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# THE HONG KONG POLYTECHNIC UNIVERSITY DEPARTMENT OF BUILDING AND REAL ESTATE

# Investigating the Current Application and Exploring the Future Development of Pay for Safety Scheme (PFSS) in Hong Kong Construction Industry

by

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A thesis submitted in partial fulfilment of the requirements for the Degree of Master of Philosophy

February 2012

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### ABSTRACT

Safety has always been a prime concern within the construction industry of many countries. With the purpose of improving the prevailing safety performance of the Hong Kong construction industry, the Pay for Safety Scheme (PFSS) has been launched in the public sector since 1996 to enhance safety awareness by taking the contractor's pricing for safety items out from the consideration of competitive bidding. This research aims to explore the current application and future development of PFSS within the Hong Kong construction industry. The research study will focus on how PFSS can be effectively applied in the public sector, extending the application of PFSS in the private sector, as well as the feasibility of introducing PFSS downstream to subcontractors.

An empirical questionnaire survey was launched to solicit the opinions of various safety practitioners on the benefits, difficulties, limitations and recommendations on implementing PFSS in Hong Kong. A five-level data analysis framework was applied to analyze the survey results. The respondents were divided into two main groups (i.e. client group vs contractor group) for comparison of different perspectives on the implementation of PFSS. It was found that the industrial practitioners generally agreed that PFSS is effective for implementation within the Hong Kong construction industry. Both the client group and contractor group ranked "Increased safety training" and "Enhanced safety awareness" as the two most significant benefits of PFSS. Moreover, the industrial practitioners encountered some difficulties during the implementation of PFSS in their projects. Both the

client group and contractor group ranked "Plenty of paperwork required for certifying payment to contractor" and "Complicated contract documents and lengthy assessment process" as the two most challenging difficulties associated with PFSS. After determining the key difficulties in applying PFSS, some major limitations of PFSS were identified and improvement measures were recommended to facilitate the smooth implementation of PFSS in future.

A series of eight structured face-to-face interviews were conducted with relevant senior safety practitioners from large-scale leading main contractors in Hong Kong. The interviewees were invited to illustrate various forms of safety incentive schemes or measures currently implemented at subcontractor level, to provide their opinions on the feasibility of extending PFSS downstream to subcontractors and to recommend possible payable safety items for subcontractors. The interview findings revealed that monetary award, peer recognition and certificate of appreciation are the common forms of safety incentive measures offered to frontline workers for achieving better safety performance. Most of the interviewees also demonstrated positive attitude towards extending PFSS for subcontractors. Some possible payable safety items were recommended by the interviewees. It was indicated that additional safety measures for high-risk operations include the identification of high-risk operations (e.g. major falsework erection, tower crane installation and operation, tunnelling work, etc) and the implementation of corresponding safety measures, as well as pre-task training in high-risk processes, would be the most useful safety items for consideration. Other recommended safety items encompass additional safety measures (e.g. "double shackle" safety belts and elevator working platform),

provision of welfare facilities and workers uniforms. All these interview results have provided essential pointers for the application of various safety incentive schemes or measures at subcontractor level, implementation of PFSS for subcontractors and determination of suitable payable safety items for inclusion.

The research findings are expected to provide a critical review of applying PFSS in both the public sector and private sector regarding its benefits, difficulties, limitations and possible recommendations for successful implementation of PFSS. By consolidating the opinions from different key project stakeholders, the research results have generated some valuable insights into the future development of PFSS, have encouraged a wider application of PFSS in the private sector and have facilitated the implementation of PFSS for subcontractors in near future. It is also expected to allow decision makers to have a clearer insight in determining the appropriate payable safety items for PFSS and PFSS for subcontractors, as well as the optimal budget of contract sum allocated for the payable safety items in tender pricing by both main contractor and subcontractor organizations at an early stage of project development, and to investigate whether and how the site accidents can be mitigated via PFSS.

## LIST OF RESEARCH PUBLICATIONS ON THE WORK REPORTED IN THIS THESIS

### **Refereed Journal Articles (Published)**

- Chan, D.W.M., Chan, A.P.C. and Choi, T.N.Y. (2010). An Empirical Survey of the Benefits of Implementing Pay for Safety Scheme (PFSS) in the Hong Kong Construction Industry. *Journal of Safety Research*, 41(5), October, 433-443.
- Choi, T.N.Y., Chan, D.W.M. and Chan, A.P.C. (2011). Perceived Benefits of Applying Pay for Safety Scheme (PFSS) in Construction – A Factor Analysis Approach. *Safety Science*, 49(6), July, 813-823.
- Choi, T.N.Y., Chan, D.W.M. and Chan, A.P.C. (2012). Potential Difficulties in Applying the Pay for Safety Scheme (PFSS) in Construction Projects. Accident Analysis and Prevention - Special Issue on Accident Analysis and Prevention in Construction and Engineering, Volume 48, September, 145-155.

### **Refereed Conference Papers (Published)**

- Choi, T.N.Y., Chan, D.W.M. and Chan, A.P.C. (2009). An Investigation of the Current Application and Future Development of Pay for Safety Scheme (PFSS) in Hong Kong. *Proceedings of the CIB W099 International Conference 2009 on Working Together: Planning, Designing and Building a Safe and Healthy Construction Industry*, 21-23 October 2009, Melbourne, Australia (CD-Rom Proceedings under Theme: Client-led Occupational Health and Safety on Pages 22-32).
- Choi, T.N.Y. and Chan, D.W.M. (2010). A Critical Review of the Effectiveness of Safety Measures in Hong Kong Construction Industry. *Proceedings of the Second International Postgraduate Conference on Infrastructure and Environment*, 1-2 June 2010, Hong Kong, China, Volume 1, 339-352.
- Chan, A.P.C., Wong, F.K.W., Yam, M.C.H., Chan, D.W.M. and Choi, T.N.Y. (2011). A Research Framework for Developing a "Pay for Safety Scheme for Subcontractors (P<sub>f</sub>SS<sub>f</sub>S)" for Better Safety Performance. *Proceedings of The Third International Postgraduate Conference on Infrastructure and Environment (IPCIE 2011)*, 11-12 July 2011, Hong Kong, China, Volume 1, 356-363, ISBN 978-988-17311-6-6.

### **SCHOLARSHIP / AWARD OBTAINED**

- 1. Postgraduate Student Research Project adjudicated as *one of the Successful* Scholarship Holders for the Occupational Safety and Health (OSH) Student Research Scholarship 2009 on 22 December 2009 by the Occupational Safety and Health Council.
- Dissertation adjudicated as the Champion Award (Master Degree Group) for the *HKICM Construction Management Award 2011-2012* on 4 August 2012 by the Hong Kong Institute of Construction Managers.

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#### CHAPTER 1 INTRODUCTION

#### **1.1 Background of the Study**

The construction industry is characterized by continual changes, involving varying technologies, poor working conditions and the need for co-ordination of different interdependent trades and operations (Laukkanen, 1999). Due to the hazardous and complexity of work, safety issues have always been a major problem and a prime concern besetting the construction industry in many countries (Teo and Phang, 2005). It is evident that the construction industry has recorded the highest number of accident rate and fatalities among various key industry sectors in most parts of the world (Koehn et al., 1995; Sawacha et al., 1999; Ahmed et al., 2000; Wong and So, 2004; Choudhry and Fang, 2008). Some previous research pointed out that site accidents are mainly caused by competitive tendering, extensive use of subcontractors, poor accident record keeping and reporting system, the low priority given to safety, inadequate safety training provided to contractors management and workers, etc (Poon, 1998; Tam and Fung, 1998). Ngowi and Mselle (1999) observed that some contractors may gain little competitive advantage from good health and safety management. The practices of competitive tendering and award of most public sector contracts to the lowest bidder in many countries compel the contractors to drive their prices low, while cutting costs, which in turn, affects health and safety considerations.

In order to improve the current state of construction safety performance, different safety initiatives were implemented in both the public and private sectors (Ng, 2007). In 1992, the safety management system was first introduced in public works projects of Hong Kong. The Works Bureau promulgated the Independent Safety Audit Scheme and the Pay for Safety Scheme in 1996 to facilitate the application of efficient safety management systems and to improve the standard of safety performance.

#### **1.2 Research Problems**

An effective safety measure can substantially improve site safety performance because it can help the management to come up with safer means of operations and to create a safer working environment for the workers (Anton, 1989; Abdelharmid and Everett, 2000; Rowlinson, 2003). Furthermore, by incorporating effective safety measures, strong safety culture can be fostered within organizations because it can encourage co-operation and communication between management and workers on different site safety operations. There has been a number of safety improvement measures developed within the construction industry of Hong Kong. It is crucial to review the application and effectiveness of these safety measures. Having conducted a comprehensive literature review on different safety measures adopted in the Hong Kong construction industry, a research problem was identified as 'there exists a strong need for investigating the development and application of the Pay for Safety Scheme (PFSS) and for suggesting some possible recommendations for its smooth and effective implementation". As PFSS has been regarded as one of the most widely used safety measures in the public sector works projects since 1996, it is prudent to review its effectiveness and seek further improvements for application.

This research focuses on one of these safety measures, the Pay for Safety Scheme (PFSS) which is a public sector initiative was launched in the public sector by the government in 1996 to encourage safety awareness by taking the contractor's pricing for safety items out from the realm of competitive bidding. However, PFSS has not yet been widely adopted in the private sector of the construction industry. Although

the scheme has been applied in Hong Kong for over 15 years since 1996, the implementation mechanism such as the assessment and certification procedures, requirements of each of the payable safety items, etc have not been sufficiently evaluated and analyzed. Only a limited number of research studies have investigated PFSS in general, and none on its perceived benefits, potential difficulties and future development in Hong Kong. Thus, an industry-wide empirical investigation of PFSS is considered to be essential and timely to identify any deficiencies of PFSS and suggest possible recommendations to ensure its effective implementation in town.

Main contractors prefer to sublet their work for a number of compelling reasons such as financial benefits, workload pressures, human or plant resource constraints, and better efficiency (Hsieh, 1998; Elazouni and Metwally, 2000; Wadhwa and Ravindran, 2007). Work can be delivered more economically by further subdividing it into works of a range of trades and assigning the works in each trade to workers who have both adequate knowledge and specific skills to carry out the works efficiently (Yik *et al.*, 2007). Unfortunately, many contractors have underestimated the risk of employing incapable subcontractors. Subcontractors are particularly vulnerable to market fluctuations and extreme economic conditions resulting in poor business practices and non-performance (Wong *et al.*, 2004). Subcontractors are normally small in size and simple in organisational structure. They may lack safety commitment because of limited budget, time and human resources (Wong *et al.*, 2004). To prevent the scarification of profit, the main contractors may pyramid down all safety responsibilities to subcontractors without providing adequate support for the provisions of safety measures or safety training. Construction accidents frequently happen due to the fact that subcontractors' workers tend to have less safety training and inadequate awareness of safe working practices (Rowlinson, 1999).

The Hong Kong construction industry is heavily reliant on the practice of subcontracting. Earlier research studies indicated that subcontractors and their workers have weaker safety awareness and culture than their main contractor counterparts (e.g. OSHC, 2003; Chan *et al.*, 2005). Since over 80% of the injured workers are subcontracted labourers (Tam and Fung, 1998; Rowlinson, 1999), better motivation of subcontractors is believed to be instrumental in further improving site safety performance. In order to make further improvement in construction safety, more resources should be allocated and wider attention should be paid to enhance

safety awareness and safety culture of the subcontractors' workers. With the successful implementation of PFSS in public works projects, the Pay for Safety Scheme (PFSS) may be down-streamed to also cover the subcontractors to further improve safety performance and so such a feasibility study in relation to Hong Kong conditions is timely and indispensable. Therefore, another research problem is how the implementation of PFSS can be extended to subcontractor level.

#### **1.3 Research Objectives**

The research study aims to explore the current application and future development of PFSS in the Hong Kong construction industry. The research will focus on how the PFSS can be effectively implemented in the public sector, extending the application of PFSS in the private sector, as well as the feasibility of implementing PFSS for subcontractors. In order to achieve the research aim, the specific objectives have been developed as follows:

- To provide a critical review of current application of PFSS in both the public and private sectors of the Hong Kong construction industry.
- (2) To examine the benefits, difficulties and limitations of implementing PFSS and

analyze their importance.

- (3) To explore various safety incentive schemes or measures adopted by main contractors to motivate their subcontractors for achieving better safety performance.
- (4) To investigate the feasibility of implementing PFSS for subcontractors  $(P_FSS_FS)$ .
- (5) To suggest possible recommendations for facilitating the successful implementation of PFSS and future development of  $P_FSS_FS$  in Hong Kong.

#### **1.4 Outline of Research Approach**

The research was conducted through both qualitative and quantitative approaches. The research process started with a comprehensive literature review, which identified gaps in the knowledge of PFSS that formulated research problems. The literature review provides the background for the research and also forms the framework on which an empirical survey questionnaire is based. A series of structured face-to-face interviews were employed as the qualitative approach. Table 1.1 shows different methods adopted to achieve respective research objectives.

Table 1.1 Achievements of Research Objectives

Proposed research objectives	Methods to achieve	
1. To provide a critical review of current application of PFSS in both the public and private sectors of the Hong Kong construction industry.	<ul> <li>Literature Review</li> <li>Structured Interviews</li> <li>Questionnaire Survey</li> </ul>	
2. To examine the benefits, difficulties and limitations of implementing PFSS and analyze their importance.	<ul> <li>Literature Review</li> <li>Questionnaire Survey</li> </ul>	
3. To explore various safety incentive schemes or measures adopted by main contractors to motivate their subcontractors for achieving better safety performance.	<ul> <li>Literature Review</li> <li>Structured Interviews</li> </ul>	
4. To investigate the feasibility of implementing PFSS for subcontractors (P <sub>F</sub> SS <sub>F</sub> S).	<ul> <li>Literature Review</li> <li>Structured Interviews</li> </ul>	
5. To suggest possible recommendations for facilitating the successful implementation of PFSS and future development of P <sub>F</sub> SS <sub>F</sub> S in Hong Kong.	<ul> <li>Literature Review</li> <li>Questionnaire Survey</li> <li>Structured Interviews</li> </ul>	

### 1.5 Significance and Value of the Research

PFSS can be an effective measure to improve the overall safety performance of contractors and reduce accident rate of the construction industry in Hong Kong. This research study will carry out a thorough investigation of the current application and future development of PFSS in Hong Kong. It will first provide a critical review of applying PFSS in both the public sector and private sector regarding its benefits, difficulties, limitations and possible recommendations for successful implementation. By consolidating the opinions from different key project stakeholders, the research results would provide some valuable insights into the future development of PFSS and encourage a wider application of PFSS in the private sector.

The research is also timely because PFSS has been introduced in the public sector of Hong Kong since 1996 and in the private sector since 2005. It is timely to review its effectiveness in upgrading the site safety performance and seek further improvement for future use. The research findings are also expected to allow decision makers to have a clearer insight into setting aside the optimal budget of contract sum allocated for the payable safety items in tender pricing by both main contractor and subcontractor organizations at an early stage of project development, and to investigate whether and how the site accidents can be mitigated via PFSS. It is important to set minimum investment on safety-related items in return of maximum profit of a construction project for improvement in prevailing site safety performance. After exploring the present status of implementation of PFSS between client and main contractor in Hong Kong, the application of PFSS for subcontractors in near future will also be studied by developing a practical P<sub>F</sub>SS<sub>F</sub>S for achieving better safety performance.

#### **1.6** Structure of the Thesis

This thesis is divided into six chapters. This chapter (**Chapter 1**) gives the background information of this research study. It reports on the recent development and current application of PFSS in the construction industry of Hong Kong, and it also covers the research problems, research objectives and outline research approach. The value and significance of this research are highlighted and the structure of this thesis is given in this chapter as well.

**Chapter 2** contains an extensive literature review on safety performance and application of safety incentive schemes in the construction industry. It aims to inform the readers about the application of safety incentive schemes in different parts of the world. Particular attention will be paid to the development of PFSS in

Hong Kong. Literature on the relationship between safety performance and subcontracting practices will be also reviewed in this chapter.

**Chapter 3** introduces the overall research methodology for the study. Different methods of data collection by desktop search, a questionnaire survey as well as face-to-face interviews will be explained in detail. Various statistical techniques such as the Cronbach's alpha reliability test, the Kendall's concordance test, the Spearman's rank correlation test and the Mann-Whitney U test, which are employed in analyzing the empirical questionnaire survey, are also mentioned.

**Chapter 4** provides the data analysis of the questionnaire survey launched in Hong Kong, with the results and discussions deduced from the data analysis. A five-level data analysis framework including: (1) the Cronbach's alpha reliability test; (2) descriptive statistics; (3) the Kendall's concordance test; (4) the Spearman's rank correlation test; and (5) the Mann-Whitney U test, will be used in data analysis to explore any differences in perceptions between different groups of respondents.

**Chapter 5** reports on the key findings of a series of interviews launched in Hong Kong with regard to different safety measures including safety incentive schemes for subcontractors introduced by main contractors, opinions on the current application of PFSS and on extending PFSS downstream to subcontractors in the Hong Kong construction industry. The findings are explained with cross reference to published literature wherever deemed appropriate.

**Chapter 6** summarizes the main conclusions of the research study. The achievements of the research objectives are reviewed. Contributions to existing knowledge base of this research are highlighted and core directions for future studies are recommended in this chapter.

**References and appendices** are also attached at the end of the thesis for reference.

#### **1.7** Chapter Summary

This introduction chapter has outlined the background of the work addressed in this thesis and the justifications for this research study. The research approach employed

is described and the research problems and research objectives are illustrated. A summary of the value of this research is given, together with the structure of the thesis.

### **CHAPTER 2 – LITERATURE REVIEW**

#### 2.1 Introduction

This chapter focuses on the safety performance in Hong Kong, application of safety incentive schemes, development of PFSS in Hong Kong and the relationship between safety performance and the subcontracting practice. The purpose of review of previous work is to capture the important ideas behind the concepts of PFSS, and then to identify what have been done in this research area and, more importantly, what may be significant but has not been done before (i.e. to identify the existing knowledge gap).

#### 2.2 Construction Site Safety in Hong Kong

The construction site safety of Hong Kong is mainly governed by the Factories and Industrial Undertakings Ordinance (F&IUO), Chapter 59 and its subsidiary Regulations through the Labour Department. Prosecutions would be taken against any breach of the statutory provisions. Besides, the Hong Kong SAR Government has introduced a plethora of different safety initiatives in both the public and private sectors over the past decade. Most of the mandatory safety measures specified in the public works contracts are not enforceable in the private sector and some are being adopted on a voluntary basis. The significant improvement of the safety performance of the Hong Kong construction industry over the past decade indicated the profound effect of these safety measures.

The downward trend of the accident rate is also supported by the statistics announced by the Labour Department (Labour Department, 2010). As shown in Figure 2.1, the accident rate of the Hong Kong construction industry has been declining in recent years from 2000 to 2009. When compared with 2000, it is encouraging to observe that the number of industrial accidents decreased from 11,925 in 2000 to 2,755 in 2009, down by 76.9% (Figure 2.1). The number of non-fatal accident rate has decreased from 149.8 accidents per 1,000 workers in 2000 to 54.6 accidents per 1,000 workers in 2009, equivalent to a reduction of 63.6%. The shape of the curve is convex to the origin. It is obvious that the decreasing rate of the number of accident is diminishing from 2003.

As shown in Figure 2.2, the number of fatal accidents tends to show in general a downward trend over the past decade of 2000-2009 (Labour Department, 2010). The number of fatal accidents has reduced progressively from 29 in 2000 to 19 in 2009, equivalent to a drop of 34.5%.



Figure 2.1 Number of industrial accidents and accident rate per 1,000 workers in the construction industry from 2000 to 2009 (Labour Department, 2010)


Figure 2.2 Number of industrial fatalities and fatality rate per 1,000 workers in the construction industry from 2000 to 2009 (Labour Department, 2010)

One of the possible reasons is that most of the safety initiatives (e.g. Pay for Safety Scheme (PFSS), Safety Management System (SMS), Independent Safety Auditing Scheme (ISAS) and Site Supervision Plan System (SSPS), etc) were introduced by the government during the 1990s. As a start, these initiatives yielded some remarkable initial results in terms of reducing the number of industrial accidents. However, there are not many resources allocated for reviewing, refining and upgrading those schemes. The effectiveness of these safety initiatives is reduced as implementation details have not been regularly reviewed and properly refined in light of the prevailing changes of the construction industry throughout the past decade. To maintain this downward trend, it is necessary to review the existing safety initiatives for making further improvements.

# 2.3 Application of Safety Incentive Schemes

It has long been recognised that incentive schemes can improve company performance and motivate the workforce (Leichtling, 1997). There are various types of safety initiatives that companies utilize to promote site safety of workers; perhaps the most widely implemented type of programme involves safety incentives (Hinze and Gambatese, 2003). Safety incentive schemes are one of the high-impact zeroaccident techniques (Hinze and Wilson, 2000). Many organisations within the United Kingdom implement safety incentive schemes for improving safety performance of workers (Krause, 1998). Typically, some tangible "prizes" (e.g. bonus, prize, gift, coupon, etc) were awarded to individual employees or contractors under safety incentive scheme. Tangible rewards can be powerful motivators of safety performance (Austin *et al.*, 1996).

According to Opfer (1998), safety incentive programs can be considered as psychological approach in which employees can be rewarded for safe work habits. Both LaBar (1997) and Laws (1996) expressed that safety incentive schemes are generally applied to reduce accidents, improve safety behaviours and safety-related records. Geller (1999) supported that the implementation of safety incentives may provide positive outcomes. This is reinforced by two empirical research findings. The research conducted by McAfee and Winn (1989) indicated that "every study without exception, found that incentives enhanced safety and/or reduced accidents in the workplace, at least in the short term". Another research by Simonet and Wilde (1997) opined that safety incentives bring about desirable safety performance. Sims (2002) and Toft (2006) identified 10 categories of incentives: (1) recognition; (2) time off; (3) stock ownership; (4) special assignments; (5) advancement; (6) increased autonomy; (7) training and education; (8) social gatherings; (9) prizes; and (10) money. Gambatese (2004) divided safety incentive programmes into 3 types, namely, outcome-based, behaviour-based and activity-based. The details of these three types of incentive programmes will be discussed in the later section. Under the activity-based approach, employees are rewarded when they participate in the prescribed safety activities such as safety toolbox talk and safety training courses.

The "Pay for Safety Scheme (PFSS)" launched by the Works Bureau of Hong Kong Government in 1996 can be categorised as an activity-based approach. This approach is easier to implement and more objective to measure than other behaviour-based incentives. Performance with respect to the incentives can be measured by seeing whether the workers have participated in the some stipulated safety-related activities or not (Gambatese, 2004). This can be verified with a review of attendance record sheets and/or certificate of attendance. As the activity-based payable safety items are easy and objective to measure throughout the whole construction period, it can facilitate the process of interim payment certification under PFSS.

# 2.3.1 Outcome-based approach

The typical form of safety incentives practised in the United States of America focuses on project outcomes (Gambatese, 2004). The objective of this kind of incentive is to meet a specified outcome or level of performance. Examples of such outcome can be number of days and number of labour-hours worked without sustaining an injury. This approach is easy to implement, the employer only has to set a performance objective and the associated benefits. This simple format helps communicating incentives to employees to facilitate clearer understanding of incentive among them. However, this approach has also its own limitations. In some cases, there are unsafe work practices which may not result in reportable accidents. Workers receiving rewards for not having an injury may be in fact behaving in an unsafe manner. If this is the case, the incentive scheme does not really promote safe work behaviours.

## 2.3.2 Behaviour-based approach

Workers receive rewards for exhibiting certain safe behaviours under this kind of incentive. It should be noted that the performance is not a measurable outcome, as in the case with an outcome-based incentive. It is rather a kind of behaviour which is assumed will result in a desired outcome. Workers are rewarded for demonstrating desirable safe practices in their work. For instance, a worker will be rewarded with a gift if he is observed performing a work task in a particularly safe manner (Gambatese, 2004).

This type of incentive is more difficult to implement than outcome-based safety incentives. The employer has to establish the types of safe behaviours which deserve a reward. This is not an easy task since a considerable number of behaviours can be demonstrated by the workers. It is also important that reward should be consistently provided for safe behaviour. When the reward is given to one worker for an observed safe behaviour, other workers who exhibit the same behaviour should also be rewarded. Gambatese (2004) asserted that the desired outcomes may not be achieved when certain safe behaviours are rewarded. The employer should consider the potential impact of the safe behaviours on safety performance when giving the reward. Another limitation of this approach is that behaviours of workers change constantly in reaction to external factors such as new equipment and new facilities (Gangwar and Goodrum, 2005).

## 2.3.3 Activity-based approach

As Gambatese (2004) points out, activity-based approach is similar to behaviourbased approach, but focuses on the participation in specified activities. Employees are rewarded when they participate in sanctioned activities related to safety such as safety toolbox talk and safety training courses. The more safety related activities the worker participates in, the more he is rewarded. The "Pay for Safety Scheme" launched by the Works Bureau of Hong Kong Government in 1996 can be classified as an activity-based approach (Chan *et al*, 2010a).

This approach is easier to implement than behaviour-based incentives. Performance with respect to the incentive can be measured by whether the workers participated in the safety related activities or not (Gambatese, 2004). This can be verified with a review of attendance sheets and/or certificate of attendance. The implementation of this approach cannot be successful without establishing the sanctioned activities.

Similar to behaviour-based approach, it is also assumed that there is a relationship between participation of the sanctioned activities and improved safety performance. To ensure this actually takes place, the employer should carefully consider the impact of different activities on safety performance and he may also develop a proper mechanism to make sure that the potential impacts are realized. The key features of the three various safety incentive approaches are summarized in Table 2.1. Table 2.1 Key features of three various safety incentive approaches (Gambatese,

2004)

Approach	Outcome-based	Behaviour-based	Activity-based
Objective	To meet a specified outcome or level of performance	To reward workers for demonstrating safe behaviours	To focus on participation in specified activities
Proposed Means	Award safety bonus or penalty to subcontractors if SPI of projects falls within a certain range as determined from historical data	Award workers if they demonstrate some specified safe behaviours	Award workers after participating in certain safety related activities
Rewards	Monetary reward	Coupons for bakery, cash coupons in supermarket etc./cumulative incentives	Coupons for bakery, cash coupons in supermarket etc./cumulative incentives
Award Time	After completion of project	Instant reward	Instant reward
	• Ensure safety targets are met before awarding bonus or penalty	• Ensure instant reward to workers – better motivation	• Ensure instant reward to workers, easier to implement with example set up by DEVB
Merits	<ul> <li>Easy to implement</li> <li>Employer only has to set up a performance objective and the associated benefits</li> </ul>	• To encourage workers to behave in a safe manner during working process	• Easier to implement than behaviour-based approach
Demerits	<ul> <li>Long time lag – too remote to motivate front-line workers</li> </ul>	<ul> <li>Difficult to determine types of behaviours to be rewarded</li> <li>Resource draining for implementation</li> </ul>	• Safety targets may not be realised after giving rewards
	<ul> <li>Unsafe practice may not result in accidents</li> <li>Workers receiving</li> </ul>	<ul> <li>Performance is not a measurable outcome</li> <li>More difficult to</li> </ul>	• Employer should carefully consider impact of different activities on safety

## 2.4 Pay for Safety Scheme

Competition within the construction industry is particularly intense (Betts and Ofori, 1992). As the contractors may try to lower its tender prices, it causes the sum payable for the safety-related items not to be measured and identified in the tender rates and prices. Therefore, contractors are likely to cut the budgets under the safety items to put in other necessary items (ETWB, 2000). PFSS is one of the initiatives launched by the Works Bureau in 1996. It primarily aims to take the contractor's pricing for site safety out from the realm of competitive tendering (ETWB, 2000; REDA/HKCA, 2005).

## 2.4.1 Development of PFSS in Public and Private Sector

Generally, contracts on public works projects including electrical and mechanical (E&M) services and design-and-build (D&B) works, having an estimated contract

sum of HK\$20 million or more, or term contracts having a total estimated expenditure of HK\$50 million or above, are required to participate in PFSS. However, the cost of equipment contributing to a great portion of contract should be excluded from the contract sum in determining whether the contract should be included in the scheme. In addition, contracts with duration of 12 months or less can be exempted from inclusion under the scheme (ETWB, 2000).

Under this scheme, the "Site Safety" section under the bill of quantities (BQ) covered all the payable safety items. There is about 2% of total contract sum set aside for the contractors to carry out the safety-related items. However, the fixed sum may be adjusted depending on the size of the project. When the contractors comply with each of the following typical specified site safety items and have been certified with satisfactory performance, payment is then to be made to the contractors on a monthly basis (ETWB, 2000).

- (a) Complete draft of Site Safety Plan
- (b) Complete Site Safety Plan
- (c) Updating of Safety Plan

- (d) Provision of Safety Officer
- (e) Attendance to Site Safety Management Committee
- (f) Attendance to Site Safety Committee
- (g) Arrangement of and attendance to weekly safety walk
- (h) Provision of safety training in the form of trade specific advanced safety training to skilled workers
- (i) Provision of safety training in the form of site specific induction training
- (j) Provision of safety training in the form of toolbox talk
- (k) Participation in safety promotional campaign as instructed by the Architect/
   Engineer
- (l) Safety Audit
- (m) Attendance on Safety Auditor

Building upon the successful implementation of PFSS in public works projects, the Real Estate Developers Association of Hong Kong (REDA) and the Hong Kong Construction Association (HKCA) have jointly established the Pay for Safety Scheme (PFSS), which is one of the essential initiatives of a Safety Partnering Programme conducted in June 2005 for the private building projects. The HKCA has started promoting the application of PFSS in the private sector on a voluntary basis since October 2005. A total of 84 construction sites have participated in the Safety Partnering Programme since October 2005, with 25 active sites up to the end of April 2011 (REDA/HKCA, 2011). The operation of PFSS in the private sector is more or less the same as the public sector. However, it seems that it has not yet widely adopted in the private sector. The developer should indicate the intention to establish a higher standard of site safety performance during the tender stage. Then the developer should demonstrate his commitment to pay for safety-related expenditure in the schedule of rates for site safety, and set the financial incentive to support the contractor's efforts on site safety between 0.5% and 2% of the contract sum (Figure 2.3).



Figure 2.3 Sliding scale of Pay for Safety price value relative to project size (REDA/HKCA, 2005)

PFSS was implemented within the Hong Kong construction industry for more than ten years. It is evident that the implementation of PFSS benefited, to a certain extent, to the construction projects. The Works Bureau has implemented the Pay for Safety Scheme (PFSS) in the public works contracts since 1996. Both the number of fatal accidents and non-fatal accident rate for Works Bureau's construction projects from 1995-1997 are listed in Table 2.2. It can be noted that there is noticeable improvement in both the number of fatal accidents and non-fatal accident rate since the introduction of PFSS. The number of fatal accidents has reduced progressively from 24 in 1995 to 14 in 1997 and the non-fatal accident rate has declined significantly from 62 accidents per 1000 workers in 1995 to 55 accidents per 1000 workers in 1997 (Lam, 2008). These figures can strongly support that PFSS reduces the number of construction accidents effectively as echoed by both Ng (2007) and Ko (2010).

Table 2.2 Number of fatal and non-fatal accidents for Works Bureau's construction projects from 1995-1997 (Lam, 2008).

Year	Number of fatal	Non-fatal accidents (number of
	accidents	accidents per 1000 workers)
1995	24	62
1996	20	61
1997	14	55

Before the introduction of PFSS, the promotion of safety and health highly depends on the willingness of contractors. By monitoring and control system under this scheme, those tenderers have absorbed the safety amount in the overall tender price to be paid back after the contract is awarded (Ng, 2007). Chow (2005) expressed that PFSS serves as a blowing horn to remind contractors on safety and tenderers to have a serious consideration before they cut the budget for safety-related items. This scheme also brings the clients into the safety issues of the project. Active involvement of clients is very crucial for good safety performance, since not all the contractors are enthusiastic and willing to monitor and promote safety themselves (Chow, 2005). The effectiveness of PFSS on site safety performance was further investigated by comparing the accident rates of two similar and comparable new public housing projects in Hong Kong (Ko, 2010). The accident rate per 1,000 workers of the project without the implementation of PFSS recorded in 2000 (71.6) nearly doubles that of the project with PFSS in 2002 (37.8). Since the contractual requirements regarding site safety in the project with PFSS have promulgated more extra items related to site safety, e.g. safety training, safety campaign and safety plan with possible cost reimbursement, the contractor will have higher initiatives to participate more in those safety-related activities. Then, site safety can be greatly enhanced.

Both Wong and So (2004) and Ng (2007) asserted that PFSS is an effective tool to improve construction safety by encouraging contractors to perform safely on-site. PFSS provides strong incentives to raise overall safety performance of the projects.

Most of the contractors would try their best endeavors to carry out the stipulated safety measures so as to get the full payment. Fung et al. (2005) pointed out that the implementation of safety training, formation of safety committee and launch of safety audit under PFSS can enhance safety culture. A general review by the Safety and Environmental Advisory Unit (SEAU) of the Civil Engineering and Development Department revealed that the safety performance of those contracts under PFSS are generally better than non-PFSS contracts for works having similar nature (Chau and Lee, 2007). It has also been considered that some of the safety activities, especially the weekly safety walks, site safety management committee meetings and payment for site safety items, do provide a strong impetus to contractors' site management towards better safety and are conducive to enhanced safety culture of contractors. Fung et al (2005) also advocated that the site safety training to personnel working in the construction industry can effectively raise the workers' safety awareness. Safety awareness is found to be an influential factor of safety performance (Chan et al., 2005).

#### 2.4.2 Extending PFSS for subcontractors

The Hong Kong construction industry is heavily dependent upon the practice of subcontracting work. Earlier studies indicate that subcontractors and their workers have a less positive attitude towards safety than their main contractor counterparts (OSHC, 2003; Chan *et al.*, 2005). More performance driven emphases were implemented into PFSS under new works contracts in 2007. The implementation of PFSS has been extended to the Building Services Nominated Subcontracts (BS NSC) in public works projects and public housing projects (Fung, 2007a). The incentive level allowed for PFSS for NSC is 2% of the subcontract value in general (Fung, 2007b).

## 2.5 Literature review of perceived benefits of PFSS

The implementation of PFSS benefits both the client and the contractor. Wong and So (2004) and Ng (2007) asserted that PFSS is an effective tool to improve construction safety by encouraging contractors to perform safely on-site. PFSS provides strong incentives to raise overall safety performance of the projects. The majority of contractors would devote every effort to implement the relevant safety measures in order to secure the whole payment. The literature search for the benefits of PFSS was conducted under the "all" field of two common search engines "Scopus" and "Google Scholar" which are regarded as powerful, comprehensive and reliable search tools adopted by several researchers nowadays (e.g. Al-Sharif and Kaka, 2004; Ke *et al.*, 2009). Search keywords included "pay for safety scheme", "pay for safety" and "safety incentive schemes". Any published papers with these specific terms anywhere within the manuscripts were considered to have met the requirements of this research study.

A thorough scrutiny of the paper contents extracted was undertaken to identify the perceived benefits of implementing PFSS and was cross-checked with the respective leading journal websites. Under this rigorous search process, most of the relevant publications in relation to the pay for safety scheme or similar safety incentive measures were sought and examined in detail as a solid base to launch the investigation. Review of the published literature indicates that common benefits of adopting PFSS can be grouped under six major headings (Figure 2.4).



Figure 2.4 Benefits of adopting PFSS

## 2.5.1. Reduced accident rate

Chau and Lee (2007) stated that the introduction of PFSS to public works contracts has proved to be a right move towards better safety as reflected by the significant reduction in the accident rates over the last ten years. It is manifested that there is a significant decrease in the accident rate of the Hong Kong Housing Authority (HKHA) public housing projects from 1998 to 2008 (Figure 2.5). Since the number of construction accidents of HKHA projects in terms of both new works and maintenance works is well below that of the overall Hong Kong construction industry (Figure 2.6), it reinforces that the safety measures are effectively implemented in the public works projects. Rowlinson (2007) concurred that the majority of these safety initiatives have been public sector sponsored or administered and the performance of the private sector has undoubtedly lagged behind the public sector. Thus, a remarkable reduction of accident rate and fatality rate was resulted in public sector projects.



Figure 2.5 Accident rate per 1,000 workers from 1989 to 2008

(Labour Department, 2008)



Figure 2.6 Number of construction accidents from 1989 to 2008 (Labour Department, 2008)

# 2.5.2 Increased safety training

Safety training is considered by most researchers as an important safety tool in mitigating site accidents (Hinze and Harrison, 1981; Duff *et al.*, 1994; Lingard and Rowlinson, 1994). Safety training is also considered as a key factor affecting safety performance (Wong *et al.*, 2004; Chan *et al.*, 2005). Tam and Fung (1998) reported that provisions of more detailed and higher-level safety training at all level generates better safety performance. Hinze (1997) also revealed that safety training is an effective vehicle to enhance the safety knowledge and awareness of construction

workers. Under PFSS, contractors are supported to provide adequate safety training to the workers by payment. Payment of this item will be made based on the number of workers that actually attend safety training programmes in each month (ETWB, 2000). In order to get the full payment, the contractor will be obliged to provide sufficient safety training towards the workers. Fung *et al.* (2005) also indicated that the site safety training to personnel working in the construction industry can effectively raise the workers' safety awareness.

#### 2.5.3 Stronger safety awareness and safety commitment

Under PFSS, payment is to be made to the contractor when the contractor complies with each of the stipulated safety items. Ng (2007) suggested that PFSS enhances safety awareness and ensures the safety measures to be carried out by the contractor from tender stage until project completion. Lingard and Rowlinson (2005) mentioned that a genuine commitment to safety from senior management is one of the important ingredients for achieving good safety performance. PFSS reinforces safety awareness of the senior management or line management (Ng, 2007). Safety awareness is found to be an influential factor of safety performance (Chan *et al.*, 2005).

#### 2.5.4 Better safety culture

Fung *et al.* (2005) pointed out that the implementation of safety training, formation of safety committee and launch of safety audit under PFSS can enhance safety culture. A general review by the Safety and Environmental Advisory Unit (SEAU) of the Civil Engineering and Development Department revealed that the safety performance of those contracts under PFSS are generally better than non-PFSS contracts for works having similar nature (Chau and Lee, 2007). It has also been considered that some of the safety activities, especially the weekly safety walks, site safety management committee meetings and payment for site safety items, do provide a strong impetus to contractors' site management towards better safety and are conducive to enhanced safety culture of contractors.

## 2.5.5 Enhanced safety attitude of workers

Fung *et al.* (2005) pointed out that workers are generally indifferent and passive on safety issues and have poor safety attitude. Furthermore, most of the workers are less-educated when compared with the management teams and supervisory staff, they always ignore importance of construction safety. When a project adopted PFSS,

the contractor was also encouraged to provide sufficient safety training to the workers. Those safety training programs would be useful in educating the workers towards the importance of site safety, their legal rights and duties on site safety issues and raising their safety awareness. Longbottom *et al.* (2001) suggested that the concepts of PFSS will enhance both safety culture and attitude of construction workers effectively. Ng (2007) also supported that adopting PFSS could strengthen safety awareness of site employees, especially the front-line workers. Therefore, site safety can be reinforced to provide a safer working environment and reduce construction accidents eventually.

#### 2.5.6 Improved safety-related communication

Effective communication of safety-related information between different contracting parties is one of the essential elements to develop good site safety management (Koys and De Cotiis, 1991; Cheyne *et al.*, 1998; Hoffmann and Stetzer, 1998; Wong *et al.*, 2004). Two site safety committees should be set up, that is, the Site Safety Committee and Site Safety Management Committee. The major difference between these two committees is that the former includes the main contractor and

subcontractors with representatives from front-line workers while the latter one is primarily formed by the project and site management staff from both the client and main contractor (Chow, 2005). Chow (2005) also pointed out that the payment of these two kinds of safety meetings will be made monthly if they are held regularly and the contractor has completed the tasks required by the committees properly and satisfactorily. Tam and Fung (1998) revealed that the set-up of site safety committees reduces accident rates. Communication of safety-related information conveyed and discussed during the safety committee meetings facilitates an open, free-flow and transparent exchange of dialogue with management staff about safety issues within the project team.

# 2.6 Literature review of potential difficulties in implementing safety incentive schemes

The implementation of safety incentives may provide positive outcomes. However, some difficulties may be encountered during the implementation of safety incentives. Only a limited number of research studies have investigated difficulties in implementing PFSS, so difficulties in implementing safety incentive schemes in general instead of PFSS have been reviewed in this section. Kheni (2008) reported that a large proportion of his survey respondents experienced some form of difficulties that hindered the effective safety scheme. These problems or difficulties might adversely affect the effectiveness of the safety scheme. A review of the published literature indicates that common difficulties in implementing safety incentive schemes can be grouped under seven major headings (Figure 7).



Figure 2.7 Difficulties in implementing safety incentive schemes

#### 2.6.1 Low literacy level of workers

The survey respondents from Kheni (2008) indicated that the majority of front-line workers on construction sites were illiterate. They needed more training on health and safety issues which addressed the specific needs of such workers. Illiterate workers were often difficult to convince about many health and safety issues partly because of language barriers between them and their immediate supervisors. What was often important to illiterate workers is the salary they earn for working on site, any other issues relating to the conditions of site safety was considered secondary by them. Koehn *et al.* (2000) stressed that a key barrier to safety incentive scheme is the difficulty in training illiterate workers. Also, many small-scale contractors and their employees have not received sufficient formal education and this makes interpretation of contract documents and documents on safety incentive scheme very difficult.

#### 2.6.2 Poor safety attitude of workers

Poor safety attitude of front-line workers has long been recognized as the main reason for poor safety performance (Chan *et al.*, 2005). Kheni (2008) echoed indicated that the attitude of employees, especially front-line workers towards health and safety, was one of the prime concerns of the successful implementation of safety incentive scheme. The individual characteristics of workers were seen to be a significant barrier to the management of safety incentive program. Teo and Phang (2005) reinforced that the attitude of workers is one of the besetting obstacles to the successful application of safety incentive program. Cheyne *et al.* (1998) expressed that the safety attitude of workers remains as the most pivotal factor in explaining safety activity.

#### 2.6.3 High turnover rate of workers

In Hong Kong, the subcontracted labour is highly mobile. This high mobility of subcontracted labour makes the workers less familiar with the site working environment and the associated potential hazards, and difficult to follow the client's stipulated safety management program, which are the key factor contributing to the high accident rate (Poon *et al.*, 2000). Kheni (2008) explained that uncertainty of demand was a key factor that compelled contractors to rely heavily on casual labour and labour only subcontractors. The casual labour may not work continuously at one construction site, and they may find it difficult in adapting to contractors' safety incentive scheme. The higher turnover rates are associated with the higher injury

rates. Higher turnover means more new hires on the job. New hires have been noted as the workers who are most susceptible to being injured (Hinze, 1997). As a result, it is essential to place closer attention to the newly hired workers in order to ensure their work safety (Hinze, 1978 and 1990).

### 2.6.4 Limited budget, human resources and facilities on site safety

Owners or managers were faced with how to allocate the meagre resources they had to fulfil business functions. Limited resources were stated as factors that impacted negatively on safety incentives. Ahassan (2001) pointed to the lack of resources as the major reason for the lack of effective implementation of safety incentives. The adoption of a comprehensive safety incentive system has been shown to be a difficult task (Dawson *et al.*, 1988; Eakin *et al.*, 2000; Mayhew, 2000). Some reasons as to why it is difficult in adopting such systems include the lack of adequate resources on site safety and the fact that they operate in a competitive environment (Banfield *et al.*, 1996; Mayhew, 1997; Vassie *et al.*, 2000). When the size of the organization undertaking construction work is too small, the resources and facilities to enable safe construction are not readily available. Thus, safety incentives will be difficult to be implemented by the small-sized subcontractors.

The safety problem may be exacerbated by the limited financial capability of small subcontractors, which make them unable to implement comprehensive safety incentives (Tam et. al, 2006). Kheni (2008) expressed that the benefits that result from an effective safety incentive scheme cannot come about without investing in health and safety issues. The survey respondents from Kheni (2008) stated the cost of investing in safety incentives as a major problem.

## 2.6.5 Inadequate safety attitude of top managers

Lack of safety awareness of a firm's top management may exert an enormous hindrance in implementing safety incentive scheme. Both Sawacha *et al.* (1999) and Lingard and Rowlinson (1997) have demonstrated the importance of the top management's role in affecting the effectiveness of safety incentive scheme. Hinze and Raboud (1988) found that all successful safety incentive schemes must be supported by top management. Furthermore, many site accidents are the results of management negligence. Several research studies (e.g. O'Toole, 2002; Lingard and Rowlinson, 1997; Sawacha *et al.*, 1999) have warranted that safety performance is directly linked to the top management's perception on safety. Commitment and

support from senior management are essential in bringing the accident rate down. Top management's commitment is thus crucial to the success of any safety programmes.

## 2.6.6 Poor organization of safety incentive program

The structure and composition of the safety incentive program need to be well planned and systematic during implementation; otherwise the scheme may not be implemented effectively. Construction organizations with strong safety programs find that the proper use of safety incentives can achieve additional benefits of improved safety records on a cost-effective manner (Opfer, 1998).

# 2.6.7 Prevailing subcontracting practice

Ahmed *et al.* (2000) advocated that multi-level subcontracting is one of the key reasons in implementing safety incentives. Subcontractors are also seen as vital to good safety performance by contractors. The Hong Kong construction industry is characterized by its many levels of subcontracting, and coupled with a relatively

weak regulatory system of controlling subcontractors, does have a major role to play in improving safety performance.

The situation of multi-layered subcontracting poses difficulties in implementing safety incentive schemes. In most of the cases, the communications between client, main contractor and subcontractors are inefficient that hinder the safety incentive schemes to be implemented effectively. The lower-tier subcontractors may not be fully aware of the client's stipulated safety requirements or any safety measures agreement that lead to adverse project performance, safety performance and ineffective implementation of safety measures (Yik *et al.*, 2008; Wong *et al.*, 2004).

# 2.7 Relationship between Safety Performance and Subcontracting Practice

Most building or civil engineering works are undertaken on a subcontract basis. Typical subcontracting firms specialize in areas such as concreting works, bricklaying, falsework and formwork erection, and foundation construction. In Hong Kong, there is a large presence of subcontractors. They are typically small firms but collectively undertake most of the works (Chiang, 2009). The survey carried out by Tam and Fung (1998) indicated that among the total 1,948 accidents recorded, there were 357 (18%) victims who are directly employed workers and 1,591 (82%) victims who were subcontracted labourers. Rowlinson (1999) found from his study for the Hong Kong Housing Authority that an average of 84% of the workers injured from 1995 to 1998 was subcontractors' workers. These may be attributable to the highly sub-contracted structure of the construction industry and reflects that subcontractors' workers are the main high-risk groups. Therefore, in order to make further improvement in construction safety, more resources should be allocated and wider attention should be paid to enhance safety awareness and safety culture of the subcontractors' workers.

Subcontractors generally form a large part of the workforce for different trades of work in a construction project. Thus, subcontractors play an important role in upholding site safety as revealed by earlier research studies (Debrah and Ofori, 2001; Rowlinson, 1997; Hislop, 1999). Subcontractors and their workers, being the front-line operators on site, are the ones with the highest liability for site safety (Toole, 2002; Langford *et al.*, 2000; Love, 1997). Based on past statistical data and elemental cost analyses in Chiang (2009)'s research, over 80% of the value of

building works is undertaken by small subcontractors. The organization actually undertaking the construction works is rather small compared with the total size of the project. If the size of the organization undertaking the construction works is small, then the site resources and facilities to enable safe construction may not be readily available. This is a major problem that occurs in the Hong Kong construction industry and poses management difficulties in terms of construction site safety. The small-scale subcontractors may not have adequate resources to train and educate their workers hence resulting in poor safety performance (Rowlinson, 2004). Moreover, the vast majority of subcontractors are small and not fully competent in safety management (Wilson and Koehn, 2000; Matthews and Rowlinson, 1999). The safety problem may be exacerbated by the limited financial capability of small subcontractors, which make them unable to implement comprehensive safety programmes (Tam and Fung, 1998). As such, it is hard to uphold their safety awareness. Besides, the subcontracted labour is rewarded according to the number of pieces of work that have been completed. Therefore, these workers often give way to productivity at the expense of safe working practices (Poon et al., 2000).

Site safety responsibilities have to be borne by both the main contractor and the subcontractors in order to reduce the number of site accidents (Rowlinson, 1997). Indeed, it is not unusual for a building contractor in Hong Kong to subcontract all the works, leaving themselves responsible only for the provision of site facilitations for their subcontractors and suppliers (Chiang, 2009).

There exist some potential problems with effective safety control for subcontractors. A prime concern over managing the delivery process is the effectiveness of control over a large number of subcontractors on construction sites due to diversification of site activities. This responsibility becomes significantly more difficult to discharge if there is multi-layered subcontracting. Furthermore, main contractors may shift the safety responsibilities to subcontractors without knowing the subcontractors concerned are capable of providing a safe working environment or not (Wilson and Kohen, 2000). In Hong Kong the subcontracted labour is highly mobile, and this makes the worker less familiar with the site environment and the potential hazards. This is perhaps a constituting factor for the high accident rate (Poon *et al.*, 2000; Teo *et al.*, 2005).

In addition, due to the deficiency of the existing safety regulations, the main contractors are held liable under the majority of the existing construction site safety regulations. The main contractors usually bear the primary responsibility for ensuring a safe and healthy working environment for their workers. In this regard, they should strive to manage the safe behaviours of their workers/employees, who are also obliged under the prevailing occupational safety and health (OSH) laws to take care of their own safety and health, and that of other employees at the workplace. The Labour Department also initiates prosecutions against those workers who have placed themselves or others at risk, through their wilful acts or omissions, if contractors and employers have fully discharged their legal responsibilities. This results in the number of prosecutions made to subcontractors are relatively much less than the one to main contractors. This information has given a wrong message to the subcontractors that site safety is not their own responsibility (Poon et al., 2000).

Another safety-related problem arising from excessive layering of subcontracted work is that as work is passed down through the supply chain, each layer shaves off a profit margin. The individuals on site who end up doing the work have little or no
resources available for safety even if they have the awareness and interest to invest in safety. Therefore, it is important and timely to investigate and develop a practical approach to implementing a safety incentive scheme for subcontractors.

#### 2.8 Motivation of Subcontractors towards Safety

Earlier studies indicate that subcontractors and their workers have a less positive attitude towards safety than their main contractor counterparts (OSHC, 2003; Chan *et al.*, 2005). Thus, PFSS should be made down-streamed to cover "subcontracts". Better motivation of subcontractors is believed to be instrumental in making further construction safety improvement because subcontracting represents over 80% of the project cost for most construction projects in Hong Kong.

The pay for safety scheme (PFSS) has contributed observable safety improvement in public works contracts since its launch in 1996. Under this scheme, contractors are motivated to attain better safety performance by means of cash incentive if they fulfil the safety requirements as set out in the tender documents. However, subcontractors may not always benefit from the current scheme. To make further improvement in safety performance, this study aims at investigating the feasibility of extending PFSS to subcontractor level, i.e. Pay for Safety Scheme for Subcontractors ( $P_FSS_FS$ ).

# 2.9 Chapter Summary

This chapter provides a comprehensive review of the relevant safety research studies and contemporary literature. The current state of construction site safety in Hong Kong, application of safety incentive schemes, development of PFSS and how the subcontracting practice affects site safety have also been fully addressed in this chapter. To improve the prevailing safety performance of the Hong Kong construction industry, the government has introduced numerous effective safety measures to public works contracts in recent years and has devoted tremendous efforts on the implementation of those safety measures. It is encouraging to observe that the safety performance of the Hong Kong construction industry has been improved significantly over the past decade but the site accident rate has still plenty of rooms for improvement (CIRC, 2001; Tam *et al.*, 2002 and 2006). Safety incentives can be regarded as the most widely adopted type of safety measures (Hinze and Gambatese, 2003). The application of different types of safety incentive schemes have been reviewed in this chapter. PFSS is a safety incentive scheme which was launched by the government in 1996. The overall development and the implementation details of PFSS in both the public sector and private sector are reviewed. Subcontractors generally form a large proportion of workforce for different trades of work in a construction project. It is advocated that subcontractors play an important role in improving site safety. Thus, part of this chapter was spent on reviewing the relationship between safety performance and subcontracting practice. The literature review can serve as a sound theoretical foundation for launching this research study.

# **CHAPTER 3 – RESEARCH METHODOLOGY**

## **3.1 Introduction**

This chapter introduces the overall research methodology for the study. It starts with outlining the research process for the study. A comprehensive investigation of relevant research methodology is conducted to find out the most appropriate research methods. Different research tools, i.e. literature review, in-depth interview, and questionnaire survey have been adopted to collect appropriate and sufficient information and data of construction projects using PFSS based in Hong Kong.

# **3.2 The Research Process**

The research has gone through a number of processes in order to achieve the research objectives as stated in Chapter 1. Fellows and Liu (2008) pointed out that the selection of an appropriate research method is dependent on the scope and depth of a research. A number of systematic research methodologies and strategies are utilised and described in this chapter, including: (1) literature review; (2) questionnaire survey; and (3) face-to-face interviews with field experts. Figure 3.1

illustrates the overall research framework of this study. Various statistical tools for data analysis in this research will also be introduced in this chapter.



Figure 3.1 Overall research framework of this research.

#### **3.2.1 Literature Review**

Fellows and Liu (2008) advocated that an essential early stage of conducting a research study is searching and examining the relevant theory and literature. The research study began with a comprehensive literature review from related textbooks, professional journals, conference papers, refereed publications, research monographs, previous dissertations, workshop seminars, magazines, newsletters and internet materials to capture an abundant knowledge base on construction safety management, and past and current implementation practices locally on PFSS will be documented. A comprehensive desktop search was conducted under the "Title/Abstract/Keyword" field of the two powerful search engines "Scopus" and "Google Scholar". The search keywords are "pay for safety scheme", "safety measure", "safety incentives", "safety scheme", "safety initiatives", OR "safety performance" AND "construction" etc. A holistic review of previous research work could help a researcher to gain a wider perspective of a field of interest (Xe et al., 2009). A systematic analysis of previous work would assist the researchers to explore the current status and to continue from what the previous work has left. An extensive literature review would be useful for the researcher to dig out the research gaps of existing knowledge. It also helps develop an overall research framework and to prepare an appropriate template for the structured interview and questionnaire survey.

#### **3.2.2 Questionnaire Survey**

According to Mangione (1995), conducting questionnaire surveys for construction management studies can bring a lot of significant benefits including: (1) surveys are relatively not expensive; (2) allow a large number of respondents to be evaluated within a relatively short period of time; (3) facilitate respondents to have adequate time to answer the questionnaire and look up information and data if necessary; (4) provide privacy for responding; (5) generate visual data input rather than auditory input solely; (6) help respondents to answer the questionnaire at their convenience; (7) allow respondents to read and understand the context of a series of questions; and (8) insulate respondents from the expectations of interviewer. Questionnaire surveys may be generally accepted as the most preferable method in construction management studies because data with standardised form could be collected from samples of a population (Chow, 2005). The questions set on the empirical survey questionnaire aim to collect the perceptions of various contracting parties (i.e. clients and contractors) on implementing PFSS in terms of the benefits, difficulties, limitations, recommendations, together with any desirable supplementary safety-related schemes suggested by the survey respondents and recommendations for further improvement to PFSS.

Self-administered blank survey questionnaires were distributed to the key participants involved in those PFSS construction projects. The respondents include Project Managers, Safety Managers, Architects, Engineers, Quantity Surveyors and other related professionals of main contractors and relevant government works departments which have gained sound experience in applying PFSS in Hong Kong. The main contractor companies are those on the Approved Contractors List for public works projects provided by ETWB and HKHA Counterpart Lists. Questionnaires were sent to different client organizations including both from the public and private sectors. The public client organizations includes the Architectural Services Department (ArchSD), Buildings Department (BD), Civil Engineering and Development Department (CEDD), Drainage Services Department (DSD), Electrical and Mechanical Services Department (EMSD), Highways Department (HyD), Housing Department (HD) and Water Supplies Department (WSD). The contacts of relevant safety managers and project managers were available from the project lists of respective departmental websites. Leading private property developers and their project main contractors were also considered for inclusion in the list of potential survey respondents. The target private property developers were those on the member lists and project lists of the Hong Kong Construction Association (HKCA), which established PFSS in the private sector together with the Real Estate Developers Association of Hong Kong (REDA). Survey questionnaires were also sent to the Safety Departments of listed private property developers. The data collected will also be used to compare the opinions between client organizations and main contractors on each of the above attributes towards PFSS. A blank questionnaire is attached in Appendix 1 for reference. The key survey results will be summarised and discussed in Chapter 4.

#### 3.2.3 Structured Face-to-face Interviews

A series of structured face-to-face interviews were conducted to explore the application of different safety measures for subcontractors and their opinions on PFSS and extending PFSS downstream to subcontractors. Senior professional staffs from the major construction companies having gained abundant hands-on experience in implementing safety measures for their workers in Hong Kong were targeted for interview. In all, ten individuals at the managerial level from eight different largescale main contractors were interviewed. The eight large-scale major contractors have won several safety awards in both the public and private sectors with a track record of outstanding safety performance amongst their counterparts. A previous research study conducted by Chiang et al. (2006) indicated that the interviewees including from Contractor 6, Contractor 4 and Contractor 3 are perceived as the top three main contractors in Hong Kong with a total market share of nearly 40%. As all the interviewees are the key active players in establishing and implementing safety measures for their organizations, it is considered that their opinions and findings could be highly representative and valid for the whole construction industry. Major results of the interviews will be summarised in Chapter 5.

As advocated by Simister (1995), interviews should be conducted with dexterity and care to avoid the collection of useless data. In addition, the interview questions should be designed with thorough thought to avoid any misunderstanding. Appropriate interview techniques should also be adopted so as to achieve the results effectively and efficiently. Strauss and Corbin (1997) suggested that interview dialogues should be tape-recorded, transcribed and analysed using a coding process in which the interview data are categorised using qualitative methods. In this study, the interview dialogues were duly analyzed with the concepts of the content analysis technique in a matrix table format (i.e. each question posed against answers from each interviewee and the answers were classified into different groupings according to the nature of contents) in order to capture any similarities and differences for comparisons (Chan et al., 2007 & 2010b). Content analysis classifies textual materials, reducing it to more relevant, manageable bits of data (Weber, 1990). It is applied to obtain information and understanding of issues relevant to the general aims and specific questions of a research project (Gillham, 2000). Outcomes derived from the analysis of interviews were cross-referenced to the published literature and to complement each other for validation. Several valuable suggestions and opinions on implementing the PFSS were solicited from the interviewees.

# 3.3 Data Analysis

After determining the research methodology used, it is also important to select appropriate tools to be applied in data analysis. Data analysis is of utmost importance to turn raw data into useful information by quantitative methods so meaningful conclusions can be drawn. Data collected from the questionnaire survey were first inputted into the computerised database system and the statistical software, Statistical Package for Social Sciences (SPSS) was employed to carry out the data analysis.

Various statistical tools were employed in data analysis including the Cronbach's alpha reliability test, descriptive statistics, Kendall's concordance test, Spearman's rank correlation test, and Mann-Whitney U Test to test for consistency and compare the perceptions of different groups of survey respondents on PFSS.

### 3.3.1 Cronbach's alpha reliability test

The Cronbach's alpha reliability (the scale of coefficient) measures were used to verify the internal consistency or reliability amongst the responses under the adopted Likert scale of measurement regarding the various attributes of PFSS under study, i.e. benefits, difficulties, limitations and recommendations (Santos, 1999). Shen (2003) pointed out that measurement of reliability is essential to the validity of results of a questionnaire survey. The Cronbach's alpha value was adopted by Akintoye et al. (2000) to test the reliability of Likert scale in their study on key success factors on the development of supply chain management. Lam et al. (2006) used the same tool to confirm the reliability of a five-point Likert scale on contributions of designers to improvement of buildability or constructability. The Cronbach's alpha coefficients range from 0 to 1 in value and may be used to describe the reliability of factors extracted from dichotomous (i.e. questions with two possible answers) and/or multi-point formatted questionnaires or scales (i.e. rating scale: 1 = poor and 5 = excellent) (Santos, 1999). If the items making up the score are all identical and perfectly correlated, then  $\alpha = 1$ . If the items are all independent, then  $\alpha = 0$ . Thus, the higher the score, the more reliable the generated scale will be. The usual rule is that if the alpha value is larger than 0.70, it can be concluded that the adopted measurement scale is reliable (Santos, 1999; Norusis, 2002). Nunnally (1978) also indicated 0.7 to be an acceptable reliability coefficient for pre-validated instruments, while non-validated items should have alpha values of at least 0.6. Thus, the Cronbach's alpha reliability tests were applied to test the reliability of the measurement scales of the different attributes of PFSS under investigation in the questionnaire survey.

## **3.3.2 Descriptive Statistics**

The mean score method employed by Chan and Kumaraswamy (1996) was applied in the current study to establish the relative importance of the various attributes associated with PFSS. In our study, a five-point Likert scale was adopted to calculate the mean score of each item. The mean score determines the relative rankings of different items in descending order of importance, as perceived by the clients and contractors. The descriptive statistics is important to show an overall picture of the perceptions of respondents. The mean score (MS) for each PFSS item identified was computed by the following formula:

$$MS = \frac{\sum (f \times s)}{N}, (1 \le MS \le 5)$$
(1)

where s = Score given to each item by the respondents, ranging from 1 to 5 (1 = Strongly Disagree and 5 = Strongly Agree)

f = Frequency of responses to each rating (1-5), for each item

N = Total number of responses concerning that item

## 3.3.3 Kendall's concordance test

The Likert scale ranking exercise in a questionnaire survey is based on the individual perceptions of the respondents, but not an objective judgment (Chan *et al.*, 2003). A subjective assessment of the ranking result is conducted for the analysis of the perceptions on different items of PFSS in the survey of this study. As the Likert scale of measurement was used in the questionnaire survey and the data are ordinal in nature, non-parametric statistical tests are considered as more appropriate to be applied in this study. Kendall's concordance analysis, which is a non-parametric test, was undertaken to measure the agreement of different respondents on their rankings

of items based on mean values within a particular group. In this paper, the survey respondents were divided into two major groups based on their roles in construction for analysis: client group and contractor group. The value of Kendall's coefficient of concordance (W) can range from 0 to 1. The value 0 implies perfect disagreement whereas 1 implies perfect agreement (Daniel, 1978). Therefore, a high or significant value of W indicates that there is a high level of consensus amongst the respondents within the group. The W for the PFSS items was calculated by the following formula (Siegel and Castellan, 1988):

$$W = \frac{\sum_{i=1}^{n} (\overline{R}_{i} - \overline{R})^{2}}{n(n^{2} - 1)/12}$$
(2)

where n = Number of items being ranked

 $\overline{R}_{i}$  = Average of the ranks assigned to the items  $\overline{R}$  = Average of the ranks assigned across all items

Siegel and Castellan (1988) suggested that W is only appropriate when the number of items is less than or equal to 7. If the number of items is greater than 7, chi-square is used as a near approximation instead. The critical value of chi-square is obtained by referring to the table of critical values of chi-square distribution, which can be found from Siegel and Castellan (1988). When the actual calculated chi-square value equals or exceeds the critical value derived from the table for a certain level of significance and a particular value of degrees of freedom, then the null hypothesis that the respondents' sets of rankings are unrelated (independent) to each other within a survey group can be rejected. Therefore, it can be concluded that there is a significant degree of agreement on the rankings of items amongst the respondents within the group. The actual calculated chi-square value with (N - 1) degrees of freedom is defined as below:

$$\Psi^2 = k(N-1) W \tag{3}$$

where k = number of respondents ranking the items

N = number of items being ranked

### **3.3.4 Spearman's rank correlation test**

To investigate the level of agreement between any two respondent groups on their rankings of the various attributes of PFSS, Lomax (2001) indicated that the Pearson Product-Moment Correlation is most appropriate when both variables are measured at interval level. If both variables are not at least interval level, then the Pearson Correlation is not appropriate.

The data obtained in this research was based on the Likert scale so the data was only ordinal in nature. The "concordance correlation coefficient" was first proposed by Lin (1989) for assessment of concordance in continuous data. The Spearman's rank correlation test is a non-parametric test for measuring the statistical significance and the strength of relationship between the rankings of two groups (El-Sayegh, 2008). The Spearman's rank correlation coefficient is appropriate when both variables are ordinal level. Huck (2008) expressed that Spearman's rank correlation coefficient (rs) is a popular bivariate correlational technique. The same technique was applied by Barber (2005); Lu and Yan (2007) and Olawale and Sun (2010) in construction related research. The Spearman's rank correlation coefficient (rs) was adopted to measure the level of agreement between any two parties on their rankings of the various items in implementing PFSS in construction. The Spearman's rank correlation coefficient,  $(r_s)$  ranges between -1 and +1. A value of +1 indicates a perfect positive linear correlation while negative values indicate perfect negative linear correlation meaning that low ranking on one is associated with high ranking

on the other. When  $r_s = 0$ , there is no linear association at all. If  $r_s$  was statistically significant at a pre-determined significance level of 0.05, then the null hypothesis that no significant correlation between the two groups on the rankings can be rejected. Therefore, there is adequate evidence to conclude that there is no significant disagreement between the two groups on the ranking exercise. The Spearman's rank correlation coefficient (rs) for the items associated with PFSS was computed by the following formula (SPSS, 2002):

$$r_{s} = 1 - \frac{6\sum d^{2}}{N(N^{2} - 1)}$$
(4)

where d = Difference in rank of the two groups for the same item

N = Total number of responses concerning that item

### **3.3.5 Mann-Whitney U test**

The Mann-Whitney U test is a non-parametric test undertaken to distinguish whether statistically significant differences or divergences exist in the median values of the same item under study between any two respondent groups (SPSS, 2007). It is also

popular to adopt t-test for this purpose. However, there are some assumptions of the t-test, such as interval/ ratio data, normally distributed population, random sampling and homogeneity of variance that the researcher must be aware of (Harris, 1995). If stated assumptions are not met, the researcher should employ other ways of testing his/her hypotheses though using non-parametric techniques.

The Mann-Whitney U test may be used when the conditions for using the t-test are not met (Taylor, 2005). The data analyzed by the Mann-Whitney U test must at least be on the ordinal level (Siegel and Castellan, 1988; Abdel-Kader, 2001; Love *et al.*, 2004). In the test, the results are interpreted by the Z-value and p-value. If the actual calculated p-value is less than the pre-determined significance level of 0.05, then the null hypothesis that no significant differences in the median values of the same item between the respondents of client group and contractor group can be rejected. Thus, it can be concluded that the median values of a certain item of PFSS between the two respondent groups are significantly different from each other (SPSS, 2002).

### **3.4** Chapter Summary

The chapter has introduced the research process and the various research approaches which have been applied in this study. To achieve significant research outputs, an appropriate research method has to be adopted. A six-step research methodology is basically used for this study, encompassing: (1) research initiation and finalisation of research areas; (2) preliminary data collection through a comprehensive literature review; (3) determination of research objectives; (4) data and information collection; (5) data analysis and consolidation; (6) interpretation and presentation of research findings.

A combination of desktop literature review, empirical questionnaire survey and faceto-face interviews with field experts, have been adopted to achieve the research aim and objectives. A number of statistical techniques employed in data analysis have also been introduced in this chapter. The research outputs are harvested throughout the study period, including preparation, presentation and publication of different conference papers, journal articles and this MPhil thesis.

# **CHAPTER 4 – QUESTIONNAIRE SURVEY**

## 4.1 Introduction

An empirical questionnaire survey was launched to solicit the opinions of industrial practitioners on the benefits, difficulties, limitations and recommendations on implementing PFSS in the Hong Kong construction industry from March to May of 2009. The questionnaire design and key findings from the survey are reported in this chapter.

# 4.2 Structure of Survey Questionnaire

An empirical survey questionnaire was designed by incorporating personal particulars, perceived benefits, potential difficulties, possible limitations and suggested recommendations associated with implementing PFSS identified from the contemporary literature (Lam, 2008; Wong and So, 2004; Chow, 2005; Fung *et al.*, 2005; Chau and Lee, 2007; Ng, 2007). This was followed by a "pilot" survey with five industrial safety experts who have obtained extensive direct hands-on experience with PFSS construction projects in Hong Kong to verify the adequacy of

items and clarity of the survey form. The pilot survey enabled the development and fine-tuning of the empirical research questionnaire. After the pilot survey, the items were found sufficient, clear and appropriate. A blank survey form is attached in Appendix 1 for reference.

The final questionnaire comprised three essential sections. The first part was about respondents' personal profiles. The second part focused on the level of agreement on each of the identified benefits, difficulties, limitations and recommendations on applying PFSS with a five-point Likert scale from 1 to 5, where '1' represented 'strongly disagree'; '3' = 'neutral / no comment' and '5' represented 'strongly agree' on the statements with reference to a particular PFSS project they had been involved in. Electronic mail communications together with follow-up telephone calls were launched wherever possible towards the target respondents for reminding the return of completed questionnaires and clarifying any unclear items on the survey form. Respondents were also invited to suggest and rate any other unmentioned benefits, difficulties, limitations and recommendations based on their personal discretion and actual experience, but no new items were ultimately received from them. Thus, the enlisted items describing the major benefits, difficulties, limitations and recommendations on PFSS in Hong Kong were perceived to be adequate and clear for further data analysis. The third part was related to other PFSS-related issues, and there are four pre-determined questions which are listed below:

1. What do you think of the maximum 2% of contract sum allocated to carry out all the safety-related items?

Are there any new items that you suggest adding to the list of payable safety items?
 Is it necessary for the private sector construction projects to launch PFSS?
 Will PFSS be widely adopted within the future construction industry of Hong Kong?

## 4.3 **Results of Questionnaire Survey**

## **4.3.1** Profile of Survey Respondents

Industrial practitioners, including those from the client organizations and main contractors, who have had direct hands-on involvement in PFSS construction projects in Hong Kong were the target respondents of the questionnaire survey. The target survey respondents from main contractors were those on the list of Approved Contractors List for public works projects which were available from the website of the former Environment, Transport and Works Bureau (ETWB) and the Hong Kong Housing Authority (HKHA) Counterpart List, which were retrievable from the website of the Housing and Lands Bureau. As most of the contracts on public works projects including electrical and mechanical (E&M) services and design-and-build (D&B) works are required to implement PFSS, these enlisted main contractors may be most likely involved in PFSS projects as well. Self-administered blank questionnaires were sent to different client organizations including both the public and private sectors. The public client organizations includes eight relevant government works departments: Architectural Services Department (ArchSD), Buildings Department (BD), Civil Engineering and Development Department (CEDD), Drainage Services Department (DSD), Electrical and Mechanical Services Department (EMSD), Highways Department (HyD), Housing Department (HD) and Water Supplies Department (WSD). The contact details of relevant safety managers and project managers were available from the project lists of respective departmental websites. The target private property developers were those on the member lists and project lists of the Hong Kong Construction Association (HKCA), which established PFSS in the private sector together with the Real Estate Developers Association of Hong Kong (REDA). Survey questionnaires were also dispatched to the Safety Departments of listed private property developers in order to maximize responses.

Altogether, 329 sets of self-administered blank survey questionnaires were sent to individual target respondents by means of postal mail and electronic mail. All the key project stakeholders participating in PFSS projects from relevant government works departments, prospective private property developers and leading major contractors had been covered in the list of target respondents of the questionnaire survey. They included contracts managers, project managers, site managers, safety managers, safety officers, safety supervisors, safety advisors, engineers, and quantity surveyors. Therefore, their perceptions could substantially represent the PFSS project population in Hong Kong over the past decade of 1996-2009. Finally, there were 146 completed survey questionnaires returned with a response rate of 44.38%. One returned questionnaire was found void due to the lack of hands-on experience in PFSS projects. The non-response rate is about 55%. The possible explanations for those who did not return the questionnaires back are that the respondents did not gain direct hands-on experience with PFSS construction projects or they were busy with their current personal work commitments. Hence, the data analysis of this research was based on 145 valid survey questionnaires.

The survey respondents were divided into two major groups for comparison (i.e. client group and contractor group) who are the two primary parties involved in PFSS. So it is essential and necessary to detect any similarities or differences on their opinions across various attributes of PFSS. Fifty-one percent of the respondents worked for client organizations while 49% worked for main contractors. As there are too few PFSS projects completed in the private sector, the client group respondents who worked for public sector organizations account for a large proportion of whole sample. In the client respondents group, there are only 12 out of 74 respondents worked for private developers. The respective number of respondents between public sector and private sector was not balanced to carry out a direct "representative" comparison.

All respondents were well-experienced professionals in the construction sector who should be able to give reliable data and genuine opinions to the research, as over 80% of them had already gained a wealth of over 10 years of working experience within the construction industry (Table 4.1). Nearly 70% of the respondents had acquired over 15 years of working experience in construction, while only 6% had obtained less than five years of experience within the industry. All respondents possessed hands-on experience in implementing PFSS, despite their different experience levels. Nearly 40% of them had handled over five PFSS projects (Table 3.1). As all respondents had abundant experience in managing PFSS projects, their opinions solicited from the questionnaire survey would be reliable and representative of the survey population, and reflected the true perceptions of practicing PFSS in construction. The survey data were analyzed using the Statistical Package for the Social Sciences (SPSS).

Information about respondents	Number of respondents	Percentage							
A. Type of organization									
1. Client	74	51%							
2. Main Contractor	71	49%							
Total	145	100%							
B. Years of working experience in const	truction								
1. Less than 5 years	9	6.2%							
2. 5-9 years	11	7.6%							
3. 10-14 years	26	17.9%							
4. 15 years or above	99	68.3%							
Total	145	100%							
C. Experience in managing PFSS projects									
0	0	0%							
1-2	49	33.8%							
3-5	39	26.9%							
6-8	13	9.0%							
9-10	5	3.4%							
More than 10	39	26.9%							
Total	145	100%							

Table 4.1 Background information about the survey respondents

# **4.3.2** Approach of Data Analysis

A five-level data analysis approach was adopted in this study as illustrated in Figure

4.1. At the first level, the reliability of the measurement scale adopted is tested with

the Cronbach's alpha reliability test. The purpose of this statistical test is to verify the internal consistency or reliability amongst the responses under the adopted Likert scale of measurement regarding the various attributes of PFSS under study (Santos, 1999). At the second level, the individual factors are ranked in descending order of the mean scores of the benefits, difficulties, limitations and recommendations on PFSS. This shows an overall picture of the perceptions of survey respondents on the different attributes of PFSS. At the third level, the agreement of respondents' perceptions within a particular survey group is checked by the Kendall's concordance analysis. At the fourth level, the association on the rankings of the various attributes of PFSS between any two survey groups is verified using the Spearman's rank correlation test. At the fifth level, the Mann-Whitney U Test is applied to enable two-group comparisons to identify if there is any individual factor on which different perceptions between any two groups of respondents are placed.



Figure 4.1 Five-level Data Analysis Framework

## 4.4 Results on Benefits of Adopting PFSS

Before the rigorous data analysis, the Cronbach's alpha reliability coefficient was found out for testing the internal consistency or reliability amongst the responses under the adopted 5-point Likert scale of measurement on the benefits of PFSS. The usual rule is that if the alpha value is larger than 0.70, it can be concluded that the adopted measurement scale is reliable (Santos, 1999; Norusis, 2002). The Cronbach's alpha coefficient was 0.842 which was much higher than the threshold value of 0.70. It indicates that the 5-point Likert scale used for measuring the PFSS benefits is reliable and internally consistent amongst the responses at the 5% significance level.

The perceived benefits of implementing PFSS in construction were assessed from different perspectives of the client group and contractor group. The means of each benefit for each respondent group were calculated and ranked in descending order of agreement level as shown in Table 4.2.

# 4.4.1 Agreement of Respondents within each Survey Group

The perceived benefits of PFSS were assessed from two different perspectives of the client group and contractor group. As shown in Table 4.2, the Kendall's coefficient of concordance (W) for the rankings of benefits was 0.362, 0.377 and 0.359 for "All respondent group", "Client group" and "Contractor group" respectively. The

computed W's were all statistically significant with a significance level of less than

0.001.

Table 4.2 R	Results o	of the	ranking	and	Kendall's	concordance	test	for	the	perceiv	ed
benefits of I	PFSS										

		All respondent group			Client group			Contractor group		
No.	Benefits of PFSS	Median	Mean	Rank	Median	Mean	Rank	Median	Mean	Rank
6	Increased safety training	4	4.01	1	4	4.16	1	4	3.86	1
4	Enhanced safety awareness	4	3.98	2	4	4.12	2	4	3.83	2
9	Encouragement of developing safety management system	4	3.91	3	4	4.01	4	4	3.80	3
5	Improved safety commitment	4	3.91	3	4	4.04	3	4	3.77	5
7	Encouragement of participating in safety promotional campaigns	4	3.84	5	4	3.88	5	4	3.80	3
8	Improved communication on safety issues at all levels	4	3.74	6	4	3.70	7	4	3.76	6
1	Reduced accident rate	4	3.73	7	4	3.82	6	4	3.65	7
3	Higher quality of work	3	2.95	8	3	3.00	9	3	2.90	8
2	Increased construction productivity	3	2.92	9	3	3.07	8	3	2.76	9
	Number (N)	145		74 0.377 223.273 15.51 8			71 0.359 203.954 15.51 8			
	Kendall's coefficient of concordance (W)	0.362 419.857 15.51 8 <0.001								
	Actual calculated chi-square value									
	Critical value of chi-square from table									
	Degree of freedom (df)									
	Asymptotic level of significance				< 0.001			< 0.001		

 $H_0$  = Respondents' sets of rankings are unrelated (independent) to each other within each group Reject  $H_0$  if the actual chi-square value is larger than the critical value of chi-square from table

Note: Items were rated on a 5-point Likert scale (1 = Strongly Disagree; 3 = Neutral / No Comment and 5 = Strongly Agree).

As the number of attributes considered were above seven, as mentioned previously the chi-square value would be referred to rather than the W value. According to the degree of freedom (9 - 1 = 8) and the allowable level of significance (5%), the critical value of chi-square from table was found to be 15.51 (Siegel and Castellan, 1988). For all the three groups (i.e. all respondent group, client group and contractor group), the actual computed chi-square values were all above the critical value of chi-square of 15.51. They included 419.857, 223.273 and 203.954 for "all respondents", "client group" and "contractor group" respectively (Table 4.2). This result indicates the null hypothesis that "Respondents' sets of rankings are unrelated (independent) to each other within a certain group" has to be rejected. Consequently, there is sufficient evidence to conclude that there is significant degree of agreement among the respondents within each group and all respondents on the rankings of the benefits of PFSS. This concordance test ensures the data and opinions collected from the questionnaire survey to be valid and consistent for further analysis.

#### **4.4.2 Overall Ranking of the Benefits of PFSS**

The mean values for the benefits as rated by all respondents ranged from 2.92 to 4.01. For those scored by respondents working for client organizations, the mean value ranged from 3.07 to 4.16 while those rated by respondents from contractors the mean value spanned from 2.76 to 3.86. The results showed that the respondents from client organizations rated these benefits in general much higher than those respondents from the contractor group. It can thus be interpreted that the respondents from the client group were more agreeable to the benefits (all the mean values above 3) than the contractor group.

The nine perceived benefits of PFSS could be divided into two categories, i.e. direct benefits and indirect benefits. The first three items, namely, Item 1 "Reduced accident rate", Item 2 "Increased construction productivity" and Item 3 "Higher quality of work" are classified as indirect benefits and the rest of them are regarded as direct benefits of adopting PFSS. For those benefits directly related to the payable safety items under PFSS, they could be categorized as direct benefits.

The direct benefits of PFSS were generally ranked higher than those indirect benefits. The overall ranking of the three indirect benefits of PFSS (i.e. Items 1-3) were ranked as the bottom three items. A possible explanation is that the payable safety items under PFSS are the key drivers for achieving direct benefits. Thus, the achievement of direct benefits is more significant than indirect benefits from the viewpoint of the respondents. All respondents believed and ranked Item 6 "Increased safety training" and Item 4 "Enhanced safety awareness" to be the top two benefits. The survey results reinforce the research findings reported by Chan et al. (2005) in that both safety training and awareness were found to be the primary determinants of safety performance in construction. Under PFSS, about one-fourth of the budget set aside for the safety issues is invested on items related to safety training (Ng, 2007). Safety training not only provides for the new employees, but also offers to construction workers who are trade specific and skilled to reinforce their basic knowledge about personal job safety. A relatively large proportion of the budget was allocated to those items related to safety training so as to generate sufficient confidence for both clients and contractors that safety training was being maintained and increased. Lam (2008) stated that under the implementation of PFSS on public works projects of relevant government departments such as the Housing
Department, Water Supplies Department, Highways Department, Drainage Services Department, Civil Engineering and Development Department and Architectural Services Department, enhanced safety training was provided to construction workers to maintain necessary safety and health standards on construction sites. Wong *et al.* (1996) revealed that through attending safety training the workers also aggravate safety awareness on top of the enhancement of safety knowledge. Thus, Item 4 "Enhanced safety awareness" was ranked as the second most important benefit which may possibly be due to the positive outcome of safety training. Chau and Lee (2007) pointed out that launching activities such as safety committee meetings, safety walks and safety promotional campaigns by the supervisory staff and frontline workers not only promotes their safety awareness but also helps improve housekeeping and site tidiness.

The interaction / relationship between the payable safety items under PFSS and perceived benefits of PFSS is further illustrated in Figure 4.2. Item 9 "Encouragement of developing safety management system" is one of the aims of PFSS as suggested by ETWB and HKHA. As it is one of the ultimate goals of implementing PFSS, some of the payable safety items (e.g. arrangement of safety committees, safety promotion and provision of safety officer) are the key elements when developing a proper safety management system. Molenaar *et al.* (2009) expressed that the safety plan is an integral part of a company's safety practice. The company can clearly delineate its safety goals through the preparation of an effective safety plan. There are three payable safety items which are related to safety plan. Payment of the item on the "Complete draft safety plan", "Complete safety plan" and "Updating of Safety Plan", should only be made upon satisfactory execution of the requirements (ETWB, 2000). When the safety plan and safety goals are being prepared, the safety commitment of the project team or the company would be significantly improved.



4.2 Relationship between payable safety items under PFSS and benefits of

PFSS.

However, it is rather surprising that Item 1 "Reduced accident rate" was not ranked as the top three benefits from all respondent group, client group and contractor group. It was ranked as the 6th by client group and the 7th by both all respondent group and contractor group. Li (2006) and Li and Poon (2007) asserted that PFSS is only an indirect method in the reduction of accident rates. The payable safety items under PFSS are designed to ensure that the contractor will implement sufficient safety measures (e.g. development of safety plan, provision of safety officer and arrangement of weekly safety walk) but not directly designed to reduce accident rates.

As the respondents were requested to rate the nine PFSS benefits according to a Likert scale from 1 to 5 ("1" represented "Strongly disagree" and "5" represented "Strongly agree"), a value above "3" would represent general agreement to that benefit. Altogether, seven out of nine benefits scored above the middle value of "3" for both all respondent group and contractor group (Figure 4.3). This result indicated that the respondents have general agreement to these seven benefits towards their

projects. Two of the benefits were rated by the all respondent group below the middle value of "3", i.e. Item 3 "Higher quality of work" (2.95) and Item 2 "Increased construction productivity" (2.92). Within the contractor group, these two benefits also achieved a low mean value of "2.90" and "2.76" respectively. The mean scores of these two benefits were also rated relatively low when compared with the other seven benefits within the client group. The respondents in general did not believe that the implementation of PFSS could improve productivity and work quality.



Figure 4.3 Line graph of the mean scores for the benefits of PFSS across different

## respondent groups

Notes:

Item 6 Increased safety training

Item 4 Enhanced safety awareness

Item 9 Encouragement of developing safety management system

Item 5 Improved safety commitment

Item 7 Encouragement of participating in safety promotional campaigns

Item 8 Improved communication on safety issues at all levels

Item 1 Reduced accident rate

Item 3 Higher quality of work

Item 2 Increased construction productivity

### 4.4.3 Agreement of Respondents between Client Group and Contractor Group

Having established the internal consistency of the rankings within the respondent groups, the next stage of analysis was to test whether there is any significant agreement/ disagreement on the rankings between the survey groups, which is indicated by the Spearman's rank correlation coefficient  $(r_s)$  again using the SPSS software package (SPSS, 2002). The correlation coefficient of the rankings between the client group and contractor group on the benefits of PFSS was 0.912 with a significance level of 0.001 as indicated in Table 4.3. Therefore, the null hypothesis has to be rejected. There is adequate evidence to conclude that there is significant correlation between the client group and contractor group on the rankings of PFSS benefits, particularly both Item 6 "Increased safety training" and Item 4 "Enhanced safety awareness" (both ranked as the first and second by both client group and contractor group, respectively). This result implies that both the respondents of the client group and contractor group shared significant level of agreement on the rankings of perceived benefits.

Table 4.3 Results of the Spearman's rank correlation test between the client group and contractor group on the perceived benefits of PFSS

Comparison of rankings	r <sub>s</sub>	Significance level	Conclusion
Client ranking vs Contractor ranking	0.912	0.001	Reject H <sub>0</sub> at 5% significance level

where  $H_0 = No$  significant correlation on the rankings between two groups

 $H_a$  = Significant correlation on the rankings between two groups

Reject  $H_0$  if the actual significance level (p-value) calculated is less than the allowable value of 5%

Furthermore, the Mann-Whitney U test was undertaken to examine if there were any significant differences in the median values of the responses between the two respondent groups on each of the nine benefits of PFSS under scrutiny. When the actual calculated p-value is below the prescribed significance level of 0.05 for a certain benefit, a large variation in the median values is detected. As indicated in Table 4.4, only two benefits were less than 0.05, whilst the others were not statistically significant. Significant differences in the median values between the client group (about 80) and the contractor group (about 65) were found in both Item 4 "Enhanced safety awareness" and Item 6 "Increased safety training". This result has reinforced that the respondents from the client group were in general more agreeable to the benefits and hence rated them much higher than the contractor group, especially the two benefits associated with safety awareness and training.

PFSS has been adopted in several relevant government departments for more than ten years since 1996, therefore the application of the scheme should be more mature and effective, and hence the higher rating given by the client group than their counterparts.

Table 4.4 Results of the Mann-Whitney U test between the client group and contractor group on the perceived benefits of PFSS

No	Benefits of PFSS	Mean rank		7	
		Client	Contractor	Z-	p-value <sup>a</sup>
		group	group	value	
1	Reduced accident rate	77.11	68.72	-1.334	0.182
2	Increased construction productivity	78.93	66.82	-1.889	0.059
3	Higher quality of work	74.34	71.61	-0.429	0.668
4	Enhanced safety awareness	80.23	65.46	-2.457	0.014*
5	Improved safety commitment	78.72	67.04	-1.888	0.059
6	Increased safety training	80.49	65.19	-2.535	0.011*
7	Encouragement of participating in safety promotional campaigns	74.50	71.44	-0.499	0.618
8	Improved communication on safety issues at all levels	72.02	74.02	-0.325	0.745
9	Encouragement of developing safety management system	77.32	68.49	-1.399	0.162

<sup>a</sup> p-value less than 0.05 which indicates significant statistical differences

## 4.5 Results on Difficulties in Implementing PFSS

Before the discussion of the survey results, the Cronbach's alpha reliability test was

launched to check the internal consistency or reliability amongst the responses under

the adopted scale of measurement regarding the potential difficulties of PFSS. The Cronbach's alpha coefficient for the eight rated difficulties of PFSS was 0.894 which was much higher than the threshold value of 0.70 according to Santos (1999) and Norusis (2002). It was indicated that the 5-point Likert scale used for measuring the PFSS difficulties is reliable and internally consistent amongst the responses at the 5% significance level.

## 4.5.1 Agreement of Respondents within each Survey Group

The potential difficulties encountered with PFSS in construction were evaluated from two different perspectives, namely, the client group and the contractor group. The mean of each potential difficulty for each respondent group were calculated and each difficulty was ranked in descending order of the mean values within a particular group as shown in Table 4.5. The Kendall's coefficient concordance (W) for the rankings of difficulties amongst all respondents was 0.137; amongst the client group was 0.173; and amongst the contractor group was 0.155. The computed W's were all statistically significant with a significance level of less than 0.001.

### Table 4.5 Results of the Ranking and Kendall's concordance test for the potential

		All Client Group		up	Contractor Group		roup			
No.	Difficulties in implementing PFSS	Median	Mean	Rank	Median	Mean	Rank	Median	Mean	Rank
1	Plenty of paperwork required for certifying payment to contractor	3	3.47	1	3	3.16	1	4	3.79	1
2	Complicated contract documents and lengthy assessment process	3	3.36	2	3	3.12	2	4	3.61	3
5	Over-tight project schedule requiring rush jobs	3	3.32	3	3	2.96	3	4	3.69	2
3	Difficult to suit the safety requirements of different employers.	3	3.10	4	3	2.68	4	4	3.54	4
6	Unfamiliarity with PFSS by clients and contractors	3	2.89	5	3	2.64	5	3	3.15	7
4	Difficult to arrange staff and time to attend safety- related activities, e.g. safety training, weekly site walk, etc.	3	2.87	6	2	2.57	6	3	3.18	6
8	Lack of government financial support	3	2.83	7	2	2.20	8	3	3.49	5
7	Low level of safety awareness by senior management	3	2.70	8	2	2.42	7	3	2.99	8
	Number (N)		145			74			71	
	Kendall's coefficient of concordance (W)	0.137		(	).173		(	0.155		
	Actual calculated chi-square value	139.303		139.303 89.681			76.823			
	Critical value of chi-square from table	1	4.07		]	4.07		1	4.07	
	Degree of freedom (df)		7			7			7	
	Asymptotic level of significance	<	0.001		<	0.001		<	0.001	

## difficulties of PFSS

 $H_0$  = Respondents' sets of rankings are unrelated (independent) to each other within each group Reject  $H_0$  if the actual calculated chi-square value is larger than the critical value of chi-square from table

Note: Items were rated on a 5-point Likert scale (1 = Strongly Disagree; 3 = Neutral / No Comment and 5 = Strongly Agree).

Since the number of attributes considered was above seven, and as mentioned before,

the chi-square value would be referred to rather than the W value. According to the

degree of freedom (8 - 1 = 7) and the allowable level of significance (5%), the

critical value of chi-square from table was found to be 14.07 (Siegel and Castellan, 1988). For all the three groups (i.e. all respondent group, client group and contractor group), the actual computed chi-square values were all well above the critical value of chi-square from table of 14.07. They included 139.303, 89.681 and 76.823 for "all respondent group", "client group" and "contractor group" respectively (Table 4.5). This result indicates the null hypothesis that "Respondents' sets of rankings are unrelated (independent) to each other within a certain group" has to be rejected. Therefore, there is adequate evidence to conclude that there is significant degree of agreement amongst the respondents within each survey group and all respondents on the rankings of the potential difficulties of PFSS. The concordance test ensures the data and opinions gleaned from the questionnaire survey to be valid and consistent for further analysis.

## **4.5.2 Overall Ranking of the Difficulties of PFSS**

The mean values for the difficulties as rated by all respondents ranged from 2.70 to 3.47. For those rated by respondents working for client organizations, the mean value ranged from 2.42 to 3.16 while those scored by respondents from contractors

the mean value spanned from 2.99 to 3.79. The results showed that the respondents from the contractor group rated these difficulties in general much higher than those from the client group. It can therefore be interpreted that the respondents from the contractor group were more agreeable to the difficulties (all the mean values above 3 except Item 7) than the client group. In other words, the respondents from the contractor group encountered more difficulties in introducing PFSS to their projects than those from the client group.

All the respondents discerned and ranked Item 1 "Plenty of paperwork required for certifying payment to contractor", Item 2 "Complicated contract documents and lengthy assessment process" and Item 5 "Over-tight project schedule requiring rush jobs" to be the top three difficulties associated with PFSS. Such ranking reflects that most of the respondents always encountered these three difficulties under PFSS. The survey results reinforce the research findings reported by Ng (2007) in that both plenty of paperwork required and complicated contract document and process were found to be the primary obstacles of implementing PFSS in construction. The payments of most of the payable safety items had to be certified through the submission of relevant documents by the contractors for verification. Therefore,

contractors were required to compile a lot of written records for each safety-related item so as to obtain the payment, e.g. minutes of every site safety meeting and attendance records of workers to the safety toolbox talk. The process of relaying the documents from one party to another was time consuming. The processing duration would be even longer if the client does not grant the payment directly and requires further clarifications by the contractor. Chan and Kumarawamy (1996) explained that a project is regarded as successful if it is completed on schedule, within target budget and to the level of quality standard specified by the client. Therefore, overtight project schedule may pose a difficulty to both the client and contractor to launch PFSS.

It is also interesting to note that both the clients and contractors rated "Low level of safety awareness by senior management" very low (ranked as the 8th in all respondent group and contractor group and 7th in client group). It is implied that the senior management of both parties well understand the importance of safety at construction sites. Most of the survey respondents are working for large-scale construction-related organizations. The safety awareness of site personnel engaged by these large-scale organizations should be higher through regular safety training programs in order to maintain their good safety culture and established corporate image towards safety which may not be always the case for small and medium enterprises. Thus, they are the strong advocates of PFSS. Therefore, the results indicated that low level of safety awareness is not perceived as a potential difficulty in implementing PFSS at all.

However, there was a noticeable variance between the rankings of client group and contractor group on Item 8 "Lack of government financial support", ranked as the 8th by client group and 5th by contractor group. It may be attributed that the 2% of contract sum allocated for carrying out the payable safety items is not sufficient from the contractors' point of view in general whereas the clients perceive as adequate. Thus, the respondents from contractor group assigned a higher score to this particular difficulty.

Since the respondents were requested to rate the eight major PFSS difficulties according to a Likert scale from 1 to 5 (where 1 = Strongly Disagree; 3 = Neutral / No Comment and 5 = Strongly Agree), a value of above "3" would represent general agreement to a certain difficulty. Altogether, six out of eight difficulties scored

below the middle value of "3" for the client group (Figure 4.4). In other words, this result indicated that the client group respondents agreed with two difficulties only, i.e. Item 1 "Plenty of paperwork required for certifying payment to contractor" (mean = 3.16) and Item 2 "Complicated contract documents and lengthy assessment process" (mean = 3.12), towards their projects under PFSS. As most of the PFSS difficulties in client group were given a lower score of less than 3, it can be interpreted that the clients did not see the implementation of PFSS too much a trouble. Nevertheless within the contractor group, these two difficulties also achieved a high mean value of "3.79" and "3.61" respectively. And there was only one item (Item 7 "Low level of safety awareness by senior management") was rated below the middle value of "3". The results suggested that the contractors often encounter more difficulties during the implementation of PFSS than the clients.



Figure 4.4 Line graph of the mean scores for the difficulties of PFSS across different

respondent groups

### 4.5.3 Agreement of Respondents between Client Group and Contractor Group

The next stage of the analysis was to test whether there is any similar substantial agreement among the respondents in the two survey groups which is determined by the Spearman's rank correlation coefficient ( $r_s$ ) again using the SPSS software package (SPSS, 2002). The  $r_s$  was 0.810 with a significance level of 0.015 as indicated in Table 4.6. Therefore, the null hypothesis has to be rejected. So there is

adequate evidence to conclude that there is significant correlation between the client group and contractor group in general on the rankings of PFSS difficulties. In particular, the three items, Item 1 "Plenty of paperwork required for certifying payment to contractor", Item 3 "Difficult to suit the safety requirements of different employers" and Item 4 "Difficult to arrange staff and time to attend safety-related activities, e.g. safety training, weekly site walk, etc" were ranked the same (i.e. as the 1st, 4th and 6th respectively by both client group and contractor group as discerned in Table 4.5), manifesting that the respondents from the client group and contractor group held unanimous perceptions particularly on the rankings of these three difficulties. The rankings of other difficulties were also found to be very close to each other. This result implies that both the respondents of the client group and contractor group shared significant level of agreement on the rankings of potential PFSS difficulties.

Table 4.6 Results of the Spearman's rank correlation test between the client group and contractor group of respondents on the difficulties of PFSS

Comparison of rankings	r <sub>s</sub>	Significance level	Conclusion				
Client ranking vs Contractor ranking	0.810	0.015	Reject H <sub>0</sub> at 5% significance level				
where $H_0 = No$ significant correlation	on the	rankings betw	reen two groups				
$H_a = Significant correlation the$	ranking	gs between two	o groups				
Reject $H_0$ if the significance level (p-value) calculated is less than the allowable value of 5%							

In addition, the Mann-Whitney U test was adopted to examine if there were any significant differences in the median values of the responses between the two respondent groups on each of the eight difficulties in launching PFSS under scrutiny. When the actual calculated p-value is below the prescribed significance level of 0.05 for a certain difficulty, a large variation in the median values is detected. As indicated in Table 4.7, the p-values of all eight difficulties were less than 0.05. Significant differences in the mean rank between the client group (ranging between 51 and 63) and the contractor group (ranging between 83 and 95) were found in all eight items. This result has reinforced that the respondents from the contractor group were in general more agreeable to the difficulties and hence rated them much higher than the client group.

Since PFSS has been adopted by several government works departments (e.g. Hong Kong Housing Authority, Architectural Services Department, Highways Department, Civil Engineering and Development Department, Drainage Services Department, etc) where most of the respondents from client group are working for more than a decade since 1996, the application of the scheme should be more mature and effective in terms of familiarity, implementation and assessment, and hence the lower rating of PFSS difficulties given by the client group than their counterparts. On the other hand, the main contractors may encounter more difficulties during PFSS implementation due to excessive paperwork required for certifying safety payment, complicated and lengthy assessment procedures, over-tight project schedule and low safety awareness by top management. The contractors may also have less degree of influence and control on the application of PFSS as the incentive level is only 2% of contract sum and all the payable safety items are determined well in advance within the tender documents. In some projects, the contractors may find it difficult in allocating necessary resources for carrying out all safety items because of insufficient government financial support to safety-related issues in construction.

Table 4.7 Results of the Mann-Whitney U test between client group and contractor

		Mea	n rank	7		
No	Difficulties in implementing PFSS	Client	Contractor	Z- value	p-value <sup>a</sup>	
		group	group	value		
1	Plenty of paperwork required for certifying payment to contractor	60.30	86.24	-3.907	0.000	
2	Complicated contract documents and lengthy assessment process	63.02	83.21	-3.012	0.003	
3	Difficult to suit the safety requirements of different employers, e.g. HKHA, ArchSD, HyD, CEDD, etc.	56.78	89.90	-4.999	0.000	
4	Difficult to arrange staff and time to attend safety-related activities, e.g. safety training, weekly site walk, etc.	60.40	86.13	-3.836	0.000	
5	Over-tight project schedule requiring rush jobs	58.48	88.13	-4.416	0.000	
6	Unfamiliarity with PFSS by clients and contractors	61.71	84.77	-3.501	0.000	
7	Low level of safety awareness by senior management	62.45	83.99	-3.229	0.001	
8	Lack of government financial support	51.22	95.70	-6.574	0.000	

group on the difficulties of PFSS

<sup>a</sup> p-value less than 0.05 which indicates significant statistical differences

## 4.6 Results on Limitations of PFSS

Apart from the benefits and difficulties, those target survey respondents were also invited to indicate the level of agreement against each of the possible limitations under PFSS. The Cronbach's alpha coefficient for the five rated limitations of PFSS was 0.714 which was higher than the threshold value of 0.70 according to Santos (1999) and Norusis (2002). It was indicated that the 5-point Likert scale used for measuring the PFSS limitations is reliable and internally consistent amongst the responses at the 5% significance level.

### 4.6.1 Agreement of Respondents within each Survey Group

The limitations of PFSS were assessed from the client's and contractor's perspectives. The rankings and the results of the Kendall's coefficient of concordance of the two survey groups are tabulated in Table 4.8. The results of computation of the Kendall's coefficient of concordance (W) for the rankings of the limitations of all respondents, client group and contractor group were 0.193, 0.298 and 0.132 respectively. The computed W's were all statistically significant with a significance level of less than 0.001. The null hypothesis had to be rejected, which indicated that the respondents' sets of rankings are related (dependent) to each other within each survey group. All the conclusions were made based on the significance level of less than 0.001.

Table 4.8.	Ranking and Kendall's coefficient of concordance for the limitations of
PFSS	

		All respondent Client group group		Cor g	Contractor group					
No.	Limitations of PFSS	Median	Mean	Rank	Median	Mean	Rank	Median	Mean	Rank
2	Contractors may only concern the payable safety items	4	3.61	1	4	3.59	1	4	3.74	2
5	PFSS is a voluntary system in the private sector, not a statutory requirement	4	3.42	2	3	3.30	2	4	3.56	4
1	Some of the key safety elements have not yet included in the payable safety items	3	3.37	3	3	3.16	3	4	3.59	3
3	It is insufficient to set aside only 2% of contract sum for the payable safety items	3	3.35	4	3	2.95	4	4	3.79	1
4	PFSS is designed to be used only for new construction	3	2.69	5	2	2.36	5	3	3.03	5
	Number (n)	144			74		70			
	Kendall's Coefficient of Concordance (W)	0.193		0.298			0.132			
	Level of Significance	<	0.001		<	0.001		<0.		

 $H_0$  = Respondents' sets of rankings are unrelated (independent) to each other within the group

Reject  $H_0$  if the significance level (p-value) calculated is less than the allowable value of 5%

Note: Items were rated on a 5-point Likert scale (1 =Strongly Disagree; 3 =Neutral / No Comment and 5 =Strongly Agree).

#### 4.6.2 Overall Ranking of the Limitations of PFSS

When taking all responses into consideration, Item 2 "Contractors may only concern

the payable safety items" and Item 5 "PFSS is a voluntary system in the private

sector, not a statutory requirement" were ranked as the top two limitations of PFSS.

Conversely, Item 4 "PFSS is designed to be used only for new construction" was

regarded as the least significant limitation.

An obvious disparity was observed between the rankings of the client group and the contractor group on Item 3 "It is insufficient to set aside only 2% of contract sum for the payable safety items". The contractor group ranked this item as the most significant limitation of PFSS whereas the client group ranked as the 4th. The proportion of contract sum for carrying out all safety-related items on the list was determined mainly by the government (ETWB) and their in-house safety experts theoretically since 1996 (Ng, 2007). The respondents from the client group (i.e. payers) believed that the 2% of contract sum is adequate and suitable. However, the ranking reflected that the contractors (payees) found the 2% of contract sum not enough to undertake all the stipulated safety items under PFSS. Hence, it is not surprising to see such a diversified view on the payment percentage allocated for payable safety items as a limitation of PFSS due to different roles played under the scheme.

#### 4.6.3 Agreement of Respondents between Client Group and Contractor Group

The spearman's rank correlation coefficients,  $(r_s)$  were calculated using SPSS package to test whether there is any similar agreement among the two groups of respondents. The correlation results are shown in Table 4.9. The correlation coefficient of the rankings between the client group and contractor group on the limitations of PFSS was 0.300 with a significance level of 0.624. Therefore, the null hypothesis cannot be rejected. And there was significant disagreement between the client group and contractor group on the rankings of PFSS limitations.

Table 4.9 Results of the Spearman's rank correlation test between the client group and contractor group on the limitations of PFSS

Comparison of rankings	rs	Significance level	Conclusion
Client ranking vs Contractor ranking	0.300	0.624	Cannot reject H <sub>0</sub> at 5% significance level

where  $H_0 = No$  significant correlation on the rankings between two groups

 $H_a$  = Significant correlation on the rankings between two groups

Reject  $H_0$  if the actual significance level (p-value) calculated is less than the allowable value of 5%

The next stage of analysis was to test if there were any significant differences in the median values of the responses between the two respondent groups on each of the five limitations of PFSS under scrutiny, which is again indicated by the Mann-Whitney U test. A large variation in the median values is detected when the actual calculated p-value is below the prescribed significance level of 0.05 for a certain limitation. As shown in Table 4.10, there are three limitations of PFSS whose pvalues were less than 0.05, whilst the others were not statistically significant. Significant differences in the median values between the client group (about 50-60) and the contractor group (about 80-90) were found on Item 1 "Some of the key safety elements have not yet included in the payable safety items", Item 3 "It is insufficient to set aside only 2% of contract sum for the payable safety items" and Item 4 "PFSS is designed to be used only for new construction". This result manifested that the respondents from the contractor group were in general more agreeable to the limitations of PFSS and hence scored them much higher than the client group, especially the three limitations associated with payable safety items, payment percentage and the implementation of PFSS only in new construction projects. PFSS has been launched for more than ten years since 1996, therefore the implementation details and procedures, list of payable safety items, and payment percentage should be reviewed regularly in order to maintain the effectiveness and

efficiency of the scheme.

Table 4.10 Results of the Mann-Whitney U test between the client group and contractor group on the limitations of PFSS

		Mean	n rank		n	
No	Limitations of PFSS	Client	Contractor	Z-value	p- value <sup>a</sup>	
		group	group		value	
	Some of the key safety elements					
1	have not yet included in the	62.51	83.06	-3.175	0.001*	
	payable safety items					
2	Contractors may only concern	60.00	76.22	1 109	0.221	
2	the payable safety items	08.88	70.55	-1.190	0.231	
	It is insufficient to set aside only					
3	2% of contract sum for the	54.41	91.62	-5.660	0.000*	
	payable safety items					
Λ	PFSS is designed to be used	58.88	86.0	1 203	0.000*	
7	only for new construction	50.00	80.7	-4.295	0.000*	
	PFSS is a voluntary system in					
5	the private sector, not a statutory	65.86	79.52	-2.103	0.360	
	requirement					

<sup>a</sup> p-value less than 0.05 which indicates significant statistical differences

## 4.7 Results on Recommendations on PFSS

Some recommendations for improving the current application of PFSS were

suggested. Respondents were asked to rate their degree of agreement towards the

identified recommendations with a five-point Likert scale. The Cronbach's alpha

coefficient for the six rated recommendations on PFSS was 0.798 which was much higher than the threshold value of 0.70, it was indicated that the 5-point Likert scale used for measuring the recommendations is reliable and internally consistent amongst the responses at the 5% significance level.

## 4.7.1 Agreement of Respondents within each Survey Group

The proposed recommendations for improving PFSS were appraised from both perspectives of the client group and the contractor group. The Kendall's coefficient concordance (W) for the rankings of recommendations was 0.090, 0.216 and 0.132 for "All respondents group", "Client group" and "Contractor group" respectively(Table 4.11). Since the computed W's were statistically significant with a significance level of less than 0.001 for all groups, the null hypothesis was rejected. In conclusion, there is significant degree of agreement amongst the respondents within each group and all respondents on the rankings of the proposed recommendations on PFSS.

#### 4.7.2 Overall Ranking of the Recommendations on PFSS

All respondents believed and ranked Item 2 "Increase promotion on PFSS within industry" to be the top recommendation on PFSS (Table 4.11). Currently, PFSS has not yet been widely used and accepted in the whole construction industry of Hong Kong. Since this scheme is now mainly used in public works contracts and has started launching in the private sector since October 2005, many of the private property developers and main contractors lack direct hands-on experience with PFSS. More promotion on the perceived benefits and implementation procedures of PFSS should be carried out through different channels (e.g. conferences, seminars, workshops, meetings, etc) so as to increase public awareness and wider application in Hong Kong.

		resp	All oonde roup	nt	Clie	Client group		Con	Contractor group	
No.	Recommendations on PFSS	Median	Mean	Rank	Median	Mean	Rank	Median	Mean	Rank
2	Increase promotion on PFSS within industry	4	4.00	1	4	3.88	2	4	4.13	2
5	Regularly update the payable safety items	4	3.97	2	4	3.89	1	4	4.04	3
4	Make PFSS mandatory to all construction projects including private sector	4	3.85	3	4	3.82	3	4	3.84	5
6	Provide more financial support from government in facilitating PFSS	4	3.77	4	3	3.35	5	4	4.20	1
3	Increase the number of safety officers looking after safety issues on-site	4	3.55	5	3.5	3.54	4	4	3.56	6
1	Increase the proportion (%) of contract sum on payable safety items	4	3.53	6	3	3.15	6	4	3.93	4
	Number (n)		145			74			71	
	Kendall's Coefficient of Concordance (W)	0	.090		0	.216		(	).132	
	Level of Significance	<	0.001		<	0.001		<	0.001	

Table 4.11 Ranking and Kendall's coefficient of concordance for the recommendations on PFSS

 $H_0$  = Respondents' sets of rankings are unrelated (independent) to each other within each group

Reject H<sub>0</sub> if the significance level (p-value) calculated is below the allowable value of 5%

Note: Items were rated on a 5-point Likert scale (1 =Strongly Disagree; 3 =Neutral / No Comment and 5 =Strongly Agree).

Item 5 "Regularly update the payable safety items" was ranked as the second most important recommendation. Most of the respondents concurred that a regularly updated list of payable safety items would be essential to the success of PFSS. The safety-related items that are statutorily required shall not be included in the list of payable safety items. Therefore, a regular review and update of the list can prevent the duplication of resources in relation to site safety. Moreover, if some items which become very easy for the contractor to grant the payment certification or become usual practice shall also be excluded from the list and are replaced by some new safety items that are essential and practical, especially the participation of various trade subcontractors at different stages of the project.

## 4.7.3 Agreement of Respondents between Client Group and Contractor Group

The correlation coefficient of the rankings of the recommendations on PFSS between client group and contractor group was 0.086 and significance level is 0.872 (Table 4.12). Therefore, the null hypothesis that no significant correlation on the rankings between the client group and the contractor group cannot be rejected at the 5% significance level. It was found that there exists significant disagreement between the client group and contractor group on the rankings of PFSS recommendations.

Table 4.12 Results of the Spearman's rank correlation test between the client group and contractor group for the recommendations on PFSS

Comparison of rankings	r <sub>s</sub>	Significance level	Conclusion
Client ranking vs Contractor ranking	0.086	0.872	Cannot reject H <sub>0</sub> at 5% significance level

where  $H_0 = No$  significant correlation on the rankings between two groups  $H_a = Significant$  correlation on the rankings between two groups

Reject  $H_0$  if the actual significance level (p-value) calculated is less than the allowable value of 5%

The Mann-Whitney U test was again adopted to examine if there were any significant difference in the median values of the responses between the two respondent groups. When the actual calculated p-value is below the prescribed significance level of 0.05 for a certain recommendation, a large variation in the median values is revealed. As shown in Table 4.13, the p-values of three recommendations on PFSS were less than 0.05, whilst the others were not statistically significant. Significant differences in the median values between the client group (about 50-60) and the contractor group (about 80-90) were found in Item 1 "Increase the proportion (%) of contract sum on payable safety items", Item 2 "Increase promotion on PFSS within industry" and Item 6 "Provide more financial support from government in facilitating PFSS". This result has again reinforced that the respondents from the contractor group believed the payment percentage of 2% of

contract sum allocated for payable safety items is inadequate and hence rating both

the Item 1 and Item 6 much higher than the client group.

Table 4.13 Results of the Mann-Whitney U test between the client group and

		Mean	n rank		n
No	Recommendations on PFSS	Client	Contractor	Z-value	p- value <sup>a</sup>
		group	group		value
	Increase the proportion (%) of				
1	contract sum on payable safety	55.02	91.74	-5.593	0.000
	items				
2	Increase promotion on PFSS	65.66	80.65	2 583	0.010
2	within industry	05.00	80.05	-2.385	0.010
	Increase the number of safety				
3	officers looking after safety	70.97	75.11	-0.635	0.526
	issues on-site				
	Make PFSS mandatory to all				
4	construction projects including	71.68	74.37	-0.426	0.670
	private sector				
5	Regularly update the payable	68.88	77 30	1 1 1 1 0	0 147
5	safety items	08.88	77.50	-1.449	0.147
	Provide more financial support				
6	from government in facilitating	53.45	93.38	-6.135	0.000
	PFSS				

contractor group on the recommendations on PFSS

<sup>a</sup> p-value less than 0.05 which indicates significant statistical differences

#### 4.8 Results on other PFSS-related issues

# 4.8.1 Opinions on the maximum 2% of contract sum allocated to carry out all the safety items

This question explores the views of survey respondents towards the payment level 2% of contract sum under PFSS. Very few of the respondents from the client group (7.58%) expressed that the maximum 2% of contract sum is insufficient to carry out all the safety items (Figure 4.5). However, only 17.24% of the respondents from the contractor group claimed that it is sufficient for them to carry out all the stipulated safety items. The respondents from the client group and contractor group hold opposite views on this question. The results were consistent with those on the limitations of PFSS. One possible reason is that the clients might not be willing to sacrifice their profits for setting aside excessive resources on site safety whereas the contractors might wish to secure more budget to cover all the safety items required. Some respondents even suggested that the appropriate payment level could be ranging from 3% to 5% of contract sum.



Figure 4.5 Opinions on the maximum 2% of contract sum allocated to carry out all

the safety items under PFSS

#### 4.8.2 Suggested items to add on the payable safety items list

Some possible items were suggested by the respondents to add on the payable safety items list. For example, zero accident for the whole project at completion, cumulative target accident free hours, participation in externally organized safety training courses, trade specific safety training courses for workers (e.g. silver card, green card, confined spaces, etc), innovative safety measures, provision of temporary working platforms, method statements and risk assessment of their compliances, penalty for any accidents found on site, independent checking of safety equipment, awards to well-performed workers or to high score in safety audit, specific safety training, provision of personal protective equipment for workers such as safety helmet, safety shoes, safety belt, safety goggles, etc, reasonable working time, safety climate survey, accident investigation report, and pay for subcontractors.

#### **4.8.3** Application of PFSS in the private sector construction projects

This question investigates the opinions of survey respondents towards developing PFSS in the private sector construction projects. Respondents hold different views on this question. Over 70% of the respondents agreed that it is necessary for the private sector projects to implement PFSS due to the lessons of success learned from the public sector construction contracts. About one-fifth of the respondents showed no strong view and only 4.1% of them disagreed with implementing PFSS in the private sector projects probably because of the potential difficulties encountered during implementation with the extra financial implications in the private sector.


Figure 4.6 Opinions on the private sector construction projects to launch PFSS

# 4.8.4 Future development of PFSS

This question is concerned with the future development of PFSS. As shown in Figure 4.7, most of the respondents provided positive feedback on the future development of PFSS as more than 60% of them agreed with the statement "PFSS will be widely adopted within the future construction industry of Hong Kong" owing to the previous lessons of success learned from the public sector construction contracts. Only 2.1% disagreed with and about one-third indicated no strong view on this issue.



Figure 4.7 Future development of PFSS in the Hong Kong construction industry

### **4.9 Chapter Summary**

The major results of the questionnaire survey on the benefits, difficulties, limitations and recommendations on implementing PFSS in the Hong Kong construction industry were presented in this chapter. A four-level data analysis framework was applied to this study. The respondents were divided into two main groups (i.e. client group vs contractor group) for comparison of different attributes on the implementation of PFSS. Generally, the industrial practitioners agreed that PFSS is effective for implementation within the Hong Kong construction industry. Both the client group and contractor group ranked "Increased safety training" and "Enhanced safety awareness" as the two most significant benefits of PFSS. They recognized that the implementation of PFSS has brought numerous benefits to a construction project, including increasing safety training, enhancing safety awareness, ensuring budget in safety issues, increasing safety commitment and encouraging participation in safety promotional campaigns.

The industrial practitioners faced some difficulties during the implementation of PFSS in their construction projects. Both the client group and contractor group ranked Item 1 "Plenty of paperwork required for certifying payment to contractor" and Item 2 "Complicated contract documents and lengthy assessment process" as the two most challenging difficulties associated with PFSS. Some potential difficulties such as Item 5 "Over-tight project schedule requiring rush jobs and Item 3 "Difficult to suit the safety requirements of different employers" were also recognized as top on the ranking list by the respondents.

After determining the key difficulties in applying PFSS in construction, some possible limitations of PFSS and suggested improvement measures are recommended to facilitate the smooth implementation of PFSS. Most of the respondents believed Item 2 "Increase promotion on PFSS within industry" and Item 5 "Regularly update the payable safety items" to be the top two recommendations on PFSS. The respondents from the contractor group ranked Item 6 "Provide more financial support from government in facilitating PFSS" as the top recommendation on PFSS. This result has indicated that the respondents from the contractor group believed the payment percentage of 2% of contract sum is inadequate for them to carry out all stipulated safety items.

# **CHAPTER 5 – STRUCTURED INTERVIEWS**

#### **5.1 Introduction**

The results of eight structured interviews are reported in this chapter. In order to explore the application of different safety measures towards subcontractors and the feasibility of extending PFSS downstream to subcontractors, a series of structured in-depth face-to-face interviews were launched with some senior safety practitioners in the Hong Kong construction industry. The government has launched several safety measures since 1996 to improve the safety performance of the Hong Kong construction industry. However, most of these safety measures only involve the client organizations and the main contractors. It would be necessary and essential to investigate the various safety measures for subcontractors introduced by the main contractors. With the purpose of soliciting the opinions of main contractors on extending PFSS for subcontractors by means of the safety payment from the clients under the current PFSS, senior professional staffs from the major leading construction companies having gained abundant hands-on experience in implementing safety measures for their workers in Hong Kong were targeted for this study. In all, ten individuals at the managerial level from eight large-scale main contractors were interviewed between March and May of 2010 to further investigate subcontractors' opinions on extending PFSS downstream to subcontractors. As shown in Table 5.1, all the ten interviewees participating in eight interviews worked for the Group C main contractors on the Development Bureau's List of Approved Contractors for Public Works Projects and seven of the eight contractor organizations are listed companies in Hong Kong. A previous survey carried out by Chiang et al. (2006) indicated that the interviewees including from Contractor 6, Contractor 4 and Contractor 3 are perceived as the top three main contractors in Hong Kong with a total market share of nearly 40% (Table 5.2). Moreover, the eight large-scale major contractors have won several safety awards with a track record of outstanding safety performance amongst their counterparts. As all the interviewees are the key active players in establishing and implementing safety measures for their companies, it is considered that their opinions and findings could be highly representative, sufficient and valid for the whole construction industry.

Organisation	Listed Company	Group (Buildings)
Contractor 1	Subsidiary of a listed company	СР
Contractor 2	Subsidiary of a listed company	С
Contractor 3	$\checkmark$	С
Contractor 4	$\checkmark$	С
Contractor 5	$\checkmark$	С
Contractor 6	$\checkmark$	С
Contractor 7	$\checkmark$	С
Contractor 8	×	С

Table 5.1 Background of interviewed construction companies

Notes:

'C' denotes Group C for contracts of any values exceeding HK\$75 million

'P' denotes probationary status in the category indicated.

Table 5.2 Top three main contractors in Hong Kong (Chiang et. al., 2006)

Rank	Main Contractor	Market Share
Top-ranked	Contractor 6	17%
contractor		
Second-ranked	Contractor 4	14%
contractor		
Third-ranked	Contractor 3	8%
contractor		
	Total Volume of Work	39%

The details of the interviewees are shown in Table 5.3. The opinions obtained from the interviews were first audio-recorded and later transcribed into written dialogues. The interview dialogues were later reverted back to corresponding interviewees for verification via email transmission. A systematic account of information and data gleaned from in-depth interviews were archived for subsequent analysis. The interview dialogues were duly analyzed with the fundamental concepts of content analysis technique in a matrix table format to capture any similarities and differences for comparisons. Content analysis, which classifies textual materials, reduces it to more relevant, manageable bits of data (Weber, 1990), is applied to obtain information and understanding of issues relevant to the general aims and specific questions of a research project (Gillham, 2000). This approach can help identify the most commonly adopted safety incentive schemes for subcontractors.

ID	Stakeholder	Position of Interviewee	Organisation
1	Contractor 1	Chief Officer – Safety and Security	Major construction
1		Section	contractor
2	Contractor 1	Assistant Safety Manager	Major construction
2		Assistant Safety Manager	contractor
3	Contractor 2	Senior Manager	Major construction
5		Senior Wanager	contractor
Λ	Contractor 3	Safety Manager	Major construction
4	Contractor 5	Safety Manager	contractor
5	Contractor A	General Manager – Safety &	Major construction
5	Contractor 4	Environmental Protection Department	contractor
6	Contractor 5	Technical Director	Major construction
0	Contractor 5	Teeninear Director	contractor
7	Contractor 5	Safety Manager	Major construction
	Contractor 5	Safety Wanager	contractor
8	Contractor 6	Senior Manager – Health, Safety &	Major construction
0	Contractor	Environment	contractor
0	Contractor 7 Senior Managar Compliance		Major construction
9	Contractor /	Senior Wanager – Compliance	contractor
10	Contractor 8	Aggistant Draiget Manager	
10	10 Contractor 8 Assistant Project Manager		contractor

Table 5.3 Details of 10 interviewees for 8 structured interviews

Notes:

(1) Interviewees 1 and 2 were both interviewed in one single meeting held on 30 March 2010 and their opinions were consolidated as views of "Contractor 1" in this study.

(2) Interviewees 6 and 7 were both interviewed in one single meeting held on 19 May 2010 and their opinions were consolidated as views of "Contractor 5" in this study.

Questions about the safety incentive schemes adopted in their respective companies,

implementation details of the safety incentive schemes, their opinions on PFSS and

extending PFSS downstream to subcontractors were asked during the interviews, and the interviewees were encouraged to express freely on the issues concerned, without being restrained by the pre-determined questions. The interview questions were raised based on a structured interview flowchart. The interview flowchart is attached in Appendix 2 for reference.

# **5.2 Interview Findings and Discussions**

The accident rate per 1,000 workers of the eight interviewed contractors ranged from 4 to 14 and five contractors' accident rates are below 10 as compared to the industry norm of 54.6 (Table 5.4). The interviewee of Contractor 8 did not provide his answer to this question during the interview. The accident rates of the interviewed contractors were noticeably below the overall accident rate in Hong Kong. In order to reduce the number of accidents, it would be essential to investigate the safety incentive measures which have been established and adopted in some main contractors' organizations with relatively good safety performance.

Organisation	Accidents rate per 1,000 workers
Contractor 1	13-14
Contractor 2	9
Contractor 3	Below 10
Contractor 4	Below 10
Contractor 5	4
Contractor 6	5
Contractor 7	11
Contractor 8	Not Applicable

Table 5.4 Accidents rate per 1,000 workers of the interviewed main contractors

# **5.2.1 Safety incentive schemes**

Table 5.5 summarizes the key findings of the interview survey on the research questions pertaining to the safety incentive schemes which has been implemented in their respective companies, as gleaned from the eight interviews.

	Contractor 1	Contractor 2	Contractor 3	Contractor 4	Contractor 5	Contractor 6	Contractor 7	Contractor 8	Total no. of hits
Outcome-based approach	1	1	1	1		1	1	1	1
Best subcontractor award					$\checkmark$				1
Safety bonus scheme						$\checkmark$			1
Behaviour-based approach							-		
Safety model worker award	$\checkmark$			$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	6
Safety ambassador	$\checkmark$				$\checkmark$				2
Activity-based approach									
Pay for safety personnel and safety related items	~								1
Incentive to subcontractors							$\checkmark$		1
Pay for safety scheme for subcontractors								✓	1
Safety lucky draw								✓	1
Other safety incentive approaches									
Safety quiz competition					~				1
Safety promotion fund		✓	~						2
Safety campaign (e.g. barbecue, fun day)						$\checkmark$	$\checkmark$		2
Site safety stamps award scheme				$\checkmark$					1

Table 5.5 Summary of key safety incentive schemes for subcontractors

Various safety incentive schemes have been implemented by the interviewed construction companies to motivate their workers for achieving better safety performance. Altogether, 12 different safety incentive schemes were identified, which can be divided into 4 major types, namely, outcome-based incentive approach, behaviour-based incentive approach, activity-based incentive approach and other safety incentive approaches. The four grouped safety incentive approaches are discussed as follows.

#### **Outcome-based incentive approach**

Two of the twelve identified safety incentives were classified as outcome-based approach. These include "Best subcontractor award" and "Safety bonus scheme" adopted by Contractor 5 and Contractor 6 respectively. The focus of this approach is largely on project outcomes (Gambatese, 2004). A typical outcome measure is injury-free within the stated length of time (i.e. number of days or number of labourhours). The employer simply needs to establish the safety performance target or objective (e.g. number of labour-hours without an injury) and associated benefits (e.g. cash, written appreciation, coupon, etc), and then monitors when an injury occurs and the length of time between injuries. A clear understanding of the incentive schemes minimizes confusion and discouragement regarding employee participation and increases motivation to attain the stipulated level of performance (Gambatese, 2004).

The two interviewees from Contractor 5 expressed that an incentive scheme, namely, the best subcontractor award has been implemented on each construction site. The assessment criteria for the best subcontractor are based on the number of accidents, number of incidents and number of convictions. The name of the best subcontractor will be posted up on the site safety notice board which is located at the main entrance of the site to attract maximum attention. Cash bonus or coupons and certificate of appreciation will be given to the workers of the awarded subcontractor. Another outcome-based incentive scheme, safety bonus scheme, has been launched at project level by Contractor 6 for around three years. Monetary award will be given to individual construction site if the accident rate is less than the company target each year. The company target will be reviewed annually. In 2009, the safety target of Contractor 6 is 7 accidents per 1,000 workers. In 2010, the safety target has been reviewed and reduced to 5 accidents per 1,000 workers. In order to obtain the incentive award from the main contractor, the subcontractors need to meet a specific safety outcome or level of performance. Thus, the average accident rates of Contractor 5 and Contractor 6 are recorded at a relatively low level with 4 and 5 accidents per 1,000 workers respectively.

#### Behaviour-based incentive approach

As shown in Table 5.6, six out of the eight interviewed organisations have adopted a behaviour-based incentive approach and "Safety model worker award" has been implemented within their companies. A behaviour-based incentive approach to safety management has been advocated by several researchers and has been found to effectively improve safety performance of the construction industry (Lingard and Rowlinson, 1997; Geller, 1998; Langford *et al.*, 2000; Miozza and Wyld, 2002). Teo *et al.* (2005) advocated that incentives such as monetary rewards, bonuses and job promotions offered by contractors are important in motivating workers to perform their trade work in a safe manner. The results indicated that "Safety model worker award" is commonly adopted by main contractors to motivate workers for achieving better safety performance. With this type of incentive approach, workers will receive tangible rewards after exhibiting certain safe behaviours.

To reward their subcontractors' workers through the behaviour-based safety incentive approach, the main contractor must first establish the types of safe behaviours that deserve the award. The selection criteria include the safety performance of the workers themselves, correct use of personal protective equipment (PPE), strict compliance with the statutory safety requirements, reporting of any unsafe actions to safety personnel, etc. One or two "Safety model worker(s)" would be nominated from each site by the site safety personnel of each contracting firm on a monthly basis. The ways of implementing the "Safety model worker award" by the six contractors are largely similar but the forms of awards vary. Different forms of awards are summarized in Table 4.6. Chaturvedi (2006) pointed out that safety awards always constitute an important part of the behaviour-based safety incentive system. They are the "carrot" used to reward good safe behaviours. One commonly used form of award for the "Safety model worker award" is a monetary award which was adopted by Contractor 1, Contractor 5 and Contractor 7. Monetary award of HK500 (HK7.80 = US) and certificate of appreciation will be given to the winning workers by Contractors 1 and 5. For Contractor 7, a monetary award of HK\$1,000 would be bestowed to each model worker. In addition, the safety model workers and their families would be invited to participate in future safety campaigns. It aims to enhance the workers' safety awareness by the influence of their family members and spread the important message of site safety to other workers.

Organisation	Forms of awards
Contractor 1	Monetary award of HK\$500 and Certificate of appreciation
Contractor 4	20 stamps for the "Site safety stamps award scheme"
Contractor 5	Monetary award of HK\$500 and Certificate of appreciation
Contractor 6	Coupons for bakery and Cash award for near-miss reporting
Contractor 7	Monetary award of HK\$1,000 and invitation for participating in
	future safety campaigns
Contractor 8	Company Director's home visit

Table 5.6 Forms of awards for the Safety Model Worker Award

Apart from the monetary awards, different reward systems have been established for the "Safety model worker award". A total of 20 stamps will be awarded to the monthly Safety Model Worker by Contractor 4. The worker may accumulate their stamps to exchange for their desirable gifts (e.g. towels, coupons and mobile phones) under the "Site safety stamps award scheme". For Contractor 6, coupons for bakery would be presented to the safety model workers and cash awards for near-miss reporting is in place as well. These safety award incentives are effective in encouraging workers to work safely. Contractor 6 also expressed that these safetyrelated expenses came from the main contractor's own pocket. However, these expenses would be well paid off because the company's insurance premium may increase a lot should a site accident occur (Tang *et al.*, 2004). Contractor 8 rewarded their safety model workers in form of recognition. If a worker is nominated as the "Safety model worker of the month", his efforts on achieving better safety performance would be recognized by the main contractor as well as his peers. This would certainly set a good example to other workers/staff on how to perform better on site safety. The Director of Contractor 8 may launch a "home visit" to the safety model worker. The spirit of proper safety management/improvement can be extended from the construction site to the worker's family through this home visit.

Another behaviour-based safety incentive scheme, "safety ambassador" was adopted by Contractor 1 and Contractor 5. Contractor 5 explained that the safety ambassador scheme is implemented on a project basis. It aims to enhance the safety awareness of construction workers. Safety ambassadors are selected on the basis of better personal safety performance and awareness (e.g. correct use of PPE and strict compliance with the statutory safety requirements). The term of service of a safety ambassador will normally last for one year. Monetary award and certificate of appreciation will be conferred to the safety ambassadors upon the satisfactory completion of the service. A sticker label will be given to the selected safety ambassador to be placed on their safety helmet for easy identification. A booklet which describes the key responsibilities of a safety ambassador and the engagement process will be distributed to each of them. The major responsibility of a safety ambassador is to monitor site safety and report on any unsafe actions to relevant safety personnel. A certificate of thanks will also be given to the safety ambassador by Contractor 1.

#### Activity-based incentive approach

Activity-based incentives focus on the participation in specified safety activities rather than behaviours under the behaviour-based safety incentives. Four different activity-based safety incentive schemes have been established by Contractor 1, Contractor 7 and Contractor 8. To ensure a smooth implementation of the activitybased incentive schemes, some contractors may add a section to the subcontract for describing the sanctioned safety activities that deserve a reward. A "safety section" is added to the tender documents for the subcontractors to price. The items in the safety section include the provision of safety plan and safety personnel (e.g. safety officers and safety supervisors). Although the amount of financial incentives may not be adequate to pay for all employed safety personnel, it can be taken as a subsidy for the subcontractors. The scheme aims to encourage their subcontractors to provide safety personnel for monitoring site safety on their own.

The payment for the safety personnel is calculated on the basis of the number of days that a safety personnel stays on site for work. The safety officer or supervisor should stay for a certain time on site, prepare the safety plan, attend safety meetings, attend site risk assessment meetings, monitor site safety and provide safety training to workers. The subcontractor could price for safety related items (e.g. attendance to meetings) under the Preliminaries of the Bills of Quantities document.

The scheme has been implemented by Contractor 1 for half a year only. It has been applied to the major trade subcontractors (i.e. formwork erection, reinforcement bar fixing and concreting). The selection of suitable subcontractors depends on three main criteria, namely, the trade of subcontractors, number of workers involved (e.g. over 50 workers) and risk of the job nature.

The in-house safety officers of Contractor 1 are responsible for monitoring and evaluating the job performance of the subcontractors' safety personnel. The quantity

surveyor takes in the safety officer's advice when calculating the monthly payment to subcontractors. The project manager of main contractor is responsible for certifying the payment to subcontractors. The two interviewees from Contractor 1 expressed that it is difficult to determine the incentive level for the scheme. The incentives for the subcontractors and the company profit should be well-balanced. The incentive level should be high enough for encouragement but not too excessive, otherwise contractor's profit level may be jeopardised.

Contractor 7 stated that they would apportion part of the payment received from the client under the traditional Pay for Safety Scheme (PFSS) to their subcontractors. For instance, the main contractor would pay their subcontractors for attending safety induction training.

Contractor 8 further extended the application of PFSS downstream to subcontractors' level. The Pay for Safety Scheme for Subcontractors ( $P_FSS_FS$ ) was initiated by the project team responsible for foundation works. The subcontractors were not notified about the implementation of  $P_FSS_FS$  in the bidding exercise of subcontracts. A schedule of safety items for  $P_FSS_FS$  was attached as an appendix in

subcontracts concerned and formed part of the subcontracts. When subcontractors comply with each of the payable safety items (e.g. attendance to site safety walk, submission of weekly safety inspection report, appointment of safety supervisors and attendance to safety training) and have been certified with satisfactory performance, payment is then made by the main contractor to the subcontractors on a monthly basis. Interviewee from Contractor 8 pointed out that the incentive came from the profit margin of their own company.

Safety lucky draw will be held by Contractor 8 on a monthly basis. The workers attending safety-related activities would be given a ticket for lucky draw. A lucky draw would be launched once a month to keep the momentum of workers attending safety activities. A cash prize would be given to the workers and the interviewee from Contractor 8 discovered that the cash prize is the most popular and a direct reward to front-line workers.

#### Other safety incentive schemes

Some safety programmes which cannot be categorized under the above three common incentive approaches will be classified as "others". This group of incentive approach consists of four safety incentive measures. Two contractors, Contractor 2 and Contractor 3 established "Safety promotion fund" for awarding frontline workers and organizing safety campaigns for individual construction sites. Interviewee from Contractor 2 further explained that the fund together with a "Penalty Scheme for Subcontractors" has been set up since 1992. For example, subcontractors will be penalized at the rate of HK\$100 per worker if they fail to wear a safety helmet on site. Subcontractors will also be penalized if they fail to comply with the necessary specified safety measures (e.g. wearing safety harness when working at height). The fund has increased from HK\$200,000 in 1992 to the current figure of HK\$13 million in 2010 which helps set up a "Safety Promotion Fund". Cash rewards will be distributed to front-line workers and trade supervisors with outstanding safety performance. The fund has also been used to reward workers, provide ex-gratia relief payment, provide safety training, sponsor safety conferences, safety promotion and organise safety campaigns.

Contractor 6 would organize the "Construction Safety Fun Day" three times every year. The elected "Safety Model Worker" and their families would be invited to participate in the Construction Safety Fun Day. Certificate of appreciation and monetary award of HK\$1,000 would be conferred to each elected worker on the fun day. Similarly, large-scale safety campaigns (e.g. barbecue) would be oraganised by Contractor 7. The safety model workers and their families would be invited to participate in the safety campaigns as well. The interviewee from Contractor 7 pointed out that the safety campaigns would be useful in enhancing the workers' safety awareness by means of the influence of their family members and spread the message of the importance of site safety to other workers.

The friendly nature of safety competition may also encourage workers to work towards zero injury rate (Teo *et al.*, 2005). Safety quiz competition has been implemented by Contractor 5. All front-line workers are eligible to participate in the competition on a voluntary basis. Monetary award would be given to the participants who have scored a good mark in the quiz. A cash bonus of HK\$5,000 will be awarded to the participant who has obtained the highest mark. "Site safety stamps award scheme" implemented by Contractor 4 is a combination of outcome-based, behaviour-based and activity-based incentive approaches. For example, if a worker carried out a particular safety action and was spotted by the site supervisor, a certain number of stamps would be awarded to the worker. The worker may accumulate their stamps to exchange for desirable gifts (e.g. towels, coupons and mobile phones). The scheme is not designed for a single project. If the project is completed, the awarded stamps can be transferable to other projects as well.

Contractor 4 has compiled an implementation manual which clearly lists out the criteria for awarding stamps and the corresponding number of stamps for different established safety actions. The implementation manual is distributed to each worker. The listed safety actions included safe behaviours, safety activities and stipulated safety outcomes such as attending induction training, morning assembly, tool box talk, completion of pre-work inspection checklist, reporting unsafe actions to site supervisor and any safety actions observed by safety personnel, engineer, manager and clerk of works. Geller (1996) pointed out that incentives and rewards should be properly specified and should be perceived as achievable. Thus, the scheme is regularly reviewed at the monthly site meetings. The scheme will be further

reviewed once every half a year at company level. The interviewee from Contractor 4 stated that the outcomes of the scheme are favourable. The workers are actively participated in the scheme.

# Forms of Incentive Rewards

The gifts or benefits received by those workers who have fulfilled the stated safety performance objectives may take many forms (Gambatese, 2004). Rewards such as cash, gifts, coupons and certificates are common. These rewards may be given directly to the workers, or the workers might obtain them through accumulating safety stamps during the whole project life. Higher-value prizes require more safety stamps to be obtained. After a study of large construction firms and large construction projects, Hinze (2002) revealed that 26 percent of incentive rewards were financial in nature (i.e. cash), and 38 percent were small gifts such as T-shirts and jackets. Another study by Banik (2002) investigated the types of rewards of 150 general contractors in southeastern part of the United States. It was found that the most common incentive rewards given were gifts, recognition and cash. Table 5.7

summarizes the various forms of incentive rewards derived from the 12 previously

identified safety incentive measures.

	Cash	Recognition	Social gathering	Certificate of appreciation	Coupon for bakery	Gift	Others
Outcome-based approach							
Best subcontractor award	$\checkmark$	$\checkmark$		$\checkmark$			
Safety bonus scheme	$\checkmark$						
Behaviour-based a	Behaviour-based approach						
Safety model worker award	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		$\checkmark$
Safety ambassador		$\checkmark$		$\checkmark$			
Activity-based ap	oproa	ch					
Pay for safety personnel and safety related	$\checkmark$						
items	-						
Incentive to subcontractors	$\checkmark$						
Pay for safety scheme for subcontractors	$\checkmark$						
Safety lucky draw	$\checkmark$						
Other safety incentive	e appr	oach	es				
Safety quiz competition	$\checkmark$						
Safety promotion fund			$\checkmark$				$\checkmark$
Safety campaign (e.g. barbecue, fun day)			$\checkmark$				
Site safety stamps award scheme						$\checkmark$	
Total number of hits	10	3	3	3	1	1	2

The most common form of incentive rewards offered by contractors to front-line workers is cash. Monetary award has been adopted in 10 of the 12 safety incentive schemes. All activity-based incentive measures attempted to motivate their workers via cash. The results were further supported by Crosby and Wood (2003) that cash bonuses were regarded as the most common type of reward used by the employers. The result of Teo *et al.* (2005) showed that among different positive reinforcements such as monetary award, job promotion, and shopping vouchers, the most effective one is to provide monetary award when workers have exhibited consistent safe work behaviours.

Other common forms of incentive rewards include recognition, social gathering and certificates of appreciation. For Contractor 5, the name of the best subcontractor will be posted up on the site safety notice board which is located at the main entrance of the site to attract maximum attention and recognise the safety achievement of the best subcontractor. The interviewee from Contractor 8 advocated that the company director's home visit to the winning worker would be a high recognition of the worker's safety achievement. The outstanding safety performance of the safety ambassador of Contractor 5 will be praised during the "safety ambassador

inauguration ceremony". Huang (2005) suggested that safety recognition of workers with good safety performance can strengthen their safe behaviours in their future tasks. The impact of praising workers in front of their peers should never be underestimated.

Social gathering such as safety fun day and safety campaign adopted by Contractor 6 and Contractor 7 may also be useful in raising the workers' safety awareness through the influence of their family members.

#### **5.2.2 Opinions on PFSS**

Regarding the experience of the interviewees in handling PFSS construction projects, they were all well experienced in implementing PFSS projects in government (public sector) projects (including projects from the Hong Kong Housing Authority and the Development Bureau). Since the implementation of PFSS in private sector projects is not much as popular as in the public sector, not too many private projects have implemented PFSS in town. However, interestingly half of the interviewees indicated that PFSS has been adopted in some of their private sector projects (Table 5.8). Interviewee from Contractor 1 pointed out that over 50% of the construction projects which have joined the voluntary Safety Partnering Scheme of the REDA/HKCA, were undertaken by their company. PFSS was adopted in about 80% of their private sector projects. Two interviewees (from Contractor 4 and Contractor 7) indicated that PFSS in some of their private sector projects was initiated as a contractual requirement by the private clients. PFSS was also implemented in some new university premises in Hong Kong.

Organization	Experience in implementing PFSS in public sector construction projects	Experience in implementing PFSS in private sector construction projects
Contractor 1	$\checkmark$	$\checkmark$
Contractor 2	✓	×
Contractor 3	✓	×
Contractor 4	✓	$\checkmark$
Contractor 5	✓	×
Contractor 6	✓	×
Contractor 7	$\checkmark$	$\checkmark$
Contractor 8	✓	$\checkmark$

Table 5.8 Experience of construction firms in implementation of PFSS

Table 5.9 summarizes the key findings from the interview survey on the research questions pertaining to PFSS and extending PFSS for subcontractors, as gleaned from the eight interviews.

	Contractor 1	Contractor 2	Contractor 3	Contractor 4	Contractor 5	Contractor 6	Contractor 7	Contractor 8	Total no. of hits
Payment level									
It is insufficient to set aside only 2% of contract sum for the payable safety items	✓	✓	✓	✓		✓	✓		6
The payment level is not reviewed regularly				$\checkmark$	$\checkmark$	$\checkmark$			3
The payment level is not sufficient especially on small to medium sized projects		$\checkmark$							1
Payable safety items									
Carrying out payable safety items may improve site safety	✓		~					✓	3
Payable safety items are not reviewed regularly				~	$\checkmark$	~		✓	4
PFSS allocates an excessive budget to silver card training							~		1
Safety items for the identification of high-risk operations would be valuable to be included in PFSS							~		1
Assessment and certification process									
Preparation and submission of supporting documents under PFSS increase contractors' administrative cost and work	~		~		~		~	~	5
Subjective measurement of contractors' safety performance under PFSS			$\checkmark$						1

Table 5.9. Summary of interviewees' opinions on Pay for Safety Scheme (PFSS)

### Payment level

The key findings from the interview survey on the opinions on PFSS are summarized in Table 5.9. Implications on these findings are discussed in this section. Six out of the eight interviewed construction firms expressed that it is insufficient to set aside only 2% of contract sum for the payable safety items. The results showed that the majority of the interviewees considered that the 2% payment percentage is not enough for the contractor to carry out all stipulated safety items. Ng (2007) also found out that in her research, the 2% of contract sum is insufficient for contractors to carry out all safety items under PFSS. One interviewee from Contractor 2 opined that 2% of contract sum under PFSS is not adequate for the contractor to launch all specified safety items especially on small to medium sized projects (i.e. project sum less than HK\$100 million). For example, a safety tool-box talk priced at HK\$25 per worker payable under PFSS to the main contractor may not be sufficient. The contractor may need to pay extra money to carry out those required safety items. Berry (2005) indicated that the general level of safety investment ranges from 4% to 5% of the estimated tender price. The interviewee from Contractor 6 stressed that the safety-related payment under PFSS from the client is not enough for the main

contractor to perform all the necessary safety items. In general, 7-8% of the contract sum is spent on site safety. But the incentive level of 2% under PFSS is not enough to cover the total expenses on the payable safety items actually incurred. Another example is that although the safety tool-box talk is one of the payable safety items under PFSS, the actual amount cannot be fully reimbursed due to insufficient number of attendees. It is also difficult to hire a full-time safety officer on-site with a payroll of HK\$9,000 only under PFSS. In some cases, private property developers may pay more sufficient than the government organizations under PFSS.

Sawacha *et al.* (1999) pointed out that safety programmes need to be reviewed regularly. Some interviewees (Contractor 4, Contractor 5 and Contractor 6) expressed that the payment level of the existing PFSS is not reviewed regularly. The incentive level of 2% has been established since 1996 for more than ten years. The payment level may not be realistic and practical for the current situation. One interviewee from Contractor 6 suggested that the payment level should be reviewed regularly (e.g. once in every one or two years) in order to ensure the effectiveness of PFSS.

#### Payable safety items

Four interviewees mentioned that the payable safety items of the existing PFSS are not reviewed regularly. Similarly, the payable safety items were stipulated at the time of launching PFSS by the government back in 1996. However, it appears that there has been a lack of regular review of the suitability of the different safety items included in this scheme, and the items may not truly reflect the safety needs on construction sites nowadays. Interviewee from Contractor 6 pointed out that the specific payable safety items can be removed if they have become the usual practice of several main contractors now. To ensure the effectiveness of PFSS, it should be reviewed once in every one or two years.

The interviewees from three contractors (Contractor 1, Contractor 3 and Contractor 8) expressed that some payable safety items under PFSS may enhance the contractors' site safety performance. This is because some safety requirements must be fulfilled so that the payment can be certified. In addition, this finding is consistent with that reported by Chan *et al.* (2010a) indicated that the implementation of PFSS

has brought numerous benefits to a construction project and improve the overall site safety performance.

# Assessment and certification process

Under the existing PFSS, there are a bundle of payable safety items such as preparation of safety plan, attendance to site safety walk, safety meeting, safety induction training, tool box talk and safe working cycle have been included in the safety section. For some safety items, the contractor may need to submit documentary evidence for the payment certification. Several interviewees expressed that the preparation and submission of supporting documents may greatly increase their administrative cost/work. The survey results further reinforce the research findings obtained by Chan et al. (2010a) and Ng (2007) which indicated that both plenty of paperwork and complicated contract documentation and certification process were found to be the primary obstacles of implementing PFSS in construction. The payments of most of the payable safety items had to be certified through the submission of relevant documents by the contractors for verification. Therefore, contractors were required to compile a lot of written records for each safety-related item so as to obtain the payment, e.g. minutes of every site safety meeting. The process of relaying the documents from one party to another was time consuming. The processing duration would be even longer if the client does not grant the payment directly and requires further clarifications from the contractor.

### 5.2.3 Opinions on P<sub>F</sub>SS<sub>F</sub>S

As for contractors' opinions on extending PFSS downstream to subcontractor level, there is no negative answer to this question. Six out of the eight interviewed construction firms posed positive attitude towards PFSS. Some interviewees expressed that it would be worth to explore the feasibility of implementing PFSS for subcontractors.  $P_FSS_FS$  would be effective in encouraging the small-sized subcontractors towards better safety as their safety performance is always unsatisfied and not up to standard. However, the interviewee from Contractor 1 responded that large-scale companies may have more resources to implement PFSS for their subcontractors. The implementation of  $P_FSS_FS$  would be difficult in small-and medium-sized enterprises (SMEs). This finding is supported by previous literature (e.g. Rowlinson, 2004 ; Shaw, 1998; Tam and Fung, 1998) that small-scale
subcontractors may not have sufficient necessary resources to launch comprehensive safety programmes. One interviewee from Contractor 2 advocated that the outcome of  $P_FSS_FS$  is still uncertain. The current implementation mechanism of PFSS may not be suitable and totally applicable to subcontractors. Contractor 6 echoed this concern and opined that the implementation of  $P_FSS_FS$  should be considered with caution. It might not be an appropriate time or might be premature to extend the implementation of PFSS downstream to subcontractors for the time being. There are still plenty of rooms for improvement to the existing PFSS. Prior to the implementation of  $P_FSS_FS$ , the current PFSS should be reviewed, reinforced and fine-tuned.

#### Payment level

Most of the interviewees expressed that it is difficult to determine an appropriate incentive percentage for the scheme (Table 5.10). Some interviewees found that the current implementation mechanism of PFSS may not be suitable for implementing at subcontractor level. And the existing incentive level of PFSS may not be applicable to  $P_FSS_FS$  due to different natures and scales of work. The scope of safety items and

the payment level of the P<sub>F</sub>SS<sub>F</sub>S should be considered carefully. In determining a suitable incentive level, four out of the eight interviewees suggested that the incentives for the subcontractors and the company profit of main contractor should be well-balanced. The incentive level should be high enough for encouragement but not be excessive, otherwise contractor's profit level may be sacrificed. Contractor 4 and Contractor 5 recommended that the incentive level of P<sub>F</sub>SS<sub>F</sub>S should be fixed for every subcontractor. This arrangement would make the implementation of such scheme easier.

Contractor 3 further indicated that the Hong Kong Housing Authority has implemented  $P_FSS_FS$  to their nominated subcontractors (NSCs), but the incentive level for those subcontractors is not attractive. The subcontractors might not be incentivized to perform the stipulated safety items in order to get the full payment. The administration cost for carrying out those safety items would be higher than the payment received from the main contractor. The situation may become even worse for lower-tier subcontractors along the supply chain.

# Table 5.10 Summary of interviewees' opinions on extending PFSS for

### subcontractors

	Contractor 1	Contractor 2	Contractor 3	Contractor 4	Contractor 5	Contractor 6	Contractor 7	Contractor 8	Total no. of hits
Payment level									
Difficult to determine an appropriate incentive level for P <sub>F</sub> SS <sub>F</sub> S	~	~	~		~	~		~	6
The incentive for subcontractors and main contractors' profit should be well-balanced	~	~	~				~		4
The existing incentive level of PFSS may not be applicable to P <sub>F</sub> SS <sub>F</sub> S				~	~	~		~	4
The amount of incentive can be proportional to contract sum								~	1
The incentive level of P <sub>F</sub> SS <sub>F</sub> S should be fixed for every subcontractor				~	~				2
Payable safety items									
Existing payable safety items under PFSS may not be applicable to P <sub>F</sub> SS <sub>F</sub> S		$\checkmark$	$\checkmark$	$\checkmark$	~	~	$\checkmark$	~	7
Difficult to determine which safety items should be included in PrSSrS			$\checkmark$			~			2
Payable safety items of $P_FSS_FS$ should be determined based on the subcontractors' resources and their canabilities			~						1
Safety items for different trade subcontractors may vary greatly				~					1
Selection of suitable subcontractors and per	forma	ance	moni	toring	5				
The problem of monitoring would arise from excessive layers of subcontracted works					~				1
The assessment and certification process should be determined carefully to prevent heavy site administrative work				~				~	3
Difficult to determine who is responsible for monitoring and control						~			1
Difficult to determine which types of trade subcontractors should be involved in P <sub>F</sub> SS <sub>F</sub> S			~			~			2
Subcontractors should be involved in $P_FSS_FS$ The implementation of PFSS for specialist subcontractors may be possible and practical		~				~			2

#### Payable safety items

The existing implementation mechanism of PFSS may not be suitable for implementing at subcontractor level. Most of the interviewees expressed that the payable safety items under PFSS may not be applicable to P<sub>F</sub>SS<sub>F</sub>S. The safety items and the implementation mechanism of P<sub>F</sub>SS<sub>F</sub>S should be determined with care. However, two interviewees pointed out that it would be difficult to determine which safety items should be included in the scheme, and how to measure and monitor the safety performance of the subcontractors. Contractor 3 further emphasized that the payable safety items under P<sub>F</sub>SS<sub>F</sub>S should be determined based on the subcontractors' resources and their capabilities. It would be important and practical not to include any items which are beyond the subcontractors' capabilities. Contractor 6 explained that the specific payable safety items under P<sub>F</sub>SS<sub>F</sub>S would be difficult to determine due to various natures of work and scales of subcontractors. It would be hard to determine suitable payable safety items for different trades of subcontractors. Moreover, it is not easy to establish a tailor-made P<sub>F</sub>SS<sub>F</sub>S for each specific trade.

#### Selection of suitable subcontractors and performance monitoring

Three interviewees suggested that the assessment and certification process of  $P_FSS_FS$  should be determined carefully in order to prevent heavy site administrative work. As the small-scale subcontractors may not have adequate human and financial resources (Shaw, 1998; Tam and Fung, 1996), heavy administrative work for certifying payment might lower the attractiveness of the scheme.

Some interviewees pointed out that the work duration of these subcontractors may vary greatly and usually short that hinder the implementation of P<sub>F</sub>SS<sub>F</sub>S. It would be hard to determine which types of trades should be included in P<sub>F</sub>SS<sub>F</sub>S. Contractor 2 advocated that the implementation of PFSS for these specialist subcontractors (e.g. E&M services, fire services, MVAC, plumbing and drainage, etc) may be possible and practical. Contractor 6 shared a similar view and expressed that the specialist subcontractors are generally large in scale and their business operational models are more systematic and structured with strong management team. The implementation of PFSS for other trade subcontractors (i.e. formwork erection, steel bar fixing and concreting) would be difficult and complicated due to small scale with relatively less

labour involved (e.g. one-man band of steel-fixing company with a few workers working on different construction sites intermittently). Moreover, the common practice of multi-layered subcontracting would become difficult for the main contractor to monitor and control a large number of different small-sized trade subcontractors (e.g. 30-40 numbers).

#### Recommended payable safety items for $P_FSS_FS$

Some interviewees indicated that the current operational mechanism of PFSS may not be suitable for implementing at subcontractor level. A number of payable safety items for  $P_FSS_FS$  were suggested by the interviewees. Those payable items recommended by 3 or more interviewees are further discussed in this section (as highlighted in Table 5.11). "Additional safety measures for high-risk operations" was considered to be a suitable safety item to be included in  $P_FSS_FS$  by the four interviewees. Contractor 6 and Contractor 7 expressed that the safety items for the identification of high-risk operations (e.g. major falsework, tower crane and tunneling) and the implementation of corresponding safety measures would be considered for inclusion in the existing PFSS or the  $P_FSS_FS$  in future. Contractor 3 suggested that pre-task training in high-risk operations would be useful for improving site safety. If a specific task involves special operations, the pre-task training may provide more guidance to the workers and draw their attention to the unique site conditions and specific operational procedures. To encourage the subcontractors to carry out additional safety measures, some interviewees suggested that the safety items under P<sub>F</sub>SS<sub>F</sub>S should specify a certain level of safety performance which is on top of the legal requirements (e.g. elevator platform and "double shackle" safety belt).

	Contractor 1	Contractor 2	Contractor 3	Contractor 4	Contractor 5	Contractor 6	Contractor 7	Contractor 8	Total no. of hits
Physical operative items/tasks (e.g. safety harness and safety helmet)		~							1
Additional safety measures (e.g. "double shackle" safety belt and elevator platform)				~	~			~	3
Additional safety measures for high-risk operations			✓	~		✓	✓		4
<b>Provision of welfare facilities (e.g. washing facilities and drinking area)</b>	✓		✓		✓				3
Provision of uniforms			$\checkmark$	✓			$\checkmark$		3
"Hardware" items (e.g. installation of audio and visible alarm system and CCTV)			~		~				2
"Software" items (e.g. safety training for workers and trade supervisors)			~						1
Provision of safety personnel on-site	$\checkmark$								1

Table 5.11 Summary of recommended payable safety items for P<sub>F</sub>SS<sub>F</sub>S

Some interviewees suggested "provision of welfare facilities" and "provision of uniforms" as possible payable safety items for P<sub>F</sub>SS<sub>F</sub>S. The interviewee from Contractor 3 explained that welfare facilities including washing facilities, drinking area and rest area should be provided by the main contractor during hot seasons. Anumba and Bishop (1997) pointed out that it is important to provide adequate welfare facilities and maintain toilets in a clean and hygienic condition and is no doubt that improving the general working environment has a positive impact on construction site safety. However, the problem of rest time for workers is difficult to solve. The Labour Department (2009) recommended the main contractors to arrange their workers for regular rest breaks when the relative humidity and temperature reach a specific level (e.g. when the "Very Hot Weather Warning" with a temperature equal to 33°C or above is issued and the relative humidity of the workplace exceeds 85%). It would be difficult and costly to implement. Similarly, provision of uniforms to their workers may improve the overall image of the construction industry, enhance the sense of belongings and attract youngsters to join the industry. However, it may greatly increase the contractors' expenditure. So the payable safety items under P<sub>F</sub>SS<sub>F</sub>S can focus on the compensation for these two initiatives.

#### **5.3 Chapter Summary**

This chapter has reported on the summary of key findings obtained from the indepth interviews. With the purpose of exploring the various incentive schemes adopted by the main contractors to motivate their subcontractors for better safety performance, and soliciting opinions on extending PFSS downstream to the subcontractor level, a total of eight structured face-to-face interviews were launched with ten senior professional staff from eight large-scale main contractors in the Hong Kong construction industry.

Generally, all of the interviewed contractors have implemented some forms of safety incentive schemes to motivate their subcontractors. Twelve safety incentive schemes or initiatives were identified from the interviews and were divided into 4 major types, namely, outcome-based incentive approach, behaviour-based incentive approach, activity-based incentive approach and other safety incentive approaches. The results indicated that "Safety model worker award" is the most common incentive scheme adopted by the main contractors. Other safety schemes such as safety ambassador, safety promotion fund, safety campaign (i.e. barbecue, fun day) were also implemented by the contractors.

Furthermore, the interviewees were invited to give their opinions on PFSS, extending PFSS downstream to subcontractors and suggest possible payable safety items for  $P_FSS_FS$ . The interviewees pointed out some deficiencies of the current PFSS. For example, the 2% of contract sum is not sufficient for carrying out all the required payable safety items and the preparation and submission of supporting documents increase contractors' administrative cost and work. Most of the interviewees demonstrated positive attitude towards extending PFSS for subcontractors. It would be worth exploring the feasibility of implementing PFSS for subcontractors in future.

Some possible payable safety items for  $P_FSS_FS$  were suggested by the interviewees. The research findings revealed that additional safety measures for high-risk operations include identification of high-risk operations (e.g. major falsework, tower crane and tunnelling work) and implementation of corresponding safety measures, pre-task training in high-risk process would be the most useful safety items for inclusion in  $P_FSS_FS$ . Other suggested safety items such as additional safety measures (e.g. "double shackle" safety belt and elevator platform), provision of welfare facilities and provision of uniforms would be suitable for  $P_FSS_FS$ . All these findings can provide some essential pointers to implement  $P_FSS_FS$  and determine suitable payable safety items for the scheme.

### CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Introduction

There has been a multitude of safety improvement measures developed within the construction industry of Hong Kong. However, it is found from the literature review that only limited comprehensive and systematic research on some common safety measures have been conducted so far. Amongst these, the current research study has provided an in-depth investigation into the application of PFSS in the Hong Kong construction industry and the feasibility of extending PFSS downstream to subcontractors' level. This chapter will first review the stated objectives of the research, followed by the main conclusions of the study. The value of the research, contributions to existing knowledge and the limitations of the study will also be highlighted, and recommendations will be made for future research work.

#### **6.2 Review of Research Objectives**

The research study aims to explore the current application and future development of PFSS within the Hong Kong construction industry. The research has focused on how PFSS can be effectively implemented in the public sector, extending the application of PFSS in the private sector, as well as the feasibility of implementing PFSS for subcontractors. In order to achieve the research aim, some specific objectives have been developed as follows:

- (6) To provide a critical review of current application of PFSS in both the public and private sectors of the Hong Kong construction industry.
- (7) To examine the benefits, difficulties and limitations of implementing PFSS and analyze their importance.
- (8) To explore various safety incentive schemes or measures adopted by main contractors to motivate their subcontractors for achieving better safety performance.
- (9) To investigate the feasibility of implementing PFSS for subcontractors ( $P_FSS_FS$ ).
- (10) To suggest possible recommendations for facilitating the successful implementation of PFSS and future development of  $P_FSS_FS$  in Hong Kong.

# 6.2.1 To provide a critical review of current application of PFSS in both the public and private sectors of the Hong Kong construction industry

A comprehensive literature review of PFSS and other similar schemes was first launched to review the development and application of PFSS in both the public and private sectors worldwide in general. Afterwards, an empirical questionnaire survey was conducted to solicit the opinions of relevant industrial practitioners on the development and application of PFSS in Hong Kong. It was found that PFSS has been widely adopted in most of the public sector projects whereas it is rarely introduced to private sector projects. The survey results also indicated that over 70% of the respondents agreed that it is necessary for the private sector projects to implement PFSS and more than 60% of them agreed that PFSS will be widely adopted within the future construction industry of Hong Kong. Some suitable and feasible payable safety items (e.g. zero accident for the whole project at completion, cumulative target accident free hours, participation in externally organized safety training courses, innovative safety measures, provision of temporary working platforms, etc.) were suggested by the respondents to be included in the current PFSS. A series of structured face-to-face interviews were then undertaken with those industrial practitioners having direct hands-on involvement in PFSS construction projects in Hong Kong. Based on the interview findings, the mainstream opinions on the current implementation of PFSS projects were identified as: (1) It is insufficient to set aside only 2% of contract sum for the payable safety items; (2) Payable safety items are not reviewed regularly; and (3) Preparation and submission of supporting documents increase contractors' administrative cost and work.

# **6.2.2** To examine the benefits, difficulties and limitations of implementing PFSS and analyze their importance

Nine key benefits of and eight major difficulties in implementing PFSS were first identified from a comprehensive literature review. An empirical survey questionnaire was then designed by incorporating individual significant benefits, difficulties, limitations and recommendations associated with implementing PFSS. Industrial practitioners, including those from the client organizations and main contractors, who have gained direct hands-on involvement in PFSS construction projects in Hong Kong, were the target respondents of the questionnaire survey. A five-level data analysis framework, including the Cronbach's alpha reliability test, descriptive statistics, the Kendall's concordance test, the Spearman's rank correlation test and the Mann-Whitney U test, was employed in data analysis for the questionnaire survey. The survey findings manifested the most significant benefits derived from adopting PFSS to be: (1) "Increased safety training"; (2) "Enhanced safety awareness"; (3) "Encouragement of developing safety management system"; and (4) Improved safety commitment. The three most conspicuous difficulties encountered with PFSS were found as: (1) "Plenty of paperwork required for certifying payment to contractor"; (2) "Complicated contract documents and lengthy assessment process"; and (3) "Over-tight project schedule requiring rush jobs".

# 6.2.3 To explore various safety incentive schemes or measures adopted by main contractors to motivate their subcontractors for achieving better safety performance

A series of structured face-to-face interviews were conducted to explore the application of different safety measures including safety incentive schemes for subcontractors. In all, ten individuals at the managerial level from eight large-scale leading main contractors were interviewed. This objective has provided an overview of the current application of safety incentive schemes or measures at subcontractor level.

Generally, all the interviewed contractors have implemented some forms of safety incentive schemes to motivate their subcontractors. Twelve safety incentive schemes were identified which could be divided into 4 major categories, namely: (1) outcome-based incentive approach; (2) behaviour-based incentive approach; (3) activity-based incentive approach; and (4) other safety incentive approaches. The results indicated that "Safety model worker award" is commonly adopted by main

contractors to motivate workers for improving site safety performance. The selection criteria for Safety model worker award for the six contractors are based on the individual safety performance of the workers, correct use of PPE, strict compliance with the statutory safety requirements, reporting of any unsafe actions to safety personnel, etc. which are properly observed by the responsible safety personnel. Other safety incentive schemes such as safety ambassador, safety promotion fund, safety campaign (i.e. barbecue and fun day) were also implemented by the contractors.

The research findings revealed that monetary award is the most common form of safety incentive measure offered to frontline workers. Other common forms of safety rewards include peer recognition, social gathering and certificate of appreciation. It is recommended that the main contractors should adopt some safety incentive schemes identified in this study to drive their frontline workers for achieving better safety performance. These findings can provide some valuable insights into the implementation of various safety incentives and the appropriate forms of safety awards for subcontractors.

# 6.2.4 To investigate the feasibility of implementing PFSS for subcontractors $(P_FSS_FS)$

A series of in-depth face-to-face interviews were also conducted to explore the feasibility of implementing PFSS for subcontractors. Eight structured interviews were launched with senior professional staff from large-scale main contractors in the Hong Kong construction industry. As for contractors' opinions on extending PFSS downstream to subcontractors, there is no negative answer to this question. Six out of the eight interviewed contractors exhibited positive attitude towards P<sub>F</sub>SS<sub>F</sub>S. Some interviewees expressed that it would be worth exploring the feasibility of implementing PFSS for subcontractors. P<sub>F</sub>SS<sub>F</sub>S would be effective in encouraging small-sized subcontractors to improve their current safety performance. However, the availability of contractors' resources and the implementation mechanism of P<sub>F</sub>SS<sub>F</sub>S are the prime concerns to the interviewees.

Based on the interview results, most of the interviewees expressed that the payable safety items of PFSS may not be applicable to  $P_FSS_FS$ . The suitable safety items and the implementation mechanism of  $P_FSS_FS$  should be determined with care. The interviewees were invited to suggest some possible payable safety items to be

included in  $P_FSS_FS$ . The interviewees provided some opinions on this issue and suggested a number of payable safety items for  $P_FSS_FS$ . For example, recruitment of safety personnel, identification of high-risk operations (e.g. major falsework, tower crane and tunnelling work) and implementation of corresponding safety measures, pre-task training in high-risk process and additional safety measures (e.g. "double shackle" safety belt and elevator platform).

# 6.2.5 To suggest possible recommendations for facilitating the successful implementation of PFSS and future development of P<sub>F</sub>SS<sub>F</sub>S in Hong Kong

The last objective of this research is to generate possible recommendations for facilitating the successful implementation of PFSS and future development of  $P_FSS_FS$  in Hong Kong. According to the results of questionnaire survey, the top three recommended measures as perceived by all respondents encompass: (1) Increase promotion on PFSS within the construction industry; (2) Regularly update the list of payable safety items; and (3) Make PFSS mandatory to all construction projects including those in the private sector. The respondents from the contractor group believed that "Item 6 Provide more financial support from government in facilitating PFSS" would be the most significant recommendation for PFSS. The respondents from the contractor group claimed that it is insufficient for them to carry

out all of the stipulated safety items under PFSS. Moreover, some possible new items were advocated by the respondents to be added to the list of existing payable safety items to remedy its current deficiencies. For example, zero accident for the whole project at completion, cumulative target accident free hours, participation in externally organized safety training courses, innovative safety measures, provision of temporary working platforms, method statements and risk assessment of their compliances, accident investigation report, and pay for subcontractors, etc. According to the results of structured interviews, some valuable opinions on and effective recommendations for PFSS were also solicited to facilitate the successful application of PFSS in future.

#### 6.3 Value of the Research

The research has initiated a comprehensive investigation into the current implementation of PFSS in the construction industry of Hong Kong. It has provided an extensive review of previous research studies on safety performance in the Hong Kong construction industry, application of different safety measures in general and PFSS in particular. In order to explore the benefits, difficulties, limitations and recommendations for PFSS, an empirical questionnaire survey was launched to glean information and solicit personal perceptions on PFSS from those industrial practitioners who have acquired direct hands-on experience in PFSS construction projects in Hong Kong. A series of structured face-to-face interviews were subsequently conducted with senior professional staffs from the major leading construction companies to collect their opinions on PFSS and extending PFSS downstream to subcontractors.

With the key benefits and potential difficulties of PFSS identified from this research in mind, decision makers are provided with strong evidence and essential pointers to determine whether to adopt PFSS in future projects or not. A wider application of PFSS across a wide spectrum of the construction industry is anticipated with the aim of completing projects with far less casualties. It is hoped that the current research study has instigated a wider debate on the underlying advantages and significant barriers associated with PFSS in both a local and international context for reference by the construction industry at large. It is recommended that a similar scheme to PFSS currently applied in Hong Kong may be extended to other regions or countries for implementation to achieve excellence in construction site safety worldwide.

#### 6.4 Contributions to Existing Knowledge

This research study has adopted an innovative approach to the investigation of the implementation of PFSS in the construction projects in Hong Kong. The literature review indicated that previous research studies on PFSS are rather limited in depth. The major contribution from this research is that it has attempted to fill up the knowledge gap of the application of PFSS in construction. This study adopted an empirical questionnaire survey to examine the benefits, difficulties, limitations and recommendations on PFSS. Such findings enable industrial practitioners to equip with better knowledge and understanding of PFSS and facilitate a smooth implementation of PFSS in their projects. A series of structured face-to-face interviews have gleaned valuable opinions on PFSS and extending PFSS for subcontractors, which have not been sufficiently evaluated and analyzed and only a limited number of research studies have investigated the feasibility of implementing P<sub>F</sub>SS<sub>F</sub>S. A set of possible payable safety items for P<sub>F</sub>SS<sub>F</sub>S have been recommended by the interviewees, and they would be useful in implementing P<sub>F</sub>SS<sub>F</sub>S in future. It is hoped that this research study has served as a first step towards extending PFSS downstream to subcontractors in the Hong Kong construction industry.

#### 6.5 Limitations of the Study

The research findings derived from this study are particularly useful in enhancing construction site safety, considering that a scarcity of comprehensive and systematic investigations have been conducted on implementing PFSS in Hong Kong. However, the scope of study is only restricted to Hong Kong, but she has an internationalised construction market. It would be more desirable to compare different safety incentive schemes with other countries as well.

The overall credibility of research findings will be increased if more survey samples are obtained from industrial practitioners (including clients and contractors), and more structured interviews are undertaken with senior safety experts. As there are too few PFSS projects completed in the private sector so far, the client group respondents who have worked for public sector organizations account for a large proportion of whole sample. Within the client group, there are only 12 out of 74 respondents working for private property developers. The distribution of respondents between public sector (84%) and private sector (16%) are not balanced to facilitate a holistic, representative comparison, and thus more samples from private sector clients should be gleaned.

#### 6.6 Recommendations for Future Research

PFSS purports to enhance safety awareness by taking the contractor's pricing for safety-related items out from the consideration of competitive bidding. PFSS has been implemented in Hong Kong for over 15 years and has been applied mainly in public sector projects. When more PFSS projects are launched in the private sector, further studies can be carried out to study the effectiveness of PFSS in the private sector. Moreover, a comparative study can be conducted to investigate the implementation of PFSS between public sector projects and private sector projects to seek their similarities and differences for further improvement. When PFSS extends to subcontractor level in near future, further research studies may be carried out to explore its effectiveness. The same research methodology may also be replicated in investigating other safety measures currently adopted within the construction industry (e.g. Safe Working Cycle).

#### 6.7 Chapter Summary

In this chapter, the achievement of the stated research objectives was reviewed. The main conclusions and the value of the research were summarised. Core directions for further studies were suggested based on the major research findings from this study. It is believed that the current research can serve as a concrete foundation for future research on PFSS and provide useful insights into the application of PFSS in the construction industry, which is scarce in the available literature.

# APPENDICES

Appendix 1 - Blank Survey Questionnaire

Appendix 2 - Interview Flowchart

16 March 2009

Dear Sir/Madam,

#### **<u>Re: Invitation for Participation in a Research Survey</u>**

We are a team of members currently undertaking a department funded research project entitled "*Exploring the Application of Pay for Safety Scheme (PFSS) in Hong Kong Construction Industry*". The main objectives of this project are to examine the effectiveness of PFSS in construction and to suggest improvement measures for successful implementation in the Hong Kong construction industry.

Being an active participant in both public and private construction projects under PFSS, you are cordially invited to give your views on this scheme by completing the survey questionnaire as enclosed. I strongly believe that your experience and expertise is definitely valuable to our research. Please rest assured that the information and data you provided will be treated in strict confidence.

It would be very grateful if you could complete the survey questionnaire and return it by your preferred choice: (a) <u>by post to Dr Daniel Chan using the attached</u> <u>stamped self-addressed return envelope; OR (b) via fax to 2764-5131 for</u> <u>the attention of "Dr Daniel Chan"; OR (c) via email</u> to <u>bsdchan@</u>, on or before 3 April 2009 (Friday).

Should you have any further enquiries about our research, please feel free to contact our research colleague, Miss Tracy Choi by phone at XXXX-XXXX or by email at <u>bsnychoi@</u> I look forward to receiving your early response soon. Thank you very much for your kind assistance with our research.

Yours sincerely,

Dr Daniel Chan (Principal Investigator) Associate Professor Department of Building and Real Estate The Hong Kong Polytechnic University Hung Hom, Kowloon, Hong Kong

#### <u>Project Title: Exploring the Application of Pay for Safety Scheme (PFSS) in</u> <u>Hong Kong Construction Industry</u>

The Pay for Safety Scheme (PFSS) is to take the contractor's pricing for site safety out from the realm of competitive tendering. The objectives of this research are to evaluate the effectiveness of PFSS in Hong Kong and to suggest recommendations for successful implementation by exploring its benefits, difficulties and limitations.

#### A. Respondent's information

1.	Name of your company:		
2.	Position in your company:		
3.	Years of working experience in the	construction industry	/:
	Less than 5 years	5-9 years	10-14 years
	$\Box$ 15 years or above		
4.	Type of organization in which you a	are working:	
	Client organization	Main contractor	Consultant
	Subcontractor	Supplier / Manufactu	urer
	Other (please specify):		
5.	Nature of projects undertaken by yo	ur company (you ma	y tick more than one box):
	Government building	Private building	Civil engineering
	□ Repair and maintenance □	Other (please specify	y):
6.	Please indicate your experience in in	mplementing PFSS (	you may tick more than one
	box):		— ~· ·· ·
	Government building	Private building	Civil engineering
	Repair and maintenance	Other (please specify	y):
7.	Please indicate your experience in the	he number of project	(s) introducing PFSS:
		3-5 6-8	9-10
0	More than 10	1 6	
8.	rease indicate your experience in the	ne number of project	(s) introducing PFSS
	$\square 0 \square 1 2 \square$	$\begin{array}{c} \text{uarming scheme (ISA)} \\ 3.5 \qquad \Box 6.9 \end{array}$	$\square 0 10 \square$
	$\square 0 \qquad \square 1^{-2} \qquad \square$ More than 10		<u> </u>

#### **B.** Benefits of adopting PFSS

Please score the level of significance of the following benefits that are obtained from adopting PFSS.

		Strongly disagree	Disagree	Neutral / No comment	Agree	Strongly agree
1.	Reduced accident rate					
2.	Increased construction productivity					
3.	Higher quality of work					
4.	Enhanced safety awareness					
5.	Improved safety commitment					
6.	Increased safety training					
7.	Encouragement of participating in safety promotional campaigns					
8.	Improved communication on safety issues at all levels					
9.	Encouragement of developing safety management system					
10.	Other (please specify):					

## C. Difficulties in implementing PFSS

Please score the level of significance of the following difficulties that you had encountered when implementing PFSS.

	Strongly disagree	Disagree	Neutral / No comment	Agree	Strongly agree
1. Plenty of paperwork required for certifying payment to contractor					
2. Complicated contract documents and lengthy assessment process					
3. Difficult to suit the safety requirements of different employers, e.g. HKHA, ArchSD, HyD, CEDD, etc.					
4. Difficult to arrange staff and time to attend safety-related activities, e.g. safety training, weekly site walk, etc.					
5. Over-tight project schedule requiring rush jobs					
6. Unfamiliarity with PFSS by clients and contractors					
7. Low level of safety awareness by senior management					
8. Lack of government financial support					
9. Other (please specify):					

## **D.** Limitations of PFSS

Please indicate your level of agreement on the following limitations of PFSS.

	Strongly disagree	Disagree	Neutral / No comment	Agree	Strongly agree
1. Some of the key safety					
elements have not yet					
included in the payable					
safety items					
2. Contractors may only	_	_			_
concern the payable safety					
items					
3. It is insufficient to set aside					
only 2% of contract sum for					
the payable safety items					
4. PFSS is designed to be used					
only for new construction					
5. PFSS is a voluntary system					_
in the private sector, not a					
statutory requirement					
6. Other (please specify):					

### **E.** Recommendations on PFSS

Please rate your level of agreement on the following recommendations on PFSS.

	Strongly disagree	Disagree	Neutral / No comment	Agree	Strongly agree
1. Increase the proportion					
(%) of contract sum on					
payable safety items					
2. Increase promotion on					
PFSS within industry					
3. Increase the number of					
safety officers looking					
after safety issues on-site					
4. Make PFSS mandatory to					
all construction projects					
including private sector					
5. Regularly update the					
payable safety items					
6. Provide more financial					
support from government					
in facilitating PFSS					
7. Other (please specify):					

#### F. Other PFSS-related Issues

- 1. What do you think of the maximum 2% of contract sum allocated to carry out all the safety items?
  - insufficient, please specify the appropriate percentage:
  - sufficient
  - too much, please specify the appropriate percentage:
- 2. Any items that you suggest adding to the list of payable safety items?
- 3. Is it necessary for private sector construction projects to launch PFSS?

<b>X</b> 7		
I VAS	I I Insure / No strong view	<b>£</b> 7
103	Onsult / INO sublig viev	v

4. PFSS will be widely adopted within the future construction industry of Hong Kong.

Disagree

Neutral / No strong view

Agree

~ End of the questionnaire ~

~ Thank you for your kind co-operation ~

Appendix 2 - Interview Flowchart



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