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Potential difficulties in applying the Pay for Safety Scheme (PFSS) in construction projects

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ABSTRACT

Since 1996, the Government of the Hong Kong Special Administrative Region (HKSAR) has introduced the Pay for Safety Scheme (PFSS) to the public works construction contracts to uplift their safety performance. However, the adoption of PFSS has also encountered some difficulties that merit considerable attention. This paper purports to provide a concise review of the prevailing application of PFSS in Hong Kong in general, and to explore the potential difficulties associated with PFSS in particular. By means of an empirical questionnaire survey geared towards industrial practitioners with extensive direct hands-on PFSS experience, their opinions were solicited, analyzed and compared between the client group and contractor group of respondents. The three most significant difficulties in implementing PFSS were found to be: (1) "Plenty of paperwork required for certifying payment to contractor"; (2) "Complicated contract documents and lengthy assessment process"; and (3) "Over-tight project schedule requiring rush jobs". The output of this research study is particularly essential in assisting the contracting parties to mitigate the avoidable hindrances when embarking on PFSS. It has also generated valuable insights into developing effective recommendations for alleviating the barriers to PFSS success for future construction projects.

Keywords: Pay for Safety Scheme (PFSS), Safety performance, Difficulties, Hong Kong, Construction industry

1. Introduction

Safety issues have always been a major problem and prime concern besetting the construction industry in many countries (Teo and Phang, 2005). Past government statistics have manifested that the highest number of accidents and fatalities are found in the construction industry worldwide (Koehn et al., 1995; Sawacha et al., 1999; Ahmed et al., 2000; Wong and So, 2004; Choudhry and Fang, 2008). Some previous research pointed out that site accidents are primarily attributed to competitive tendering, extensive use of subcontractors, poor accident record keeping and reporting system, the low priority given to safety, inadequate safety training provided to contractors management and workers, etc (Poon, 1998; Tam and Fung, 1998). Ngowi and Mselle (1999) observed that some contractors may gain little competitive advantage from good health and safety management. The practices of competitive tendering and award of most public sector contracts to the lowest bidder in many countries compel the contractors to drive their prices low, while cutting costs, which, in turn, affects health and safety considerations.

The Government of the Hong Kong Special Administrative Region (HKSAR) launched a Pay for Safety Scheme (PFSS) in public works contracts in 1996 to alleviate the safety problems associated with competitive bidding and uplift the standard of safety performance of the Hong Kong construction industry. PFSS purports to enhance the safety awareness by taking the contractor's pricing for safety-related items out from the consideration of competitive bidding. Although the scheme has been applied in Hong Kong for over 15 years, the implementation mechanism such as the assessment and certification procedures, requirements of each of the payable safety items, etc have not been sufficiently evaluated and analyzed. Only a limited number of research studies have investigated PFSS in general, and none on its potential difficulties encountered during implementation in Hong Kong.

Thus, an industry-wide empirical investigation of the major potential difficulties of PFSS is considered to be essential and timely to identify any deficiencies of PFSS and then to ensure its effective implementation. The objectives of this paper are to: (1) review the prevailing application of PFSS in Hong Kong; (2) present the major findings of an empirical questionnaire survey on the potential difficulties of PFSS; and (3) compare the difficulties in applying PFSS between the clients and contractors. The research outcomes of this study could generate some useful insights, optimize the implementation procedures and facilitate a successful application of PFSS within the construction industry.

2. Relationship between safety incentive schemes and safety performance

There are various types of safety initiatives that companies utilize to promote worker safety; perhaps the most widely implemented type of program involves safety incentives (Hinze and Gambatese, 2003). To provide positive reinforcement, incentives can be awarded in different forms. Both 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. Safety incentive programs can be classified into 3 types: outcome-based, behavior-based and activity-based (Gambatese,

2004). The "Pay for Safety Scheme (PFSS)" can be regarded as an activity-based approach in which workers are bestowed some rewards in case of attending the prescribed safety activities like safety toolbox talks and safety training courses.

Based on the research undertaken by Goodrum and Gangwar (2004), the top three objectives of implementing a safety incentive program include: (1) changing worker behavior to adopt safer work practices; (2) improving safety awareness among workers; and (3) reducing recordable accidents. Several companies use a safety incentive program not only to reduce accident rates but also to have an impact on worker behavior. By changing worker behavior and safety awareness, safety performance could be improved. Some previous studies (Geller, 1999; Simonet and Wilde, 1997) also indicated that the implementation of safety incentives may bring about desirable safety performance.

3. Safety performance of the construction industry

According to the Occupational Safety and Health Statistics of 2009 published by the Labour Department (2010), over 20% of the industrial accidents were related to the construction industry in Hong Kong. The safety record of the construction industry was poor and much worse than other industries in Hong Kong (Wong et al., 2004). Although the Government of the HKSAR has promulgated several safety and health policies and regulations to reduce the accident rate and fatality rate, the overall safety performance is still at a high level.

As shown in both Figures 1 and 2, the number of non-fatal accident rate and fatal accidents tend to show in general a downward trend over the past decade of 2000-2009 (Labour Department, 2010). The number of non-fatal accident rate has decreased from 149.8 accidents per 1,000 workers in 2000 to 54.6 accidents per 1,000 workers in 2009, equivalent to a reduction of 63.6%. The number of fatal accidents has reduced progressively from 29 in 2000 to 19 in 2009, equivalent to a drop of 34.5%.

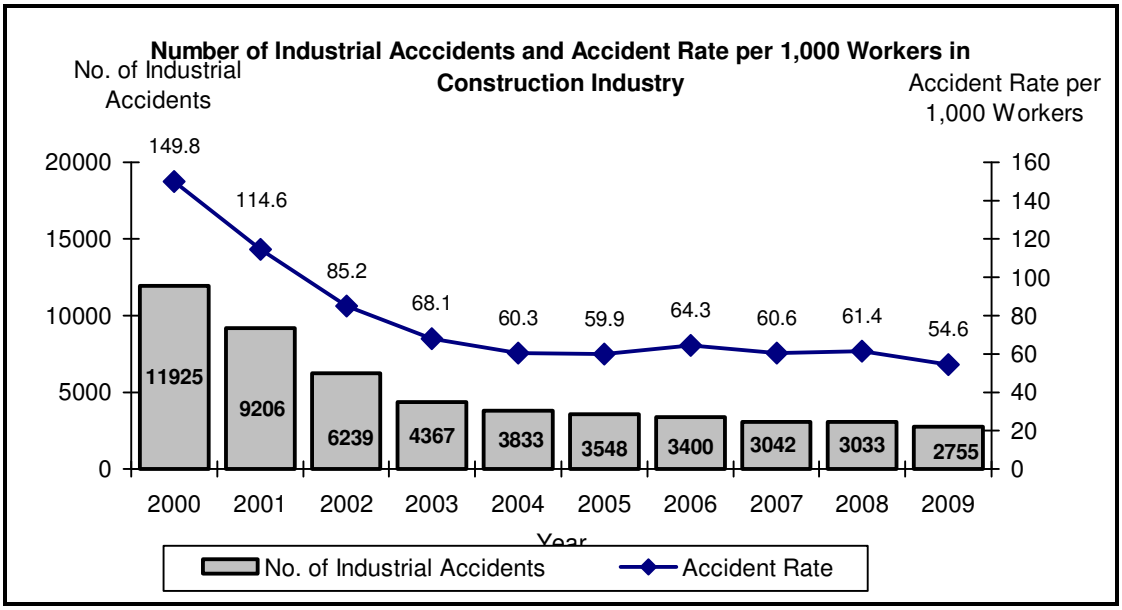

Figure 1. Number of industrial accidents and accident rate per 1,000 workers in the construction industry from 2000 to 2009 (Labour Department, 2010)

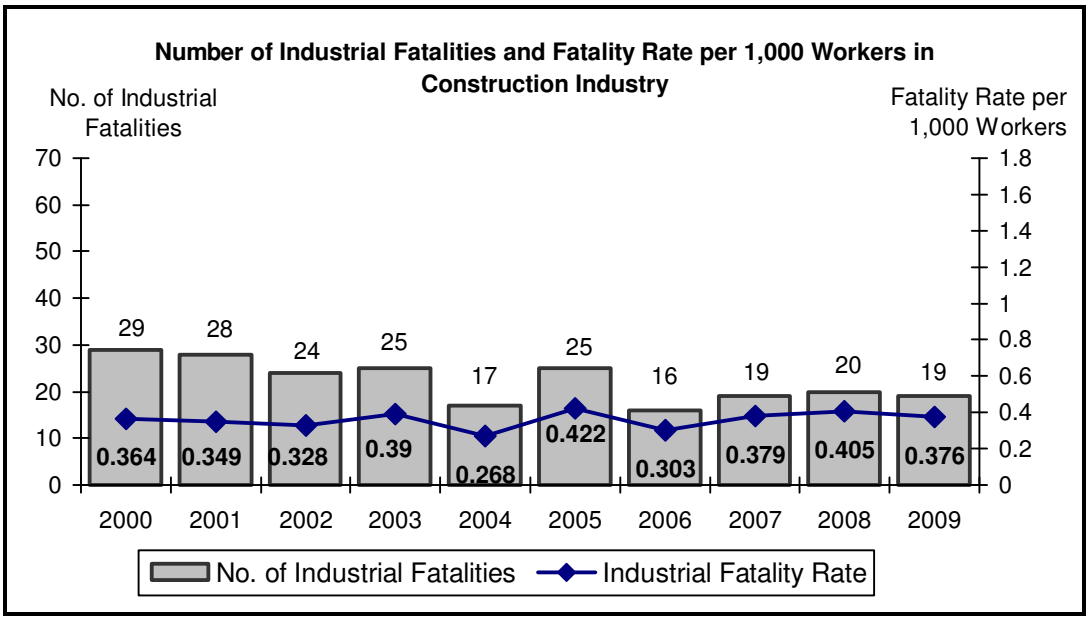

Figure 2. Number of industrial fatalities and fatality rate per 1,000 workers in the construction industry from 2000 to 2009 (Labour Department, 2010)

4. Development of Pay for Safety Scheme (PFSS)

The Works Bureau (now the Works Branch under the Development Bureau of the HKSAR Government) introduced a "Pay for Safety Scheme (PFSS)" towards the government construction contracts in 1996. The scheme 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, 2005). Under PFSS, contractors tendering for public works contracts should include a number of safety-related tasks (e.g. provision of complete safety plan, provision of safety manager and attendance of safety audit) as a part of the Bills of Quantities (ETWB, 2000). The contractors are paid for those items when the specified activities are successfully performed and certified.

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. The Real Estate Developers Association of Hong Kong (REDA) and the Hong Kong Construction Association (HKCA) have jointly established and promoted the Pay for Safety Scheme (PFSS) in the private sector on a voluntary basis since October 2005. The operation of PFSS in the private sector is similar to that in the public sector. Since the scheme is on voluntarily basis and not too many privately developed projects have implemented PFSS as yet, the accident rates remain very high in the private sector. Therefore, more immediate efforts should be placed on site safety management in the private sector to remedy this unfavorable situation.

PFSS has been implemented within the Hong Kong construction industry for 15 years up to 2011. 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 in 1996. The number of fatal accidents has reduced progressively from 24 in 1995 to 14 in 1997 and the non-fatal accident rate has declined significantly from 62 accidents per 1,000 workers in 1995 to 55 accidents per 1,000 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 1,000 workers)
1995	24	62
1996	20	61
1997	14	55

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

Both Wong and So (2004) and Ng (2007) asserted that PFSS is an effective tool to improve construction safety by encouraging contractors to perform safely on-site. PFSS provides strong incentives to raise overall safety performance of the projects. Most of the contractors would try their best endeavors to carry out the stipulated safety measures so as to get the full payment. Fung et al. (2005) pointed out that the implementation of safety training, formation of safety committee and launch of safety audit under PFSS can enhance safety culture. A general review by the Safety and Environmental Advisory Unit (SEAU) of the Civil Engineering and Development Department revealed that the safety performance of those contracts under PFSS are generally better than non-PFSS contracts for works having similar nature (Chau and Lee, 2007). It has also been considered that some of the safety activities, especially the weekly safety walks, site safety management committee meetings and payment for site

safety items, do provide a strong impetus to contractors' site management towards better safety and are conducive to enhanced safety culture of contractors. Fung et al (2005) also advocated that 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). More descriptions of the development and application of PFSS in both the public sector and private sector of Hong Kong can be found from Chan et al. (2010).

5. Literature review of potential difficulties in implementing safety incentive schemes

The implementation of safety incentives may provide positive outcomes. However, some difficulties may be encountered during the implementation of safety incentives. Kheni (2008) reported that a large proportion of his survey respondents experienced some form of difficulties that hindered the effective safety scheme. These problems or difficulties might adversely affect the effectiveness of the safety scheme. Krause and Hodson (1998) expressed that the value of safety incentive schemes has been debated for a long time. The evidence as to whether they are effective safety management tools is ambiguous. Krause (1998) opined that the success of the safety incentives may depend on choosing an appropriate scheme for the particular situation. A review of the published literature indicates that common difficulties in implementing safety incentive schemes can be grouped under three major categories, namely: (1) challenges associated with workers; (2) challenges associated with contractors; and (3) prevailing subcontracting practice.

5.1 Challenges associated with workers

5.1.1 Low literacy level of workers

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

5.1.2 Poor safety attitude of workers

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

safety incentive program. Cheyne et al. (1998) expressed that the safety attitude of workers remains as the most pivotal factor in explaining safety activity.

5.1.3 High turnover rate of workers

In Hong Kong, the subcontracted labour is highly mobile. This high mobility of subcontracted labour makes the workers less familiar with the site working environment and the associated potential hazards, and difficult to follow the client's stipulated safety management program, which are the key factor contributing to the high accident rate (Poon et al., 2000). Kheni (2008) explained that uncertainty of demand was a key factor that compelled contractors to rely heavily on casual labour and labour only subcontractors. The casual labour may not work continuously at one construction site, and they may find it difficult in adapting to contractors' safety incentive scheme. The higher turnover rates are associated with the higher injury rates. Higher turnover means more new hires on the job. New hires have been noted as the workers who are most susceptible to being injured (Hinze, 1997). As a result, it is essential to place closer attention to the newly hired workers in order to ensure their work safety (Hinze, 1978 and 1990).

5.2 Challenges associated with contractors

5.2.1 Limited budget, human resources and facilities on site safety

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

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

5.2.2 Inadequate safety attitude of top managers

Lack of safety awareness of a firm's top management may exert an enormous hindrance in implementing safety incentive scheme. Both Sawacha et al. (1999) and Lingard and Rowlinson (1997) have demonstrated the importance of the top management's role in affecting the effectiveness of safety incentive scheme. Hinze and Raboud (1988) found that all successful safety incentive schemes must be supported by

top management. Furthermore, many site accidents are the results of management negligence. Several research studies (e.g. O'Toole, 2002; Lingard and Rowlinson, 1997; Sawacha et al., 1999) have warranted that safety performance is directly linked to the top management's perception on safety. Commitment and support from senior management are essential in bringing the accident rate down. Top management's commitment is thus crucial to the success of any safety programmes.

5.2.3 Poor organization of safety incentive program

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

5.3 Prevailing subcontracting practice

Ahmed et al. (1999) advocated that multi-level subcontracting is one of the key reasons in implementing safety incentives. Subcontractors are also seen as vital to good safety performance by contractors. The Hong Kong construction industry is characterized by its many levels of subcontracting, and coupled with a relatively weak regulatory system of controlling subcontractors, does have a major role to play in improving safety performance.

The situation of multi-layered subcontracting poses difficulties in implementing safety incentive schemes. In most of the cases, the communications between client, main contractor and subcontractors are inefficient that hinder the safety incentive schemes to be implemented effectively. The lower-tier subcontractors may not be fully aware of the client's stipulated safety requirements or any safety measures agreement that lead to adverse project performance, safety performance and ineffective implementation of safety measures (Yik et al., 2007; Wong et al., 2004).

6. Survey methodology

The research method used for this paper was to conduct an empirical questionnaire survey towards the key project stakeholders within the Hong Kong construction industry between March and May of 2009 to solicit their perceptions of the difficulties in implementing the Pay for Safety Scheme (PFSS). An empirical survey questionnaire was designed by incorporating individual difficulties associated with PFSS identified from the previous literature review. A total of 8 major potential difficulties of PFSS were identified and consolidated as individual statements on the survey questionnaire and followed by a "pilot" survey with a few well-experienced safety experts to verify the adequacy of items and clarity of the survey form. After the pilot survey, some items have been replaced and rephrased. So the final survey form was found sufficient, clear and appropriate. An extract of the blank survey form is attached in Appendix 1 for reference.

The final questionnaire comprised two essential sections. The first section was about respondents' personal profiles. The second section focused on the level of agreement on each of the identified difficulties in implementing PFSS with a five-point Likert

scale from 1 to 5, where 1 = strongly disagree; 3 = neutral / no comment and 5 = 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 difficulties on the survey form based on their personal discretion and actual experience but eventually no new difficulties were received from them. Thus, the enlisted 8 items describing the major difficulties in applying PFSS in Hong Kong were perceived to be adequate and clear for further data analysis.

6.1 Profile of survey respondents

The target group of survey respondents consisted of all the key project stakeholders participating in PFSS construction projects from relevant government departments, prospective private property developers and leading major construction contractors. They included contracts managers, project managers, site managers, safety managers, safety officers, safety supervisors, safety advisors, engineers and quantity surveyors. Altogether 329 sets of self-administered blank survey forms were sent to the target respondent groups by postal mail and electronic mail including those industrial practitioners working for both the client organizations and the main contractors. Electronic 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. Finally, 146 completed survey questionnaires were returned, representing 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 completed survey forms. Since all target respondents involved in PFSS projects in Hong Kong had been covered in the survey, the opinions and data collected could substantially reflect the perceptions of project population towards PFSS over the past decade of 1996-2009.

The 145 valid questionnaires included industrial practitioners working for client organizations (51%) and main contractors (49%). All the respondents were well-experienced construction professionals who should be able to provide 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 2). Over 93% of the respondents have acquired over 5 years of working experience with the industry and nearly 70% of them have obtained 15 years or above. All the respondents possessed hands-on experience in implementing PFSS, despite their different experience levels, nearly 40% of them had hands-on experience for over 5 PFSS projects so far (Table 2). The survey data were analyzed using the Statistical Package for the Social Sciences (SPSS).

6.2 Tools for data analysis

A four-level data analysis approach was adopted in this research as illustrated in Figure 3. At the first level, the individual factors were ranked in descending order of the mean scores on the difficulties in implementing PFSS. This shows an overall picture of the perceptions of survey respondents. At the second level, the agreement of different respondents on their rankings of difficulties based on the mean values within a particular group was checked by the Kendall's concordance analysis.

Table 2. Background information about the survey respondents

Information about respondents	Number of respondents	Percentage
A. Type of organization		
1. Client organization	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		
0	0	0%
1-2	49	33.8%
3-5	39	26.9%
6-8	13	9.0%
9-10	5	3.4%
More than 10	39	26.9%
Total	**145**	**100%**

At the third level, the association on the rankings of the various PFSS difficulties between any two survey groups was verified using the Spearman's rank correlation test. The data obtained from this research study were based on a 5-point Likert scale so the data were only ordinal in nature. The "concordance correlation coefficient" was first proposed by Lin (1989) for assessment of concordance with continuous data. So the Spearman's rank correlation test is appropriate in this study when both variables are measured at ordinal level.

At the fourth level, the Mann-Whitney U Test was applied to enable two-group comparisons to identify whether there is any individual factor on which different perceptions on the median values between any two groups of respondents were placed. It is also common to adopt the independent 2-sample t-test for this purpose. However, there are some underlying assumptions of the t-test, such as interval/ ratio levels of data, normally distributed population, random sampling and homogeneity of variance that the researcher must be aware of (Harris, 1995). If the stated assumptions are not met, the researchers should employ other ways of testing their hypotheses though using non-parametric statistical techniques. The Mann-Whitney U test may be used when the conditions for using the t-test are not satisfied (Taylor, 2005). The data variables analyzed by the Mann-Whitney U test must at least be on the ordinal level of measurement (Siegel and Castellan, 1988; Abdel-Kader and Dugdale, 2001; Love et al., 2004). A more detailed explanation on each statistical technique can be referred to Chan et al. (2010).

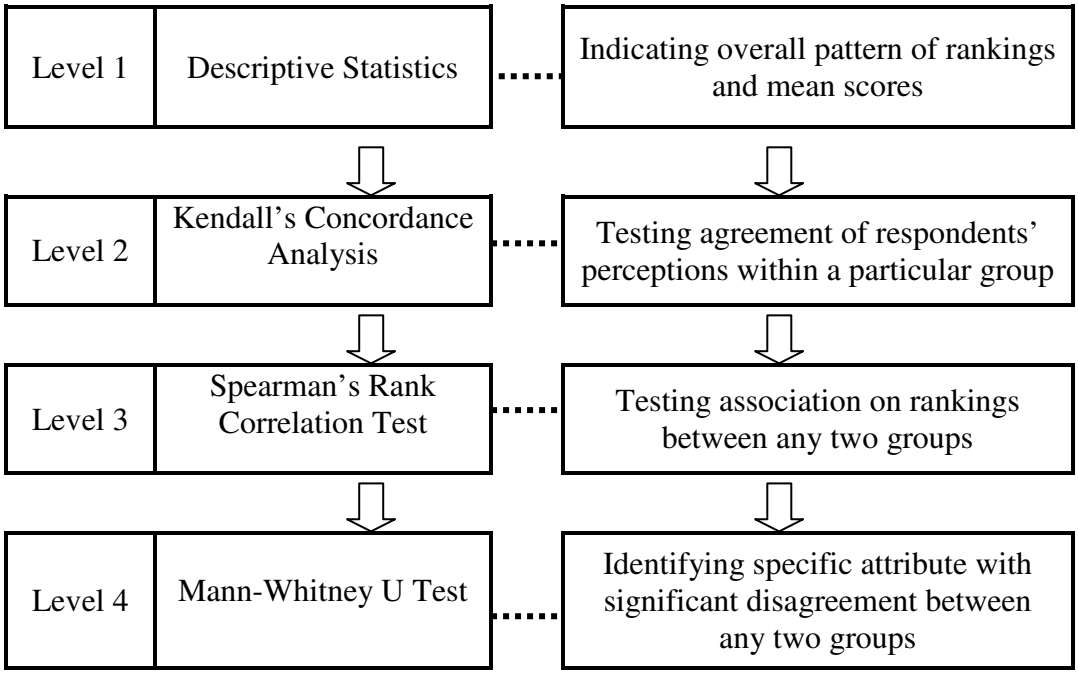

Figure 3. Four-level data analysis framework

6.3 Discussion of survey results

Results derived from the analysis of empirical questionnaire survey were cross-referenced to the published literature wherever appropriate and to complement each other for validation. Before the discussion of the survey results, the Cronbach's alpha reliability test was launched to check the internal consistency or reliability amongst the responses under the adopted scale of measurement regarding the potential difficulties of PFSS. In this study, the Cronbach's alpha coefficient for the eight rated difficulties of PFSS was 0.894 which was much higher than the threshold value of 0.70 according to Norusis (2002). It was indicated that the 5-point Likert scale used for measuring the PFSS difficulties is internally consistent and reliable at the 5% significance level.

6.3.1 Agreement of respondents within each survey group

The potential difficulties encountered with PFSS in construction were evaluated from two different perspectives, namely, the client group and the contractor group. The mean of each potential difficulty for each respondent group were calculated and each difficulty was ranked in descending order of the mean values within a particular group as shown in Table 3. The Kendall's coefficient concordance (W) for the rankings of difficulties among all respondents was 0.137; among the client group was 0.173; and among the contractor group was 0.155. The computed W's were all statistically significant with a significance level of less than 0.001.

Since the number of attributes considered were above seven, and as mentioned before the chi-square value would be referred to rather than the W value. According to the degree of freedom (8 – 1 = 7) and the allowable level of significance of 5%, the critical value of chi-square from table was found to be 14.07 (Siegel and Castellan, 1988). For all the three groups (i.e. all respondent group, client group and contractor group), the

actual computed chi-square values were all well above the critical value of chi-square from table of 14.07. They included 139.303, 89.681 and 76.823 for "all respondent group", "client group" and "contractor group" respectively (Table 3). 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 amongst the respondents within each survey group and all respondents on the rankings of the potential difficulties of PFSS. The concordance test ensures the data and opinions collected from the questionnaire survey to be valid and consistent for further analysis.

Furthermore, the dispersion of ratings for each difficulty among the respondents was also tested by using the standard deviation (SD). It shows how much variation or "dispersion" there is from the mean. A low standard deviation indicates that the data points tend to be very close to the mean, whereas a high standard deviation denotes that the data are spread out over a large range of values. In this study, the standard deviation of each item among the respondents was about 1 (Table 3). A low standard deviation of about 1 reflected that the respondents shared significant level of agreement on rating each item.

6.3.2 Overall ranking of the difficulties of PFSS

The mean values for the difficulties as rated by all respondents ranged from 2.70 to 3.47. For those rated by respondents working for client organizations, the mean value ranged from 2.42 to 3.16 while those scored by respondents from contractors the mean value spanned from 2.99 to 3.79. The results showed that the respondents from the contractor group rated these difficulties in general much higher than those from the client group. It can therefore be interpreted that the respondents from the contractor group were more agreeable to the difficulties (all the mean values above 3 except Item 7) than the client group. In other words, the respondents from the contractor group encountered more difficulties in introducing PFSS to their projects than those from the client group.

All the respondents discerned and ranked Item 1 "Plenty of paperwork required for certifying payment to contractor", Item 2 "Complicated contract documents and lengthy assessment process" and Item 5 "Over-tight project schedule requiring rush jobs" to be the top three difficulties associated with PFSS. Such ranking reflects that most of the respondents always encountered these three difficulties under PFSS. The survey results reinforce the research findings reported by Ng (2007) in that both plenty of paperwork and complicated contract document and process were found to be the primary obstacles of implementing PFSS in construction. The payments of most of the payable safety items had to be certified through the submission of relevant documents by the contractors for verification. Therefore, contractors were required to compile a lot of written records for each safety-related item so as to obtain the payment, e.g. minutes of every site safety meeting. The process of relaying the documents from one party to another was time consuming. The processing duration would be even longer if the client does not grant the payment directly and requires further clarifications by the contractor. Chan and Kumarawamy (1996) explained that a project is regarded as successful if it is completed on schedule, within target budget and to the level of quality standard specified by the client. Therefore, over-tight project schedule may pose a difficulty to both the client and contractor to launch PFSS.

Table 3. Results of the Ranking and Kendall's concordance test for the potential difficulties of PFSS

No.	Difficulties in implementing PFSS	All Respondent Group		Client Group		Contractor Group	
		Mean	Rank	Mean	Rank	Mean	Rank
1	Plenty of paperwork required for certifying payment to contractor	3.47	1	3.16	1	3.79	1
2	Complicated contract documents and lengthy assessment process	3.36	2	3.12	2	3.61	3
5	Over-tight project schedule requiring rush jobs	3.32	3	2.96	3	3.69	2
3	Difficult to suit the safety requirements of different employers.	3.10	4	2.68	4	3.54	4
6	Unfamiliarity with PFSS by clients and contractors	2.89	5	2.64	5	3.15	7
4	Difficult to arrange staff and time to attend safety-related activities, e.g. safety training, weekly site walk, etc.	2.87	6	2.57	6	3.18	6
8	Lack of government financial support	2.83	7	2.20	8	3.49	5
7	Low level of safety awareness by senior management	2.70	8	2.42	7	2.99	8
	Number (N)	145		74		71	
	Kendall's coefficient of concordance (W)	0.137		0.173		0.155	
	Actual calculated chi-square value	139.303		89.681		76.823	
	Critical value of chi-square from table	14.07		14.07		14.07	
	Degree of freedom (df)	7		7		7	
	Asymptotic level of significance	<0.001		<0.001		<0.001	

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

Reject H_0 if the actual calculated chi-square value is larger than the critical value of chi-square from table

Note: Items were rated on a 5-point Likert scale (1 = strongly disagree; 3 = neutral / no comment and 5 = strongly agree).

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

However, there was a noticeable variance between the rankings of client group and contractor group on Item 8 "Lack of government financial support", ranked as the 8th by client group and 5th by contractor group. It may be attributed that the 2% of contract

sum allocated for carrying out the payable safety items is not sufficient from the contractors' point of view in general whereas the clients perceive as adequate. Thus, the respondents from contractor group assigned a higher score to this particular difficulty.

Since the respondents were requested to rate the eight major PFSS difficulties according to a Likert scale from 1 to 5 (where 1 = Strongly Disagree; 3 = Neutral / No Comment and 5 = Strongly Agree), a value of above "3" would represent general agreement to a certain difficulty. Altogether, six out of eight difficulties scored below the middle value of "3" for the client group (Figure 4). In other words, this result indicated that the client group respondents agreed with two difficulties only, i.e. Item 1 "Plenty of paperwork required for certifying payment to contractor" (mean = 3.16) and Item 2 "Complicated contract documents and lengthy assessment process" (mean = 3.12), towards their projects under PFSS. As most of the PFSS difficulties in client group were given a lower score of less than 3, it can be interpreted that the clients did not perceive the implementation of PFSS as a major trouble. Nevertheless within the contractor group, these two difficulties also achieved a high mean value of "3.79" and "3.61" respectively. And there was only one item (Item 7 "Low level of safety awareness by senior management") was rated below the middle value of "3". The results suggested that the contractors often encounter more difficulties in introducing PFSS to their projects than the clients.

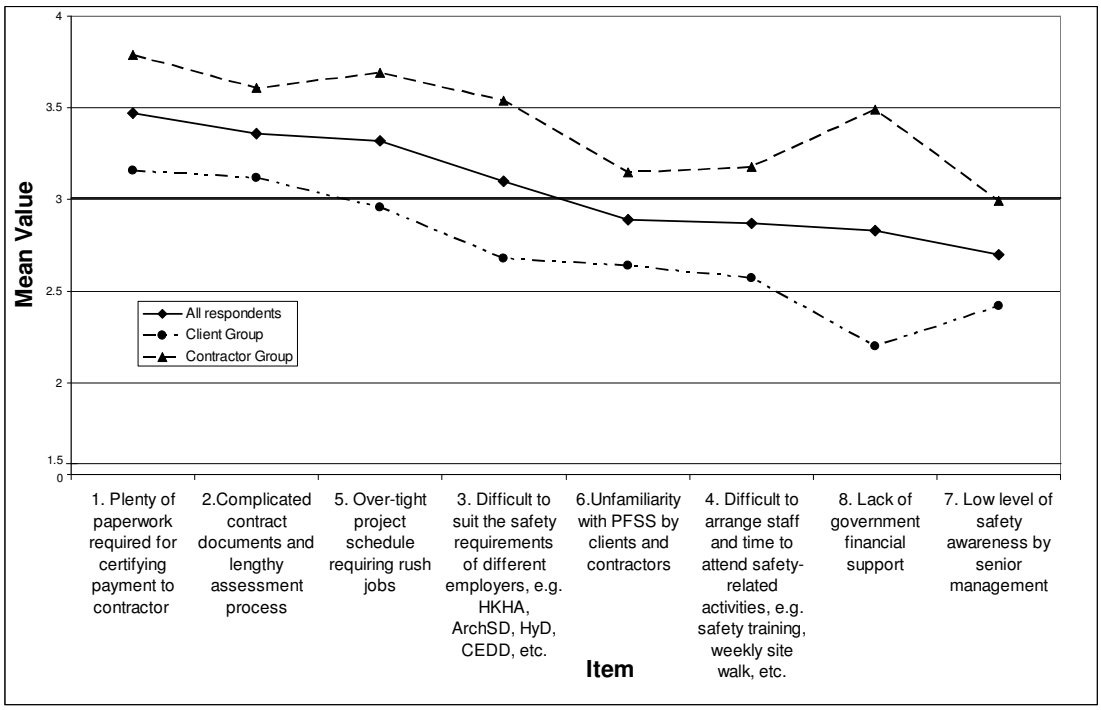

Figure 4. Line graph of the mean scores for the difficulties of PFSS across different respondent groups

6.3.3 Agreement of respondents between client group and contractor group

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

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

Table 4. Results of the Spearman's rank correlation test between the client group and contractor group of respondents on the difficulties of PFSS

Comparison of rankings	r_s	Significance level	Conclusion
Client ranking vs Contractor ranking	0.810	0.015	Reject H_0 at 5% significance level

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

H_a = Significant correlation the rankings between two groups

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

6.3.4 Results of Mann-Whitney U test

In addition, the Mann-Whitney U test was adopted to examine if there were any significant differences in the median values of the responses between the two respondent groups on each of the eight difficulties in launching PFSS under scrutiny. When the actual calculated p-value is below the prescribed significance level of 0.05 for a certain difficulty, a large variation in the median values is detected. As indicated in Table 5, the p-values of all eight difficulties were less than 0.05. Significant differences in the mean rank between the client group (ranging between 51 and 63) and the contractor group (ranging between 83 and 95) were found in all eight items. This result has reinforced that the respondents from the contractor group were in general more agreeable to the difficulties and hence rated them much higher than the client group.

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

payable safety items are determined well in advance within the tender documents. In some projects, the contractors may find it difficult in allocating necessary resources for carrying out all safety items because of insufficient government financial support to safety-related issues in construction.

Table 5. Results of the Mann-Whitney U test between client group and contractor group on the difficulties of PFSS

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

7. Conclusions and recommendations

The application of incentives may be effective in reducing workplace injuries, but this may depend on how the incentives are structured as incentives themselves without safety culture may not positively affect the safe work behaviors (Champoux and Brun, 2003). The major objectives of this paper were to review the current state of application of PFSS and to investigate the key potential difficulties in implementing PFSS within the Hong Kong construction industry as perceived by clients and contractors. A total of eight statements describing various PFSS difficulties were compiled from the published literature 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 amongst the survey respondents.

The computation of Kendall's coefficient of concordance showed that the responses within each group (i.e. all respondent group, client group and contractor group) were consistent, implying that the survey respondents were essentially applying the same standard in ranking those difficulties of PFSS and hence their opinions were valid and

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

After determining the key difficulties in applying PFSS in construction projects, some improvement measures are recommended to facilitate the smooth implementation of PFSS. To mitigate the problems associated with complicated payment certification and lengthy assessment process, some survey respondents suggested that standardised safety payment forms or checklists have to be designed. There exists a strong need to review and revise the old payment forms or checklists, so as to speed up the assessment and certification process. The design of the new and revised payment forms/checklists should be made through extensive consultations with those senior industrial practitioners involved in site safety management. The research conducted by Ng (2007) pointed out that "Increase promotion on PFSS within the industry" is regarded as a key recommendation on PFSS. PFSS has not yet been widely used and accepted in the whole construction industry of Hong Kong. Since this scheme is now mainly applied to public works contracts and has started launching in the private sector since October 2005, many of the private property developers and main contractors lack direct hands-on experience with PFSS. More promotion on the perceived benefits and implementation procedures of PFSS should be carried out so as to increase public awareness and wider application in Hong Kong.

To sum up, PFSS can be an effective means of motivating contractors to achieve more favorable safety performance on construction sites. As PFSS has been introduced for over 10 years since 1996 in Hong Kong, such an industry-wide investigation of the major potential difficulties encountered is timely and indispensable, especially in the local context. The survey results have provided strong evidence and useful pointers to assist key project stakeholders in mitigating the hindrances caused by potential difficulties in order to make PFSS succeed. The research study has also made substantial contributions to new knowledge and practical information of PFSS applications and implementation for the whole construction industry, so as to drive for excellence in site safety. By reducing the occurrence of major difficulties, more applications of PFSS across a wide spectrum of the construction industry are anticipated with the purpose of delivering projects with far less casualties.

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Appendix 1: 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. Difficulties in implementing PFSS

Please rate the level of agreement on the following difficulties that you had encountered when implementing PFSS.

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

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 ~