# 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.
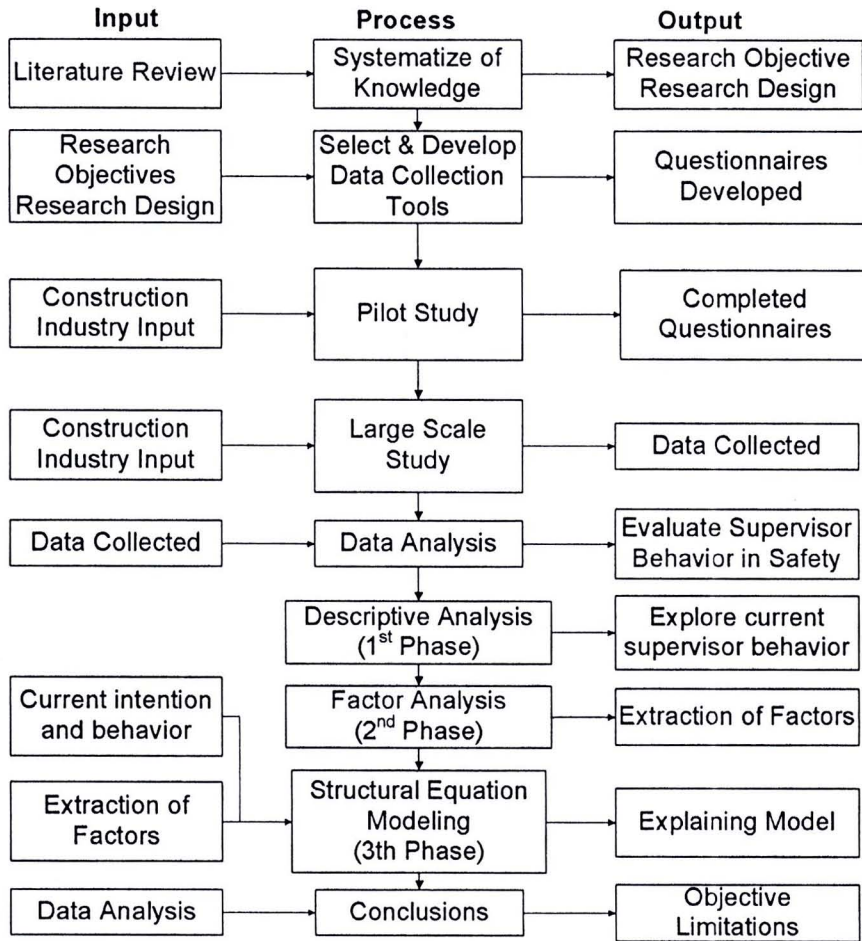
| Input | Process | Output |
|---|---|---|
| Literature Review | Systematize of Knowledge | Research Objective Research Design |
| Research Objectives Research Design | Select & Develop Data Collection Tools | Questionnaires Developed |
| Construction Industry Input | Pilot Study | Completed Questionnaires |
| Construction Industry Input | Large Scale Study | Data Collected |
| Data Collected | Data Analysis | Evaluate Supervisor Behavior in Safety |
| | Descriptive Analysis (1st Phase) | Explore current supervisor behavior |
| Current intention and behavior | Factor Analysis (2nd Phase) | Extraction of Factors |
| Extraction of Factors | Structural Equation Modeling (3th Phase) | Explaining Model |
| Data Analysis | Conclusions | Objective Limitations |

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