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An empirical survey of the benefits of implementing Pay for Safety Scheme (PFSS) in the Hong Kong construction industry

Daniel W.M. Chan[1], Albert P.C. Chan[2] and Tracy N.Y. Choi[3]

[1] Associate Professor, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China
[2] Professor and Associate Head, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China
[3] Research Assistant, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China

ABSTRACT

The Government of the Hong Kong Special Administrative Region (SAR) has implemented different safety initiatives to improve the safety performance of the construction industry over the past decades. The Pay for Safety Scheme (PFSS) which is one of the effective safety measures launched by the government in 1996 has been widely adopted in the public works contracts. It is obvious that both the accident rate and fatality rate of public sector projects have been decreased noticeably over this period. This paper aims to review the current state of application of PFSS in Hong Kong, and attempts to identify and analyze the perceived benefits of PFSS in construction via an industry-wide empirical questionnaire survey. A total of 145 project participants who have gained abundant hands-on experience with the PFSS construction projects were requested to complete a survey questionnaire to indicate the relative importance of those benefits identified in relation to PFSS. The perceived benefits were measured and ranked from the perspectives of the client and contractor for cross-comparison. The survey findings suggested 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. A wider application of PFSS should be advocated so as to achieve better safety performance within the construction industry. It is recommended that a similar scheme to PFSS currently adopted in Hong Kong may be developed for implementation in other regions or countries for international comparisons.

Keywords: Pay for Safety Scheme (PFSS), Safety Performance, Benefits, Hong Kong, Construction Industry

1. Introduction

The construction industry is one of the most hazardous industries due to its unique high-risk nature (Jannadi and Bu-Khamsin, 2002). It is evident that the construction industry has recorded the highest rate of accident among various industries in most parts of the world (Koehn et al., 1995; Sawacha et al., 1999; Ahmed et al., 2000; Wong and So, 2004; Choudhry and Fong, 2008). Site accidents are mainly raised from 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, as reported by Poon

(1998). The unsatisfactory safety record of Hong Kong is still a matter of grave concern to both the government and the general public (Tam and Fung, 1998).

In order to improve the prevailing safety performance of the Hong Kong construction industry, the Hong Kong SAR Government has introduced various safety initiatives to the public works contracts over the past decades and has dedicated tremendous efforts on their implementation. The Pay for Safety Scheme (PFSS) is one of the effective safety incentives launched in the public sector by the government in 1996. The objectives of this paper are to review the current state of application of PFSS in Hong Kong in general, and report on the key findings of an empirical questionnaire survey on the potential benefits associated with adopting PFSS in particular. The perceived benefits of PFSS by the clients and contractors were identified, measured and compared. The paper starts with a concise review of the overall safety performance of the construction industry and the current application of PFSS in Hong Kong. Then, the methodology of the research is outlined followed by the presentation and discussion of survey results. Lastly, conclusions are drawn based on the research findings. The research outcomes of this study could provide some useful insights to encourage a wider application of PFSS within the construction industry.

2. Overview of safety performance and application of safety incentive schemes in the construction industry

2.1. Application of safety incentive schemes

It has long been recognized that incentive schemes can improve company performance and motivate the workforce (Leichtling, 1997). Safety incentive scheme is one of the high-impact zero-accident techniques (Hinze and Wilson, 2000). 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 behaviors and safety-related records. Many organizations in the United Kingdom organize safety incentive schemes internally 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).

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 study by Simonet and Wilde (1997) opined that safety incentives bring about desirable safety performance. Gambatese (2004) divided safety incentive programs into 3 types, namely, outcome-based, behavior-based and activity-based. Under the activity-based approach, employees are rewarded when they participate in the prescribed safety-related 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 classified as an activity-based approach.

2.2. Safety performance of the construction industry

The safety performance of the Hong Kong construction industry has demonstrated a remarkable improvement over the past decade (Lam, 2008). The accident rate of the construction industry in Hong Kong has been declining in recent years from 1998 to 2007 (Labour Department, 2008a). It is encouraging to observe that the number of industrial accidents in the construction industry of Hong Kong decreased from 3,400 in 2006 to 3,042 in 2007, down by 10.5%, while the accident rate per 1,000 workers decreased from 64.3 to 60.6, down by 5.8% as compared with the 2006 statistical figures. When compared with 1998, the construction accidents in 2007 fell heftily by 84.5% and the accident rate per 1,000 workers also dropped by 75.6% (Figure 1). Despite these significant improvements in construction safety performance, the high-risk construction industry still recorded the highest number of fatalities and accident rate amongst various industry sectors.

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In 2007, the number of industrial fatalities in the construction industry was 19, higher than 16 in 2006 by 18.8%, but lower than 56 in 1998 by 66.1% and the average of the past five years (20.4) by 6.9%. The industrial fatality rate of the construction industry in 2007 was 0.379, higher than 0.303 in 2006 by 25.1% and the average of the past five years (0.352) by 7.5%, but lower than 0.709 in 1998 by 46.6% (Figure 2).

Please insert figure 2

The Hong Kong SAR Government has introduced a plethora of different safety initiatives in both the public and private sectors over the past decades for improving the safety record of the Hong Kong construction industry. In 1996, the Works Bureau developed a couple of major safety schemes, i.e. the Pay for Safety Scheme and the Independent Safety Audit Scheme, to facilitate the implementation of efficient safety management systems and to uplift the standard of safety performance (Hong Kong Government, 1996).

2.3. Development of PFSS in the public sector

PFSS is one of the public sector initiatives launched by the Works Bureau towards the government capital projects in 1996. It primarily aims to encourage the safety awareness by taking the contractor's pricing for site safety items out from the realm of competitive bidding (ETWB, 2000; REDA/HKCA, 2005a). Lau (2005) added that PFSS was designed to encourage establishment of the Safety Management System in government construction contracts. As the contractors may try to bid contracts at the lowest price, 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 was launched to remove concerns on safety consideration from the realm of competitive bidding (Fung, 2007), enable any sums payable for carrying out safety measures to be identified in the construction contract.

A similar PFSS was later launched by the Hong Kong Housing Authority (HKHA) in 2000 to set aside a contract sum within the contract provision to encourage contractors to achieve good safety performance. The HKHA also required all the public housing projects to be undertaken under PFSS. There have been more than 800 public works projects which had implemented PFSS between 1996 and 2003 (Ng 2007). Hands-on experience derived from the public sector in implementing PFSS has proved effective in improving the overall safety performance of contractors working for government works contracts and HKHA's construction and maintenance projects. It is indicated that there has been significant improvement in both the number of fatal accidents and the number of non-fatal accidents since the introduction of PFSS.

In general, 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 HKD20 million (USD2.58 million) or more, or term contracts having a total estimated expenditure of HKD50 million (USD6.45 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. Irrespective of the value of the contract, contracts with duration of 6 months or less can be exempted from inclusion under the scheme (REDA/HKCA, 2005b).

Under PFSS, the "Site Safety" section under the bill of quantities covered all the payable safety items. There are about 2% of 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 contractor fulfils the stipulated safety requirements and has been certified with satisfactory performance, payment is then made to the contractor on a monthly basis (ETWB, 2000). Therefore, by encouraging the contractor to carry out these necessary safety measures and items from tender stage until project completion, PFSS is expected to improve the overall safety performance of the project eventually.

Typical site safety items specified in PFSS include the followings (ETWB, 2000):

- Complete draft safety plan
- Complete safety plan
- Updating of safety plan
- Provision of safety officer
- Attendance to site safety management committee
- Attendance to site safety committee
- Arrangement of and attendance to weekly safety walk
- Provision of safety training in the form of trade specific advanced safety training to skilled workers
- Provision of safety training in the form of site specific induction training
- Provision of safety training in the form of toolbox talk
- Participation in safety promotional campaign as instructed by the Architect/Engineer

2.4. Development of PFSS in the private sector

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 key initiatives of a Safety Partnering Programme launched in June 2005 for the private building projects, building upon the success of a similar one implemented by the public sector. The HKCA has started promoting the application of PFSS in the private sector on a voluntary basis since October 2005. A total of 54 construction sites have participated in the Safety Partnering Programme since October 2005 with 21 active sites up to the end of February 2009 (REDA/HKCA, 2009). The operation of PFSS in the private sector is more or less the same as the public 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 3).

Encouraged by the success story of this major initiative, the HKCA took the initiative further down the supply chain by signing a "Safety Partnering Programme" agreement with the Hong Kong Subcontracting Association (HKSA) to encourage its members to support the safety charter, deploy resources for safety devices and equipment, and develop and implement various safety management systems. Since its introduction in March 2007, over 50 members of HKCA have joined this programme. As there are too few projects which have implemented PFSS in town, the accident rates remain very high in the private sector. There exists a strong, urgent need for the private sector to devote more efforts on site safety management.

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2.5. 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. Most of the contractors would try their best endeavors to carry out the stipulated safety measures so as to get the full 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, namely, increased safety training, reduced accident rate, better safety culture, stronger safety awareness and

safety commitment, enhanced safety attitude of workers and improved safety-related communication between different contracting parties.

2.5.1. 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.

2.5.2 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 4). 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 5), 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.

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2.5.3 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.

2.5.4 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).

2.5.5 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 (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.

3. Research methodology

An industry-wide empirical questionnaire survey was undertaken from March to May of 2009 in Hong Kong to solicit the perceptions of the benefits towards implementing PFSS by major project stakeholders. A total of 9 perceived benefits of PFSS identified from the contemporary literature constituted the basis of the survey questionnaire. The 9 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.

Respondents were requested to rate their different levels of agreement against each of the identified benefits according to 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 based on their personal discretion and actual experience but no new benefits were received from them.

3.1 Collection of research data

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 selected from the lists of approved contractors for public works which are available on the website of the Development 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. Questionnaires were sent to different client organizations including both the public and private sectors as well. The public client organizations includes seven 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), Housing Department (HD) and Water Supplies Department (WSD). The target private property developers were selected from the member 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).

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 in participating in PFSS projects from relevant government 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 their questionnaires 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.

Fifty-one percent of the respondents worked for client organizations while forty-nine percent worked for main contractors. 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 ten years of working experience within the construction industry (Table 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 5 PFSS projects (Table 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 perceived benefits of practicing PFSS in construction. The survey data were analyzed using the Statistical Package for the Social Sciences (SPSS).

Please insert Table 1

3.2 Mean score ranking technique

The 'mean score' method adopted by Chan and Kumaraswamy (1996) was applied in the current study to establish the relative importance of PFSS benefits. In our study, the five-point Likert scale was applied to calculate the mean score of each benefit. The mean score determines the relative rankings of different benefits in descending order of importance. The mean score (MS) for each PFSS benefit identified was computed by the following formula:

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

where s = Score given to each benefit 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 benefit
N = Total number of responses concerning that benefit

3.3 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 perceived benefits of PFSS (Santos, 1999). 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). Thus, the Cronbach's alpha tests were employed to test the reliability of the measurement scales of the perceived benefits of implementing PFSS in the questionnaire survey.

3.4 Kendall's concordance analysis

Based on the role of survey respondents in the construction projects, they were divided into two major groups for analysis: the client group and contractor group. Kendall's concordance analysis was conducted to measure the agreement of different respondents on their rankings of benefits based on mean values within a particular 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 benefits was calculated by the following formula (Siegel and Castellan, 1988):

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

where n = Number of benefits being ranked

$\overline{R}_i$ = Average of the ranks assigned to the benefits

$\overline{R}$ = Average of the ranks assigned across all benefits

If the number of attributes 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). If 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 benefits among the respondents within the group. The actual calculated chi-square value with (N – 1) degrees of freedom is defined as below:

$$\Psi^2 = k(N - 1)\, W \qquad (3)$$

where k = number of respondents ranking the benefits

N = number of benefits being ranked

3.5 Spearman's rank correlation test

The level of agreement between any two respondent groups on their rankings of benefits of implementing PFSS in construction was measured by the Spearman's rank correlation coefficient (r_s). 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 (r_s) for the benefits of PFSS was computed by the following formula (SPSS, 2002):

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

where d = Difference in rank of the two groups for the same benefit
N = Total number of responses concerning that benefit

3.6 Mann-Whitney U test

The Mann-Whitney U test is a non-parametric test undertaken to detect whether statistically significant differences or divergences exist in the median values of the same factor under study between any two respondent groups (SPSS, 2007). The matched parametric testing method, t-test, was not employed in this study, since the parametric assumptions were not satisfied and the variables were measured using an ordinal scale of measurement (Abdel-Kader and Dugdale, 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 factor between the respondents of client group and contractor group can be rejected. Thus, it can be concluded that the median values of a certain benefit of PFSS between the two respondent groups are significantly different from each other (SPSS, 2002).

4. Presentation and discussion of survey results

Results derived from the analysis of empirical questionnaire survey were cross-referenced to the published literature wherever appropriate. In this study, the Cronbach's alpha coefficient for the nine rated benefits of PFSS was 0.842 which was much higher than the threshold value of 0.70 according to Norusis (2002). It was indicated that the 5-point Likert scale used for measuring the PFSS benefits is reliable and internally consistent 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 2.

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 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 0.000.

Please insert Table 2

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 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.

4.2 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 direct benefits of PFSS were generally ranked higher than those indirect benefits. The overall rankings of the three indirect benefits of PFSS (i.e. Item 1 "Reduced accident rate", Item 2 "Increased construction productivity" and Item 3 "Higher quality of work") 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 viewpoints 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 promotion 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 6. 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 (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.

Please insert Figure 6

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 7). 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.

Please insert Figure 7

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. 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.

Please insert Table 3

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 5, 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.

Please insert Table 4

5. Conclusions

The primary objective of this paper was to identify and investigate the major benefits of adopting PFSS within the Hong Kong construction industry as perceived by clients and contractors. A total of nine statements describing various benefits of PFSS were compiled and ranked by a group of target industrial practitioners with abundant hands-on experience in PFSS construction projects via an empirical questionnaire survey. It also aimed to compare the ranking patterns and to test for any significant agreement or disagreement among the survey respondents.

Generally, the industrial practitioners agreed that PFSS is effective for implementation within the Hong Kong construction industry. Both the client and contractor groups 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.

It is encouraging to see that the safety performance of the public works contracts has been improved remarkably since the introduction of PFSS in 1996. However, the overall safety performance of the Hong Kong construction industry has still plenty of rooms for improvement (Construction Industry Review Committee, 2001; Tam et al., 2002 and 2006). As the accident rate for the private building projects remains at a higher level in comparison with the public sector, it would be essential for the private property developers to increase promotion of PFSS and to encourage the introduction of adequate effective safety measures to their projects.

The implementation of effective safety measures, cultivation of strong safety culture and creation of a good site working environment are essential ingredients for preventing the occurrence of any accidents (Cheung, 2004). With the identified key benefits of PFSS in mind, decision makers are bestowed sufficient evidence and useful pointers to determine whether to adopt PFSS in future projects or not. It is hoped that the research study will stimulate a wider debate on the underlying benefits associated with PFSS in both a local and international context for reference by the construction industry at large like the Pearl River Delta of Mainland China. Given a plethora of potential benefits, a wider application of PFSS across a wide spectrum of the construction industry is anticipated with the purpose of delivering projects with far less casualties. 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 safety. Moreover, PFSS to be integrated with the enforcement of occupational health and safety (OHS) laws and relevant regulations may serve as an effective tool conducive to the overall improvement of OHS within the construction industry in other regions throughout Mainland China.

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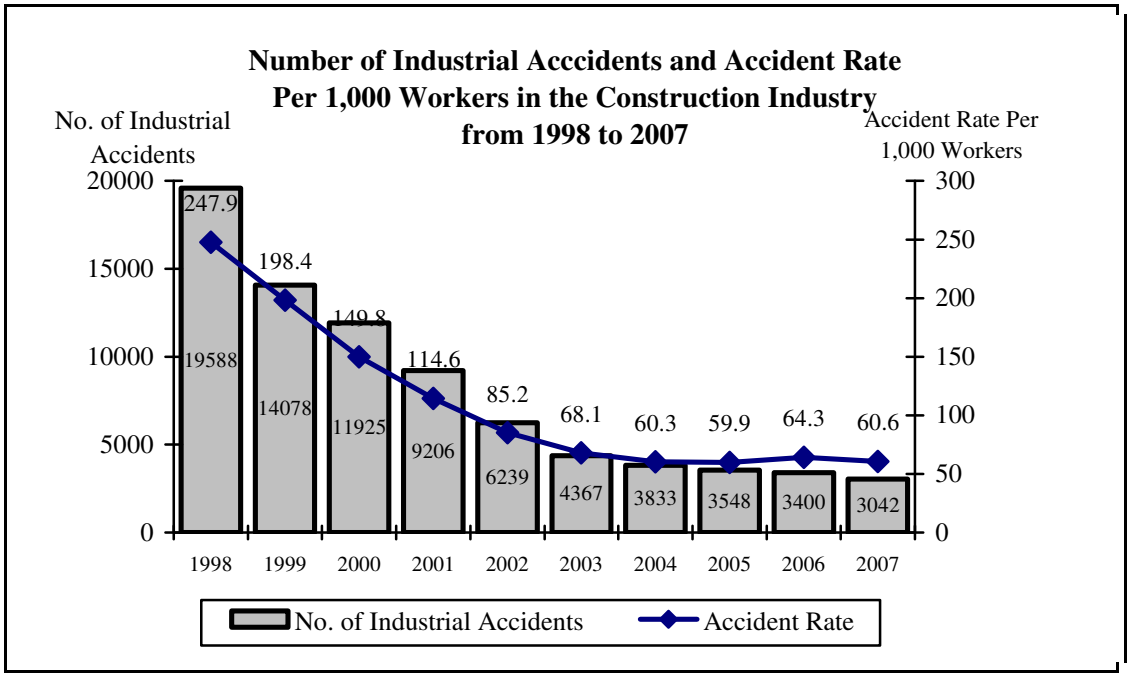

Figure 1. Number of industrial accidents and accident rate per 1,000 workers in the construction industry from 1998 to 2007
(Source: Occupational Safety and Health Branch, Labour Department, 2008a)

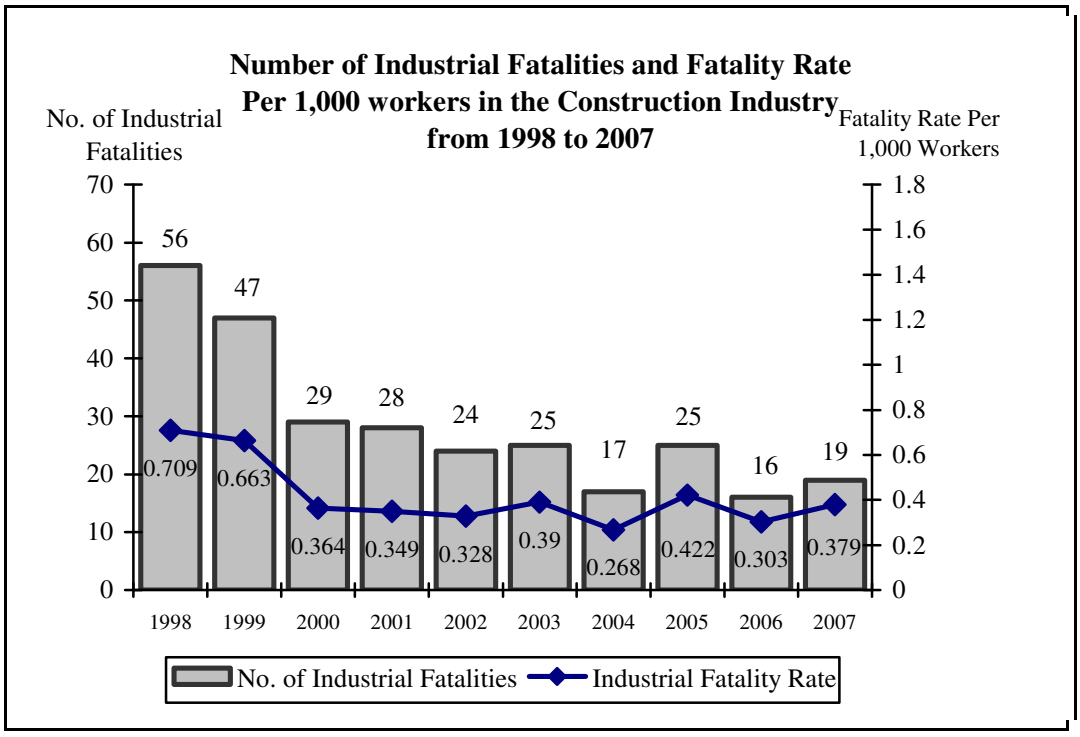

Figure 2. Number of industrial fatalities and fatality rate per 1,000 workers in the construction industry from 1998 to 2007
(Source: Occupational Safety and Health Branch, Labour Department, 2008a)

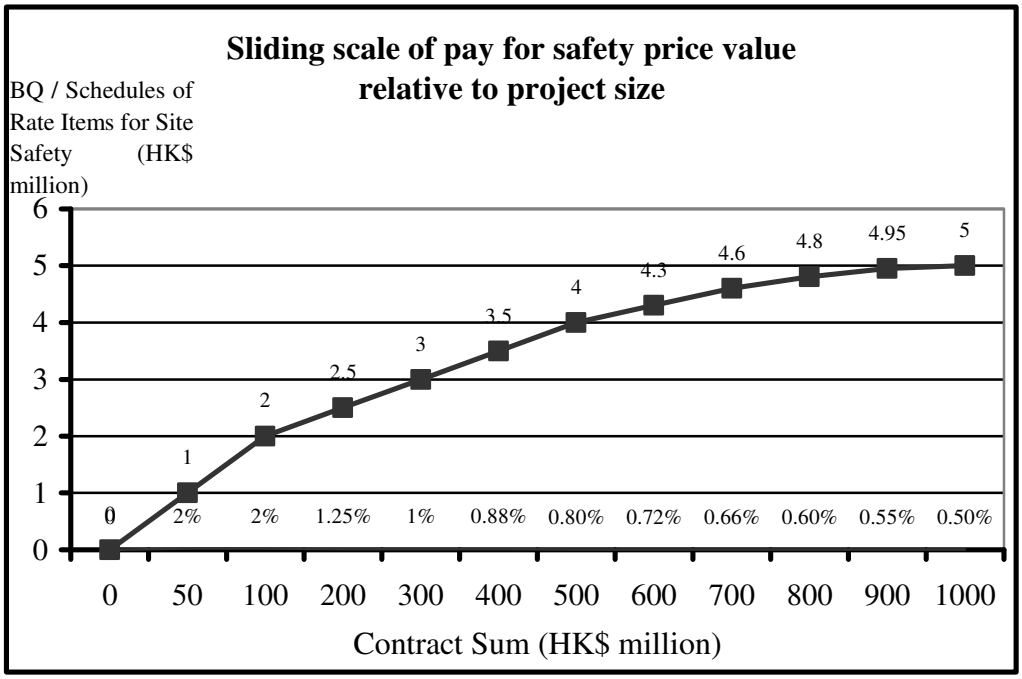

Figure 3. Sliding scale of Pay for Safety price value relative to project size (REDA/HKCA, 2005a)

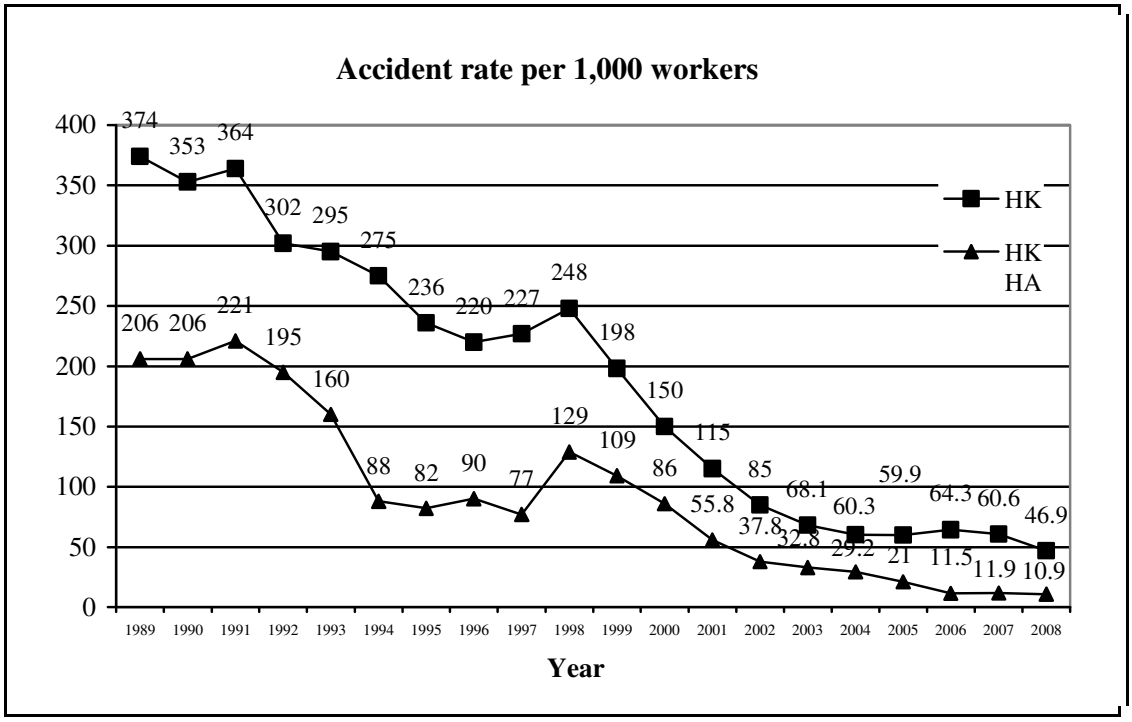

Figure 4. Accident rate per 1,000 workers from 1989 to 2008 (Labour Department, 2008b)

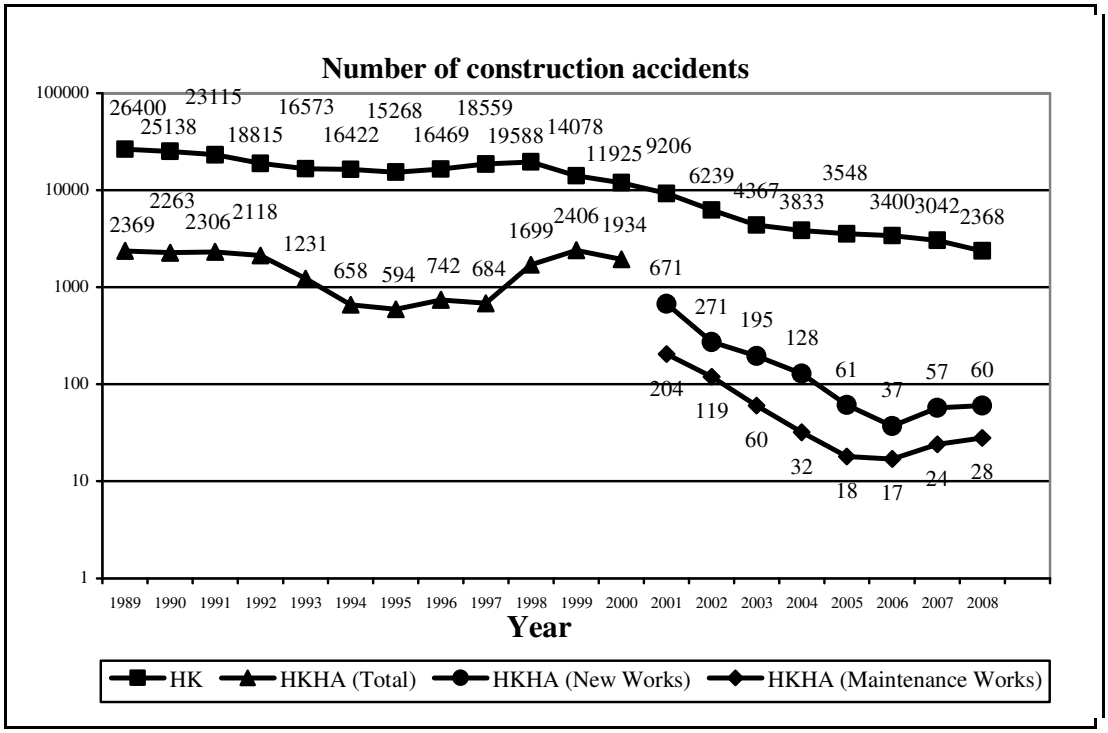

Figure 5. Number of construction accidents from 1989 to 2008 (Labour Department, 2008b)

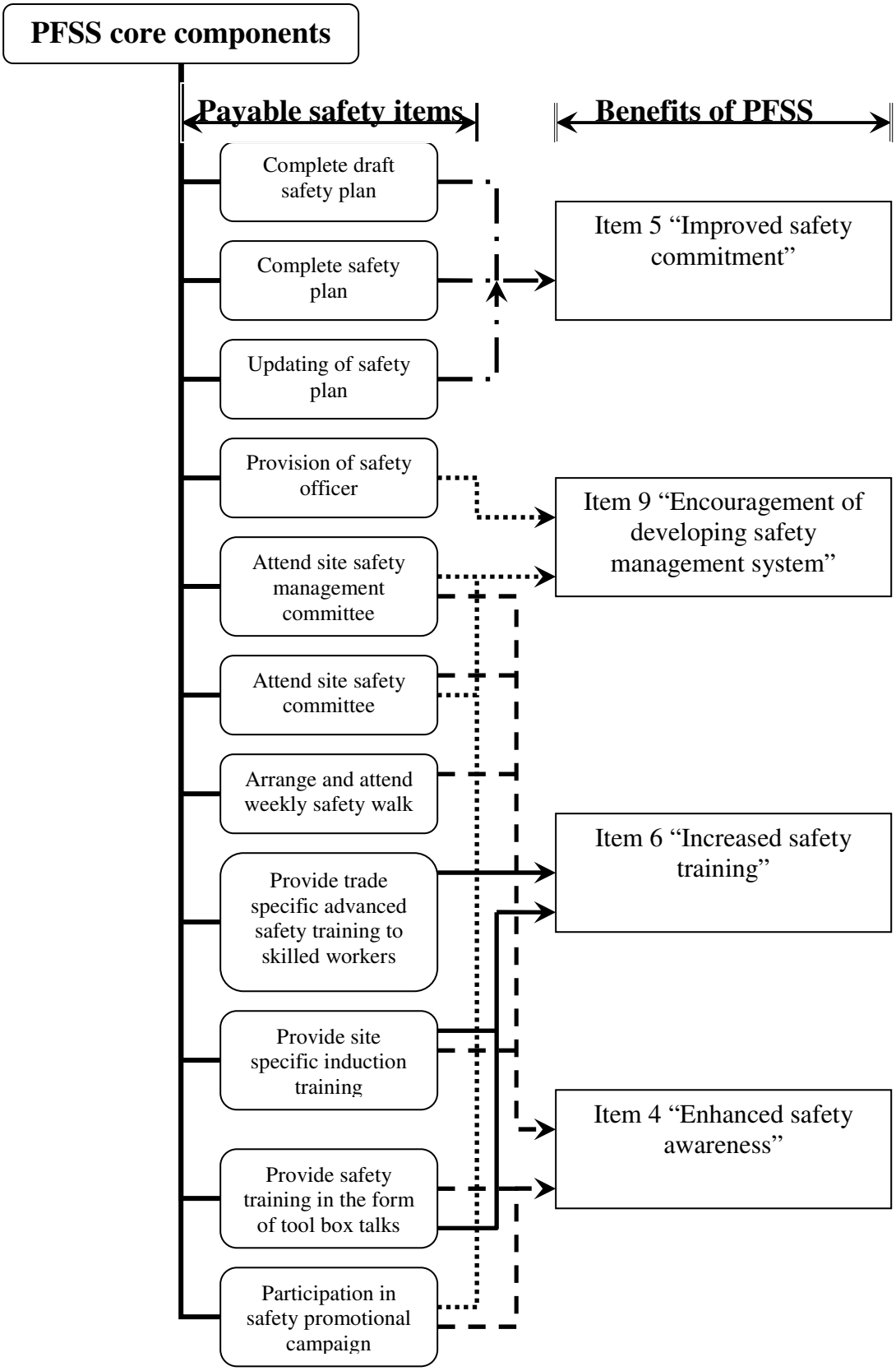

Figure 6.Relationship between payable safety items under PFSS and benefits of PFSS.

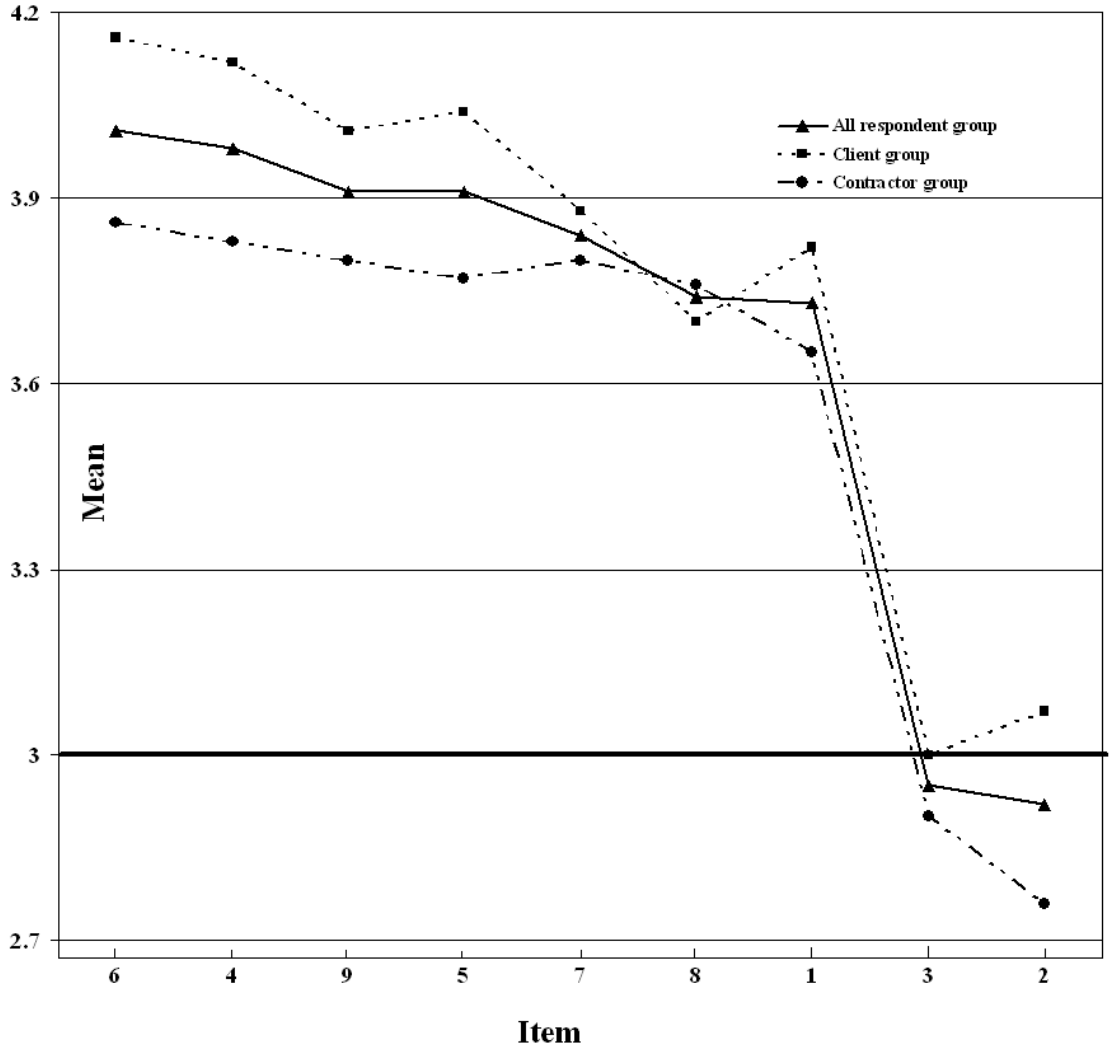

Figure 7. Line graph of the mean scores for the benefits of PFSS across different respondent groups

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

Table 1
Background information about the survey respondents

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 construction		
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		
1. 0	0	0%
2. 1-2	49	33.8%
3. 3-5	39	26.9%
4. 6-8	13	9.0%
5. 9-10	5	3.4%
6. More than 10	39	26.9%
Total	**145**	**100%**

Table 2
Results of the ranking and Kendall's concordance test for the perceived benefits of PFSS

No.	Benefits of PFSS	All respondent group		Client group		Contractor group	
		Mean	Rank	Mean	Rank	Mean	Rank
6	Increased safety training	4.01	1	4.16	1	3.86	1
4	Enhanced safety awareness	3.98	2	4.12	2	3.83	2
9	Encouragement of developing safety management system	3.91	3	4.01	4	3.80	3
5	Improved safety commitment	3.91	3	4.04	3	3.77	5
7	Encouragement of participating in safety promotional campaigns	3.84	5	3.88	5	3.80	3
8	Improved communication on safety issues at all levels	3.74	6	3.70	7	3.76	6
1	Reduced accident rate	3.73	7	3.82	6	3.65	7
3	Higher quality of work	2.95	8	3.00	9	2.90	8
2	Increased construction productivity	2.92	9	3.07	8	2.76	9
	Number (N)	145		74		71	
	Kendall's coefficient of concordance (W)	0.362		0.377		0.359	
	Actual calculated chi-square value	419.857		223.273		203.954	
	Critical value of chi-square from table	15.51		15.51		15.51	
	Degree of freedom (df)	8		8		8	
	Asymptotic level of significance	0.000		0.000		0.000	

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).

Table 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_s	Significance level	Conclusion
Client ranking vs Contractor ranking	0.912	0.001	Reject H_0 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%

Table 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		Z-value	p-value[a]
		Client group	Contractor group		
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

[a] p-value less than 0.05 which indicates significant statistical differences

Brief biography of authors

Dr Daniel W.M. CHAN, *BEng(Hons), PhD, MAPM, MHKICM, MASCE,* is an Associate Professor in Construction Project Management at the Department of Building and Real Estate, The Hong Kong Polytechnic University. He is a project manager and construction manager by profession. He obtained his BEng(Hons) degree in Civil and Structural Engineering and PhD degree in Construction Project Management, from the Department of Civil Engineering, The University of Hong Kong. He has published over 145 research papers on the broad theme of project management in construction in refereed academic journals and international conference proceedings. His current research interests include construction procurement systems, project partnering and strategic alliancing, construction safety management, public private partnership and target cost contracting.

Prof Albert P.C. CHAN is an Associate Head of the Department of Building and Real Estate of The Hong Kong Polytechnic University.

Miss Tracy N.Y. CHOI is a Research Assistant of the Department of Building and Real Estate of The Hong Kong Polytechnic University.