2.0 Study Aims and Hypotheses

2.1 Aim and Objectives

The aim of this study is to improve construction site safety by providing appropriate and adequate safety training at technician level. The objectives are:

- to identify the roles of site technicians in enforcing safety,
- to identify the lack or the inadequacy of mandatory training for site technicians,
- to identify details of the training required, and
- to develop a curriculum suitable for them.

2.2 Background Study

2.2.1 Classification of Technician Job

The Apprentice Section of the Vocational Training Council defines construction technician as a collective term for middle level personnel in the construction industry. The roles of a construction technician, in general, include:

1. supervise construction work in accordance with specifications and standards;
2. supervise and coordinate sub-contractors' work;
3. maintain and regulate the progress of work according to actual site conditions;
4. control cost and site progress.

Depending on the scope of the works, construction technicians can be classified as site supervisor, foreman, site coordinator, site surveyor, assistant site agent, inspector of work, safety supervisor, laboratory technician or a middle level position that takes up any administrative duties in construction.

In Hong Kong, work supervisors are usually referred to those technicians who work for consultants, architects, clients or the Government and are mainly responsible for quality control and contract administration. They are sometimes classified as assistant inspectors of work or assistant clerks of works. On the other hand, foremen are usually referred to those who work for the contractors and are mainly responsible for managing the workers, scheduling resources and supervising work directly. However, in some countries, the terms foreman and site supervisor are sometimes used interchangeably.

VTC (1999) reports that in 1999 there are 20,848 numbers of technicians in the building and civil engineering industries in Hong Kong. The different types of job position for construction technicians are summarized in Table 2.1.

Table 2-1 Types of Job Position for Construction Technicians (VTC, 1999)

Job Title	Number	Percentage
Inspector/Clerk of works	4,904	23.5%
Site Foreman	3,817	18.3%
Land Surveying	1,149	5.5%
plant/building services technician	970	4.7%

Site Agent	977	4.7%
Laboratory	307	1.5%
Assistant Safety Officer / Safety Supervisor	360	1.7%
Civil/structural/geotechnical technician	2,621	12.6%
Others	5,743	27.5%
Total	20,848	100%

The "others" categories are considered as more 'office' based and may include such positions as draughtsman, estimator, and quantity surveying technician. The civil/structural/geotechnical technicians are those technicians who may be involved in both site and office works. The rest of the other technicians which accounts for 59.9% (12,484 in number) of the total construction technician population are mainly site based.

It should be emphasized that there is only 1.7% of the overall technician population or 360 in number of technicians that is working as safety supervisors. The number has actually not increased much in the past two years as shown in Table 2.2.

Table 2-2 Number of Safety Officers and Safety Supervisors

(VTC 1993,1995,1997,1999)

Year	No. of Safety Officer	No. of Safety Supervisors
1999	463	360
1997	396	327
1995	261	276
1993	198	146

2.2.2 Roles of Foreman on Construction Site Safety

According to the Construction Site Safety Manual of the Work Bureau, a safety representative is required on site. A safety representative is the foreman or ganger of each labour group or team working on the site and appointed by the contractor. The safety representative is required to ensure (Work Bureau, 1999):

- that directives from the contractor, safety officer and safety supervisors are carried out;
- safety practices are adopted by the workers;
- the use of personnel protective clothing and equipment by the workers at all time.

Rowlinson (1997) considers that the role of site supervisors is extremely important in ensuring safe construction. The supervisor is the link between the worker and the management and the supervisor is fully aware of site conditions. The supervisor can spot hazards and coach the workers. He states that it is vitally important that supervisor level staffs are thoroughly trained in all safety issues to ensure safety.

Petersen (1988) points out that the supervisor or foreman is the key man in accident prevention. His application of the art of supervision to the control of worker performance is the factor of greatest influence in successful accident prevention. The roles of supervisors were also summarized as identifying the problems, finding and verifying the reason for preventing the problem, selecting the appropriate remedy and finally applying the remedy.

Kennedy (1997) states out that the key to preventing accidents is the knowledge of the safe way on performing the task. Safety knowledge is acquired through a combination of education, training and experience. Supervisors must be familiar with the way they supervise and must be aware of safety regulations and precautions in order to perform the task safely.

Gow (1991) concludes that traditional workers in Hong Kong, in general believe in authority, they will obey what the foreman asks of them. The reasons could be due to fear of being fired or loss of face. Therefore, promoting safety culture at the foreman level is effective in motivating workers to safety behaviours.

2.2.3 Safety Supervision Plan

The Building Ordinance sets out the requirements of a safety supervision plan in carrying out building works or street works by an authorized person and registered structural engineer, and by a general building contractor or registered specialist contractor. The plan would require an increasing responsibility of construction technicians in ensuring site safety. The purposes of the plan are:

1) to ensure the building works or street works to be carried out in general accordance with the provisions of the Buildings Ordinance and regulations and with the plans approved by the Building Authority;

2) to control hazards during construction.

A supervision plan comprises an outline and a detailed safety supervision plan. The outline plan sets out the management structure and line of communication. The detailed plan sets out the specific safety requirements, method statements, the effects to other works, and the precautionary and protective measures to be taken. Depending on the types of works and the streams, a Technical Competent Person (TCP) meeting the requirements can be appointed to carry out the plan.

Supervision plans can be classified into five types depending on the degree of complexity of the works. A plan can be straightforward, moderately complex, complex, very complex or extremely complex.

The Technical Memorandum for Supervision Plans (Building Department, 1998) outlines the minimum qualifications and experience for each grade of Technical Competent Persons (TCP) for site safety supervision as shown in Table 2-3.

Table 2-3 Requirements of Technical Competent Persons

Grade of TCP	Minimum qualifications and experience for each grade of Technical Competent Persons (TCP) for site safety supervision
T1	A certificate or diploma holder of any recognized examining body in a recognized subject with total relevant working experience of not less than 3 years.
T2	A higher certificate or higher diploma holder of any recognized examining body in a recognized subject with total relevant working experience of not less than 3 years.
T3	A higher certificate or higher diploma holder of any recognized examining body in a recognized subject with total relevant working experience of not less than 5 years; or a degree holder of any specified examining body in a recognized subject with

	total relevant working experience of not less than 3 years.
T4	A degree holder of any recognized examining body in a recognized subject with total relevant working experience of not less than 4 years or a recognized professional of a recognized discipline.
T5	A registered professional of a recognized discipline with total relevant working experience of not less than 5 years.

Although the safety supervision plan sets out the minimum requirements of TCPs it does not specify the amount of safety training that is necessary to carry out the work effectively. The plan just assumes that safety knowledge would be acquired through a formal technical education and work experience.

2.2.4 Safety Training

Under the Section 6 of the new Occupational Safety and Health Ordinance, employers are required to provide information, instruction, training and supervision as is necessary for ensuring the safety and health at work to his employees. The objective of safety training is to raise an individual's safety awareness and to improve an individual's safety know how (Labour Department, 1998).

The level of training can be summarized into 3 levels:

1. General safety training - to aim at raising the safety awareness of individuals. These include general safety rules and awareness of general hazards.

2. Job safety training – a job-specific safety training aimed at equipping individuals to be engaged in a specific job. Examples of training include for those workers engaged in working at height, working in excavation, working in confined space, working with machinery (including lifting appliances and heavy plant) and working with electricity etc.

3. Safety Management - such training is for supervisory staff and the training should cover principles and techniques of construction safety management, and the legal and contractual obligations in regard to safety.

Gow (1991) reports that a large percentage of responses from the construction industry said that safety education is necessary (employees 68.6%, employers 84.4%, government officials 78.3 %). He also reports that a large percentage of responses from the construction industry (employees 72.9%, employers 70.5%, and government officials 60.9%) said there is a need to have a separate independent safety education centre in Hong Kong which focuses only on safety.

Tang et al (1998) point out that safety training schemes are to be provided at different rankings and levels, including site management staff, workers and operatives of different trades. Staffs who have completed a training course should be issued with a certificate.

McKnight (1987) considers training should be provided in two stages, namely pre-service training and in-service training. Pre-service training can be categorized into

general, critical or simple, subject to the severity of the hazards arose from the job, the level of productivity, and the degree of training that will receive during the in-service training. For example, for critical operation such as working in confined space, it is necessary to have a pre-service training before workers can be allowed to start working.

The in-service training can be categorized into total job training, specialized training and refresher training. Total Job Training is a comprehensive and intensive programme intended to instruct all of the safety procedures, precautions, and hazards of the job. Specialized Training is a even more comprehensive training that focus on specific procedures and precautions. Also focus on hazards that may arise from changes in job procedures, occurrence of an incident or purchase of a new equipment. Refresher Training is a periodic refresher programme that serves as reminder and help to maintain a high level of safety consciousness (McKnight, 1987).

2.2.5 Study on Training of Foreman

Lam (1996) summarized the specific causes for the high accident rate in the construction industry in Hong Kong as below:

> mobility, safety practice, new immigrants, skill, use of modernized techniques, overtime, ill-devised incentive scheme, frequent change in supervisory staff, lack of leadership, shortage of factory inspectors, low penalty, difficult to run safety courses for workers, inadequate safety courses, inadequate authority of the labour

department and bad site safety supervision.

More than half of the causes has to do with the skill and ability of the supervisory staff. It should be possible to improve the safety practice, skill of new immigrants, use of modernized techniques, leadership, training of workers and good site safety supervision by providing sufficient training to the site supervisory staff.

Gow (1991) reports a study on identifying reasons for the high accident rates and to define the types of safety education courses needed for the construction industry in Hong Kong. The study involves conducting questionnaires and interviews on 118 employees and 122 employers of the construction industry and 24 government officials working in departments relevant to safety in Hong Kong. The report concluded that:

1. employers should take more responsibility for providing a safe working environment and for instructing their employees in safety practices,
2. employees should take initiative to understand safety precautions and to abide by operational regulations,
3. safety education is necessary, and
4. safety courses must be tailored to the individual needs of the participants.

Gow (1991) also studied the need of the course content in the construction industry. The course contents preferred by the construction industry, in the order of preference, are safety technology, management, health and hygiene, and legislation. Details of the course contents preferred are given in Table 2-4.

Table 2-4 A Profile of Safety Training in Course Content (Gow, 1991)

Course Content	Employees	Employers	Government Officials
a) Safety technology	Construction plant	Construction plant	Construction plant
	Working at height	Electrical Safety	Working at height
	Electrical Safety	Working at height	Manual lifting / Electrical Safety
	Fire prevention	Fire prevention	Fire prevention
	Manual lifting	Manual lifting	
b) Management	Accident prevention	Accident prevention	Accident prevention
	System of safety	Safety organization	System of safety
	Safety organization	System of safety	Human behaviour
		Human behaviour	Safety organization
		Loss control	Loss control
c) Health and hygiene	Dust	Dust	Noise
	Chemicals	Chemicals	Dust
	Light/Ergonomics	Noise	Chemicals/ergonomics
	Noise	Light	Light
d) Legislation	Duties of employees	Duties of proprietors	Duties of proprietors
	Duties of proprietors	Duties of employees	Duties of employees

It was also reported that employees preferred courses in operative level whereas employers and government officials preferred courses at management level (Gow, 1991).

. Rowlinson (2000) summarizes that safety systems generally used in the construction industry include green card system, pay for safety scheme, and behavioural safety management. He concludes that the reason for system failure is due to inadequate infrastructure provided by the employers.

2.2.6 Roles of Safety Supervisors

Safety supervisors are responsible for assisting the proprietor or the safety officer in promoting safety and health and their main duties are (Labour Department 1995):

- to assist the safety officer in carrying out his duties,
- to supervise the observance by the workers to safety standards,
- to advise proprietor or safety officer on safety observance by workers on safety standards,
- to promote safety, and
- to prepare and submit weekly report.

The number of safety supervisors employed on site is not enough to cope with the expanding construction works in Hong Kong and the increasing need of safety supervision on construction site. Presented in Table 2.5 and Figure 2.1 are number of safety supervisors and the increasing amount of construction work in Hong Kong.

Table 2-5 Number of Safety Supervisors vs. Public Expenditure in Construction

(VTC 1993,1995,1997,1999, Census and Statistics Department 1999)

Year	No. of Safety Supervisors	Total number of Construction Technicians	Percentage of Safety Supervisors (%)	Public Expenditure in Infrastructure ($ million)	Public Expenditure in Housing ($ million)	Public Expenditure in Infrastructure & Housing ($ million)
1999	360	20,848	1.7	--	--	--
1998	--	--	--	22,934	40,843	63,777
1997	327	19,727	1.7	21,453	24,651	46,104
1995	276	19,094	1.5	26,243	19,069	45,312
1993	146	17,326	0.8	--	--	--
1992	--	--	--	17,209	12,932	30,141

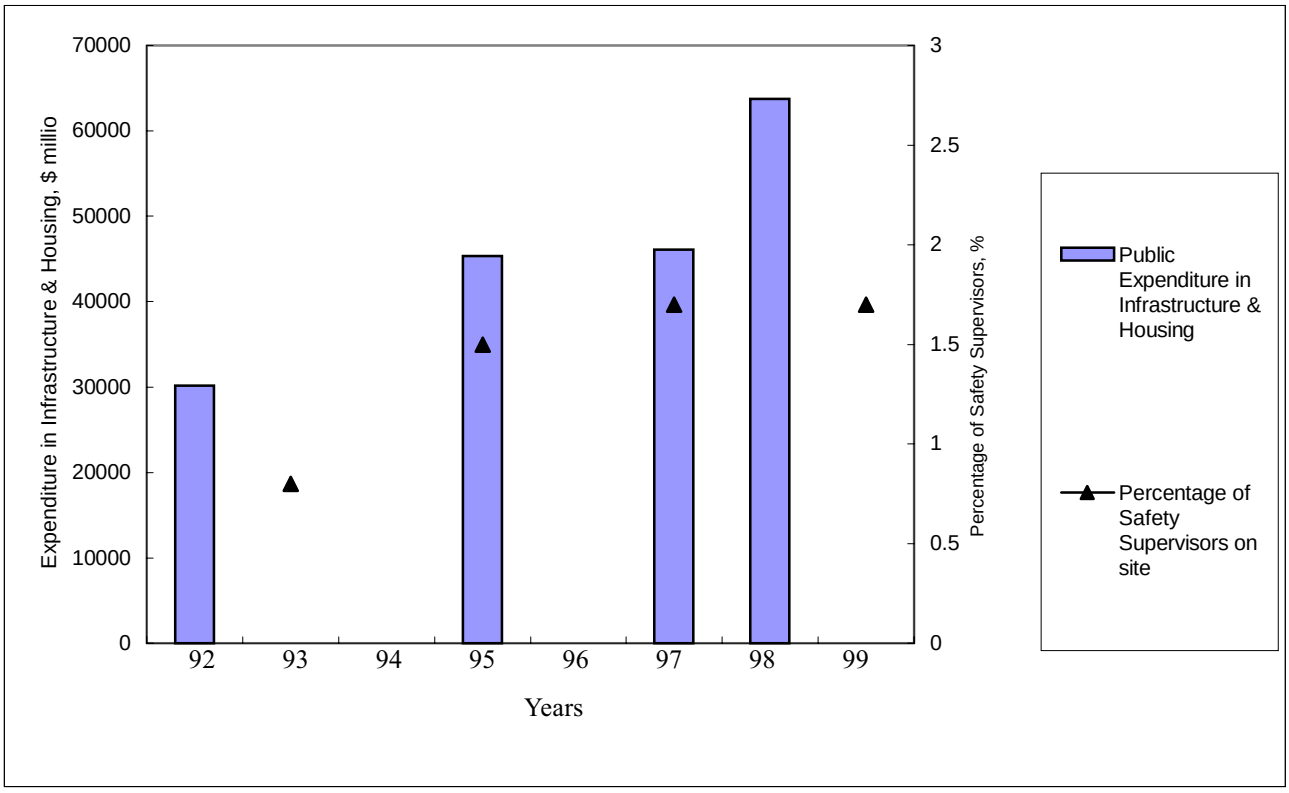

Fig 2-1 Number of Safety Supervisors vs. Public Expenditure in Construction

(VTC 1993,1995,1997,1999, Census & Statistics Department 1999)

Training of Safety Supervisor

The Regulations require no registration for the safety supervisors and do not lay down the qualification of a safety supervisor. It is expected the safety supervisor to be a person experienced of the construction site who has the knowledge to advise the proprietor on safety standards for workers, supervise the observance of such standards and promote safety at work (Labour Department, 1995). According to the Construction Site Safety Manual (Work Bureau, 1999), safety supervisors must have at least three years experience on construction work and have completed an appropriate safety training course. The Construction Industry Training Authority (CITA) provides a 42 hours training course for safety supervisors (CITA, 2000).

Training of Safety Officer

CITA also offers a one-year (about 40 weeks) part-time course to train safety officer for the construction industry. Rowlinson (1997) comments that the effectiveness of these training facilities is probably limited for a number of reasons:

1) the number of people who benefit from these course is relatively small at present;
2) most workers learn their skills through on the job and few learn about construction safety;
3) workers, due to their low level of education, may not assimilate safety messages from mass media and pamphlets;
4) tight work schedules lead to a reluctance to release site foreman to attend training courses

2.2.7 Foreman needs Training

Kennedy (1997) points out that the frontline foreman controls the activities of the workers. Workers look for direction and follow their leader. As the leader of the group, the site foremen must be abided by all site safety legislation requirements and must follow all company safety policies and procedures. Unless the site supervisors take an active interest in safety, workers will continue to take chance, use defective tools, violate rules, and perform unsafe acts.

Levitt and Samelson (1987) states that no other supervisors can take the place of the foreman directing their crews by using methods which keep accidents from happening.

McKnight (1987) considers that the supervisor's job is to see that the workers do the things they are expected in a productive and safe manner. To fulfil their responsibilities, supervisors themselves need training. They need to be trained not only in safety but in ways of passing safety onto workers and monitoring them to make sure that they perform safely.

Rowlinson (2000) also reports that accidents usually occur during the first few weeks the worker is on site. Almost 40 percent of accidents occurred to workers who had been on site for less than five weeks. Therefore, it is the site foreman's responsibility to give orientation to workers before he/she gets started.

Petersen (1996) concludes that whether the supervisors satisfy their safety

responsibility depends on

1) their knowledge on what to do

2) their knowledge on how to do it

3) their knowledge that the boss is measuring

4) their being a reward for doing it

Gow (1991) reports that 90% of workers in the construction industry in Hong Kong receive daily wages. However, foremen are usually employed under monthly wages and their influence on the site safety is more continuous and profound than the effects of training to individual workers who are mostly daily wages.

2.3 Hypotheses

The following hypotheses are made:

- Construction site technicians are playing an important role in site safety.
- The amount of training provided to site technicians is not enough.
- Number of Safety Supervisors on site is not enough.
- Safety training in the following areas are required :
    - Legal responsibilities
    - Contractual Obligation
    - Safe working procedures
    - Correct selection, use and maintenance of PPE.
    - Safety Management