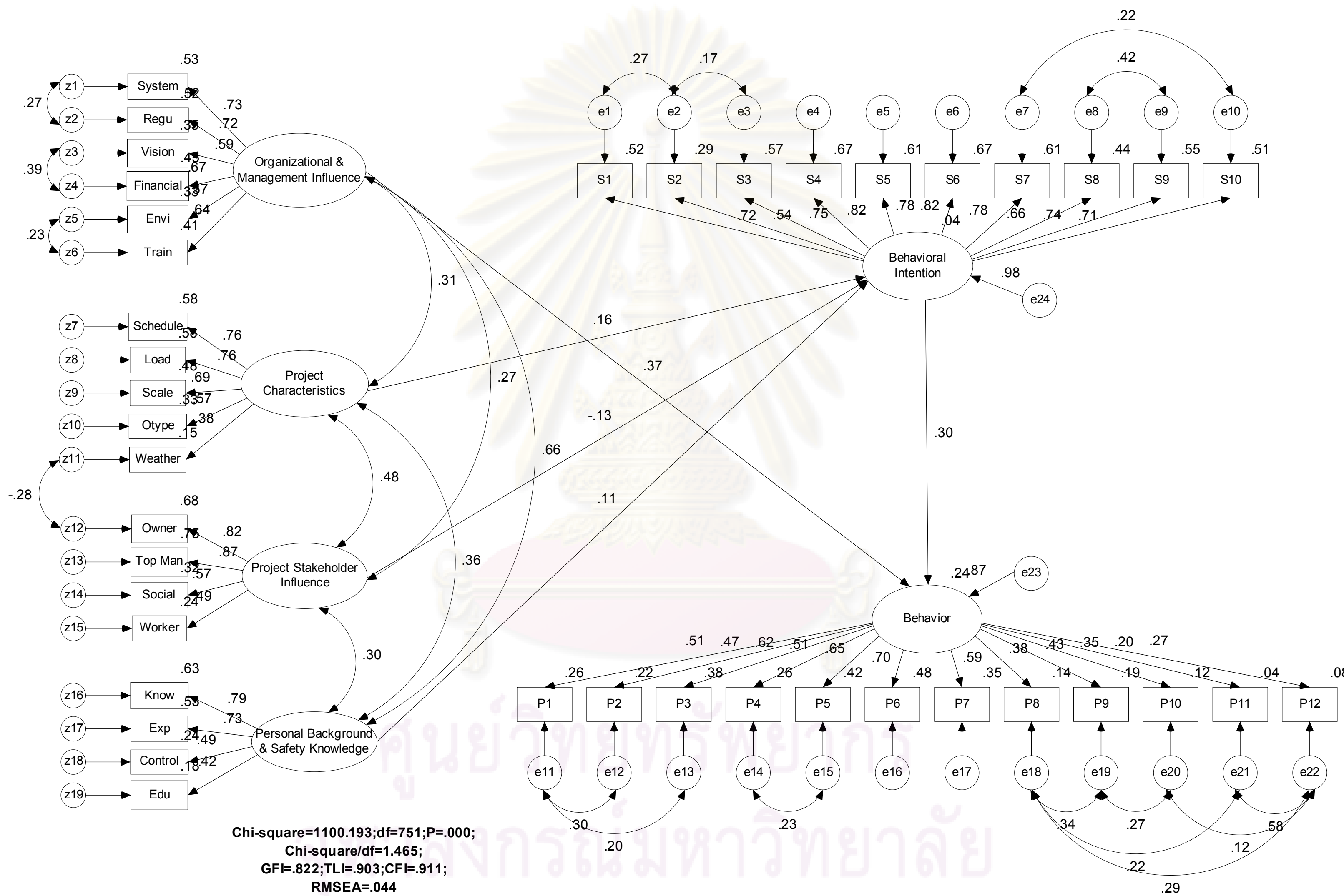

Figure 5.3 Final perception model for explaining supervisors' behavior

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5.3.3 Assessing and Results of SEM

From the analysis it was determined that social influence and habits influence did not appear in the final model. It was not contradict with the result of EFA and was not difficult to understand. Although these two factors existed as important factors but their percentage of variance explained were low than 8%. SEM results indicated the non-significant from Social and Habit Influence on both behavioral intention and behavior. The remaining factors were significant influence on behavioral intention or behavior as shown in Figure 5.3. Additionally, scatter plots between the four retained factors were conducted to ensure that a linear trend best represented (i.e. highest R_2 fit) their relationship. This model has the following fit coefficients: CMIN/DF = 1.465; RMSEA = 0.044; GFI = 0.822; AGFI = 0.796; NFI = 0.769; CFI = 0.911; and TLI = 0.903, comparing with the critical value are shown in Table 5.8. The final model satisfied more than 50% of critical standards and above the threshold of almost important standards. Thus, it can be concluded that the model is valid and can continue to analyze the outcome of the causal effects.

Figure 5.3 provides the results of testing the structural links of the proposed research model using AMOS program. The estimated path coefficients (standardized) are given. All path coefficients can be considered significant at the 90% significance level providing support for five relationships. These results represent was explaining supervisor behavior towards intention and other factors. The effects of the behavioral intention and four remained factors (Organizational and Management Influence, Project Characteristics and Work Assignment, Project Stakeholder Influence, Personal Background and Safety Knowledge) accounted for over 24% of the variance in behavior variable. This is an indication of the good explanatory power of the model for supervisor behavior.

In total, structural equations explained the five causal relationships (paths) which exist between the four retained enablers and outcome factors, shown in Figure 5.4. A summary of the developed structural equations, path coefficients and significance levels is provided in Table 5.9, for more details authors can reference in Appendix D1. The following section discusses the practical implications of each structural equation and its’ associated predictor variables.

Table 5.8 Goodness of Fit Indexes for Perception Model

Indexes	General rule for acceptable fit	Final Model	Comment
$\chi 2$ / *df*	Ratio of $\chi 2$ to $df \leq 2$ or 3, useful for nested models/model trimming	1.465	Good
NFI	>0.95 (Good); > 0.9 (Acceptable)	0.769	Not Acceptable
TLI	>0.95 (Good); > 0.9 (Acceptable)	0.903	Acceptable
CFI	>0.95 (Good); > 0.9 (Acceptable)	0.911	Acceptable
GFI	>0.95 (Good); > 0.9 (Adequate)	0.822	Not Acceptable
AGFI	>0.95 Performance poor in simulation studies	0.796	Not Acceptable
RMSEA	< 0.06 to 0.08 with confidence interval	0.044	Good

Table 5.9 Path coefficients and structural equations

Path	Estimate Un-stand	Estimate Standardized	S.E.	C.R.	P
e24 - Behavioral intention	2.233	.981	.182	12.266	***
Personal Background & Safety Knowledge - Behavioral intention	.465	.106	.373	2.447	.013
Project Characteristics & Work Assignment - Behavioral intention	.800	.158	.490	1.422	.103
Project Stakeholder Influence - Behavioral intention	-.484	-.127	.337	-1.435	.101
Behavioral intention - Behavior	.037	.303	.013	2.888	.004
e23 - Behavior	.241	.869	.062	3.860	***
Organizational & Management Influence - Behavior	.163	.366	.054	2.995	.003

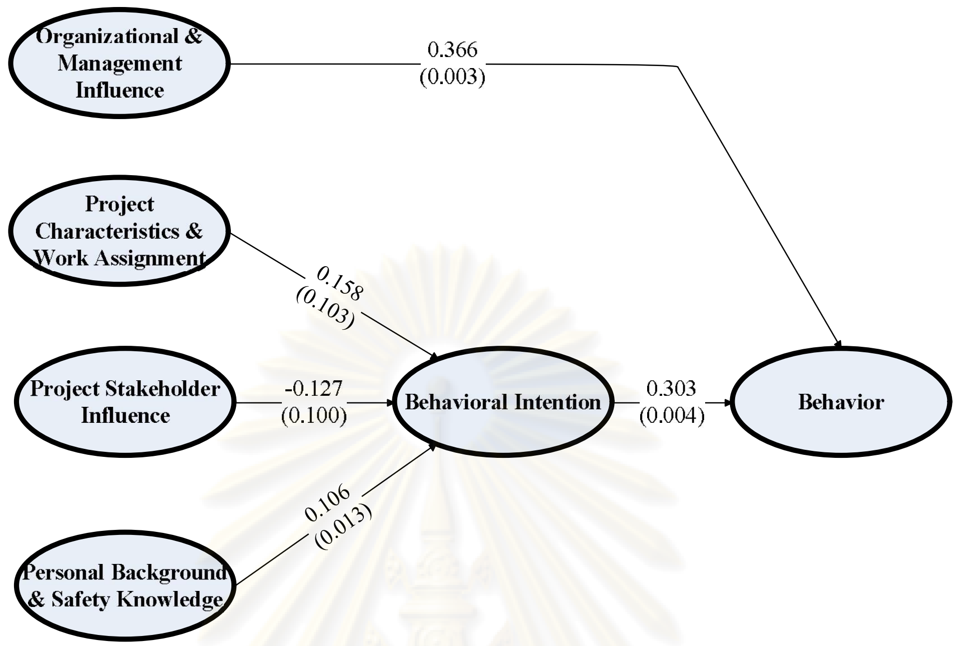

Figure 5.4 Path Perception Model for Explaining Supervisors' Behavior

From the SEM results in Table 5.9 and path perception model in Figure 5.4, supervisors' behavior on safety actions at construction site are positively affected by their behavioral intention (β= 0.30, P<0.01) and organizational management influence (β= 0.37, P<0.01). This result appropriates with some previous theory of behavior that individual behavior can be change through intention positively. However, this result indicates, behavior can be positive influenced strongly by organization in which they are working for. These results stressed the important role of organization in improving supervisors' behavior on safety.

Results from SEM also indicated the influence of project characteristics and work assignment, project stakeholder influence, personal background and safety knowledge on supervisor behavioral intention. Project characteristics and safety knowledge are positive influence in changing behavioral intention as our expected but the significant is quite low (β= 0.16, P=0.1; β= 0.11, P=0.01). In generally, statistical report is seldom expressing the results less than 95% significant. However in this results explanation, authors expect to show some results in 90% confident to extend the outcome. It helps to achieve comprehensive understand about factors affect supervisor behavior. Unexpected result is negatively affected by project stakeholder influence on behavioral intention. Normally, we expect that supervisor may constantly concern with safety if they received higher awareness from project stakeholder such as top manager, project manager, community and worker. But the output is reverse direction. The pressure from project stakeholder may influence behavioral intention in negative direction (β= -0.13, P=0.1). This result is an interesting outcome. The negative relationship indicates the way that superior impact to improving supervisor on safety is counterproductive.

5.4 Summary

This chapter aims to explore what factors influencing supervisors' behavior on safety action in order to get more understanding how to improve their current safety status. Factor analysis indicate high significant levels of variable influencing supervisor's behavior in safety action such as "Organizational and Management Influence", "Project Characteristics and Work Assignment", "Project Stakeholder", "Personal Background and Safety Knowledge", "Social Influence", and "Supervisor Habits". As a result, Supervisor's behavior can be influenced by several levels of factor which are organizational level, project level, individual level and especially social level. Some issues related to social level were discovered and highlight as family awareness about safety, influence from coworkers and salary satisfaction. Besides, the outputs pointed out the influence from learning and knowledge factor as an important factor in changing supervisor behavior. Additionally, it was interesting from the results of factor analysis that supervisor behavior may be influenced by some of their habits such as drinking and smoking.

Until SEM, the relationships of these factor and behavior are explored carefully. There is no doubt about the positive influence of organizational management influence and behavioral intention on supervisors' behavior while behavioral intention can be changed by project characteristics and safety knowledge. Unexpected and interesting outcome is the negatively influence of project stakeholder on intention. It is hoped that the current study can contribute to the improvement safety approach at construction site. By understanding the factors, manager can change and improve the supervisor behavior. The changing supervisors' behavior can directly influence on to the safety culture and workers because supervisors are the key persons who works in between senior managers and workers. However, it should to notice that, all of responses in this chapter base on supervisor perception only.

CHAPTER VI
EXPLAINING MODEL FOR SUPERVISORS' BEHAVIOR BASED ON ACTUAL PRACTICE

This chapter investigated the impact of actual practice on supervisors' behavior. Data analyzing process will be conduct from descriptive statistic to factor analysis, and finally structural equation modeling. Although this Chapter and Chapter 5 have the same approach, they have different objective and meaning of results. While Chapter 5 developed model for explaining supervisors' behavior based on their perception, Chapter 6 will examine factors considered likely to impact on supervisor behavior from actual practice. It explores the relations among these variables and develops a model for explaining behavior on safety actions. All of these objectives are conducted by supervisors' evaluation about practical safety issue and reality indexes.

6.1 Descriptive Statistics

6.1.1 General Survey Details

In order to achieve objectives as discussed above, the first section of questionnaire was used. The list of variables comprised twenty eight statements, which designed to measure current practice that impact the supervisors' behavior on safety action. There are two subsections of questionnaire section one that respondents were required to answer. The first subsection required supervisors state their reality indexes such as experience in years, their age, their personal education background, number of times attend training course as supervisor, their safety knowledge, their salary satisfaction, and some personal habits. The second subsection required supervisors evaluate the real safety issue of the construction site in which they were working. The questions were designed to evaluate variables that influence supervisors from company level to project level. The examples of variables are company safety vision, financial support for safety issue, safety management system, safety regulation and procedure and so forth. Appendix A described these questions in details.

Data collection for this chapter took place at the same time with other data which were analyzed in Chapter 4 and 5, on March and April 2010 in Vietnam. Data were screened using the complete sample (N = 434) prior to the main analyses to examine for accuracy of data entry, missing values, and fit between distributions and the assumptions of necessary analyze tools. After deleting unusable cases, 403 data are used for factor analyses and only 241 data are used for SEM.

6.1.2 Coding and Cleaning Data

Each response must be assigned a numerical code before it can be entered into SPSS. Almost responses were classified in three levels except the first, the second and the twentieth question. Data were coded from 1 to 3 with the assumption that the increase of coding value is directly proportional to the higher safety level of supervisor behavior. For example in question of safety knowledge, code the first listed response "I have little knowledge about safety" as 1, the second response "I understand necessary safety information and general hazards onsite" as 2, and the last response "I know how to control or avoid all potential hazards according to safety procedures" as 3. Coding based on assumption that the higher level of safety knowledge can increase supervisors' behavior in keeping safety at construction site.

Prior to analyses and using the usable sample (N = 403), it is important to check for mistake initially. So data were examined for accuracy of data entry, missing values. The data screening process involves a number of steps which are checking for error, finding the error in the data file and correcting the error in the data file. The accuracy of the data file was checked by proofreading a random sample of 100 of the original data against a computerized listing. In addition, the frequencies and descriptive statistic command in SPSS Version 17 was used to detect any out of range values. Table 6.1 below presents the frequency, coding value number and valid percentage of data for each item in the final sample of 403. No missing data was found.

Table 6.1 Frequency and coding of responses (N=403)

Issues	Coding	Frequency	Percent	Valid Percent	Cum Percent
Experience As Supervisor					
Less than 2 years	1	206	51.1	51.1	51.1
From 2 to 5 years	2	130	32.3	32.3	83.4
More than 5 years	3	67	16.6	16.6	100.0

Table 6.1 Frequency and coding of responses (N=403) (Continued)

Issues	Coding	Frequency	Percent	Valid Percent	Cum Percent
Age					
Less than 25	1	107	26.6	26.6	26.6
From 25 to 35	2	243	60.3	60.3	86.8
More than 35	3	53	13.2	13.2	100.0
Education Background					
Completed high school	1	36	8.9	8.9	8.9
Undergraduate	2	352	87.3	87.3	96.3
Graduate	3	15	3.7	3.7	100.0
Times attend training course as Supervisor					
Never	1	88	21.8	21.8	21.8
1 time	2	244	60.5	60.5	82.4
From 2 times	3	71	17.6	17.6	100.0
Safety Knowledge					
Little knowledge about safety	1	137	34.0	34.0	34.0
Necessary safety information and knowledge	2	186	46.2	46.2	80.1
Can control or avoid all potential hazards	3	80	19.9	19.9	100.0
Salary Satisfaction					
Not Satisfied	1	243	60.3	60.3	60.3
Satisfied	2	157	39.0	39.0	99.3
Very Satisfied	3	3	.7	.7	100.0
Control workers capacity					
Very Difficult	1	205	50.9	50.9	50.9
Not Difficult	2	177	43.9	43.9	94.8
Easy	3	21	5.2	5.2	100.0
Drinking Habit					
Drink at working time	1	6	1.5	1.5	1.5
Drink not at working time	2	261	64.8	64.8	66.3
Don’t drink at any time	3	136	33.7	33.7	100.0

Table 6.1 Frequency and coding of responses (N=403) (Continued)

Issues	Coding	Frequency	Percent	Valid Percent	Cum Percent
Smoking Habit					
Smoke at working time	1	54	13.4	13.4	13.4
Smoke not at working time	2	46	11.4	11.4	24.8
Don't smoke at any time	3	303	75.2	75.2	100.0
Safety Remind from Family					
Never remind	1	69	17.1	17.1	17.1
Rarely remind	2	162	40.2	40.2	57.3
Often remind	3	172	42.7	42.7	100.0
Safety Attitude of Coworker					
Usually break the safety regulations	1	27	6.7	6.7	6.7
Committed basic safety regulations	2	305	75.7	75.7	82.4
Against people break safety and unsafe procedures	3	71	17.6	17.6	100.0
Workers' Safety Behavior					
Usually break the safety regulations	1	76	18.9	18.9	18.9
Sometimes break the safety regulations	2	175	43.4	43.4	62.3
Rarely break the safety regulations	3	152	37.7	37.7	100.0
Awareness of Top Manager in Safety					
Rarely	1	42	10.4	10.4	10.4
Sometimes	2	114	28.3	28.3	38.7
Always	3	247	61.3	61.3	100.0
Awareness of Owner in Safety					
Rarely	1	48	11.9	11.9	11.9
Sometimes	2	124	30.8	30.8	42.7
Always	3	231	57.3	57.3	100.0

Table 6.1 Frequency and coding of responses (N=403) (Continued)

Issues	Coding	Frequency	Percent	Valid Percent	Cum Percent
Recognition of Community as Government and Neighborhoods about Safety					
Rarely remind	1	124	30.8	30.8	30.8
Sometimes remind	2	207	51.4	51.4	82.1
Seriously remind and always checking	3	72	17.9	17.9	100.0
Weather Conditions at Construction Site					
Totally uncomfortable	1	65	16.1	16.1	16.1
Little uncomfortable	2	265	65.8	65.8	81.9
Comfortable	3	73	18.1	18.1	100.0
Project Scale					
Level IV (=< 03 stories or <1,000m^2)	1	63	15.6	15.6	15.6
Level III (04-08 stories or 1,000-5,000m^2)	2	125	31.0	31.0	46.7
Level II (09-19 stories or 5,000-10,000m^2)	3	97	24.1	24.1	70.7
Level I (20-29 stories or 10,000-15,000m^2)	4	65	16.1	16.1	86.8
Special Level (>= 30 stories or >= 15,000m^2)	5	53	13.2	13.2	100.0
Project Owner Type					
Government	1	97	24.1	24.1	24.1
Private	2	248	61.5	61.5	85.6
Foreign investment	3	58	14.4	14.4	100.0
Project Schedule					
Very stressful	1	212	52.6	52.6	52.6
Normal	2	177	43.9	43.9	96.5
Idle	3	14	3.5	3.5	100.0

Table 6.1 Frequency and coding of responses (N=403) (Continued)

Issues	Coding	Frequency	Percent	Valid Percent	Cum Percent
Workload Assigned in Project					
Too much	1	97	24.1	24.1	24.1
Moderate	2	277	68.7	68.7	92.8
Gently	3	29	7.2	7.2	100.0
Safety Workplace Environment					
Unsafe	1	45	11.2	11.2	11.2
Average	2	276	68.5	68.5	79.7
Safe	3	82	20.3	20.3	100.0
Safety Management System					
Don't have safety management system	1	40	9.9	9.9	9.9
Need to be improved	2	313	77.7	77.7	87.6
Suitable to perform job	3	50	12.4	12.4	100.0
Practical of Safety Regulation and Procedure					
Useless	1	33	8.2	8.2	8.2
Average	2	234	58.1	58.1	66.3
Useful	3	136	33.7	33.7	100.0
Company Financial Support for Safety Issue					
Low	1	67	16.6	16.6	16.6
Average	2	251	62.3	62.3	78.9
High	3	85	21.1	21.1	100.0
Company Vision about Safety					
Safety is not important	1	65	16.1	16.1	16.1
Safety is important	2	232	57.6	57.6	73.7
Safety is strength of company in developing reputation	3	106	26.3	26.3	100.0

6.2 Factor Analysis

The data discussed above will be analysed with the similar factor analysis approach that was used in Chapter 5. As an early step in the data analysis, all questionnaire responses in section 6.1 were checked to ensure completeness and readability before the data was processed using the Statistical Package for Social Sciences (SPSS) version 17. The data gathered were factor-analyzed to examine the interrelationships among the 25 variables and to reduce this number of original variables into a smaller set of factors. It is important to remind this factor analysis is based on supervisors' evaluation of actual practice that influence on safety behavior.

The construct validity of the scales in sample (N = 403) was investigated by factor analyzing the items using the Maximum Likelihood (ML) technique with Varimax rotation. Although structural equation modeling was later used, factor analysis was used to help refine the measurement model.

6.2.1 Checks for Factor Analysis

Collected data is required to check whether it appropriates for performing factor analysis. Checking data contents three steps includes checking adequacy of sample size, assessing the factorability of the correlation matrix, and examining the anti-image correlation matrix.

The first step was checking adequacy of sample size. Factor analysis prefer sample size larger than 100 and at least five time of observations (Hair, Black et al., 2010). The sample size of the supervisor is 403, with the ratio of 16.12 cases to 1 variable, which satisfies the specified limit.

The second step was assessing the factorability of the correlation between observations via the correlation matrix of survey. Factor analysis requires a number of correlation which higher than 0.30 (Hair, Black et al., 2010). Result from correlation matrix among 25 observations in this research points out more than 20 percent of correlations greater than 0.30 at the 0.01 level of significance (see Appendix C2).

The third step was examining the anti-image correlation matrix, the diagonals on that specific matrix should have an overall Measure of Sampling Adequacy (MSA) of 0.50 or above (Hair, Black et al., 2010). The set of variables exhibited satisfactory values above 0.50 and therefore were deemed fit for further analysis. The checked data set of 25 variables resulted in a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.783, which is considered as meritorious. Another mode of determining the appropriateness of factor analysis is the Bartlett test of sphericity. The analysis of Bartlett test of sphericity reached statistical significance with chi-square 1718, degree of freedom 300 and significance level of 0.000. Therefore factor analysis was deemed appropriate.

6.2.2 Factor Analysis Process

The similar process of factor analysis which present in chapter 5 is used in this section. It starts with principal component of factor analysis. This exercise revealed the presence of eight (8) distinct factors. To obtain interpretable results for those eight factors, a varimax rotation was then performed.

Rotation has the effect of optimizing the factor structure and one consequence for these data is that the relative importance of the eight factors is equalized. Before rotation, factor 1 accounted for considerably more variance than the remaining seven (16.74% compared to 8.574%, 6.104%, 5.807%, 4.874%, 4.622%, 4.297%, and 4.171%), however after extraction it accounts for only 13.493% of variance (compared to 7.873%, 7.244%, 6.451, 5.612, 5.035, 4.795% and 4.691% respectively). Consequently this shows that the 25 items represent eight factors (constructs) and explains 55.19% of the total variance of supervisors' behavior.

Table 6.2 displays the Rotated Component Matrix which is a matrix of the factor loadings for each variable onto each factor. As can be seen from below Table most items loaded properly on construct. The eigenvalues, percentage of variance explained are also displayed in this table. To ensure that the items comprising the factors produced reliable scales, Cronbach's alpha coefficient of internal consistency was calculated for each scale. The results are also shown in Table 6.2. They ranged from 0.170 to 1.000, only the first and the second factor higher than standard value 0.600, indicating only two these factors inadequate internal consistency (Pallant, 2004; Hair, Black et al., 2010). It should be carefully consider for further analyze.

Table 6.2 Pattern Matrix, Eigenvalues, Percentage of Variance explained for factor influencing supervisor's behavior on safety actions based on actual practice (N = 403)

	Factor							
Item	F1	F2	F3	F4	F5	F6	F7	F8
F1.Organizational and Management Influence (Cronbach's α = 0.785)								
Workplace Environment	.730							
Safety Management System	.722							
Financial Support for Safety	.710							
Safety Regulation and Procedure	.703							
Company Vision about Safety	.526							
Type of project Owner	.519							
Worker	.494							
F2. Personal Background and Safety Knowledge Influence (Cronbach's α = 0.620)								
Age		.855						
Working Experience		.818						
Training		.420						
Safety Knowledge		.358						
F3. Project Stakeholder and Family Influence (Cronbach's α = 0.553)								
Community pressure (Government, law, neighbors)			.620					
Family			.585					
Project Owner			.569					
Top Manager			.484					
F4. Project Workload (Cronbach's α = 0.579)								
Amount of work responsibility				.800				
Project Schedule				.756				

Table 6.2 Pattern Matrix, Eigenvalues, Percentage of Variance explained for factor influencing supervisor's behavior on safety actions based on actual practice (Continued)

	Factor							
Item	F1	F2	F3	F4	F5	F6	F7	F8
F5. Weather and Worker Control (Cronbach's α = 0.500)								
Supervisor capability to control worker					.624			
Weather Conditions					.564			
F6. Education and Coworker Influence (Cronbach's α = 0.170)								
Education Background						.687		
Project Scale						.485		
Coworker						.403		
F7. Smoking Habits								
Smoking Habits							.802	
F8. Drinking and Salary Satisfaction (Cronbach's α = 0.218)								
Salary Satisfaction								.767
Drinking Habits								.627
Eigenvalues	4.186	2.143	1.526	1.452	1.219	1.156	1.074	1.043
Percentage of Variance Explained	13.493	7.873	7.244	6.415	5.612	5.035	4.795	4.691

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

6.2.3 Descriptive Factors

The correlation matrix showing relationships among the various factors, together with the means, standard deviations and important index is presented in Table 6.3.

Table 6.3 Summary Statistics and Correlations for all Factors (N = 403)

Factor	Mean	SD.	Index	F1	F2	F3	F4	F5	F6	F7	F8
F1	2.09	0.39	5.38	1.000							
F2	1.83	0.47	3.94	.124*	1.000						
F3	2.27	0.46	4.98	.409**	.179**	1.000					
F4	1.67	0.46	3.62	-.144**	-.144**	-.166**	1.000				
F5	1.78	0.45	3.94	.297**	.129**	.221**	.056	1.000			
F6	2.29	0.49	4.63	.259**	.240**	.071	-.167**	.082	1.000		
F7	2.62	0.71	3.68	.028	-.128*	-.035	.020	-.028	-.056	1.000	
F8	1.86	0.38	4.95	.015	-.034	-.033	.044	.011	-.082	.088	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Correlation matrix was used for communicating the pattern of relations among factors. These descriptive statistics were calculated using SPSS Version 17. Level of influence of eight practical factors on supervisor’s behavior was all measured using a 3-point scale. The correlation matrix indicated that more than fifty percent relations were significantly related to each other. Based on assumption discussed at the beginning, the responses were coded with an expectation the higher value will get higher level of safety behavior. It means these practical factors were expected positive relations, but the results shown above were inversed. Some significant negative correlations were found between Project Workload factor with other factors as the first, second, third, and sixth factor. This result indicated the influence of Project Workload factor on supervisor behavior on safety action in opposite direction than expected. The factor analysis and correlation results provided some initial considers to develop explaining model for further analyze.

6.3 Structural Equation Modeling (SEM)

Eight independent variables – Organizational and Management Influence, Personal Background and Safety Knowledge Influence, Project Stakeholder and Family Influence, Project Workload, Weather and Worker Control, Education and Coworker Influence, Smoking Habit, Drinking Habit and Salary Satisfaction - were explored their influence on behavioral intention and behavior that were discussed on Chapter 4. The suitable data set that used for this analyze was 241 responses. Since factor analysis reduced the number of variables to eight factors, combined with behavioral intention and behavior measured variable, a satisfactory ratio of 24:1 cases per measured variable was achieved. Moreover, the developed model needs to satisfy conditions for a number of statistic criteria. The reader is referred to Table 6.5 and Section 6.3.1 for a complete description of these and their threshold acceptance levels. For the purpose of this study, SEM was employed for the main task determining significant structural model between measured variables.

6.3.1 Structural Equation Model for Supervisors' Behavior Based on Actual Practice

Structural model was undertaken using the SEM technique to uncover the significant interrelationships between the factors retained from EFA in section 6.2. It is important to notice that EFA which was explored in section 6.2 based on evaluation and performance related to safety issues. It caused different meaning of this model comparing to model from SEM Chapter 5. In order to clearly distinguish from this section forth, "perceptual model" will be used for final explaining model from SEM Chapter 5 (Figure 5.3Figure 5.3 Final) and "practice model" will be used for final explaining model from SEM in this chapter.

The conceptual model was described in Figure 6.1. Eight constructs related to factor influencing supervisors' behavior based on actual factors which was explored from EFA, one construct represented for behavioral intention and one construct represented for current behavior were in this model. The details of each observed indicators were shown in Table 6.4. The final significant model without link between errors was called middle model shown in Figure 6.2. In order to achieve a higher Goodness-of-Fit model, some links between errors were sequential added based on the result from Modification Indices (MI). The final model which was described in Figure 6.3 was the optimum model that achieved almost criteria for several fit indexes without too complex relationship.

Table 6.4 Observed indicators used in practice model explaining supervisors' behavior

Construct	Description	Scale	Item
Organizational & Management Influence	Safety regulations and procedures	1 – 3 Useless → Useful	Regu
	Workplace environment	1 – 3 Bad → Good	Envi
	Safety management system	1 – 3 Don't have → Good	System
	Company financial supports for safety issue	1 – 3 Low → High	Finan
	Kind of project owner	1 – 3 Government → Foreign	Otype

Table 6.4 Observed indicators used in practice model explaining supervisors' behavior (Continued)

Construct	Description	Scale	Item
Personal Background & Safety Knowledge Influence	Worker behavior on safety	1 – 3 Unsafe → Safe Behavior	Worker
	Company vision or expected targets of project	1 – 3 Safety not important → Strength	Vision
	Age	1 – 3 Low → High	Age
	Working experience	1 – 3 Low → High	Exp
	Providing of safety training programs	1 – 3 Low → High	Train
	Safety knowledge	1 – 3 Low → High	Knowl
Project Stakeholder & Family Influence	Project owner awareness on safety	1 – 3 Rarely → Always	Owner
	Top manager awareness on safety	1 – 3 Rarely → Always	Top
	Community awareness on safety	1 – 3 Rarely → Always	Gov
	Family awareness on safety	1 – 3 Rarely → Always	Family
Project Workload	Amount of work responsibility	1 – 3 Low → High	Load
	Project schedule	1 – 3 Stress → Idle	Sche
Weather & Worker Control	Weather conditions at construction site	1 – 3 Uncomfortable → Comfortable	Wea
	Supervisor capability to control workers	1 – 3 Low → High	Control

Table 6.4 Observed indicators used in practice model explaining supervisors' behavior (Continued)

Construct	Description	Scale	Item
Education & Coworker Influence	Education background	1 – 3 Low → High	Educ
	Project scale	1 – 5 Small → Big	Sca
	Coworker awareness on safety	1 – 3 Rarely → Always	Coworker
Smoking Habit	Smoking	1 – 3 Never → Always	Smok
Drinking Habit & Salary Satisfaction	Salary satisfaction	1 – 3 Unsatisfied → Satisfied	Salary
	Drinking	1 – 3 Never → Always	Drink
Behavioral intention	The situations include 2 main parts which related to falling from height hazard and electrocution hazard	0 - 10 Frequency	S1 – S10
Behavior	Performances include 4 main responsibility related to safety role	0 - 4 Never - Always	P1 - P12

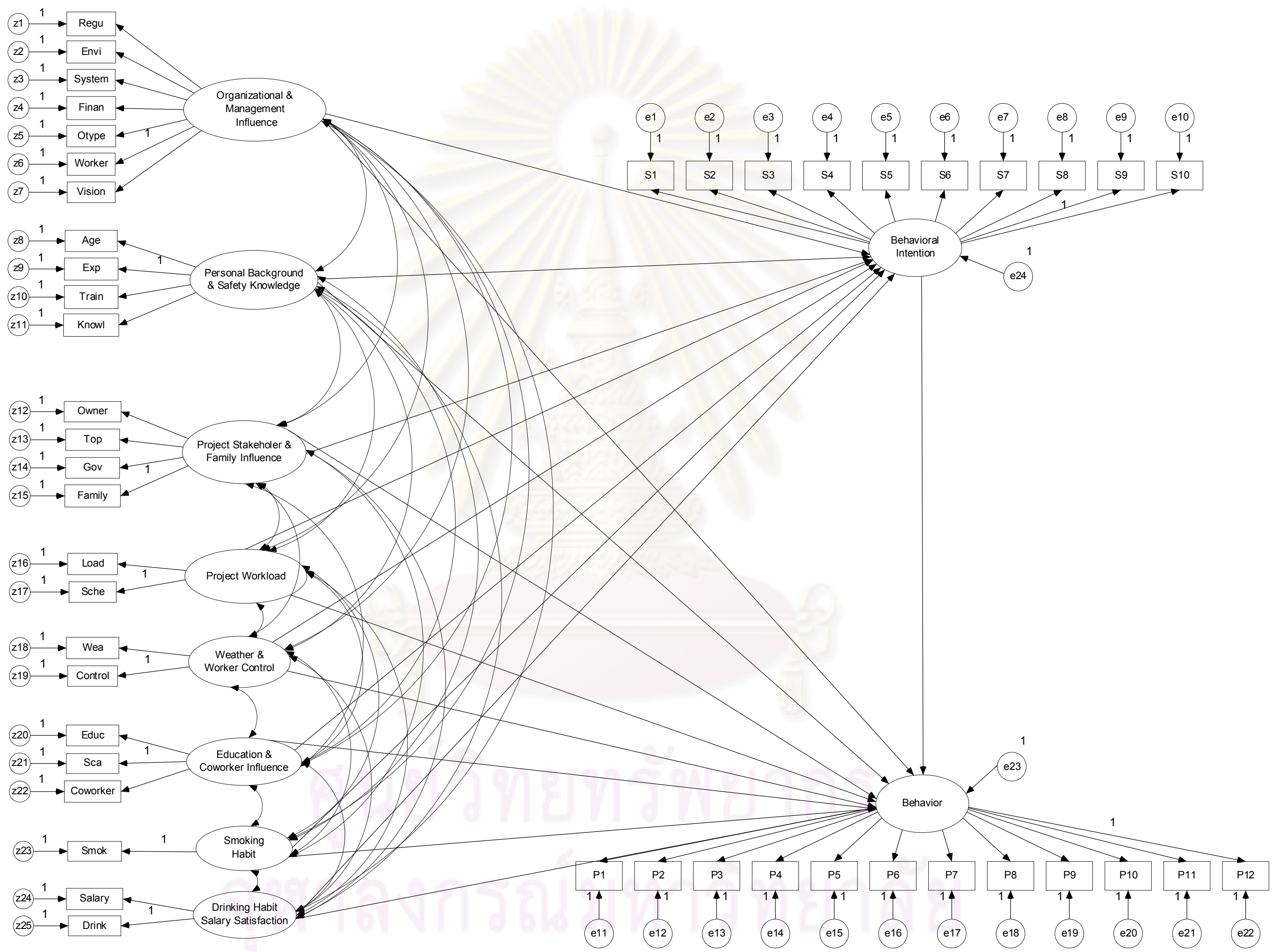

Figure 6.1 Conceptual practice model for explaining supervisors' behavior based on actual practice

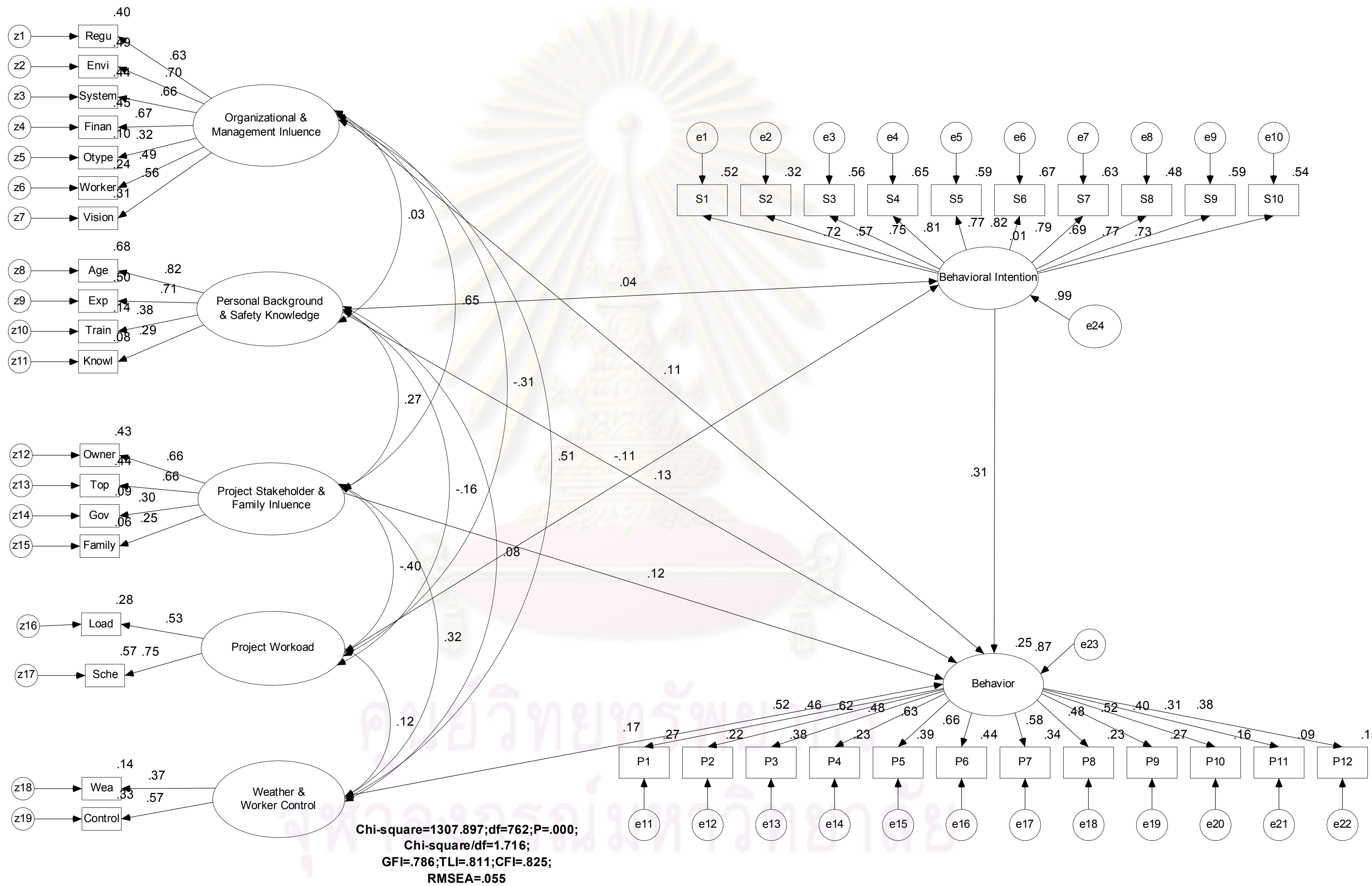

Figure 6.2 Middle practice model for explaining supervisors' behavior based on actual practice

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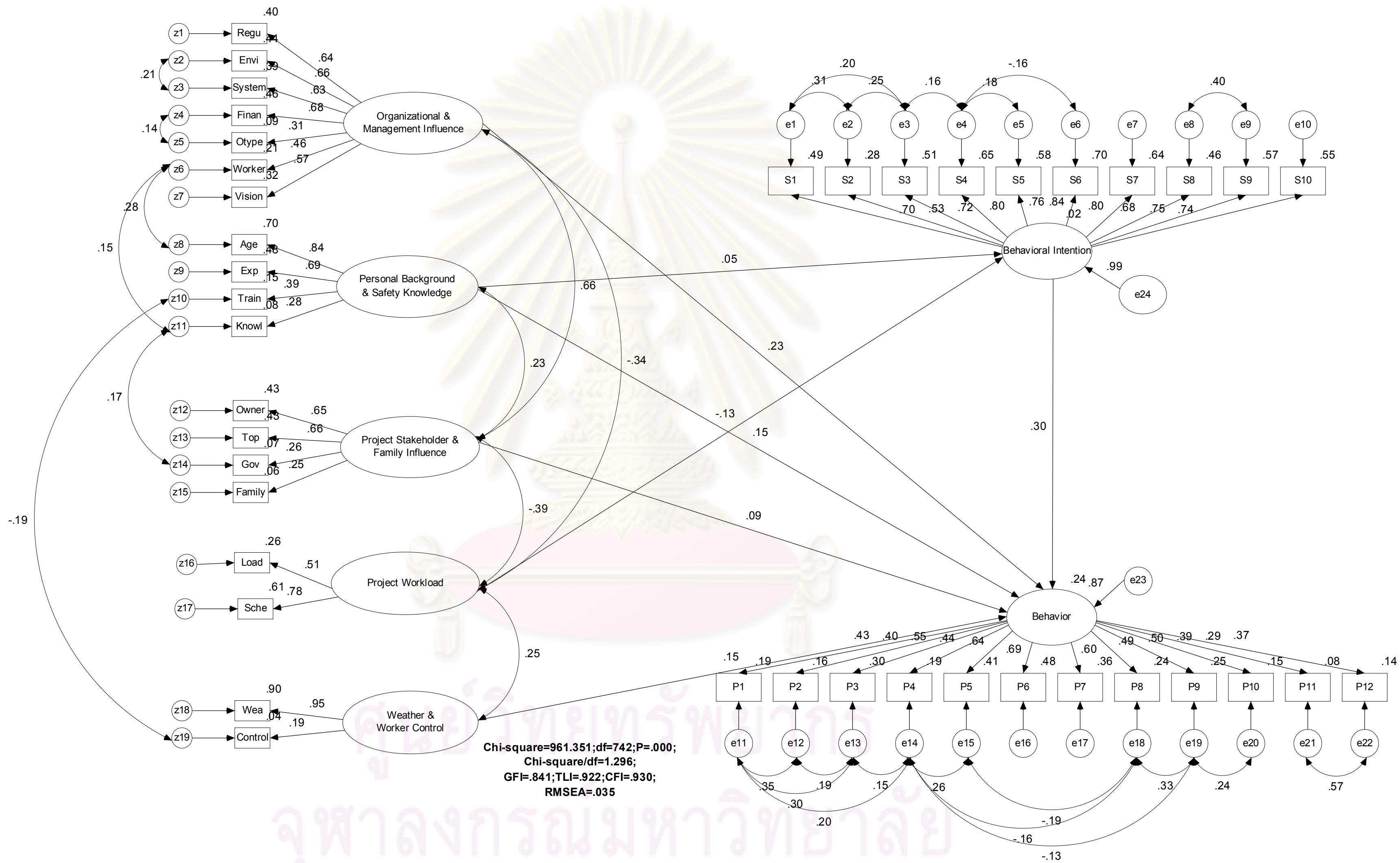

Figure 6.3 Final practice model for explaining supervisors' behavior based on actual practice

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6.3.2 Assessing and Results of SEM

The model's key statistics are good since the GFI is 0.841, the CFI is 0.930 and the RMSEA is 0.035. We can thus safely conclude that the model is valid and can continue to analyze the outcome of the causal effects. The analysis results indicated the direct impact of behavioral intention and four factors on supervisor behavior. These factors are organizational and management influence, personal background and safety knowledge, project stakeholder and family influence, weather conditions and worker control. In addition, their safety behavior was also influenced indirectly by project workload through behavioral intention. Personal background and safety knowledge affected behavior in both ways, direct and indirect through behavioral intention. Remaining three factors did not appear in the final model from current practice, they are education and coworker influence, smoking habit, drinking habits and salary satisfaction.

This SEM result was not contradict with the result of EFA and was not difficult to understand. Although these three factors existed as important factors but their percentage of variance explained were lower than 6%. SEM results indicated the non-significant from these three factors influence on both behavioral intention and behavior. Other factors were significant influence on behavioral intention or behavior as shown in Figure 6.3. This model has the following fit coefficients: CMIN/DF = 1.296; RMSEA = 0.035; GFI = 0.841; AGFI = 0.815; NFI = 0.756; CFI = 0.930; and TLI = 0.922, comparing with the critical value are shown in Table 6.5. The final model satisfied more than 50% of critical standards and above the threshold of almost important standards. So, we can be concluded that the model is valid and reliability to explaining the causal effects (Bacon, 1997; Tabachnick and Fidell, 2006).

Figure 6.3 provides the results of testing the structural links of the proposed research model using AMOS program. The estimated path coefficients (standardized) are given, shown in Figure 6.4. All path coefficients can be considered significant at the 90% significance level providing support for seven relationships. These results were explaining supervisor behavior towards intention and other factors. From actual practice, the effects of the behavioral intention and five remained factors (organizational and management influence, personal background and safety knowledge, project stakeholder and family influence, weather conditions and worker control, project workload) accounted for over 24.3% of the variance in behavior variable. This is an indication of the good explanatory power of the model for supervisor behavior.

In summary, structural equations explained the seven causal relationships (paths) which exist between the five retained enabling and outcome factors as presented in. A summary of the developed structural equations, path coefficients and significance levels is provided in Table 6.6, for more details authors can reference in Appendix D2. The following section discusses the practical implications of each structural equation and its' associated predictor variables.

Table 6.5 Goodness of Fit Indexes for practice model

Indexes	General rule for acceptable fit	Final Model	Comment
$\chi 2$ / *df*	Ratio of $\chi 2$ to *df* $\leq$ 2 or 3, useful for nested models/model trimming	1.296	Good
NFI	>0.95 (Good); > 0.9 (Acceptable)	0.756	Not Acceptable
TLI	>0.95 (Good); > 0.9 (Acceptable)	0.922	Acceptable
CFI	>0.95 (Good); > 0.9 (Acceptable)	0.930	Acceptable
GFI	>0.95 (Good); > 0.9 (Adequate)	0.841	Not Acceptable
AGFI	>0.95 Performance poor in simulation studies	0.815	Not Acceptable
RMSEA	< 0.06 to 0.08 with confidence interval	0.035	Good

Table 6.6 Path coefficients and structural equations

Path	Estimate Un-stand	Estimate Standardized	S.E.	C.R.	P
Behavioral intention ← e24	2.347	.991	.180	13.028	***
Behavioral intention ← Personal Background & Safety Knowledge	.226	.049	.347	2.455	.015
Behavioral intention ← Project Workload	-.652	-.128	.435	-1.629	.104
Behavior ← Behavioral intention	.048	.302	.014	3.356	***
Behavior ← e23	.329	.870	.063	5.243	***
Behavior ← Personal Background & Safety Knowledge	.112	.153	.065	1.620	.085

Table 6.6 Path coefficients and structural equations (Continued)

Path	Estimate Un-stand	Estimate Standardized	S.E.	C.R.	P
Behavior ← Project Stakeholder & Family Influence	.194	.093	.309	2.127	.031
Behavior ← Weather & Worker Control	.527	.153	.314	1.679	.093
Behavior ← Organizational & Management Influence	.257	.227	.159	1.615	.106

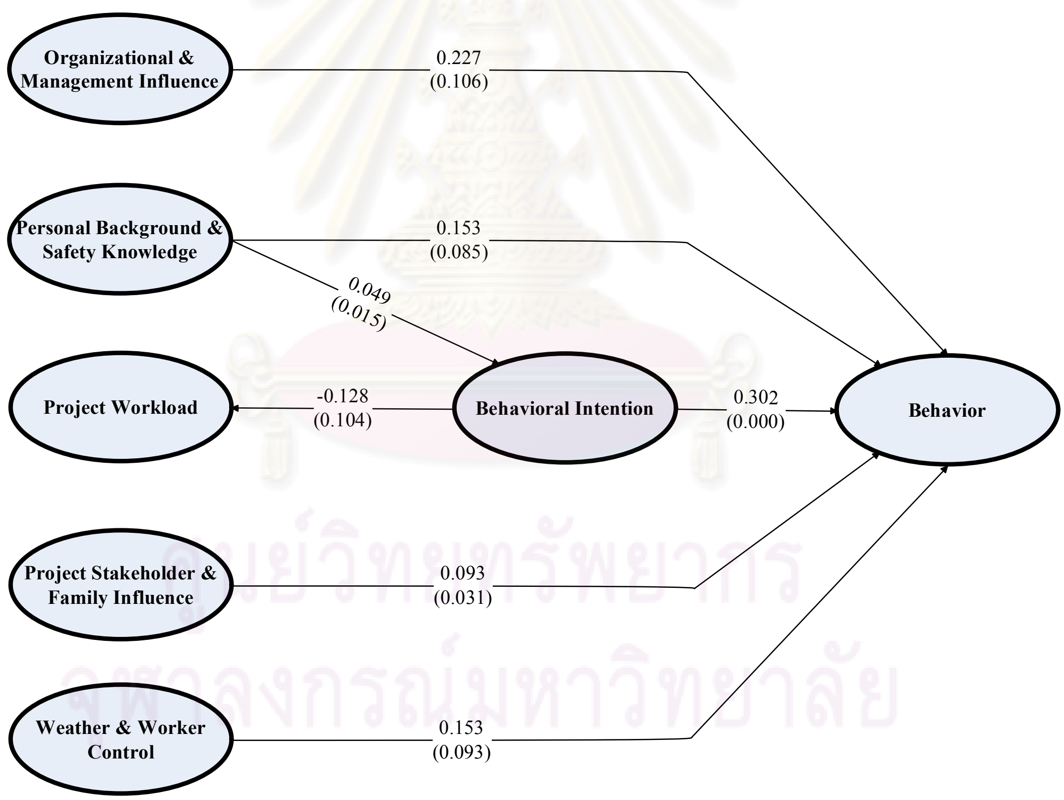

Figure 6.4 Path practice model for explaining supervisors' behavior based on actual practice

SEM result in Table 6.6 and Figure 6.4 indicated many relationships between actual practice and supervisor behavior. Supervisors' behavior on safety actions at construction site are positively affected by their behavioral intention (β= 0.302, $P<0.01$) and organizational influence (β= 0.227, $P<0.10$), these results similar with opinion explaining model in Chapter 5. This result again appropriates with some previous theory of behavior that individual behavior can be change through intention and influenced strongly by organization in which they are working for. These results stressed the important role of organization in improving supervisors' behavior on safety. However, practical explaining model indicated some other influences which did not explored from opinion explaining model. They are influences from safety knowledge and learning (β= 0.153, $P<0.10$), superiors pressure and family influence (β= 0.093, $P<0.05$), weather conditions and control ability (β= 0.153, $P<0.10$) on supervisor behavior. In addition, final practice model also indicated the influence of safety knowledge and learning on supervisor behavioral intention. Safety knowledge are positive influence in changing behavioral intention as our expected but the significant very weak (β= 0.049, $P<0.05$). One unexpected result is the negative affected by work assignment and project schedule on intention (β= -0.128, P=0.1). Normally, we expect that supervisor may constantly concern with safety if they did not stress from schedule and work assignment but the output is reverse direction.

6.4 The Difference Between Perception Model and Practice Model

Base on perception model was discussed in Chapter 5 and practice model in this chapter, we found some difference about factors influencing supervisor behavior. The difference include both what and how factors influencing supervisor behavior. This section will compare perception model and practice model in details to discovering differences in factors may cause changing their perception and current practice in safety action. They are summarized in Table 6.7. The directions of influence are provided from this Table, "Direct" means factor impact to behavior directly, and "Indirect" means factor impact to behavior indirectly through intention. Finally, the brief explaining and suggestion also provide in Table 6.7.

Table 6.7 Comparing factor influencing behavior between perception model and practice model

Item	Supervisor's perception model	Supervisor's practice model	Explaining and Suggestion
Safety regulation and procedures	Positive Direct	Positive Direct	These factors are important in both supervisor perception and practice. These factors should be strongly considered in order to achieve better safety behavior at construction site. These key factors can improve supervisor in particular and all employees at construction site in general. This result gives additional evidence about the way that organization can impact on supervisors who direct influence on workers daily.
Workplace environment	Positive Direct	Positive Direct	
Safety management system	Positive Direct	Positive Direct	
Financial supports for safety	Positive Direct	Positive Direct	
Type of project owner	Positive **Indirect**	Positive **Direct**	
Company vision about safety	Positive Direct	Positive Direct	
Working experience	Positive **Indirect**	Positive Direct, Indirect	The same results in both model indicated the level of important of these personality factor. Positive impact of experience, training, safety knowledge and control worker ability on supervisor' behavior orients manager in selecting suitable supervisor in appropriate project. In addition, this result definitive affirms the significant role of training program, enhance knowledge policy and improve supervisor authority for keeping safety at sites.
Providing of safety training	Positive Direct	Positive Direct, Indirect	
Safety knowledge	Positive **Indirect**	Positive Direct, Indirect	
Supervisor control worker	Positive **Indirect**	Positive Direct	

Table 6.7 Comparing factor influencing behavior between perception model and practice model (Continued)

Item	Supervisor's perception model	Supervisor's practice model	Explaining and Suggestion
Weather conditions	Positive **Indirect**	Positive Direct	Weather conditions were considered positive influence to supervisor' behavior direct or indirect way. Improve working conditions by applying technology, automatic dangerous work should consider improving behavior.
Age	-	Positive Direct, Indirect	Supervisor's perception indicated age was not important but real practice inverse. From practice model, age positively impact supervisor in both direct and indirect way. Older supervisor has higher level of safety behavior. It may come from their experience and knowledge. The result gives a notice about using young supervisor in project.
Family	-	Positive Direct	Supervisor did not perceive the important role of family influence on their behavior. However from the practice model, family has positively impact supervisor behavior directly. Manager should stress the supervisor role in their family in training program and always remind them about that to improve their safety awareness.

Table 6.7 Comparing factor influencing behavior between perception model and practice model (Continued)

Item	Supervisor's perception model	Supervisor's practice model	Explaining and Suggestion
Project owner	**Negative Indirect**	**Positive Direct**	Supervisor may perceive negative influence from owner, top manager, community and worker on their safety behavior. Because these stakeholders may negative effect to their behavioral intention, so supervisor think that they are neglect and unaware about safety at construction site. On the other hand, Supervisor's practice model shows that owner, top manager, community and worker are positively influence on their behavior. From this difference, the manner of expressing awareness and remind safety of project stakeholder more important than frequency of them.
Top Manager	**Negative Indirect**	**Positive Direct**	
Community	**Negative Indirect**	**Positive Direct**	
Worker	**Negative Indirect**	**Positive Direct**	
Education background	Positive Indirect	-	Although supervisor perceives education background may positive influence their behavior indirectly through behavioral intention, but it did not impact in practice. Supervisor who has higher background did not show higher safe behavior. It indicated lack of applying theory in real practice.

Table 6.7 Comparing factor influencing behavior between perception model and practice model (Continued)

Item	Supervisor's perception model	Supervisor's practice model	Explaining and Suggestion
Amount of work responsibility	Positive Indirect	Negative Indirect	The results of perception model show the project workload have positive influence on supervisor behavior. However, from the practice model, these factors have negatively impact on their behavior. It means that project schedule and workload are not supportive on their behavior. Supervisor perceives if they have more idle time, they may take care carefully for safety, but it is inversed in real. Behavior in idle sites was lower influence than stress site which required no mistake to finish on time.
Project schedule	Positive Indirect	Negative Indirect	
Project scale	Positive Indirect	-	The difference between perception and practice indicated project scale not actually impact on behavior. Safety behaviors only depend on organization policy. However in perception model, supervisor perceives their behavior influenced by scale, it should be changed in training program.
Coworker	-	-	These factors were not significant in both perception and practice models even though they were explored from EFA. They are influencing factors but not current urgent factors. However they should be considered in case company have more contexts and want to achieve higher safety level.
Smoking	-	-	
Salary	-	-	
Drinking	-	-	

6.5 Summary

A practice model was formulated to help both researchers and practitioners to better understand the supervisors' behavior on safety action in construction projects. The derived structural model consisted of seven measured structure and seven paths, representing the interrelationships between the five enabling and two outcome factor. Associating perception model in Chapter 5, the practice model provides a clear picture on how to better increase supervisor behavior on safety. EFA and SEM provided some indication that significant factors recognized influencing supervisor should be focused. In influence sequence, they in turn are behavioral intention, organization and management, personal background and safety knowledge, weather and worker control, project stakeholder and family influence.

Although all factors were extracted from EFA, but from SEM all relationships were considered carefully. Only significant influences are retained. From practice model, we can strongly affirm the positive influence of intention and organization on supervisors' behavior. Unexpected and interesting outcome is the negative influence of project workload on intention. In addition, the differences comparing between perception and practice model provide a deeply understand about the manner in changing supervisor behavior. It is hoped that the current study can contribute to the improvement safety approach at construction site in practically.

CHAPTER VII

DISCUSSIONS AND CONCLUSIONS

Based upon data analysis and findings, this final chapter will first discuss about research conclusion. Next implication for research and implication for practice will be presented followed up by the research limitations and suggestions for future research.

7.1 Research Conclusions

7.1.1 Consider Current Supervisors' Behavior on Safety Actions

The statistical results demonstrate the current issue of construction accident; site supervisors have moderately accomplished their safety obligation. The most frequently task performed is correcting hazards if the accident has happened. Some other tasks related to investigating accident to determine causes are sometimes applied. Site supervisors are not pay attention enough on coaching their worker to perform work safety or motivating worker's aspiration for being safe. Therefore, coaching and motivating responsibility should be improved in supervisor safety role.

According to the statistical results, it is obvious that supervisor still not fulfill their entire obligations. In order to create the safely working environment in which workers are guarantee, supervisors' obligations are apply all four issues related to safety responsibilities as discuss above whole working time. In practice, among four main necessary functions of a safety supervisor at construction, they just passable accomplice two of them which are "investigating accidents to determine cause" and "inspecting their area to identify hazards". Two other important liabilities to ensure the safety status at the site are coaching their worker and motivating them. These two safety action are rarely performed in their job.

The reasons for supervisors' lack of safety obligations were considered. The first reason was from construction managers and company vision. Most of respondents perceived that their managers viewed safety as a cost in the real practice. Company vision were not consider safety as an important target as quality, duration and budget. They thought safety conflicted with production and budget. So, they usually take little direct interest in safety, and rely on the site supervisor to manage safety. The second reason was from supervisor themselves. They responded that they didn't have enough time to finish their job, so they needed to focus on others targets as schedule, quality and budget first.

Moreover, some of them perceived that keeping safety was not their job and they could not control worker working safely. In the previous research from Holt (2001), supervisor also responded that “There are not enough staff on site to do the job properly and my attention has to go to production”, or “I don’t have enough time to do my job property”, “It’s not my job to spot other people’s mistakes”, “I can’t stop them doing that, because the progress of work would suffer”.

From the analysis results, investigating the accident causes and correcting hazards were the most frequently task performed because of the obligation from law. As position of site supervisors, they takes full legally responsibility for any accident happened at construction site. Consequently, they must to investigate accident to determine causes and write report. In accordance with the law, supervisor needs to correct the hazards and gives recommendations to prevent a similar accident. This is the reason why two first issued are applied by supervisors quite frequently. Two last reliabilities, coaching and motivating, are bring latent benefit in reducing accident rate. They are rarely applied by supervisor because of limitation resources.

The results point out the supervisors’ behavior lack of coaching and motivating on safety action. This lack will influence their workers’ behavior in a long-term. A research from Anderson and John (1999) showed that lack of education and training workers is one of seven factors that cause high accident rate in construction industry. Thus, it is very important to require supervisor fulfill their four obligation to ensure safety at site. The current status of supervisors’ behavior pointed out that they just perform what they are exactly required according to the law or company regulation. Supervisors give the first priority on job completion that affects their work performance. They don’t care about latent benefits of coaching and motivating worker safety. The reason may be lack of time and experience of safety. Understanding supervisors’ behavior in keeping safety is essential to improve their practice. As their current behavior is not satisfied, it is required to explore the causes of lacking on safety action behavior. The understanding of factor affecting supervisors’ behavior on safety action can help project manager to change it effectively.

7.1.2 Factors Influencing Supervisors’ Behavior

The results of this research indicated high significant level of variables influencing supervisors’ behavior on safety action. These factors were “Organizational and Management Influence”, “Project Characteristics and Work Assignment”, “Project Stakeholder Influence”, “Personal Background and Safety Knowledge”, “Social Influence” and “Supervisor Habits”. In the factor point of view, the first and the second important factor influencing supervisors' behavior are personal background and knowledge and organizational management influence. In the item point of view, supervisors' behavior is affected from their safety knowledge, safety management system, safety regulations and procedures, their experience, and company safety vision. These five items are the highest ranking within twenty items which studied in this research.

In generally, Supervisor's behavior can be influenced by several levels of factor from social level, organizational level, project level and individual level. Different level of factor influenced supervisor's behavior in different way and different intensity. The following section will discus about these influences.

At social level, the analysis results discovered and highlighted the influence from family awareness about safety, coworkers, age, salary satisfaction and community influence. The influence from coworkers and age were found and supported from some previous research (Holt, 2001; Zhou, Fang et al., 2008). Family influence, salary satisfaction and community influence were interesting results of factor analysis. There is no doubt about family role in supervisors' behavior. Supervisor should keep safe for themselves and their worker because they are very important to their family. This concept should be applied in the safety training in order to improve supervisors and workers behaviors. Furthermore, satisfaction of salary can influence on supervisors' behavior. If supervisors did not satisfy to their salary, they may not have organization commitment. Therefore, they may neglect on safety practice while they supervised the construction work task. Next is the influence from community as government, law and neighbours. Community conception believes that construction site accident is evident truth, there is no-site can get the zero-accident. The most common responses of supervisors to questions on safety practice is "Construction work is dangerous, so people have to look out for themselves" (Holt, 2001). This concept not only impacts on supervisors' behavior but also creates a fulcrum for unsafe behavior.

At organizational level, the result emphases the organizational role in creating a safety environment in which employers can work safely. Organizational and management should considered comprehensive view. It included safety system, safety regulation and procedures, safety vision, financial supports, environment and training. This finding adds further support to earlier researches on health and safety about the role of organization and management such as Jannadi (1996), Holt (2001) and Mearns (2003). This research gives additional evidence about the way that organization can impact on the worker safety through the middle level, supervisors who direct influence on workers daily.

At project level, the result indicated the influence from project schedule, workload, project scale and project owner on supervisors' behavior. The different scale and project owner causes different interest of supervisor about safety. Real practices at small construction site demonstrate supervisors usually negligent and leave workers unsafe working. In the great scale or main important project in which the safety has a strong influence to their successful, the supervisors are remarked about their safety role. In that case, their safety behavior is improved. These are normal psychology but they should be changed. Supervisors' behavior in safety should be fulfilling their obligation in any situations because the damages caused from accident are not different no matter how project size is.

At individual level, result pointed out supervisors' behavior was influenced strongly by experience, knowledge, training and learning. Training was found as the most important in improving supervisors' behavior. 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. Training construction safety aims to improve knowledge, skills and awareness in order to ensure supervisor can keep construction site at the basic safety level. Additionally, it was interesting from the results of factor analysis that supervisor behavior may be influenced by some of their habits such as drinking and smoking.

By understanding the group of factors, manager can change and improve the supervisor behavior. The changing supervisors' behavior can directly influence on the safety culture and workers because supervisors are the key persons who works in between senior managers and workers. The intensity and direction of these impacts on changing supervisor behavior were significant considered in order to help the top manager has a good orientation in selecting and training their supervisors.

7.1.3 Supervisors' Behavior Model, the Difference between Their Perception and Practice

Two models for explaining supervisors' behavior were developed. One is based on their perception and another is based on actual practice on safety issue. Statistical techniques including exploratory principal component factor analysis (EFA), factor reliability (Cronbach's alpha) were used for model grouping (factor analysis). Structural equation modeling (SEM) was then performed to test the research model and the significant interrelationships between the factors retained from EFA and behavior. The following paragraphs furnish some conclusions from SEM analysis.

Based on the results of both models, behavioral intention was found have a strong influence on Supervisors' behavior**.** As expected, this is positive relationship. It suggests that improving their behavioral intention may directly impact to change their behavior on safety action.

According to SEM results from supervisor perception, among six factors from EFA only organizational and managerial influence directly impacted supervisors' behavior. Other three factors which include project characteristics, superior pressure and worker, safety knowledge and learning, indirect influence supervisors' behavior through intention. Unexpected result is the negative affected by superior pressure on intention. Normally, we expect that supervisor may constantly concern with safety if they received higher aware from superiors level such as top manager, project manager, community and worker. But the output is reverse direction. The pressure may influence behavioral intention in negative direction. This result is an interesting outcome. The negative relationship indicates the way that superior impact to improving supervisor on safety is counterproductive.

The next results from practice model indicated the interrelationships between behavior and the factors retained from EFA which explored from practical parameters. There are four factors directly impact to behavior such as organization, safety knowledge and learning, project stakeholder and family influence and weather conditions and control ability. One unexpected result is the negative affected by work assignment and project schedule on intention. Normally, we expect that supervisor may constantly concern with safety if they did not stress from schedule and work assignment but the output is reverse direction.

7.2 Contribution to Research

This research has several implications for theory, methodology and practice related to safety at construction site. The results of the current research support this view and suggest that it would be more beneficial for safety researchers to engage in a systematic organizational diagnosis. The practical implication of safety research is predominantly concerned with highlighting courses of action that will reduce the risk of incidents. In recent years there has been a move away from relying on retrospective analyses of accidents and incidents, towards a more proactive approach (Flin et al., 2000). These more predictive measures enable the monitoring of the safety condition of an organisation so that remedial action can be taken prior to an incident occurring (Flin, 1998). This research is a supplementation in safety behavior studies system. The previous researches had already focused on top manager and worker, until this research, behavior of middle level was explore to cover all three level at construction site.

This research contributed new models to explain behavior of supervisor at construction site in both perception and practice viewpoint. These models add further support to earlier researches on health and safety about the role of organization and management such as Jannadi (1996), Holt (2001) and Mearns (2003). Holt (2001) pointed out the key elements of successful safety management are policy, organizing, planning and implementing, measuring performance, reviewing performance and auditing. Jannadi (1996) also found that roles and functions of safety management system, or safety management system to control risk can be essential factors. Both perception and practice model in this research, the role of organization and management were stress with high significant. In addition the role of knowledge and learning, project characteristics, pressure from superiors was reminded from the results. Moreover, some additional key factors for current research were found as community and social influence, smoking or drinking habits during working time. Additional factors were discussed above could impact behavior directly or indirectly through intention; however all of them had significant influence in general.

The third point is that these perception and practice model shows the significant contribution to current research. It was found that the perception model can help to understand on what supervisor perceives on factor influencing safety behavior. On the other hand, the practice model helps researcher understand the real practice of supervisors on their safety action. These two models are also significant in different aspects. Therefore, following research focus on behavior should be concerned about both perception and practice concurrently to understand what they perceive and how they practice.

In practice, the current study can contribute to the improvement of safety approach at construction site. It can help the project parties more understand about one significant part – supervisor. By understanding on supervisor current behavior and factors influencing them, manager can change and improve their behavior. The changing supervisors' behavior can directly influence on the safety culture and workers because supervisors are the key persons who works with senior managers and workers.

The first results showed the current status of supervisor's behavior on safety action at construction site. The lack of responsibility awaked party of construction project. In order to achieve a good safety system and reduce accident rate, they should take interested in supervisor action. Selecting, training, controlling, supervising and speeding up supervisor are significant as a key person.

As their current behavior is not satisfied, it is required to explore the causes of lacking on safety action behavior. The understanding of factor affecting supervisors' behavior on safety action can help project manager to change it effectively. The intensity and direction of these impacts on changing supervisor behavior were considered in this study by explaining model from both opinion and practical parameters. The perception model can help top manager understand "what supervisors are thinking about factors influencing them". Understanding supervisors' perception is important and can help the top manager have a good orientation in selecting and training their supervisors. In another way, the practice model contributes to manager's awareness. Supervisors' practice model indicates how current practice factors impacted on supervisor behavior. From these results, the top manager can realize their company current system, what advantages with positive impact should be developed, what disadvantages with negative impact should be changed. From the significant and direction of each factor influencing supervisor behavior, company can select to improve safety approach in limited resources. The stronger positive influence, the top priority must be focused.

7.3 Limitations and Directions for Future Research

The first limitation is time sampling limit. Because of time limitation, the sample used in this study consisted of supervisors from different sites of Hochiminh city in Vietnam only. The lack of sampling from supervisors in others country may affect the results. So it is highly recommended for future research in this context to use larger sample to determine factors affecting behavior on safety system.

The next limitation is method for assessing behavior. This study used indirect observation involves using interviews, questionnaires and rating scales to obtain information on the safety behavior from supervisor. The use of self-report measures for all variables is also a methodological issue in this research as these measures may not correspond with objective measures of performance. For example, self-reported errors may not reflect the actual number of errors in the workplace. The responses depended on people's memories and current emotion. 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. However, theoretical descriptions of the links between factors and behaviors also lend support to the use of self-report measures in safety research (Ajzen, 1991). Anyhow, direct observation is recommended in future for more accurate in assessing behavior.

Finally, other factors influencing supervisor behavior may exist. Further testing and expansion of our model may include factors not contemplated here. These limitations suggest ways in which the research can be extended and validated and do not reduce the importance of the aims of this series of studies.

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APPENDICES

APPENDIX A

SURVEY QUESTIONNAIRE

QUESTIONNAIRE FOR LARGE SCALE STUDY (English)

Only first-line supervisor is requested to answer this questionnaire. If you are not a first-line supervisor, please do not answer this questionnaire.

This questionnaire is designed to explore what are the main factors that affect your Behavioral Intention and yourself behavior in safety action to enhance and improve safety supervision.

Please be assured that all information collected will be kept in strict confidence, and the results will be made available only in-group summary form without identifying individuals. Your genuine response and cooperation would be much appreciated. There are three parts in this questionnaire.

Please remember, there are no correct answers; the best answers are those that honestly reflect your feelings. Kindly note that we are not seeking the views of your company, but rather your own personal views.

SECTION 1
BACKGROUND INFORMATION AND FACTORS EXPLORATION

1. Company for which you are working: ________________________________

2. Your current position is: ____________________

3. Years working in construction industry: _________ (In Years)

4. Years working as supervisor at construction site: _________ (In Years)

5. Age: _________ (In Years)

6. What is the highest level of education that you have completed? (Please tick the highest level you have completed)

   - ☐ Completed high school
   - ☐ Undergraduate university
   - ☐ Graduate university

7. How many time have you taken the training course as a Supervisor? (please tick the highest time you have completed)

   - ☐ Have never taken any course
   - ☐ One Time
   - ☐ Two Times
   - ☐ Others (Please identify) _________

8. Please tick the box to indicate which statements you will agree with, regarding your Safety Knowledge

□ I have little knowledge about safety

□ I understand necessary safety information and general hazards onsite

□ I know how to control or avoid all potential hazards according to safety procedures

9. According to your work, you think your salary should be

□ Increase, about ______ percent

□ Not change, you are satisfied with your current salary

□ Decrease, about ______ percent

10. Do you feel difficult to control your workers to obey safety regulation and process?

□ Yes, it is very difficult for me to control them

□ It is not so difficult for me to control them

□ No, it is easy for me to control them

11. Please indicate your drinking habits

□ I drink during working time (including lunch time and break)

□ I drink, but not at working time

□ I don't drink at any time

12. Please indicate your smoking habits

□ I smoke during working time (including lunch time and break)

□ I smoke, but not at working time

□ I don't smoke at any time

13. Do your family remind you to keep safe in your work?

□ No, they don't

□ They rarely remind

□ Yes, they often remind

14. What do you think about your coworkers' practice in their safety roles?

□ They usually break the safety regulations

□ They committed basic safety regulations

□ They would react strongly against people who break safety and unsafe procedures

15. What do you think about your <u>workers</u>' safety behavior?
    - ☐ They usually break the safety regulations
    - ☐ They just sometimes break the safety regulations
    - ☐ They rarely break the safety regulations to protect themselves
16. Do the Top-Managers put pressure on you to keep safety for construction site?
    - ☐ Rarely ☐ Sometimes ☐ Always
17. Do the Project Owner request you to keep safety for construction site?
    - ☐ Rarely ☐ Sometimes ☐ Always
18. What do you think about recognition of government and neighborhoods about safety?
    - ☐ They rarely remind about safety at construction site
    - ☐ They sometimes remind about safety at construction site
    - ☐ They seriously remind and always checking safety status of construction site
19. What do you think about weather conditions you are working at your construction site?
    - ☐ It is totally uncomfortable
    - ☐ It is a little uncomfortable
    - ☐ It is comfortable
20. Your current project's scale is
    - ☐ Level IV (=< 03 stories or <1,000m^2)
    - ☐ Level III (04-08 stories or 1,000-5,000m^2)
    - ☐ Level II (09-19 stories or 5,000-10,000m^2)
    - ☐ Level I (20-29 stories or 10,000-15,000m^2)
    - ☐ Special Level (>= 30 stories or >= 15,000m^2)
21. What type of project owner of your current project?
    - ☐ It belongs to government
    - ☐ It is private project
    - ☐ Foreign investment
22. How is the schedule of your current project?
    - ☐ The schedule is very stressful to finish on time
    - ☐ The schedule is normal
    - ☐ The schedule is idle

23. How is your workload assigned in current project?

□ It is too much

□ It is moderate

□ It is gently

24. How is your safety workplace environment?

□ Bad □ Average □ Good

25. How is the safety management system at your construction site?

□ Don't have safety management system

□ It need to be improved

□ It is suitable for me to perform my job

26. How can safety regulation and procedure prevent accidents and reduce injuries at construction site?

□ Bad □ Average □ Good

27. How is the company financial support for safety issues?

□ Low □ Average □ High

28. How is your company vision about safety?

□ Safety is not important than other target as quality, duration and budget

□ Safety is important equal with quality, duration and budget

□ Safety is strength of company in developing reputation

SECTION 2
EXPLORE FACTORS AFFECT THE SUPERVISOR’S BEHAVIOR ON SAFETY ACTION QUESTIONNAIRE

Please cycle the number on the right against each question that best indicates your.

Strongly disagree	Disagree	Not Sure	Agree	Strongly agree
1	2	3	4	5

Do you think these factors can influence your behavior on safety action?	1 → 5				
1. Age *can influence your behavior on safety action*	1	2	3	4	5
2. Education background *can influence your behavior on safety action*	1	2	3	4	5
3. Safety knowledge *can influence your behavior on safety action*	1	2	3	4	5
4. Working experience *can influence your behavior on safety action*	1	2	3	4	5
5. Salary satisfaction *can influence your behavior on safety action*	1	2	3	4	5
6. Supervisor capability to control workers *can influence your behavior in safety*	1	2	3	4	5
7. Drinking *can influence your behavior on safety action*	1	2	3	4	5
8. Smoking *can influence your behavior on safety action*	1	2	3	4	5
9. Family *can influence your behavior on safety action*	1	2	3	4	5
10. Coworkers *can influence your behavior on safety action*	1	2	3	4	5
11. Workers *can influence your behavior on safety action*	1	2	3	4	5
12. Top manager *can influence your behavior on safety action*	1	2	3	4	5
13. Project owner *can influence your behavior on safety action*	1	2	3	4	5
14. Community pressure as government, law, environments *can influence your behavior on safety action*	1	2	3	4	5
15. Weather *can influence your behavior on safety action*	1	2	3	4	5
16. Project scale *can influence your behavior on safety action*	1	2	3	4	5
17. Project schedule *can influence your behavior on safety action*	1	2	3	4	5
18. Amount of work responsibility *can influence your behavior on safety action*	1	2	3	4	5
19. Type of project owner *can influence your behavior on safety action*	1	2	3	4	5
20. Providing of safety training programs *can influence your behavior in safety*	1	2	3	4	5
21. Workplace environment *can influence your behavior on safety action*	1	2	3	4	5
22. Safety management system *can influence your behavior on safety action*	1	2	3	4	5
23. Safety regulations and procedures *can influence your behavior on safety action*	1	2	3	4	5
24. Company financial supports for safety issue *can influence your behavior on safety action*	1	2	3	4	5
25. Company vision or expected targets of project *can influence your behavior on safety action*	1	2	3	4	5

SECTION 3
MEASUREMENT OF SUPERVISOR'S SAFETY BEHAVIORAL INTENTION

The situations include 2 main parts which related to falling from height hazard and electrocution hazard. Please cycle the number on the right against each question that best indicates your.

Given each situation occurs 10 times *at your construction site,* ***<u>how many times</u>*** *would you stop workers working until it is fixed in safety state?*	**0** → **10**										
PART 1: FALLING FROM HEIGHT HAZARD											
SITUATION 1: Once one worker is ready to start his job, he climbs the scaffold up to the level he must work at. At that time you realize that the scaffold is not totally boarded.	0	1	2	3	4	5	6	7	8	9	10
SITUATION 2: Workers are ready to start his job which requires to use ladders to climb up to a higher level is not tied or secured or ladder not enough 1 meter above the landing place.	0	1	2	3	4	5	6	7	8	9	10
SITUATION 3: When the workers ready to start their job on roof or high level and you realize that there are many holes still not be shield	0	1	2	3	4	5	6	7	8	9	10
SITUATION 4: Your workers are working on roof or high level without edge protection and personal protections have not been provided.	0	1	2	3	4	5	6	7	8	9	10
SITUATION 5: Your workers are working on roof or high level in bad weather such as windy, small rain	0	1	2	3	4	5	6	7	8	9	10
PART 2: ELECTROCUTION											
SITUATION 6: Workers are using electrical equipment for their works but the electric wire quality not satisfy the technique requirement	0	1	2	3	4	5	6	7	8	9	10
SITUATION 7: Workers are using electrical equipment for their works but there is a part of jumper wire touch the water on the ground.	0	1	2	3	4	5	6	7	8	9	10
SITUATION 8: Workers are using handle electrical equipment for their works without any personal protections as gloves, boots.	0	1	2	3	4	5	6	7	8	9	10
SITUATION 9: Workers are using electrical equipment but don't have any circuit breaker, plug pin, safety box.	0	1	2	3	4	5	6	7	8	9	10
SITUATION 10: Electric line in your construction is very low and interlace and there is equipment inside your construction such as concrete pump, truck.	0	1	2	3	4	5	6	7	8	9	10

SECTION 4
MEASUREMENT OF SUPERVISOR'S SAFETY BEHAVIOR

The items below represent important supervisor behaviors on safety action that build positive affect to worker, please rate yourself on each item according to scale described below:

Frequency apply activities related safety issue of supervisor: 0 ⟶ 4 Never Applies — Applies most of the time				
0	1	2	3	4
Never	Rarely	Sometimes	Usually	Always

According to safety, please rate yourself on each item		Frequency Apply 0 ⟶ 4				
Investigation	01. You investigate for the causes of injuries that required the attention of a medical doctor	0	1	2	3	4
	02. You conduct an investigation on the causes of accidents immediately	0	1	2	3	4
	03. You investigate the causes of accidents carefully in details	0	1	2	3	4
Inspection	04. You may inspect and correct hazards which can cause accidents	0	1	2	3	4
	05. You can give recommendations to the management in order to prevent a similar accident would occur again	0	1	2	3	4
	06. You carry out inspections for workers realize hazards on the site	0	1	2	3	4
Coaching	07. You educate your workers to correct hazards	0	1	2	3	4
	08. You set up meetings to coach the group of workers	0	1	2	3	4
	09. You provide an orientation program to new workers on site about safety issues	0	1	2	3	4
Motivating	10. You contact workers individually to inspect them working safely	0	1	2	3	4
	11. You use safety materials to motivate the workers working safely such as safety signs, notices, and movies	0	1	2	3	4
	12. You operate some attitude activity to improve your workers safety behavior	0	1	2	3	4

QUESTIONNAIRE FOR LARGE SCALE STUDY (Vietnamese)

BẢNG KHẢO SÁT

CÁC YẾU TỐ TÁC ĐỘNG ĐẾN HÀNH VI CỦA NGƯỜI GIÁM SÁT TRONG VIỆC ĐẢM BẢO AN TOÀN LAO ĐỘNG TẠI CÔNG TRƯỜNG XÂY DỰNG

Kính gửi Quý Ông/Bà,

Tôi tên Nguyễn Anh Thư, là học viên cao học chuyên ngành Công nghệ và Quản lý xây dựng của Trường Đại học Chulalongkorn, Thái Lan. Tôi đang thực hiện luận văn tốt nghiệp với đề tài nghiên cứu: **Các yếu tố tác động đến hành vi của người giám sát trong việc đảm bảo an toàn lao động tại công trường xây dựng .** Những thông tin mà Ông/Bà cung cấp sẽ rất bổ ích cho nghiên cứu.

Dưới đây là tập hợp các câu hỏi mà việc xem xét đánh giá chúng có liên quan rất nhiều đến kinh nghiệm thực tế trong quá trình công tác của Ông/Bà. Rất mong Ông/Bà dành chút thời gian cho việc trả lời những câu hỏi này. Mọi thông tin Ông/Bà cung cấp sẽ được giữ bí mật và chỉ được dùng để phục vụ cho nghiên cứu.

Xin chân thành cảm ơn.

Tác giả sẵn sàng chia sẻ mọi thắc mắc và kết quả nghiên cứu nếu Ông Bà có quan tâm. Xin vui lòng liên hệ:

Nguyễn Anh Thư –	Học viên cao học khóa 2008, ngành Công nghệ và quản lý xây dựng, trường Đại học Chulalongkorn, Thái Lan
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PHẦN I: THÔNG TIN CHUNG

Ông/Bà vui lòng đánh dấu (X) vào câu trả lời hoặc trả lời trực tiếp cho các câu hỏi sau:

1. **Công ty** Ông/Bà đang làm việc: …………………………….
2. **Vị trí/chức danh** hiện tại của Ông/Bà: …………………………….
3. Thời gian Ông/Bà công tác trong **lĩnh vực xây dựng**: ………………..
4. Thời gian Ông/Bà công tác với cương vị là người **giám sát thi công**: ………………..
5. Xin vui lòng cho biết **tuổi** của Ông/Bà: …………………………….
6. Bằng cấp học vấn cao nhất hiện tại của Ông/Bà:
   ☐ Dưới đại học
   ☐ Đại học
   ☐ Trên đại học
7. Số lần Ông/Bà đã từng tham gia các khoá học, huấn luyện về nghiệp vụ giám sát:
   ☐ Chưa bao giờ ☐ 1 lần
   ☐ 2 lần ☐ Khác (số lần: ……………………………..)
8. Ông/Bà đánh giá thế nào về kiến thức an toàn lao động của bản thân:

   ☐ Hiểu biết một số ít thông tin cơ bản về an toàn lao động và các mối nguy hiểm trên công trường
   ☐ Có thể hạn chế và ngăn ngừa những nguy cơ có thể dẫn đến tai nạn
   ☐ Có đầy đủ kiến thức và có thể quản lý tốt đảm bảo an toàn lao động
9. Ông/Bà tự xét thấy mức lương mà công ty chi trả cho Ông/Bà tại thời điểm hiện tại nên:
   ☐ Tăng, ……………phần trăm ☐ Không tăng giảm ☐ Giảm, ……………phần trăm
10. Ông/Bà có gặp khó khăn khi kiểm soát công nhân tuân thủ các quy tắc về an toàn lao động hay không:
    ☐ Có, gặp rất nhiều khó khăn
    ☐ Không quá khó khăn
    ☐ Không có khó khăn gì
11. Ông/Bà có thói quen thường:
    ☐ Uống rượu/bia (chất tương tự) trong giờ làm việc hay thời gian nghỉ trưa, giải lao
    ☐ Uống rượu/bia ngoài giờ làm việc
    ☐ Không có thói quen uống rượu/bia bất kỳ ở đâu

12. Ông/Bà có thói quen thường:
    - ☐ Hút thuốc trong giờ làm việc hay thời gian nghỉ trưa, giải lao
    - ☐ Hút thuốc ngoài giờ làm việc
    - ☐ Không có thói quen hút thuốc dù bất kỳ ở đâu
13. Gia đình có thường nhắc nhở Ông/Bà nên đảm bảo an toàn lao động cho công trường:
    ☐ Không ☐ Có nhưng ít khi ☐ Có rất thường xuyên

14. Những đồng nghiệp (kỹ sư) xung quanh Ông/Bà thực hiện an toàn lao động như thế nào?
    - ☐ Họ thường không tuân thủ những quy tắc, quy trình về an toàn lao động
    - ☐ Họ chỉ tuân thủ một vài nguyên tắc bắt buộc về an toàn lao động
    - ☐ Họ phản đối mạnh mẽ những người hoặc những quy trình thiếu an toàn

15. Ông/Bà đánh giá như thế nào về việc tuân thủ nguyên tắc và quy trình an toàn lao động của công nhân?
    ☐ Ít khi ☐ Thỉnh thoảng ☐ Thường xuyên

16. Quản lý cấp trên có thường nhắc nhở Ông/Bà về việc phải đảm bảo an toàn lao động:
    ☐ Ít khi ☐ Thỉnh thoảng ☐ Thường xuyên

17. Chủ đầu tư có thường yêu cầu Ông/Bà phải lưu tâm đến vấn đề an toàn lao động cho công trình?
    ☐ Ít khi ☐ Thỉnh thoảng ☐ Thường xuyên

18. Chính quyền địa phương tại công trình xây dựng nhận thức thế nào về an toàn lao động?
    - ☐ Ít khi nhắc nhở về an toàn tại công trường
    - ☐ Thỉnh thoảng nhắc nhở về an toàn tại công trường
    - ☐ Thường xuyên nhắc nhở và kiểm tra tình trạng an toàn tại công trường

19. Ông/Bà đánh giá thế nào về điều kiện thời tiết tại công trường nơi Ông/Bà đang làm việc?
    - ☐ Hoàn toàn không thoải mái
    - ☐ Có một chút không thoải mái
    - ☐ Rất thoải mái

20. Quy mô dự án hiện tại Ông/Bà đang làm việc:
    - ☐ Cấp IV (=< 03 tầng hoặc <1,000m2)
    - ☐ Cấp III (04-08 tầng hoặc 1,000-5,000m2)
    - ☐ Cấp II (09-19 tầng hoặc 5,000-10,000m2)
    - ☐ Cấp I (20-29 tầng hoặc 10,000-15,000m2)
    - ☐ Cấp đặc biệt (>= 30 tầng hoặc >= 15,000m2)

21. Nguồn vốn của dự án hiện tại Ông/Bà đang làm việc:
☐ Ngân sách nhà nước
☐ Vốn tư nhân
☐ Vốn đầu tư nước ngoài hoặc có một phần vốn nước ngoài

22. Tiến độ của dự án hiện tại Ông/Bà đang làm việc:
☐ Căng thẳng, buộc phải hoàn thành đúng thời hạn
☐ Bình thường
☐ Nhàn rỗi, không bị sức ép về tiến độ

23. Ông/Bà đánh giá như thế nào về khối lượng công việc được giao:
☐ Khối lượng công việc bị quá tải
☐ Khối lượng công việc ở mức vừa phải
☐ Khối lượng công việc tương đối nhẹ nhàng

24. Ông/Bà đánh giá như thế nào về tính an toàn tại công trường đang làm việc:
☐ Thiếu an toàn ☐ Trung bình ☐ Tốt

25. Ông/Bà đánh giá như thế nào về hệ thống quản lý an toàn tại công trường đang làm việc:
☐ Không có hệ thống quản lý về an toàn lao động
☐ Cần phải cải tiến nhiều hơn
☐ Rất tốt và phù hợp

26. Các nguyên tắc về an toàn đang được áp dụng tại công trường có tác dụng như thế nào trong việc ngăn ngừa và giảm thiểu tai nạn lao động hay không:
☐ Tác dụng rất thấp ☐ Trung bình ☐ Tác dụng rất tốt

27. Ông/ Bà đánh giá thế nào về việc cung cấp đầy đủ kinh phí cho các hoạt động, thiết bị về an toàn lao động:
☐ Không, rất thiếu ☐ Mức độ trung bình ☐ Có, rất đầy đủ

28. Công ty Ông/ Bà đang làm việc có tầm nhìn như thế nào về an toàn lao động?
☐ An toàn lao động **không** quan trọng bằng những mục tiêu khác như chất lượng, lợi nhuận…
☐ An toàn lao động **cũng** quan trọng ngang những mục tiêu khác như chất lượng, lợi nhuận…
☐ An toàn lao động là một thế mạnh cạnh tranh và phát triển danh tiếng công ty

PHẦN II: CÁC YẾU TỐ TÁC ĐỘNG ĐẾN HÀNH VI CỦA NGƯỜI GIÁM SÁT TRONG VIỆC ĐẢM BẢO AN TOÀN LAO ĐỘNG TẠI CÔNG TRƯỜNG

Ông/Bà vui lòng đánh dấu (X) vào một trong các lựa chọn trả lời theo các mức độ sau:

Hoàn toàn không đồng ý	**Phần nào** không đồng ý	**Không đồng ý cũng** không phản đối	**Phần nào** đồng ý	**Hoàn toàn** đồng ý
1	2	3	4	5

STT	***Các yếu tố sau đây sẽ ảnh hưởng đến việc thực hiện trách nhiệm đảm bảo an toàn lao động tại công trường xây dựng của Ông/Bà***	**Ý kiến**				
		1	**2**	**3**	**4**	**5**
1	**Tuổi tác** sẽ *ảnh hưởng đến việc thực hiện trách nhiệm đảm bảo an toàn lao động tại công trường xây dựng*					
2	**Trình độ học vấn** sẽ *ảnh hưởng đến việc thực hiện trách nhiệm đảm bảo an toàn lao động tại công trường xây dựng*					
3	Kiến thức, sự hiểu biết về an toàn lao động					
4	Kinh nghiệm làm việc					
5	Sự thoả mãn về phúc lợi lương bổng					
6	Khả năng điều khiển công nhân					
7	Việc uống rượu bia					
8	Việc hút thuốc					
9	Gia đình					
10	Đồng nghiệp					
11	Công nhân					
12	Quản lý cấp trên					
13	Chủ đầu tư					
14	Sức ép từ xã hội, pháp luật, chính quyền địa phương					
15	Điều kiện khí hậu					
16	Quy mô của dự án					
17	Tiến độ dự án					
18	Khối lượng công việc					
19	Loại chủ đầu tư					
20	Các chương trình huấn luyện về an toàn lao động					
21	Môi trường làm việc					
22	Hệ thống quản lý an toàn					
23	Các quy tắc và quy trình an toàn					
24	Sự hỗ trợ tài chính của công ty về an toàn lao động					
25	Chiến lược của công ty về an toàn lao động					

PHẦN III: MÔ PHỎNG HÀNH VI CỦA NGƯỜI GIÁM SÁT TRONG VIỆC ĐẢM BẢO AN TOÀN LAO ĐỘNG TẠI CÔNG TRƯỜNG XÂY DỰNG

Hãy tưởng tượng những tình huống bên dưới đây xảy ra tại công trường mà Ông/Bà là giám sát thi công. Ông/Bà sẽ quyết định như thế nào, vui lòng đánh dấu (X) vào một trong số lựa chọn trả lời sau: *(Xin Ông/Bà lưu ý không có đáp án đúng hay sai, xin chọn đáp án tương ứng với những gì Ông/Bà sẽ làm nếu tình huống tương tự xảy ra trong thực tế)*

Giả định mỗi tình huống sau xảy ra 10 lần tại công trường mà Ông/Bà là giám sát thi công, ***có bao nhiêu lần trong số 10 lần trên*** Ông/Bà nhắc nhở công nhân phải cẩn thận thậm chí yêu cầu ngưng công việc cho đến khi thực sự an toàn?	Số lần trong số 10 lần tình huống xảy ra **0** ⟶ **10**
Phần 1: Nguy cơ ngã cao	
1. Khi một công nhân chuẩn bị leo lên tầng cao để thực hiện công việc được giao bằng dàn giáo, Ông/Bà nhận ra rằng dàn giáo không được lát ván hoàn toàn	0 1 2 3 4 5 6 7 8 9 10
2. Một công nhân chuẩn bị dùng thang để leo lên vị trí cao hơn để công tác nhưng thang không được chốt neo cố định, không cao hơn vị trí cần leo 1m	0 1 2 3 4 5 6 7 8 9 10
3. Các công nhân đang chuẩn bị làm việc trên cao, Ông/Bà nhận ra rằng các lỗ thông tầng, buồng thang máy vẫn chưa có hàng rào che chắn.	0 1 2 3 4 5 6 7 8 9 10
4. Các công nhân đang chuẩn bị làm việc trên mái cao, Ông/Bà nhận ra rằng các thiết bị bảo hộ lao động như dây đai an toàn vẫn chưa được trang bị đủ.	0 1 2 3 4 5 6 7 8 9 10
5. Các công nhân đang chuẩn bị làm việc trên mái cao, thời tiết không tốt như nhiều gió, mưa nhẹ.	0 1 2 3 4 5 6 7 8 9 10
Phần 2: Nguy cơ điện giật	
6. Các công nhân cần sử dụng thiết bị điện để làm việc, song dây dẫn điện không đạt tiêu chuẩn cho phép sử dụng.	0 1 2 3 4 5 6 7 8 9 10
7. Các công nhân cần sử dụng thiết bị điện để làm việc, song có một đoạn cáp nối tiếp xúc với nước trên sàn	0 1 2 3 4 5 6 7 8 9 10
8. Một công nhân đang sử dụng một thiết bị cầm tay dùng điện để thao tác mà không cò thiết bị bảo hộ lao động như găng tay cách điện, ủng…	0 1 2 3 4 5 6 7 8 9 10
9. Khi kiểm tra, Ông/Bà nhận thấy các thiết bị điện không có lưới bảo vệ, chốt cắm, hộp an toàn điện.	0 1 2 3 4 5 6 7 8 9 10
10. Mạng dây điện tại công trường hơi thấp và có thể gây vướng cho các phương tiện vận chuyển chuẩn bị vào công trường như xe đổ bê tông, xe tải…	0 1 2 3 4 5 6 7 8 9 10

PHẦN IV: HÀNH VI CỦA NGƯỜI GIÁM SÁT TRONG VIỆC ĐẢM BẢO AN TOÀN LAO ĐỘNG TẠI CÔNG TRƯỜNG XÂY DỰNG

Ông/Bà vui lòng đánh dấu (X) vào một trong các lựa chọn mô tả gần đúng nhất những gì đã được Ông/Bà thực hiện để đảm bảo an toàn cho công trường xây dựng với thang đo được mô tả bên dưới:

Tần suất áp dụng/ thực hiện các nghĩa vụ của người giám sát về an toàn lao động: 1 ⟶ 4 Không bao giờ … Luôn luôn				
0	1	2	3	4
Không bao giờ	Ít khi	Thỉnh thoảng	Thường xuyên	Luôn luôn

Ông/Bà vui lòng đánh dấu (X) vào một trong các lựa chọn mô tả gần đúng nhất những gì Ông/Bà đã thực hiện cho công trình hiện tại		**Tần suất áp dụng/ Thực hiện** 0 ⟶ 4 (Không bao giờ) (Luôn luôn)				
Nghiên cứu về tai nạn lao động	1. Tìm hiểu về nguyên nhân dẫn đến tai nạn. *Chú ý:* Tai nạn cần đến y tế hoặc nặng hơn	0	1	2	3	4
	2. Điều tra nguyên nhân tai nạn ngay lập tức sau khi tai nạn xảy ra.	0	1	2	3	4
	3. Ông/Bà cố gắng tìm hiểu càng nhiều nguyên nhân càng tốt để tìm cách ngăn chặn những rủi ro tương tự trong tương lai.	0	1	2	3	4
Hướng dẫn an toàn lao động	4. Khắc phục, sửa sai những rủi ro ngay nếu tai nạn xảy ra.	0	1	2	3	4
	5. Đề ra những biện pháp, đưa ra lời khuyên nhắc nhở công nhân tránh những rủi ro tương tự có thể xảy ra.	0	1	2	3	4
	6. Kiểm tra chỉ dẫn công nhân để họ tự nhận ra những rủi ro mà tự mình phòng tránh.	0	1	2	3	4
Huấn luyện an toàn lao động	7. Hướng dẫn công nhân tự sửa chữa những mối nguy hiểm	0	1	2	3	4
	8. Tổ chức các buổi huấn luyện cho công nhân về an toàn lao động.	0	1	2	3	4
	9. Định hướng, chỉ dẫn cho những công nhân mới vào làm về an toàn lao động.	0	1	2	3	4
Thúc đẩy ý thức an toàn lao động	10. Đến nơi chỉ dẫn từng công nhân làm việc an toàn, sửa sai khi thấy họ thao tác thiếu an toàn.	0	1	2	3	4
	11. Khích lệ, động viên công nhân làm việc an toàn bằng cách tuyên dương, trao thưởng…	0	1	2	3	4
	12. Tổ chức các hoạt động để nâng cao thái độ, quan điểm của công nhân về an toàn lao động.	0	1	2	3	4

Nếu Ông Bà không phiền lòng, xin cung cấp thông tin liên lạc:

Họ tên: …………………………………….

Cách liên hệ: …………………………………….

Một lần nữa, xin chân thành cảm ơn sự giúp đỡ nhiệt tình của Ông/Bà!

Trân trọng kính chào!

APPENDIX B

LINEAR REGRESSION RESULTS FROM SPSS PROGRAM

LINEAR REGRESSION RESULTS FROM SPSS PROGRAM

Descriptive Statistics

	Mean	Std. Deviation	N
SafetyBehavior	28.9461	6.86728	241
Behavioral Intention	51.8589	24.00531	241

Correlations

		SafetyBehavior	Behavioral Intention
Pearson Correlation	SafetyBehavior	1.000	.261
	Behavioral Intention	.261	1.000
Sig. (1-tailed)	SafetyBehavior	.	.000
	Behavioral Intention	.000	.
N	SafetyBehavior	241	241
	Behavioral Intention	241	241

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Behavioral Intention[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: SafetyBehavior

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.261[a]	.068	.064	6.64302

a. Predictors: (Constant), Behavioral Intention

b. Dependent Variable: SafetyBehavior

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	771.295	1	771.295	17.478	.000[a]
	Residual	10547.004	239	44.130		
	Total	11318.299	240			

a. Predictors: (Constant), Behavioral Intention

b. Dependent Variable: SafetyBehavior

Coefficients[a]

Model	Unstandardized Coefficients		Stand-ardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	25.073	1.020		24.572	.000	23.063	27.083
Behavioral Intention	.075	.018	.261	4.181	.000	.039	.110

a. Dependent Variable: SafetyBehavior

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions	
				(Constant)	Behavioral Intention
1	1	1.908	1.000	.05	.05
	2	.092	4.549	.95	.95

Casewise Diagnostics[a]

Case Number	Std. Residual	SafetyBehavior	Predicted Value	Residual
121	-4.013	2.00	28.6579	-26.65788
366	-3.123	5.00	25.7454	-20.74541

a. Dependent Variable: SafetyBehavior

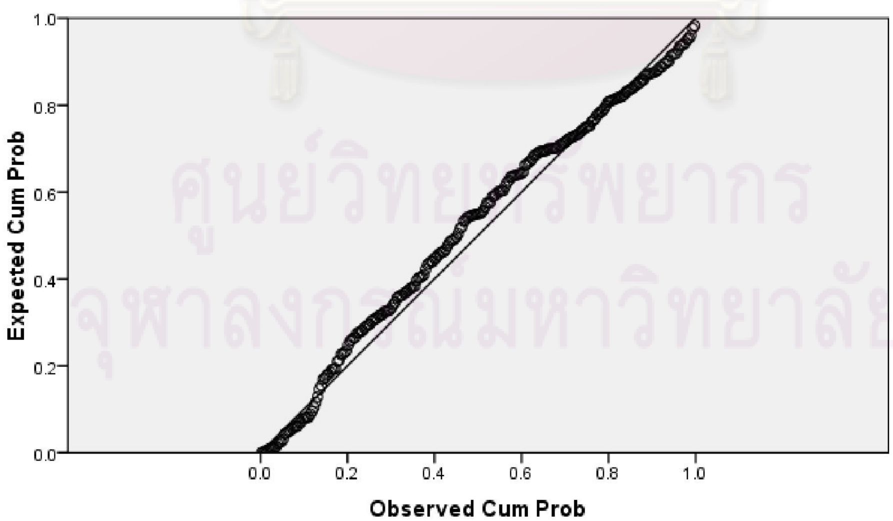
Residuals Statistics[a]

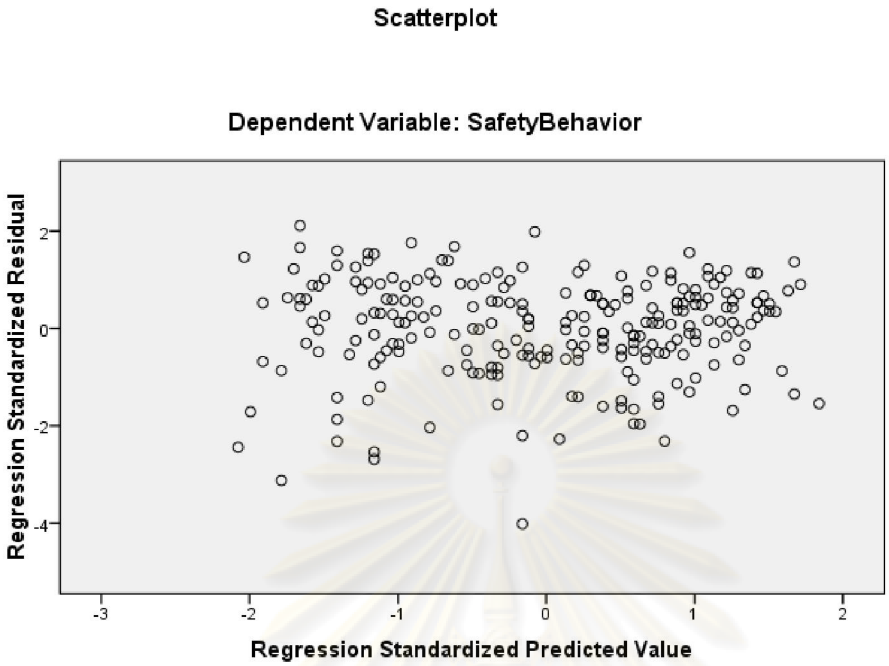
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	25.2227	32.2425	28.9461	1.79269	241
Std. Predicted Value	-2.077	1.839	.000	1.000	241
Standard Error of Predicted Value	.428	.988	.590	.135	241
Adjusted Predicted Value	25.0851	32.4327	28.9443	1.79151	241
Residual	-26.65788	14.03056	.00000	6.62917	241
Std. Residual	-4.013	2.112	.000	.998	241
Stud. Residual	-4.021	2.129	.000	1.003	241
Deleted Residual	-26.77185	14.25344	.00178	6.69062	241
Stud. Deleted Residual	-4.156	2.145	-.002	1.009	241
Mahal. Distance	.000	4.314	.996	.943	241
Cook's Distance	.000	.088	.005	.009	241
Centered Leverage Value	.000	.018	.004	.004	241

a. Dependent Variable: SafetyBehavior

Normal P-P Plot of Regression Standardized Residual

Dependent Variable: SafetyBehavior




Scatterplot
Dependent Variable: SafetyBehavior
Regression Standardized Residual
2
0
-2
-4
-3
-2
-1
0
1
2
Regression Standardized Predicted Value

APPENDIX C

FACTOR ANALYSIS RESULTS FROM SPSS PROGRAM

C1. Factor Analysis Results Based on Supervisor's Perception

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.845
Bartlett's Test of Sphericity	Approx. Chi-Square	3807.971
	df	300
	Sig.	.000

Communalities

	Initial	Extraction
Age	1.000	.511
Education background	1.000	.436
Safety knowledge	1.000	.602
Working experience	1.000	.593
Salary satisfaction	1.000	.360
Supervisor capability to control workers	1.000	.434
Drinking	1.000	.780
Smoking	1.000	.807
Family	1.000	.669
Coworkers	1.000	.642
Workers	1.000	.504
Top manager	1.000	.733
Project owner	1.000	.763
Community pressure as government, law, environments	1.000	.519
Weather conditions	1.000	.350
Project scale	1.000	.620
Project schedule	1.000	.709
Amount of work responsibility	1.000	.656
Type of project owner	1.000	.534
Providing of safety training programs	1.000	.537
Workplace environment	1.000	.557
Safety management system	1.000	.712
Safety regulations and procedures	1.000	.673
Company financial supports for safety issue	1.000	.627
Company vision about safety	1.000	.629

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.845
Bartlett's Test of Sphericity	Approx. Chi-Square	3807.971
	df	300

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.521	26.085	26.085	6.521	26.085	26.085
2	2.812	11.247	37.332	2.812	11.247	37.332
3	1.599	6.397	43.729	1.599	6.397	43.729
4	1.570	6.278	50.008	1.570	6.278	50.008
5	1.345	5.382	55.390	1.345	5.382	55.390
6	1.111	4.445	59.835	1.111	4.445	59.835
7	.996	3.986	63.821			
8	.923	3.692	67.512			
9	.833	3.332	70.844			
10	.765	3.060	73.904			
11	.753	3.011	76.915			
12	.660	2.639	79.554			
13	.572	2.289	81.843			
14	.557	2.229	84.072			
15	.500	1.998	86.070			
16	.465	1.859	87.929			
17	.449	1.796	89.726			
18	.426	1.705	91.431			
19	.384	1.535	92.965			
20	.366	1.463	94.428			
21	.361	1.444	95.872			
22	.286	1.142	97.015			
23	.279	1.118	98.132			
24	.261	1.043	99.176			
25	.206	.824	100.000			

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.845
Bartlett's Test of Sphericity	Approx. Chi-Square	3807.971
	df	300

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component					
	1	2	3	4	5	6
Company financial supports for safety issue	.640	-.399				
Workplace environment	.628	-.343				
Safety management system	.618	-.522				
Project schedule	.592		-.532			
Amount of work responsibility	.585		-.448			
Top manager	.581	.428				-.320
Workers	.578	.336				
Working experience	.576				-.348	-.308
Safety regulations and procedures	.573	-.515				
Providing of safety training programs	.562	-.440				
Project owner	.555	.429				-.396
Project scale	.544	.308	-.460			
Company vision about safety	.534	-.470				
Safety knowledge	.515					-.322
Coworkers	.511	.429	.332			
Community pressure as government, law, environments	.502	.386				
Type of project owner	.498	.379	-.355			
Weather conditions	.479					
Supervisor capability to control workers	.445				-.307	
Family	.437	.353	.381			.404
Salary satisfaction	.357		.304			
Drinking				.704	.313	
Age				.436	-.338	.331
Education background	.372			.382		
Smoking				.576	.604	

Rotated Component Matrix[a]

	Component					
	1	2	3	4	5	6
Safety management system	.816					
Safety regulations and procedures	.796					
Company vision about safety	.777					
Company financial supports for safety issue	.740					
Workplace environment	.660					
Providing of safety training programs	.648			.324		
Project schedule		.804				
Amount of work responsibility		.766				
Project scale		.752				
Type of project owner		.678				
Weather conditions		.484				
Project owner			.832			
Top manager			.804			
Community pressure as government, law, environments			.665			
Workers			.507		.388	
Safety knowledge				.706		
Working experience				.674		
Supervisor capability to control workers				.594		
Education background				.518	.353	
Family			.346		.720	
Coworkers			.456		.629	
Age					.580	
Salary satisfaction				.306	.495	
Smoking						.874
Drinking						.849

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

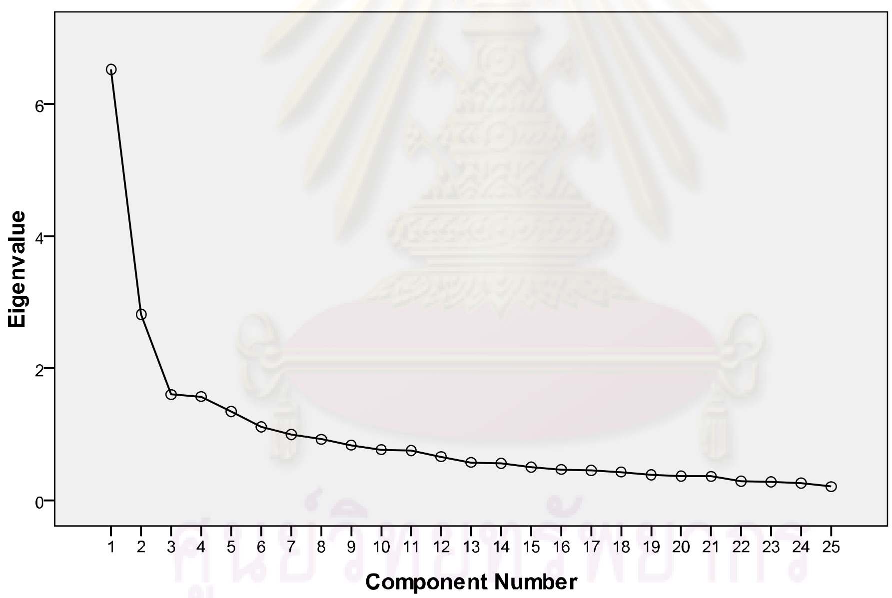
a. Rotation converged in 11 iterations.

Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	3.707	14.827	14.827
2	2.914	11.656	26.483
3	2.679	10.714	37.197
4	2.128	8.513	45.710
5	1.953	7.813	53.524
6	1.578	6.311	59.835

Extraction Method: Principal Component Analysis.

Scree Plot



Component Transformation Matrix

Component	1	2	3	4	5	6
1	.575	.487	.429	.369	.312	.124
2	-.661	.375	.508	-.267	.289	-.097
3	.027	-.734	.373	.202	.455	-.272
4	-.321	-.087	-.257	.333	.390	.749
5	.268	-.251	.388	-.619	-.129	.561
6	.239	.113	-.450	-.508	.666	-.160

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Component Correlation Matrix

Component	1	2	3	4	5	6
1	1.000	-.205	-.326	.000	-.040	.216
2	-.205	1.000	.280	-.134	.325	-.118
3	-.326	.280	1.000	-.112	.182	-.269
4	.000	-.134	-.112	1.000	-.116	.097
5	-.040	.325	.182	-.116	1.000	-.201
6	.216	-.118	-.269	.097	-.201	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

C2. Factor Analysis Results Based on Actual Practice

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.783
Bartlett's Test of Sphericity	Approx. Chi-Square	1718.060
	df	300.000
	Sig.	.000

Communalities

	Initial	Extraction
Experience As Supervisor	1.000	.693
Age	1.000	.752
Train	1.000	.542
Education Background	1.000	.608
Safety Knowledge	1.000	.446
Salary Satisfaction	1.000	.689
Difficulty to control worker	1.000	.547
Drinking Habits	1.000	.571
Smoking Habits	1.000	.679
Safety Remind from Family	1.000	.488
Safety Attitude of Coworker	1.000	.407
Workers' Safety Behavior	1.000	.395
Awareness of Top Manager in Safety	1.000	.511
Awareness of Owner in Safety	1.000	.567
Recognition of Government and Neighborhoods about Safety	1.000	.452
Weather Conditions at Construction Site	1.000	.413
Project Scale	1.000	.541
Project Owner Type	1.000	.518
Project Schedule	1.000	.623
Workload Assigned in Project	1.000	.662
Safety Workplace Environment	1.000	.593
Safety Management System	1.000	.567
Practical of Safety Regulation and Procedure	1.000	.519
Company Financial Support for Safety Issue	1.000	.553
Company Vision about Safety	1.000	.465

Extraction Method: Principal Component Analysis.

Total Variance Explained

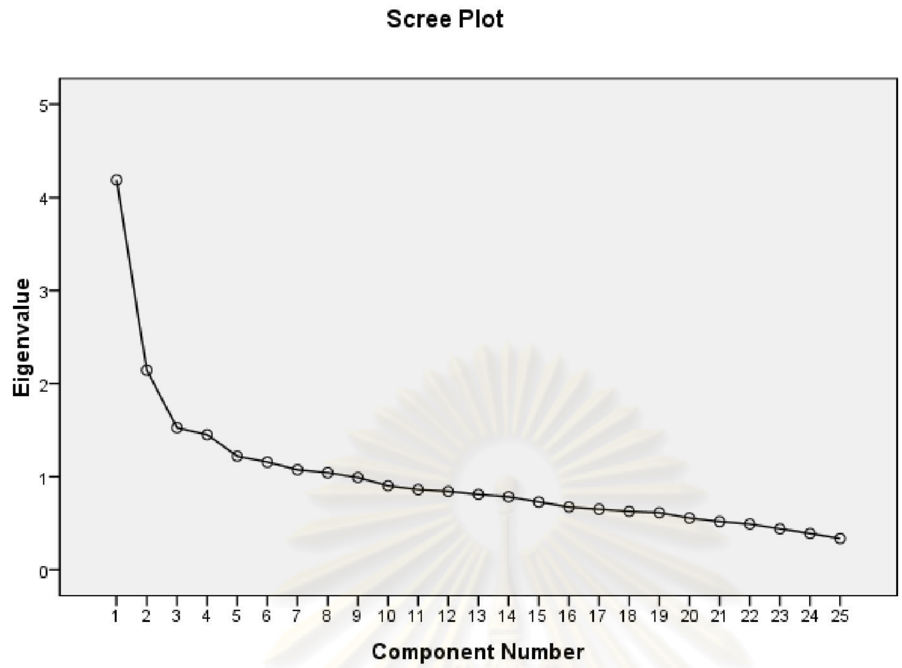
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.186	16.746	16.746	4.186	16.746	16.746
2	2.143	8.574	25.320	2.143	8.574	25.320
3	1.526	6.104	31.423	1.526	6.104	31.423
4	1.452	5.807	37.230	1.452	5.807	37.230
5	1.219	4.874	42.105	1.219	4.874	42.105
6	1.156	4.622	46.727	1.156	4.622	46.727
7	1.074	4.297	51.024	1.074	4.297	51.024
8	1.043	4.171	55.194	1.043	4.171	55.194
9	.991	3.963	59.158			
10	.901	3.605	62.763			
11	.861	3.442	66.205			
12	.841	3.364	69.569			
13	.809	3.238	72.807			
14	.783	3.131	75.938			
15	.727	2.909	78.847			
16	.674	2.695	81.542			
17	.650	2.600	84.143			
18	.627	2.507	86.650			
19	.613	2.452	89.102			
20	.556	2.222	91.324			
21	.517	2.069	93.393			
22	.491	1.964	95.356			
23	.439	1.754	97.111			
24	.389	1.554	98.665			
25	.334	1.335	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component							
	1	2	3	4	5	6	7	8
Company Financial Support for Safety Issue	.697							
Safety Workplace Environment	.673							
Safety Management System	.661							
Company Vision about Safety	.613							
Practical of Safety Regulation and Procedure	.599							
Awareness of Top Manager in Safety	.596			-.337				
Awareness of Owner in Safety	.562			-.413				
Workers' Safety Behavior	.531							
Safety Knowledge	.435	.334						
Difficulty to control worker	.385				-.322			-.382
Age		.745						
Experience As Supervisor		.721						
Train		.481						.470
Recognition of Government and Neighborhoods about Safety	.316		.397					
Weather Conditions at Construction Site			.394					
Project Scale	.307	.300	-.364					
Safety Remind from Family			.333			-.302		
Workload Assigned in Project			.475	.566				
Project Schedule	-.345	-.308	.397	.429				
Education Background				.377	.332	-.328	.361	
Drinking Habits					.618	.325		
Smoking Habits					.553			-.538
Salary Satisfaction						.792		
Project Owner Type			-.340				-.499	
Safety Attitude of Coworker	.389						.424	

Extraction Method: Principal Component Analysis.
a. 8 components extracted.



Rotated Component Matrix[a]

	Component							
	1	2	3	4	5	6	7	8
Safety Workplace Environment	.730							
Safety Management System	.722							
Company Financial Support for Safety Issue	.710							
Practical of Safety Regulation and Procedure	.703							
Company Vision about Safety	.526				.341			
Project Owner Type	.519				-.419			
Workers' Safety Behavior	.494							
Age		.855						
Experience As Supervisor		.818						
Train		.420					-.351	
Safety Knowledge		.358						
Recognition of Government and Neighborhoods about Safety			.620					
Safety Remind from Family			.585					

Rotated Component Matrix[a]

	Component							
	1	2	3	4	5	6	7	8
Awareness of Owner in Safety			.569	-.313				
Awareness of Top Manager in Safety	.382		.484					
Workload Assigned in Project				.800				
Project Schedule				.756				
Difficulty to control worker	.304				.624			
Weather Conditions at Construction Site					.564			
Education Background						.687		
Project Scale						.485	-.360	
Safety Attitude of Coworker			.374			.403		
Smoking Habits							.802	
Salary Satisfaction								.767
Drinking Habits							.329	.627

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 17 iterations.

Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	3.373	13.493	13.493
2	1.968	7.873	21.367
3	1.811	7.244	28.611
4	1.613	6.451	35.062
5	1.403	5.612	40.673
6	1.259	5.035	45.709
7	1.199	4.795	50.504
8	1.173	4.691	55.194

Extraction Method: Principal Component Analysis.

Component Transformation Matrix

Component	1	2	3	4	5	6	7	8
1	.830	.200	.390	-.220	.243	.094	-.052	.000
2	-.285	.822	-.040	-.301	-.066	.245	-.281	-.088
3	-.285	.242	.549	.530	.464	-.237	.009	.077
4	.291	.217	-.536	.650	.134	.368	-.012	.069
5	-.006	.175	.280	.080	-.477	.265	.579	.502
6	-.010	.045	-.298	-.251	.335	-.284	-.122	.799
7	-.249	-.340	.152	-.179	.421	.760	-.040	.104
8	.051	-.175	.259	.236	-.432	.102	-.753	.284

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

APPENDIX D

MODEL RESULTS FROM AMOS PROGRAM

D1. Final Perception Model Results for Explaining Supervisor's Behavior Based on Their Perception

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Behavioral Intention	<---	e24	2.233	.182	12.266	***	
Behavioral Intention	<---	Personal Background & Safety Knowledge	.465	.173	2.447	.013	
Behavioral Intention	<---	Project Characteristics & Work Assignment	.800	.290	1.422	.103	
Behavioral Intention	<---	Project Stakeholder Influence	-.484	.237	-1.435	.101	
Behavior	<---	Behavioral Intention	.037	.013	2.888	.004	
Behavior	<---	e23	.241	.062	3.860	***	
Behavior	<---	Organizational & Management Influence	.163	.054	2.995	.003	
S1	<---	Behavioral Intention	.950	.089	10.681	***	
S2	<---	Behavioral Intention	.718	.090	8.001	***	
S3	<---	Behavioral Intention	1.040	.093	11.127	***	
S4	<---	Behavioral Intention	1.141	.094	12.106	***	
S5	<---	Behavioral Intention	1.100	.095	11.547	***	
S6	<---	Behavioral Intention	1.101	.091	12.121	***	
S7	<---	Behavioral Intention	1.219	.093	13.158	***	
S8	<---	Behavioral Intention	.808	.083	9.791	***	
S9	<---	Behavioral Intention	.941	.086	10.960	***	
S10	<---	Behavioral Intention	1.000				
P12	<---	Behavior	1.000				
P11	<---	Behavior	.777	.225	3.449	***	
P10	<---	Behavior	1.338	.403	3.318	***	
P9	<---	Behavior	1.684	.498	3.380	***	
P8	<---	Behavior	1.437	.379	3.793	***	
P7	<---	Behavior	1.871	.512	3.656	***	
P6	<---	Behavior	2.323	.618	3.758	***	
P5	<---	Behavior	2.164	.582	3.715	***	
P4	<---	Behavior	1.797	.510	3.526	***	
P3	<---	Behavior	2.311	.627	3.686	***	
P2	<---	Behavior	1.846	.534	3.454	***	
P1	<---	Behavior	1.923	.547	3.517	***	
F20	<---	Organizational &	1.000				

			Estimate	S.E.	C.R.	P	Label
		Management Influence					
F21	<---	Organizational & Management Influence	.891	.107	8.317	***	
F24	<---	Organizational & Management Influence	1.057	.131	8.101	***	
F25	<---	Organizational & Management Influence	.878	.120	7.300	***	
F23	<---	Organizational & Management Influence	.995	.121	8.236	***	
F22	<---	Organizational & Management Influence	.979	.118	8.311	***	
F15	<---	Project Characteristics & Work Assignment	1.000				
F19	<---	Project Characteristics & Work Assignment	1.554	.309	5.025	***	
F16	<---	Project Characteristics & Work Assignment	1.870	.350	5.350	***	
F18	<---	Project Characteristics & Work Assignment	1.997	.364	5.484	***	
F17	<---	Project Characteristics & Work Assignment	1.901	.347	5.485	***	
F11	<---	Project Stakeholder Influence	1.000				
F14	<---	Project Stakeholder Influence	1.055	.169	6.246	***	
F12	<---	Project Stakeholder Influence	1.549	.207	7.477	***	
F13	<---	Project Stakeholder Influence	1.519	.205	7.423	***	
F2	<---	Personal Background & Safety Knowledge	1.000				
F6	<---	Personal Background & Safety Knowledge	1.007	.204	4.928	***	
F4	<---	Personal Background & Safety Knowledge	1.356	.236	5.755	***	
F3	<---	Personal Background & Safety Knowledge	1.390	.238	5.835	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
Behavioral Intention	<---	e24	.981
Behavioral Intention	<---	Personal Background & Safety Knowledge	.106
Behavioral Intention	<---	Project Characteristics & Work Assignment	.158
Behavioral Intention	<---	Project Stakeholder Influence	-.127
Behavior	<---	Behavioral Intention	.303
Behavior	<---	e23	.869
Behavior	<---	Organizational & Management Influence	.366
S1	<---	Behavioral Intention	.721
S2	<---	Behavioral Intention	.542
S3	<---	Behavioral Intention	.752
S4	<---	Behavioral Intention	.820
S5	<---	Behavioral Intention	.781
S6	<---	Behavioral Intention	.821
S7	<---	Behavioral Intention	.781
S8	<---	Behavioral Intention	.662
S9	<---	Behavioral Intention	.741
S10	<---	Behavioral Intention	.712
P12	<---	Behavior	.275
P11	<---	Behavior	.202
P10	<---	Behavior	.347
P9	<---	Behavior	.434
P8	<---	Behavior	.381
P7	<---	Behavior	.590
P6	<---	Behavior	.696
P5	<---	Behavior	.649
P4	<---	Behavior	.511
P3	<---	Behavior	.618
P2	<---	Behavior	.466
P1	<---	Behavior	.505
F20	<---	Organizational & Management Influence	.644
F21	<---	Organizational & Management Influence	.574
F24	<---	Organizational & Management Influence	.671
F25	<---	Organizational & Management Influence	.590
F23	<---	Organizational & Management Influence	.718
F22	<---	Organizational & Management Influence	.727

			Estimate
F15	<---	Project Characteristics & Work Assignment	.384
F19	<---	Project Characteristics & Work Assignment	.572
F16	<---	Project Characteristics & Work Assignment	.690
F18	<---	Project Characteristics & Work Assignment	.760
F17	<---	Project Characteristics & Work Assignment	.761
F11	<---	Project Stakeholder Influence	.492
F14	<---	Project Stakeholder Influence	.568
F12	<---	Project Stakeholder Influence	.866
F13	<---	Project Stakeholder Influence	.824
F2	<---	Personal Background & Safety Knowledge	.423
F6	<---	Personal Background & Safety Knowledge	.495
F4	<---	Personal Background & Safety Knowledge	.729
F3	<---	Personal Background & Safety Knowledge	.791

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Project Stakeholder Influence	<-->	Personal Background & Safety Knowledge	.093	.031	2.977	.003	
Organizational & Management Influence	<-->	Project Characteristics & Work Assignment	.088	.028	3.087	.002	
Organizational & Management Influence	<-->	Project Stakeholder Influence	.101	.033	3.036	.002	
Project Characteristics & Work Assignment	<-->	Project Stakeholder Influence	.128	.034	3.770	***	
Organizational & Management Influence	<-->	Personal Background & Safety Knowledge	.215	.048	4.475	***	
Project Characteristics & Work Assignment	<-->	Personal Background & Safety Knowledge	.086	.028	3.082	.002	
e1	<-->	e2	1.422	.373	3.817	***	
e8	<-->	e9	1.706	.317	5.384	***	
e22	<-->	e21	.587	.076	7.691	***	
e22	<-->	e20	.120	.050	2.405	.016	
e21	<-->	e18	.221	.064	3.454	***	
e20	<-->	e19	.262	.064	4.120	***	
e19	<-->	e18	.317	.062	5.075	***	

			Estimate	S.E.	C.R.	P	Label
e15	<-->	e14	.133	.047	2.814	.005	
e12	<-->	e11	.264	.063	4.166	***	
e13	<-->	e11	.148	.054	2.759	.006	
z6	<-->	z5	.134	.048	2.791	.005	
z4	<-->	z3	.215	.048	4.491	***	
z2	<-->	z1	.092	.036	2.545	.011	
z11	<-->	z12	-.189	.054	-3.502	***	
e7	<-->	e10	1.117	.383	2.919	.004	
e2	<-->	e3	.895	.358	2.500	.012	
e22	<-->	e18	.274	.061	4.506	***	

Correlations: (Group number 1 - Default model)

			Estimate
Project Stakeholder Influence	<-->	Personal Background & Safety Knowledge	.299
Organizational & Management Influence	<-->	Project Characteristics & Work Assignment	.313
Organizational & Management Influence	<-->	Project Stakeholder Influence	.272
Project Characteristics & Work Assignment	<-->	Project Stakeholder Influence	.477
Organizational & Management Influence	<-->	Personal Background & Safety Knowledge	.660
Project Characteristics & Work Assignment	<-->	Personal Background & Safety Knowledge	.365
e1	<-->	e2	.270
e8	<-->	e9	.422
e22	<-->	e21	.580
e22	<-->	e20	.123
e21	<-->	e18	.219
e20	<-->	e19	.269
e19	<-->	e18	.337
e15	<-->	e14	.225
e12	<-->	e11	.298
e13	<-->	e11	.200
z6	<-->	z5	.227
z4	<-->	z3	.393
z2	<-->	z1	.266
z11	<-->	z12	-.280
e7	<-->	e10	.225
e2	<-->	e3	.170

		Estimate
e22	<--> e18	.292

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e23	1.000				
e24	1.000				
Organizational & Management Influence	.389	.078	4.992	***	
Project Characteristics & Work Assignment	.203	.071	2.850	.004	
Project Stakeholder Influence	.358	.094	3.796	***	
Personal Background & Safety Knowledge	.272	.088	3.073	.002	
e1	4.313	.434	9.933	***	
e2	6.420	.609	10.541	***	
e3	4.304	.442	9.728	***	
e4	3.292	.365	9.020	***	
e5	4.016	.424	9.483	***	
e6	3.043	.338	9.005	***	
e7	4.919	.523	9.404	***	
e8	4.342	.426	10.181	***	
e9	3.772	.385	9.790	***	
e10	5.030	.509	9.887	***	
e22	.942	.087	10.809	***	
e21	1.089	.101	10.836	***	
e20	1.006	.095	10.595	***	
e19	.943	.090	10.436	***	
e18	.938	.088	10.626	***	
e17	.505	.053	9.481	***	
e16	.441	.053	8.337	***	
e15	.496	.056	8.849	***	
e14	.703	.072	9.830	***	
e13	.665	.072	9.207	***	
e12	.945	.093	10.179	***	
e11	.830	.083	9.958	***	
z6	.549	.061	8.960	***	
z5	.629	.066	9.511	***	
z4	.531	.061	8.696	***	
z3	.563	.060	9.398	***	
z2	.361	.047	7.656	***	

	Estimate	S.E.	C.R.	P	Label
z1	.332	.044	7.532	***	
z11	1.169	.111	10.546	***	
z10	1.003	.102	9.801	***	
z9	.780	.089	8.770	***	
z8	.589	.077	7.623	***	
z7	.530	.070	7.601	***	
z15	1.119	.108	10.395	***	
z14	.837	.083	10.114	***	
z13	.286	.057	5.009	***	
z12	.390	.062	6.315	***	
z19	1.246	.120	10.346	***	
z18	.850	.085	10.044	***	
z17	.441	.059	7.511	***	
z16	.314	.052	6.052	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Behavioral Intention	.038
Behavior	.244
F3	.626
F4	.531
F6	.245
F2	.179
F13	.679
F12	.750
F14	.323
F11	.242
F17	.580
F18	.578
F16	.476
F19	.328
F15	.148
F22	.528
F23	.516
F25	.348
F24	.450
F21	.329
F20	.414
P1	.255
P2	.217

	Estimate
P3	.382
P4	.261
P5	.421
P6	.485
P7	.348
P8	.145
P9	.188
P10	.120
P11	.041
P12	.076
S10	.507
S9	.549
S8	.438
S7	.610
S6	.674
S5	.610
S4	.672
S3	.565
S2	.294
S1	.520

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	110	1100.193	751	.000	1.465
Saturated model	861	.000	0		
Independence model	41	4764.770	820	.000	5.811

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.146	.822	.796	.717
Saturated model	.000	1.000		
Independence model	1.262	.350	.318	.334

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.769	.748	.913	.903	.911

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.916	.704	.835
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	349.193	264.600	441.772
Saturated model	.000	.000	.000
Independence model	3944.770	3731.270	4165.620

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	4.584	1.455	1.102	1.841
Saturated model	.000	.000	.000	.000
Independence model	19.853	16.437	15.547	17.357

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.044	.038	.050	.964
Independence model	.142	.138	.145	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	1320.193	1366.859	1703.520	1813.520
Saturated model	1722.000	2087.273	4722.410	5583.410
Independence model	4846.770	4864.164	4989.647	5030.647

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	5.501	5.148	5.887	5.695
Saturated model	7.175	7.175	7.175	8.697

Model	ECVI	LO 90	HI 90	MECVI
Independence model	20.195	19.305	21.115	20.267

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	178	185
Independence model	45	47

D2. Final Practice Model Results for Explaining Supervisor's Behavior Based on Actual Practice

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Behavioral Intention	<---	e24	2.347	.180	13.028	***	
Behavioral Intention	<---	Personal Background & Safety Knowledge	.226	.347	2.455	.015	
Behavioral Intention	<---	Project Workload	-.652	.435	-1.629	.104	
Behavior	<---	Behavioral Intention	.048	.014	3.356	***	
Behavior	<---	e23	.329	.063	5.243	***	
Behavior	<---	Personal Background & Safety Knowledge	.112	.065	1.620	.085	
Behavior	<---	Project Stakeholder & Family Influence	.194	.309	2.127	.031	
Behavior	<---	Weather & Worker Control	.527	.314	1.679	.093	
Behavior	<---	Organizational & Management Influence	.257	.159	1.615	.106	
S1	<---	Behavioral Intention	.887	.082	10.814	***	
S2	<---	Behavioral Intention	.676	.084	8.008	***	
S3	<---	Behavioral Intention	.948	.086	10.988	***	
S4	<---	Behavioral Intention	1.073	.087	12.283	***	
S5	<---	Behavioral Intention	1.031	.088	11.771	***	
S6	<---	Behavioral Intention	1.076	.083	12.994	***	
S7	<---	Behavioral Intention	1.197	.096	12.476	***	
S8	<---	Behavioral Intention	.794	.076	10.415	***	
S9	<---	Behavioral Intention	.919	.079	11.694	***	
S10	<---	Behavioral Intention	1.000				
P12	<---	Behavior	1.000				
P11	<---	Behavior	.806	.164	4.909	***	
P10	<---	Behavior	1.114	.279	3.993	***	
P9	<---	Behavior	1.423	.319	4.464	***	

			Estimate	S.E.	C.R.	P	Label
P8	<---	Behavior	1.380	.315	4.382	***	
P7	<---	Behavior	1.397	.291	4.807	***	
P6	<---	Behavior	1.685	.337	5.001	***	
P5	<---	Behavior	1.559	.320	4.867	***	
P4	<---	Behavior	1.129	.274	4.127	***	
P3	<---	Behavior	1.508	.324	4.656	***	
P2	<---	Behavior	1.174	.290	4.043	***	
P1	<---	Behavior	1.212	.289	4.191	***	
Q15	<---	Organizational & Management Influence	1.000				
Q21	<---	Organizational & Management Influence	.567	.152	3.725	***	
Q27	<---	Organizational & Management Influence	1.286	.207	6.209	***	
Q25	<---	Organizational & Management Influence	.884	.149	5.931	***	
Q24	<---	Organizational & Management Influence	1.088	.179	6.081	***	
Q26	<---	Organizational & Management Influence	1.132	.188	6.037	***	
Q4SupExp	<---	Personal Background & Safety Knowledge	1.000				
Age	<---	Personal Background & Safety Knowledge	.974	.152	6.424	***	
Q13	<---	Project Stakeholder & Family Influence	1.000				
Q18	<---	Project Stakeholder & Family Influence	.962	.394	2.441	.015	
Q16	<---	Project Stakeholder & Family Influence	2.570	.814	3.158	.002	
Q17	<---	Project Stakeholder & Family Influence	2.607	.826	3.156	.002	
Q28	<---	Organizational & Management Influence	1.118	.195	5.721	***	
Train	<---	Personal Background & Safety Knowledge	.472	.089	5.278	***	
Q8	<---	Personal Background & Safety Knowledge	.369	.098	3.762	***	
Q22	<---	Project Workload	1.000				
Q23	<---	Project Workload	.612	.166	3.689	***	
Q19	<---	Weather & Worker Control	5.210	5.800	.898	.369	
Q10	<---	Weather & Worker Control	1.000				

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
Behavioral Intention	<---	e24	.991
Behavioral Intention	<---	Personal Background & Safety Knowledge	.049
Behavioral Intention	<---	Project Workload	-.128
Behavior	<---	Behavioral Intention	.302
Behavior	<---	e23	.870
Behavior	<---	Personal Background & Safety Knowledge	.153
Behavior	<---	Project Stakeholder & Family Influence	.093
Behavior	<---	Weather & Worker Control	.153
Behavior	<---	Organizational & Management Influence	.227
S1	<---	Behavioral Intention	.701
S2	<---	Behavioral Intention	.529
S3	<---	Behavioral Intention	.715
S4	<---	Behavioral Intention	.803
S5	<---	Behavioral Intention	.762
S6	<---	Behavioral Intention	.835
S7	<---	Behavioral Intention	.799
S8	<---	Behavioral Intention	.677
S9	<---	Behavioral Intention	.753
S10	<---	Behavioral Intention	.742
P12	<---	Behavior	.370
P11	<---	Behavior	.286
P10	<---	Behavior	.392
P9	<---	Behavior	.500
P8	<---	Behavior	.491
P7	<---	Behavior	.601
P6	<---	Behavior	.690
P5	<---	Behavior	.638
P4	<---	Behavior	.440
P3	<---	Behavior	.552
P2	<---	Behavior	.404
P1	<---	Behavior	.434
Q15	<---	Organizational & Management Influence	.460
Q21	<---	Organizational & Management Influence	.308
Q27	<---	Organizational & Management Influence	.681
Q25	<---	Organizational & Management Influence	.627
Q24	<---	Organizational & Management Influence	.660
Q26	<---	Organizational & Management Influence	.636
Q4SupExp	<---	Personal Background & Safety Knowledge	.690
Age	<---	Personal Background & Safety Knowledge	.836

			Estimate
Q13	<---	Project Stakeholder & Family Influence	.252
Q18	<---	Project Stakeholder & Family Influence	.263
Q16	<---	Project Stakeholder & Family Influence	.658
Q17	<---	Project Stakeholder & Family Influence	.654
Q28	<---	Organizational & Management Influence	.569
Train	<---	Personal Background & Safety Knowledge	.392
Q8	<---	Personal Background & Safety Knowledge	.276
Q22	<---	Project Workload	.784
Q23	<---	Project Workload	.511
Q19	<---	Weather & Worker Control	.950
Q10	<---	Weather & Worker Control	.193

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Project Stakeholder & Family Influence	<-->	Project Workload	-.033	.013	-2.535	.011	
Personal Background & Safety Knowledge	<-->	Project Stakeholder & Family Influence	.022	.010	2.107	.035	
Project Workload	<-->	Weather & Worker Control	.012	.014	.865	.387	
Organizational & Management Influence	<-->	Project Stakeholder & Family Influence	.040	.014	2.808	.005	
Organizational & Management Influence	<-->	Project Workload	-.053	.016	-3.316	***	
e22	<-->	e21	.554	.075	7.417	***	
e8	<-->	e9	1.545	.306	5.047	***	
z5	<-->	z4	.038	.020	1.889	.059	
z3	<-->	z2	.032	.013	2.423	.015	
z6	<-->	z11	.064	.028	2.277	.023	
e14	<-->	e13	.112	.051	2.207	.027	
e4	<-->	e5	.705	.324	2.179	.029	
e3	<-->	e4	.658	.301	2.185	.029	
e4	<-->	e6	-.496	.253	-1.961	.050	
z14	<-->	z11	.072	.028	2.583	.010	
z19	<-->	z10	-.059	.021	-2.779	.005	
z6	<-->	z8	.059	.020	2.883	.004	

		Estimate	S.E.	C.R.	P	Label
e19	<-->e14	-.104	.051	-2.061	.039	
e18	<-->e14	-.130	.055	-2.368	.018	
e14	<-->e11	.164	.051	3.182	.001	
e12	<-->e11	.333	.068	4.903	***	
e13	<-->e11	.248	.061	4.053	***	
e19	<-->e18	.281	.064	4.360	***	
e20	<-->e19	.219	.061	3.611	***	
e15	<-->e14	.160	.048	3.350	***	
e18	<-->e15	-.127	.046	-2.730	.006	
e1	<-->e3	.928	.337	2.750	.006	
e1	<-->e2	1.725	.401	4.298	***	
e2	<-->e3	1.394	.395	3.530	***	
e13	<-->e12	.167	.062	2.716	.007	

Correlations: (Group number 1 - Default model)

			Estimate
Project Stakeholder & Family Influence	<-->	Project Workload	-.389
Personal Background & Safety Knowledge	<-->	Project Stakeholder & Family Influence	.231
Project Workload	<-->	Weather & Worker Control	.246
Organizational & Management Influence	<-->	Project Stakeholder & Family Influence	.660
Organizational & Management Influence	<-->	Project Workload	-.342
e22	<-->	e21	.572
e8	<-->	e9	.397
z5	<-->	z4	.143
z3	<-->	z2	.210
z6	<-->	z11	.152
e14	<-->	e13	.149
e4	<-->	e5	.180
e3	<-->	e4	.159
e4	<-->	e6	-.157
z14	<-->	z11	.171
z19	<-->	z10	-.186
z6	<-->	z8	.278
e19	<-->	e14	-.129
e18	<-->	e14	-.162
e14	<-->	e11	.199
e12	<-->	e11	.350
e13	<-->	e11	.303

			Estimate
e19	<-->	e18	.326
e20	<-->	e19	.238
e15	<-->	e14	.259
e18	<-->	e15	-.193
e1	<-->	e3	.198
e1	<-->	e2	.314
e2	<-->	e3	.247
e13	<-->	e12	.193

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e23	1.000				
e24	1.000				
Organizational & Management Influence	.111	.032	3.454	***	
Personal Background & Safety Knowledge	.265	.057	4.642	***	
Project Stakeholder & Family Influence	.033	.020	1.659	.097	
Project Workload	.215	.063	3.435	***	
Weather & Worker Control	.012	.015	.796	.426	
e1	4.572	.457	9.996	***	
e2	6.614	.627	10.554	***	
e3	4.824	.492	9.815	***	
e4	3.557	.426	8.359	***	
e5	4.314	.458	9.424	***	
e6	2.813	.336	8.383	***	
e7	4.566	.494	9.238	***	
e8	4.179	.414	10.092	***	
e9	3.616	.374	9.663	***	
e10	4.592	.469	9.781	***	
e22	.900	.086	10.522	***	
e21	1.042	.097	10.708	***	
e20	.974	.093	10.449	***	
e19	.868	.086	10.054	***	
e18	.855	.087	9.773	***	
e17	.492	.052	9.388	***	
e16	.446	.053	8.409	***	
e15	.505	.057	8.817	***	
e14	.755	.075	10.042	***	
e13	.742	.076	9.710	***	
e12	1.008	.097	10.379	***	
e11	.901	.087	10.340	***	

	Estimate	S.E.	C.R.	P	Label
z6	.411	.040	10.219	***	
z5	.340	.032	10.598	***	
z4	.211	.025	8.508	***	
z3	.133	.015	8.883	***	
z2	.170	.020	8.569	***	
z1	.209	.023	9.064	***	
z9	.292	.046	6.378	***	
z8	.108	.037	2.950	.003	
z15	.486	.046	10.641	***	
z14	.408	.038	10.611	***	
z13	.284	.040	7.150	***	
z12	.298	.041	7.228	***	
z19	.310	.031	9.975	***	
z18	.035	.347	.101	.919	
z7	.289	.030	9.632	***	
z10	.324	.031	10.356	***	
z11	.437	.041	10.693	***	
z17	.135	.057	2.387	.017	
z16	.228	.029	7.744	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Behavioral Intention	.019
Behavior	.243
Q23	.261
Q22	.614
Q8	.076
Train	.154
Q28	.323
Q19	.902
Q10	.037
Q17	.428
Q16	.433
Q18	.069
Q13	.063
Age	.699
Q4SupExp	.476
Q26	.404
Q24	.435
Q25	.393

	Estimate
Q27	.464
Q21	.095
Q15	.212
P1	.189
P2	.163
P3	.304
P4	.194
P5	.407
P6	.476
P7	.361
P8	.241
P9	.250
P10	.154
P11	.082
P12	.137
S10	.550
S9	.567
S8	.459
S7	.638
S6	.698
S5	.580
S4	.645
S3	.511
S2	.280
S1	.491

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
z11	<-->	Organizational & Management Influence	5.896	.034
z10	<-->	z11	6.204	.060
z7	<-->	Weather & Worker Control	7.458	.011
z18	<-->	z7	5.342	.048
z19	<-->	Organizational & Management Influence	17.595	.049
z19	<-->	z16	4.357	.037
z15	<-->	Project Workload	5.739	.058
z15	<-->	Personal Background & Safety Knowledge	6.131	-.064
z1	<-->	Project Stakeholder & Family Influence	5.199	-.014
z1	<-->	e23	5.825	-.090
z1	<-->	z13	9.198	-.058

			M.I.	Par Change
z2	<-->	z7	6.017	-.038
z2	<-->	z13	5.780	.040
z3	<-->	z10	4.268	.028
z4	<-->	z11	4.214	.043
z5	<-->	z19	4.352	-.043
e11	<-->	z10	4.356	-.065
e11	<-->	z15	4.353	-.080
e11	<-->	z6	6.427	-.089
e12	<-->	z16	4.845	.068
e12	<-->	z15	4.559	.091
e12	<-->	z8	9.426	-.086
e14	<-->	e24	5.516	.128
e14	<-->	z16	6.129	.066
e15	<-->	e11	6.543	.101
e16	<-->	e13	4.663	.085
e17	<-->	z17	5.193	.057
e18	<-->	Organizational & Management Influence	6.960	.050
e18	<-->	z8	7.541	.073
e18	<-->	z9	4.497	-.073
e19	<-->	z8	5.607	-.060
e20	<-->	e24	6.172	-.162
e21	<-->	z11	4.029	.071
e21	<-->	z6	4.530	-.074
e22	<-->	z14	6.551	.082
e22	<-->	z6	12.710	.116
e22	<-->	e16	6.742	-.097
e22	<-->	e18	10.391	.144
e22	<-->	e20	5.972	.119
e10	<-->	e23	4.391	.359
e10	<-->	z14	4.096	.187
e10	<-->	e17	11.951	.374
e9	<-->	e17	11.052	.287
e9	<-->	e19	5.401	-.230
e9	<-->	e10	4.474	.551
e8	<-->	z3	5.346	.105
e8	<-->	e19	8.741	.308
e7	<-->	Personal Background & Safety Knowledge	4.719	-.184
e7	<-->	z19	6.238	-.204
e7	<-->	z14	7.640	-.261
e7	<-->	e11	6.707	.325
e7	<-->	e10	7.213	.892

	M.I.	Par Change
e6 <--> e21	4.714	.221
e5 <--> z14	4.692	-.188
e4 <--> z2	4.035	.107
e4 <--> e15	7.766	-.253
e4 <--> e16	5.311	.213
e3 <--> Weather & Worker Control	5.071	.035
e3 <--> z18	4.692	.169
e2 <--> z11	4.045	-.203
e2 <--> z14	4.199	.202
e1 <--> z10	5.441	-.177
e1 <--> e10	4.236	-.615
e1 <--> e4	7.440	.701

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	119	961.351	742	.000	1.296
Saturated model	861	.000	0		
Independence model	41	3934.588	820	.000	4.798

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.130	.841	.815	.725
Saturated model	.000	1.000		
Independence model	1.252	.395	.365	.376

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.756	.730	.931	.922	.930
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.905	.684	.841
Saturated model	.000	.000	.000

Model	PRATIO	PNFI	PCFI
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	219.351	143.455	303.364
Saturated model	.000	.000	.000
Independence model	3114.588	2922.927	3313.669

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	4.006	.914	.598	1.264
Saturated model	.000	.000	.000	.000
Independence model	16.394	12.977	12.179	13.807

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.035	.028	.041	1.000
Independence model	.126	.122	.130	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	1199.351	1249.836	1614.042	1733.042
Saturated model	1722.000	2087.273	4722.410	5583.410
Independence model	4016.588	4033.982	4159.465	4200.465

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	4.997	4.681	5.347	5.208
Saturated model	7.175	7.175	7.175	8.697
Independence model	16.736	15.937	17.565	16.808

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	202	209
Independence model	55	56

BIOGRAPHY

Thu Anh Nguyen, raised in Vietnam, graduated her bachelor degree in 2007 from Hochiminh City University of Technology. Since then, she has been a lecture of Faculty of Engineering, HCMUT, in Vietnam. She has been granted the scholarship by Thai Petroleum Company for continuous her master degree. She entered Chulalongkorn University on autumn 2008 as a Civil Engineering major, with an emphasis in Construction Engineering and Management. The topics related to construction management that she interested in are safety management in construction and contracting in construction business.