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Perceived benefits of applying Pay for Safety Scheme (PFSS) in construction – A factor analysis approach

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Abstract

In recent years, construction safety has been a hot topic in Hong Kong. The Government of the Hong Kong Special Administrative Region (HKSAR) has launched different safety measures to improve the prevailing safety performance of the construction industry. The Pay for Safety Scheme (PFSS) has emerged as one of the major safety initiatives launched within the public sector construction industry since 1996. It aims to encourage the safety awareness by taking the contractor's pricing for safety-related items out from the consideration of competitive bidding. The objective is to provide a concise review of the prevailing application of PFSS in Hong Kong in general, and to identify and analyse the key benefits of PFSS in construction through an industry-wide empirical questionnaire survey in particular. Altogether, 145 industrial practitioners who have derived extensive hands-on experience with the PFSS construction projects participated in the survey to indicate their levels of agreement to those 14 key benefits identified which were measured and analysed by factor analysis. The results of factor analysis indicated that the 14 individual benefits of implementing PFSS were consolidated under 4 underlying factors: (1) Enhancing safety climate and attitude; (2) Promoting effective safety-related communication; (3) Streamlining the safety procedures; and (4) Ensuring adequate safety training. A wider application of PFSS should be encouraged with a view to achieving better safety performance within the industry. It is recommended that a similar scheme to PFSS currently applied in Hong Kong may be developed for implementation in other regions or countries for international comparisons.

Keywords: Pay for Safety Scheme (PFSS), Benefits, Construction industry, Hong Kong, Factor Analysis

1. Introduction

The construction industry is characterised 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 is a serious problem within the construction industry (Tam, 2002). It is evident that the construction industry has recorded the highest rate of accident among various major 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 Fang, 2008). Strank (1994) stated that the reasons for the poor safety record may correlate with many factors such as complexity of work or system, risk nature of work, management style, safety knowledge and commitment, and personal behaviour. In order to improve the current state of construction safety performance, different safety initiatives were implemented in both public and private sectors (Ng, 2007). In 1992, 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. To promote safety awareness on construction sites, the HKSAR Government required her contractors to employ adequate safety officers and exercise proper safety measures such as safety plans, safety committees and safety audits.

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 create safer working environment for the worker (Anton, 1989; Abdelharmid and Everett, 2000; Rowlinson, 2003). Furthermore, by incorporating effective safety measures, good 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 unveil the actual benefits that are brought about by implementing these safety measures. This paper focuses on one of these safety measures, the Pay for Safety Scheme (PFSS) which is an effective safety incentive 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 identify potential benefits associated with adopting PFSS based on the findings of an empirical questionnaire survey in particular. The paper starts with a concise review of the overall safety performance of the construction industry and the current state of application of PFSS in Hong Kong. Then, the methodology of the research is described followed by the presentation and discussion of survey results. Finally, conclusions are drawn based on the research findings. The research outcomes of this study could provide some useful pointers to encourage a wider application of PFSS within the construction industry.

2. Literature review of safety theories and safety performance

It is now widely recognised that most of the industrial accidents are in some way attributable to human as well as technical factors in the sense that people might perform better to avert them (Lingard and Rowlinson, 2005). Humans have characteristics that can bring about accidental injury. For example, when people are not aware of the hazards associated with their work or underestimate the risks involved, unsafe behaviours or accidents may occur. Improving the safety performance by using technological solutions are not enough. Reason (1990) suggested that modern technology has advanced to the point at which improved safety

can only be achieved through attention to human error mechanism. In the labour-intensive construction industry, human is particularly important and also fundamental to the process of constructing a structure. Thus, an in-depth understanding of the influences on human behaviours is critical to the success of safety management.

The objective of measuring safety performance is to provide a feedback mechanism that will foster improvement (Krause et al., 1990). The secondary functions are also very important, having to do with problem identification, preventive action, together with documentation and reinforcement of performance. The effectiveness of a feedback mechanism is directly dependent upon tapping the right sources of information in the first place. The most common management mistake about information sources is the reliance on accident frequency rate as sole indicators of safety performance (Krause et al., 1990). The inaccuracy of accident frequency numbers as the sole measure of safety performance is that an accident is an event, a discrete thing, whereas safety performance is an ongoing process. Furthermore, when accident frequency is viewed as though it were the sole measure of safety performance, it is a source of confusion and misguided effort (Krause et al., 1990).

Many modern safety approaches (e.g. Strickoff, 2000) advocated the use of proactive measures (e.g. safety climate, hazard identification and/or observed percentage of safe behaviours) that focus on current safety activities to ascertain system success rather than system failure. Krause et al. (1990) opined that an integrated approach which consists of gathering information, identifying problems, stimulating preventive actions, documenting safety efforts and reinforcing improvements in measuring safety performance, would be useful.

3. Construction site safety in Hong Kong

Hong Kong construction site safety 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, 2009). As shown in Figure 1, the accident rate of the Hong Kong construction industry has been declining in recent years from 1999 to 2008. When compared with 1999, it is encouraging to observe that the number of industrial accidents decreased from 14,078 in 1999 to 3,033 in 2008, down by 78.5% and the accident rate per 1,000 workers also dropped by 69.4% as well. 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.

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.

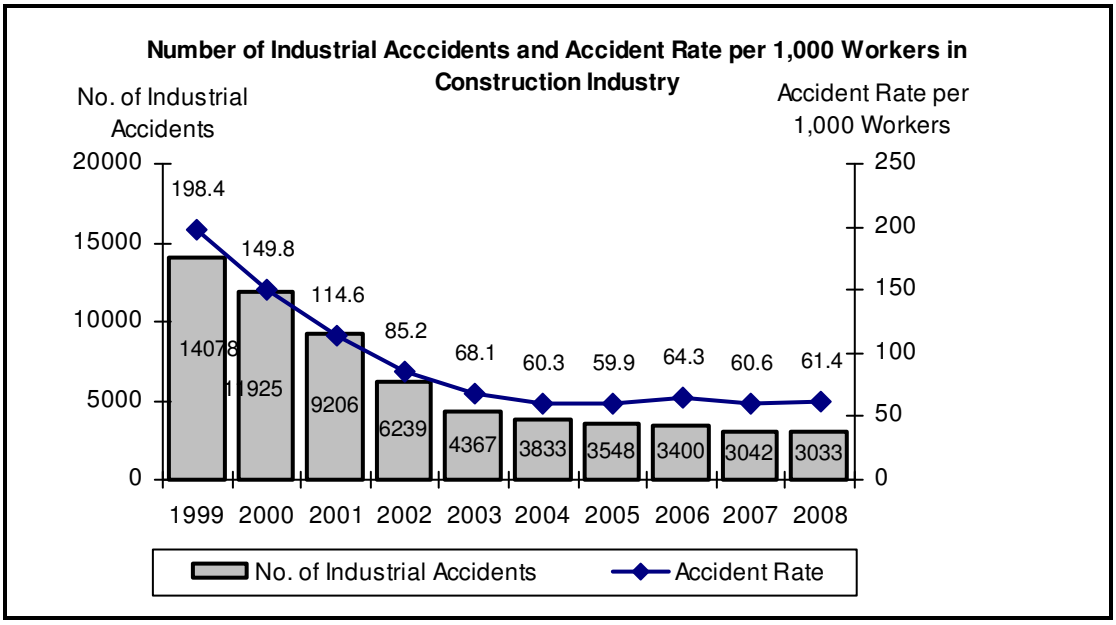

Figure 1. Number of industrial accidents and accident rate per 1,000 workers in the construction industry from 1999 to 2008 (Labour Department, 2009)

4. Application of safety incentive schemes

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). It has long been recognised 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 behaviours and safety-related records. Many organisations within the United Kingdom organise 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. 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. 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.

5. Pay for Safety Scheme

Competition within the construction industry is particularly intense (Betts et al., 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 2005a).

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$20M or more, or term contracts having a total estimated expenditure of HK$50M 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 (REDA/HKCA, 2005b).

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

(a) Provision of draft safety plan
(b) Provision of complete safety plan
(c) Updating of safety plan
(d) Provision of safety manager
(e) Provision of safety officer(s)
(f) Attendance to site safety management committee meeting
(g) Arrangement of and attendance to site safety committee meeting
(h) Arrangement of and attendance to weekly safety walk
(i) Provision of trade specific advanced safety training to skilled workers
(j) Provision of site specific induction training
(k) Tool box safety training

(l) Participation in safety promotional campaign as instructed by the Engineer
(m) Attendance of safety audit
(n) Arrangement and holding of site safe working cycle
(o) Provision of safety bulletin board

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) 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. 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.

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 1. 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 reduced 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 1. Number of fatal and non-fatal accidents for Works Bureau's construction projects from 1995 to 1997 (Lam, 2008)

Year	Number of fatal accidents	Non-fatal accidents (number of 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 items. This scheme also brings the clients into the safety issues of the project. Active involvement of clients is very crucial for a good safety performance, since not all the contractors are enthusiastic and willing to monitor and promote safety themselves (Chow, 2005).

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, 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).

6. Research methodology

The research study began with a review of relevant materials from textbooks, academic journals, professional journals, conference proceedings, research reports, previous dissertations and internet information to capture background knowledge about the implementation and associated benefits of PFSS. The objective of the literature review was to develop an overall framework for the research study and to prepare for the questionnaire survey.

An empirical survey questionnaire was designed by incorporating individual benefits associated with implementing PFSS identified from the literature. A total of 14 perceived benefits of PFSS were identified and consolidated as individual statements from the contemporary literature (primarily from Ng, 2007) and followed by a "pilot" survey with a few safety experts to verify the adequacy of items and clarity of the survey form. After the pilot survey, the items were found sufficient, clear and appropriate. An extract of the blank survey form is attached in Appendix A for reference. The final questionnaire comprised two major sections: (1) general personal information of respondents; and (2) questions on the perceptions of implementing PFSS including its benefits. Industrial practitioners, including those from the client organisations and main contractors, who have had abundant direct hands-on involvement in PFSS construction projects in Hong Kong were the target respondents of the questionnaire survey. Altogether, 329 sets of self-administered blank survey questionnaires were sent out to individual target respondents by means of postal mail and electronic mail between March and May of 2009. Electronic mail communications together with follow-up telephone calls were launched wherever possible for reminding the return of completed questionnaires and clarifying any unclear items on the survey form. 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. Hence, the data analysis of this research was based on 145 valid survey questionnaires. 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. 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 in terms of the number of projects involved. Since 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 practising PFSS in construction.

Respondents were requested to rate their levels of agreement against each of the 14 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. Respondents were also invited to suggest and rate any other unmentioned benefits based on their personal discretion and actual experience but ultimately no new benefits were received from them.

7. Discussion of the survey results

7.1. Overall ranking of the benefits of PFSS

The mean scores of each PFSS benefit for all respondents were calculated and they were ranked in descending order according to the mean score values as shown in Table 2. As the number of attributes (benefits) considered were larger than seven, the chi-square value would be used as a near approximation instead of the Kendall's coefficient of concordance to measure the agreement of different respondents on their rankings of PFSS benefits as a whole based on the mean scores. According to the degree of freedom (14 - 1 = 13) and the allowable level of significance (5%), the critical value of chi-square from table was found to be 22.36 (Siegel and Castellan, 1988). For all respondents, the actual computed chi-square value, 206.138, was well above the critical value of chi-square of 22.36. This result indicates the null hypothesis that "Respondents' sets of rankings are unrelated (independent) to each other" has to be rejected. Consequently, there is sufficient evidence to conclude that there is significant degree of agreement among 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.

The mean values for the benefits as rated by all respondents ranged from 3.38 to 3.92. Since all the mean values are above 3, it can be interpreted that the respondents were agreeable to the benefits in general but with different levels of agreement only. All respondents believed and ranked Item 8 "PFSS ensures employees to receive adequate training on how to work safely." and Item 4 "PFSS generates a safety climate that is favourable to safe attitudes and work habits." 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 and safety attitude on top of the enhancement of safety knowledge. Thus, Item 4 "PFSS generates a safety climate that is favourable to safe attitudes and work habits." And Item 5 "PFSS facilitates various project stakeholders to work together in creating a safe working environment." was ranked as the second and the third most important benefit which may possibly be due to the positive outcome of safety training.

Table 2. Results of the ranking for the perceived benefits of PFSS

No.	Benefits of PFSS	All Respondents		
		Mean	Standard deviation (S.D.)	Rank
8	PFSS ensures employees to receive adequate training on how to work safely.	3.92	0.627	1
4	PFSS generates a safety climate that is favourable to safe attitudes and work habits.	3.91	0.745	2
5	PFSS facilitates various project stakeholders to work together in creating a safe working environment.	3.88	0.661	3
3	There exist opportunities for employees to become involved in safety issues under PFSS.	3.86	0.656	4
13	PFSS ensures regular inspections of all operations.	3.85	0.692	5
7	PFSS generates a positive attitude towards safety issues at all levels.	3.81	0.754	6
9	PFSS guarantees thorough safety training for new employees.	3.80	0.723	7
6	PFSS can help to recognize safety commitment at all levels.	3.77	0.714	8
11	PFSS provides regular safety contacts with all employees.	3.74	0.656	9
2	PFSS renders safety procedures mandatory and adequate at all levels in your company.	3.66	0.669	10
12	PFSS encourages launching safety awareness programs that stress on safety issues both on and off the job.	3.62	0.773	11
14	PFSS is an effective system for dealing with reported hazards.	3.38	0.755	12
1	PFSS deals positively with the investigation of accidents.	3.38	0.826	12
10	Managers and employees can communicate freely on safety issues under PFSS.	3.38	0.773	12
	Number (n)	145		
	Kendall's Coefficient of Concordance (W)	0.102		
	Actual Calculated Chi-Square Value	206.138		
	Critical Value of Chi-Square from Table	22.36		
	Degree of freedom (df)	13		
	Level of Significance	0.000		

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

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).

7.2. Factor analysis of PFSS benefits

Factor analysis (FA) is a statistical technique used to identify a relatively small number of individual factors that can be used to represent relationships among sets of many interrelated variables (Norusis, 1993). It was used to analyse data from the survey questionnaire and identify the underlying cluster of benefits of implementing PFSS. It was conducted to reduce the 14 items (benefits of PFSS) into a small number of "underlying" grouped factors.

Principal components analysis was used to identify underlying grouped factors because of its simplicity and distinctive characteristic of data-reduction capacity for extraction. To determine how many factors would be required to represent that set of data, the total percentage of variance explained by each factor was examined. Principal factor extraction with Promax rotation and Kaiser normalisation was carried out through the SPSS FACTOR program on the 14 items of PFSS benefits from a sample of 145 responses. Table 3 contains the details and initial statistics for each of the 14 items. The total variance explained by each factor was listed in the column under factor loading. The percentage of variance and the cumulative percentage of variance are also indicated in Table 3.

In fact, there are two ways to rotate factors, namely, oblique and orthogonal. An orthogonal rotation method (e.g. varimax, equamax, quartimax, etc) constrains factors to be independent of each other, while an oblique rotation method (e.g. promax, oblimin, quartimin, etc) allows factors to be correlated. The results of an orthogonal rotation are in fact more complex than the results of an oblique rotation and can be misleading with the presence of significant correlations among factors (Fabrigar et al., 1999). Furthermore, many constructs in research cannot be expected to be independent of each other, so the oblique rotation approach would be appropriate to obtain several theoretically meaningful factors (Hair et al., 1998). Promax is one of the most commonly used oblique rotation methods (DeCoster, 1998; Biber, 2009) which has been adopted by a number of researchers (Pham and Swierczek, 2006; Lam et al., 2008; Chan and Lee, 2009; Kärnä et al., 2009). Therefore, Promax rotation method was finally applied to this study for further discussion.

The appropriateness of the factor model was evaluated before using FA in this research. Various tests are required to examine the appropriateness of FA for the factor extraction. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Barlett's test of sphericity for the extraction factors can be used. The KMO statistic ranges from 0 and 1. A value of 0 implies that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion in the pattern of correlations and hence, FA would be inappropriate (Norusis, 1993). On the contrary, a value close to 1 suggests that patterns of correlations are relatively compact and FA would yield distinct and reliable individual factors. The KMO value should be higher than the acceptable threshold of 0.5 for a satisfactory FA to proceed (Norusis, 1993). The acceptance level of KMO value is indicated in Table 4 (Field, 2005).

Table 3. Factor structure of principal factor extraction and promax rotation on the 14 benefits of PFSS

No.	Item	Factor loading	Eigenvalue	Percentage of variance explained	Cumulative percentage of variance explained
Factor 1. Enhancing Safety Climate and Attitude					
7	PFSS generates a positive attitude towards safety issues at all levels.	0.861	5.509	39.349	39.349
5	PFSS facilitates various project stakeholders to work together in creating a safe working environment.	0.829			
6	PFSS can help to recognize safety commitment at all levels.	0.797			
4	PFSS generates a safety climate that is favourable to safe attitudes and work habits.	0.769			
3	There exist opportunities for employees to become involved in safety issues under PFSS.	0.613			
Factor 2. Promoting Effective Safety-related Communication					
10	Managers and employees can communicate freely on safety issues under PFSS.	0.799	1.447	12.624	51.973
13	PFSS ensures regular inspections of all operations.	0.781			
14	PFSS is an effective system for dealing with reported hazards.	0.779			
11	PFSS provides regular safety contacts with all employees.	0.748			
Factor 3. Streamlining the Safety Procedures					
1	PFSS deals positively with the investigation of accidents.	0.827	1.139	9.424	61.396
12	PFSS encourages launching safety awareness programs that stress on safety issues both on and off the job.	0.612			
2	PFSS renders safety procedures mandatory and adequate at all levels in your company.	0.597			
Factor 4. Ensuring Adequate Safety Training					
9	PFSS guarantees thorough safety training for new employees.	0.903	1.109	9.204	70.600
8	PFSS ensures employees to receive adequate training on how to work safely.	0.838			

Table 4. Acceptance level of KMO value (Field, 2005)

KMO value	Degree of common variance
0.90 to 1.00	Excellent
0.80 to 0.89	Good
0.70 to 0.79	Middling
0.60 to 0.69	Mediocre
0.50 to 0.59	Poor
0.00 to 0.49	“Forget it”

The KMO value of this research is 0.820 which indicates a "good" degree of common variance and is well above the acceptable threshold of 0.50. The Barlett's test for sphericity is used to test the hypothesis that the correlation matrix is an identity matrix, which indicates that there is no relationship amongst the items (Pett et al., 2003). The value of the test statistic for Barlett's sphericity is large (chi-square value = 823.983) and the associated significance level is small (p-value = 0.000), implying that the population correlation matrix is not an identity matrix. The Cronbach's alpha reliability coefficient was employed for checking internal consistency (reliability) between 0 and 1, based on the average inter-item correlation. 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 (Norusis, 1993). In this study, the overall alpha value for the 14 individual benefits of PFSS was found to be 0.877, reflecting that there is good internal consistency (reliability) in terms of the correlations amongst the 14 factors, and the adopted measurement scale is reliable. As the requirements of KMO value and the Barlett's test of sphericity are both achieved, it can be concluded that factor analysis was appropriate for this research and can be proceeded with confidence and reliability.

Four underlying grouped factors were extracted in this case, totally accounted for 70.6% of the total variance in responses. SPSS drops the factors from "5" to "14" as their eigenvalues are less than 1.0. It means that they are less influential than the four observed underlying grouped factors. The 14 original benefits of PFSS were all included in one of these 4 underlying grouped factors. The criteria for group classification were that variable, which has the highest loading with a value larger than 0.50 in one component, belongs to that component (Awakul and Ogunlana, 2002). The first three grouped factors accounted for 39.35%, 12.62% and 9.42% of the variance, respectively.

All loadings of the 14 individual factors were greater than 0.5. The higher the absolute value of the individual factor loading (which cannot exceed a maximum of 1.0), the more a particular individual factor contributes to its underlying grouped factor (Proverbs et al., 1997). The values reflect the degree of contribution of individual factors to each underlying grouped factor. It is observed that the factor loadings and the interpretation of the individual factors extracted were reasonably consistent. Figure 2 provides a plot of total variance associated with each underlying grouped factor. The plot indicates a distinct break between the steep slope of the large individual factors and the gradual trailing off of the rest. This gradual trailing off is called the 'scree' because it resembles the rubble that forms at the foot of a mountain (Norusis, 1993). The figure confirms that a 4-factor model should be sufficient for the research model. A positive sign of the factor loading represents that the individual factor is positively correlated to the benefits of PFSS in the construction project and vice versa.

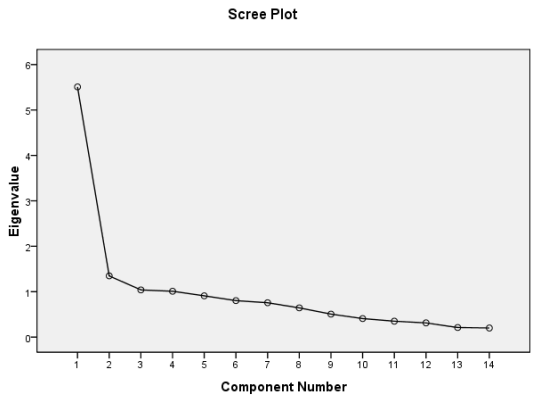

Figure 2. Scree plot of the 14 benefits of PFSS

8. Interpretation of the underlying grouped benefits of PFSS

Principal components analysis was used to identify underlying grouped benefits of implementing PFSS. Principal components analysis, with Promax rotation conducted on the 14 independent variables produced 4 underlying grouped factors (Table 3). The grouped benefits were analysed in descending order of significance to determine underlying features that linked them. A new underlying grouped factor was appropriately labelled in accordance with the set of individual factors it contained. In order to facilitate the explanation of the results of factor analysis, it is necessary to assign an identifiable, collective label to the groups of individual factors of high correlation coefficients, as each of the underlying grouped factors is an aggregation of individual factors (Sato, 2005). It is however stressed that the suggested label is subjective and other researchers may come up with a different label. The meanings of the four underlying grouped benefits of implementing PFSS are interpreted as follows.

8.1. Enhancing safety climate and attitude (Factor 1)

Factor 1 consists of six items that focus primarily on safety climate and attitude. The factor loadings on this factor are relatively large among all the items. They includes: PFSS generates a positive attitude towards safety issues, facilitates creating a safe working environment, helps recognizing safety commitment at all levels, generates a safety climate and creates opportunities for employees to become involved in safety issues under PFSS. The combination of these items indicates that PFSS brings out a safe working environment with positive safety climate and attitude at all levels. 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. According to Ng (2007), PFSS enhances safety awareness and ensures the safety measures to be carried out by the contractor from tender stage until project completion. 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.

8.2. Promoting effective safety-related communication (Factor 2)

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). This factor includes four items that are related to communication and hazard report system between managers and employees as well as regular safety contacts and inspections. Under PFSS, 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.

8.3. Streamlining the safety procedures (Factor 3)

Three items comprise elements of Factor 3 regarding safety procedures. Safety procedures include the investigation procedures of accidents, provision of adequate safety procedures and safety awareness programs that stress on safety issues. Ng (2007) pointed out that PFSS facilitates the development of accident investigation process that helps the contractors to learn from mistakes and reduce the chance of reoccurrence.

Fung et al. (2005) advocated 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. The research results of Choudhry and Fang (2008) substantiate the significant role of safety procedure as one of the key factors which influences the safety behaviours of workers at construction sites.

According to Choudhry and Fang (2008), the site management teams learn from safety policies and safety management systems on construction projects while the workforce learns more from safety toolbox talks and morning site safe working cycles which are the payable safety items under PFSS. Workers participate in these activities may ensure that individual workers must know how to perform work safely and have the requisite skills to do it in order to comply with safety rules, regulations and procedures.

8.4. Ensuring adequate safety training (Factor 4)

Factor 4 comprises two items focusing on safety training. When a project adopted PFSS, the contractor was also encouraged to provide sufficient safety training and programmes to the workers. Those safety programmes would be useful in educating the workers towards the importance of site safety and duties on site safety issues and raising their safety awareness. Under PFSS, payment is only to be made to the contractor when the contractor complies with each of the stipulated safety items. PFSS reinforces safety awareness of the senior management or line management (Ng, 2007).

Under PFSS, there are two payable safety items, provision of trade specific advanced safety training to skilled workers and provision of site specific induction training which are related to safety training. Thus, 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. 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.

9. Recommendations for improving PFSS

In order to encourage widespread implementation of PFSS within the Hong Kong construction industry, not only in the government works projects, promotion on PFSS is a must. Most of the government construction contracts were procured by the large-scale major contractors. Therefore, the relatively small-sized construction firms may not fully understand the operation and benefits of PFSS. On the other hand, PFSS is still not widely adopted in the private sector. They have just launched this scheme on a voluntary basis since October 2005. The private sector may encounter some difficulties in implementing PFSS in various areas, which may also be experienced in the public sector. Therefore, the relevant government departments are encouraged to share their experience of success and knowledge on PFSS with the private sector by holding seminars and workshops. This active action is effective in promoting PFSS in the private sector and also provides technical advice for them to overcome the potential difficulties. Making PFSS mandatory to all construction projects including in the private sector and increasing the number of safety officers/ supervisors to look after safety-related issues should be considered for enhancing the overall safety climate at construction sites.

The payable safety items are the soul of PFSS and regular review and reassessment of the necessary items is very crucial. However, the Environment, Transport and Works Bureau (ETWB) only updated twice from 1996 to 2007 and the Hong Kong Housing Authority updated once since 2000 (Ng, 2007). It is important that the payable safety item list should be updated regularly according to various stages of construction. Raising the proportion/ percentage of contract sum allocated for carrying out all the payable safety items should be fully taken in account as well by public/ private sector client organizations together with their contractors. Furthermore, the tender is usually awarded to the lowest bidder regardless the previous track record of safety performance traditionally. Clients are suggested to include previous safety performance in PFSS as one of the criteria to select tenderers and even award tenders. This could show that the whole construction industry stresses on construction safety. It is believed that the safety performance would be greatly improved.

10. Conclusions

This research programme has provided an overview of the current application of PFSS in Hong Kong and has investigated the major benefits of adopting PFSS in construction. Based on the research findings, it is evident that PFSS brings about numerous benefits to the project and also improves the safety performance of the construction industry as a whole significantly.

The empirical survey findings suggested the most significant benefits to be: (1) “PFSS ensures employees to receive adequate training on how to work safely”; (2) “PFSS generates a safety climate that is favourable to safe attitudes and work habits”; and (3) “PFSS facilitates various project stakeholders to work together in creating a safe working environment”. All the mean scores of the 14 individual benefits are found to be above 3 (ranging from 3.38 to 3.92 as shown in Table 2) indicates that all the survey respondents were generally agreeable to these benefits of PFSS but with different levels of agreement only. The four underlying grouped benefits after factor analysis included: (1) Enhancing safety climate and attitude; (2) Promoting effective safety-related communication; (3) Streamlining the safety procedures; and (4) Ensuring adequate safety training.

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). The implementation of PFSS is now being adopted in spate across the public sector whereas there are a scarcity of private sector projects which have launched PFSS so far. As the accident rate for the private building projects remains at a higher level in comparison with the public sector, it would be important to encourage the private property developers and contractors and even subcontractors to apply more safety initiatives in their projects for ensuring a safe and healthy workplace. Some possible recommendations were suggested to facilitate the smooth implementation of PFSS.

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. 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 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. 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.

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Appendix A. Extract of empirical survey questionnaire

Project Title: Exploring the Application of Pay for Safety Scheme (PFSS) in Hong Kong Construction Industry

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
   ☐ 15 years or above

4. Type of organization in which you are working:

   ☐ Client organization ☐ Main contractor ☐ Consultant
   ☐ Subcontractor ☐ Supplier / Manufacturer
   ☐ Other (please specify): _____

5. Nature of projects undertaken by your company (you may tick more than one box):

   ☐ Government building ☐ Private building ☐ Civil engineering
   ☐ Repair and maintenance ☐ Other (please specify): _____

6. Please indicate your experience in implementing PFSS (you may tick more than one box):

   ☐ Government building ☐ Private building ☐ Civil engineering
   ☐ Repair and maintenance ☐ Other (please specify): _____

7. Please indicate your experience in the number of project(s) introducing PFSS:

   ☐ 0 ☐ 1-2 ☐ 3-5 ☐ 6-8 ☐ 9-10
   ☐ More than 10

8. Please indicate your experience in the number of project(s) introducing PFSS together with Independent Safety Auditing Scheme (ISAS):

   ☐ 0 ☐ 1-2 ☐ 3-5 ☐ 6-8 ☐ 9-10
   ☐ More than 10

B. Benefits of PFSS

Please rate the level of agreement on the following statements regarding the benefits of PFSS.

Benefits of PFSS	Strongly disagree	Disagree	Neutral / No Comment	Agree	Strongly Agree
1. PFSS deals positively with the investigation of accidents.	☐	☐	☐	☐	☐
2. PFSS renders safety procedures mandatory and adequate at all levels in your company.	☐	☐	☐	☐	☐
3. There exist opportunities for employees to become involved in safety issues under PFSS.	☐	☐	☐	☐	☐
4. PFSS generates a safety climate that is favourable to safe attitudes and work habits.	☐	☐	☐	☐	☐
5. PFSS facilitates various project stakeholders to work together in creating a safe working environment.	☐	☐	☐	☐	☐
6. PFSS can help to recognize safety commitment at all levels.	☐	☐	☐	☐	☐
7. PFSS generates a positive attitude towards safety issues at all levels.	☐	☐	☐	☐	☐
8. PFSS ensures employees to receive adequate training on how to work safely.	☐	☐	☐	☐	☐
9. PFSS guarantees thorough safety training for new employees.	☐	☐	☐	☐	☐
10. Managers and employees can communicate freely on safety issues under PFSS.	☐	☐	☐	☐	☐
11. PFSS provides regular safety contacts with all employees.	☐	☐	☐	☐	☐
12. PFSS encourages launching safety awareness programs that stress on safety issues both on and off the job.	☐	☐	☐	☐	☐
13. PFSS ensures regular inspections of all operations.	☐	☐	☐	☐	☐
14. PFSS is an effective system for dealing with reported hazards.	☐	☐	☐	☐	☐

C. 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?

   ☐ Yes ☐ No ☐ Unsure / No strong view

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

   ☐ Agree ☐ Disagree ☐ Neutral / No strong view

~ End of the questionnaire ~ Thank you for your kind co-operation ~