**University of Western Sydney, Hawkesbury**

In Conjunction with

**The Hong Kong Polytechnic University**

# A Study of Application of Positive Safety Performance Indicators in Hong Kong Construction Industry

By

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## Declaration of Originality

The following work has been completed by the author in the form of a coursework research project report as part of the Master of Applied Science (Safety Management) at the University of Western Sydney, Hawkesbury, in conjunction with The Hong Kong Polytechnic University under the supervision of Mr. Peter Mok.

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of a university or other institute of higher education, except where due acknowledgment has been made in the text.

Student signature : _____

Student Name : SO KA YEE

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**Abstract**

Performance measurement is an essential aspect of monitoring and evaluating Occupational Health and Safety (OHS) performance in construction industry. Measuring performance can determine whether objectives or targets are being met by companies. The measurement of OHS performance has traditionally focused on the measurement of outcomes, such as the lost time injury frequency rate. The limitations associated with reliance on negative outcome measures as an indication of OHS performance have made it necessary for industries to consider other proactive measures, such as positive safety performance indicators, to measure their health and safety performance. The process or safety positive performance indicators (PPIs) measure safe behaviour rather than unsafe behaviour. These indicators provide essential feedback on performance before accidents occur. These on-going measures will be able to monitor the safety performance on site.

This research studies the application of safety positive performance indicators in the Hong Kong Construction Industry. 38 construction sites were successfully invited to participate to discuss the status of their development and application of performance indicators. Questionnaires were also sent to workers of these sites to collect data about their safe behaviour. The study discovered that a number of construction sites are developing and applying PPIs to varied extent, and safe behaviour of workers at these sites are stronger than those construction sites which have not yet developed positive performance indicators. The findings also supported that PPIs are proactive measures which can improve workers' safe behaviour, and supported that PPIs do serve as useful guidelines to assist the Construction industry to improve their safety. Finally, this project thesis also suggests ways to develop and select PPIs for Hong Kong

construction sites.

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# 1 Introduction

## 1.1 Background of the research

Safety at work is a complex process, and the subject of safety attitudes and safety performance in the construction industry are good examples. In the Hong Kong construction industry the risk of fatality and injuries are quite high (see Figures 1, 2 & 3). Apart from the human cost of suffering an accident, the economic effect can be devastating . Every one dollar of an accident cost, that an insurance company has to pay out, could cost the contractor between five dollars to fifty dollars in indirect costs. These indirect costs will range from product and material, to legal costs (Crocker, 1995).

| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Construction Industry | 0.851 | 0.771 | 1.423 | 0.854 | 0.960 | 0.681 | 0.502 | 0.709 | 0.663 | 0.364 |
| Manufacturing Industry | 0.012 | 0.013 | 0.01 | 0.016 | 0.015 | 0.027 | 0.013 | 0.008 | 0.008 | 0.013 |
| Catering Industry | 0.005 | 0.011 | 0.005 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 |

Figure 1 : Industrial Fatalities Rate per 1,000 workers by Selected Industries between Year 1991 to 2001

**Source: Labour Department, (2001)**

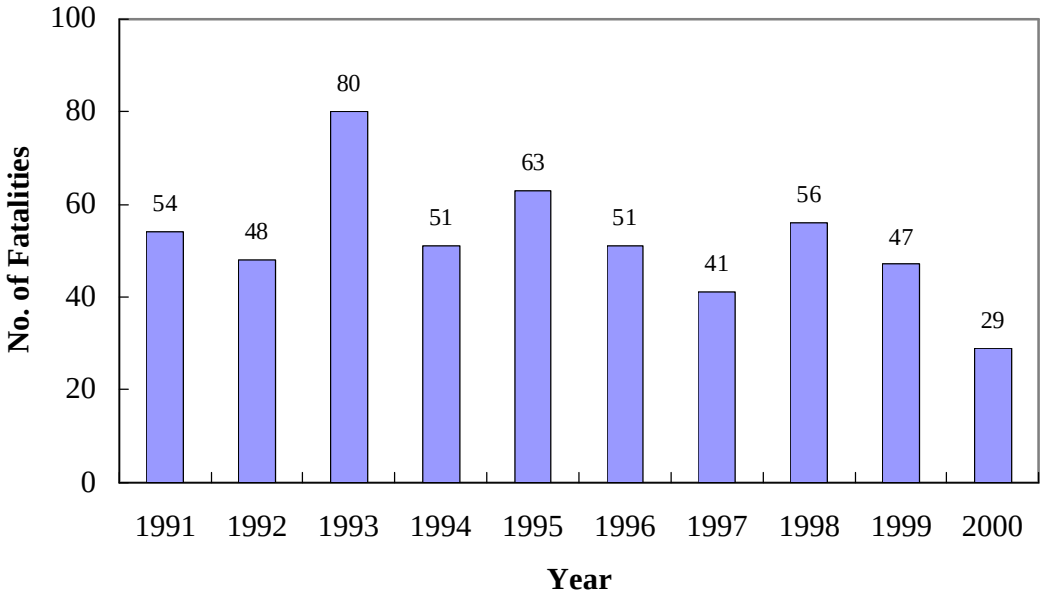



Figure 2 : Number of Industrial Fatalities in Construction Industry between Year 1991 to 2000

**Source: Labour Department, (2001)**

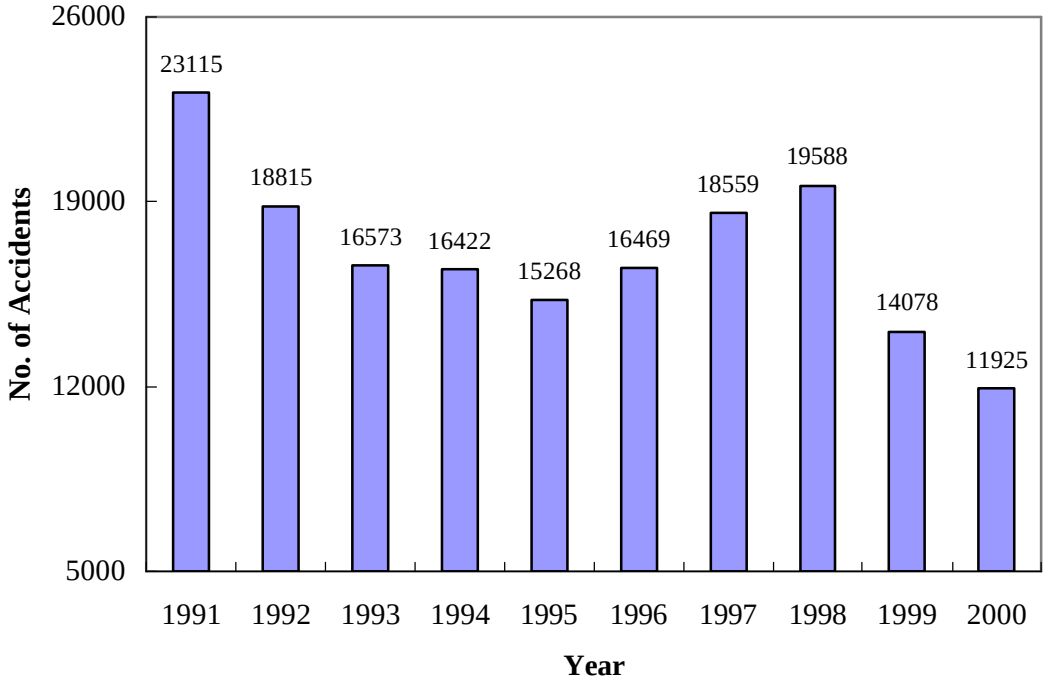



Figure 3 : Number of accidents between Year 1991 to 2000

**Source: Labour Department, (2001)**

In general, accidents at work occur either due to lack of knowledge or training, a lack of supervision, or a lack of means to carry out the task safely, or alternatively, due to an error of judgment, carelessness, apathy or downright reckless. In addition to these factors, the short term and transitory nature of the construction industry, the lack of a controlled working environment and complexity and diversity of the size of organizations, all have an effect on safety performance within the industry. In construction, it is suggested that ' unsafe behaviour' is the most significant factor in the cause of a poor safety culture (Dester and Blockley, 1995). Nevertheless, Coleman (1991) said that nearly 90% of all construction accidents leading to death could have been prevented, 70% by positive management action.

' Safety pays!' But, when it comes to putting that concept into practice, very few are actually successful at it. Reasons given include it is costly or it is a waste of time or it is not the main cause of failure. However the real problem is that there is not enough guidance as to how to improve safety performance on site. Traditional measurement approaches include accident investigations, inspections and job safety analyses. The question often posed is whether or not these statistics reflect the actual safety effectiveness on site? Almost always they do not. These numbers often just tell how lucky or unlucky the site has been and do not reflect the level of effectiveness of safety performance on site. The key question is, if this reactive, backward looking approach does not portray the true picture, what is the best approach?

What the industry needs is a new paradigm for measuring safety performance on construction sites i.e. a proactive approach rather than just depending on the reactive data. The proactive approach, such as positive performance indicators, measures site

activities. It measures safe behaviour rather than unsafe behaviour. The proactive approach is able to provide essential feedback on performance before incidents occur. These on-going measures will be able to monitor the safety performance on site.

## 1.2. Hong Kong Industrial Safety

Safety can be viewed in the most basic terms as the prevention of accidents. Over the past ten years, problems in industrial safety were really a headache to the Hong Kong Government. The accident frequency and the fatal accident statistics were comparatively higher than other industries and had remained at an unacceptably high level (see figures 4 & 5). In response to the problem of safety in the Hong Kong construction Industry, client reaction to safety performance is one of the major factors. Most developers only focus on the speed of construction and ignore the safety standard. In addition, the problems of labour intensity of the tasks, competitive element in tendering, expansion of subcontracting and long working hours are also the key factors attributing to the poor safety record in Hong Kong Construction Industry.

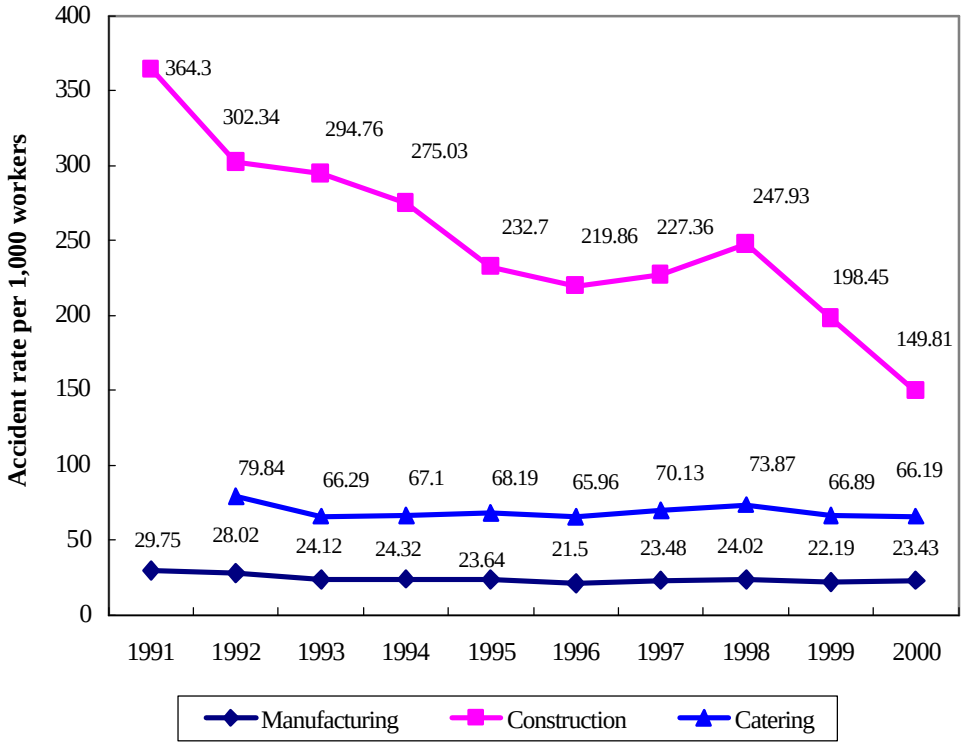



Figure 4 : Industrial Accidents Rates per 1,000 workers by Selected Industry the year 1991 to 2000

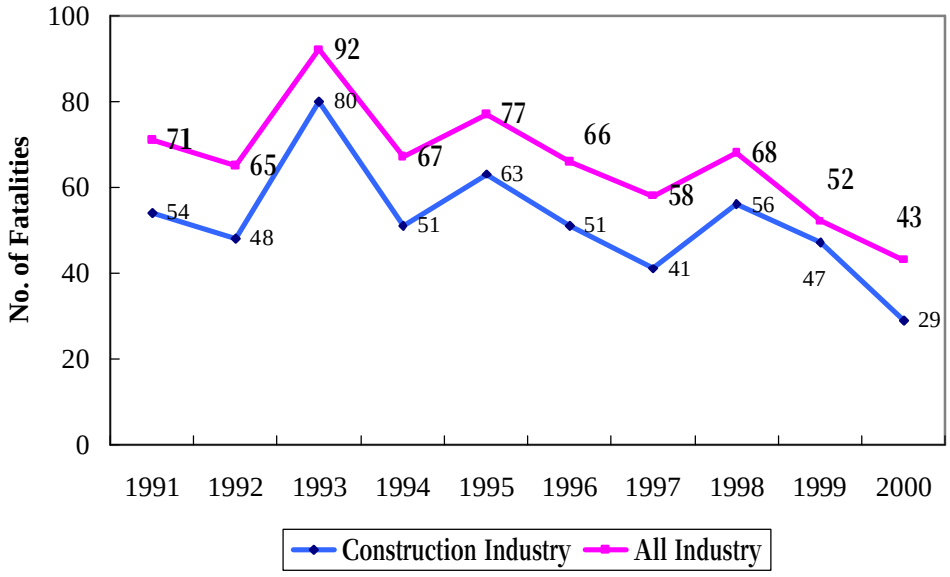



Figure 5 : Number of Industrial Fatalities between Year 1991 to 2000

**Source: Labour Department, (2001)**

Over the past three decades, the Hong Kong Government adopted an "prescription approach" to enforce industrial safety regulations in Hong Kong. It has been considered to be reactive and non-incentive. In this approach, actions would be taken only after accidents occurred. In response to the very bad situation in workplace safety in particular the construction industry, the Government disseminated a 'Consultation Paper on the Review of Industrial Safety in Hong Kong" in July 1995 proposing new strategies in industrial safety of transforming the latter from an enforcement approach to a safety management approach. A new set of regulations are enforced which will encourage employers and employees to manage safety on a self-regulatory manner through education, training, promotion of safety awareness and a better understanding of the costs of accidents (Hong Kong Government, 1995). Then, in 1997, the government enacted the Occupational Safety & Health Ordinance offering a wider coverage of safety in the workplace by the inclusion of workers from the non-industrial settings. In 1998, the self-regulatory safety management regulations which include the implementation of safety auditing system became legislated.

### 1.3. Safety Auditing in Public Works

The Works Bureau is the government department responsible for the construction of public civil engineering works in Hong Kong. Before the commencement of the safety auditing system required by law, it initiated the Pay For Safety Scheme (Hong Kong Government, 1996a) to encourage safety promotion among its contractors. About 2% of the contract sum is allowed in the bill of quantities for provision of site safety organization, safety inspection, safety training and safety auditing. The audit system being adopted in this scheme is designated as an Independent Safety Audit Scheme (Hong Kong Government, 1996b) which was developed by the Occupational Safety &

Health Council by modifying from an UK proprietary safety auditing system named "CHASE". At the same time, the Housing Authority of the Government supported the move and imposed the same scheme in their housing contracts as well. The audit system delineated fourteen key process elements for monitoring the safety performance of the contractors' management (Hong Kong OSHC, 1996).

### 1.4. Common Methods of Performance Measurement

Performance measurement is an essential aspect of monitoring and evaluating OHS performance in a company and/or industry. Construction companies typically measure employees' performance to determine whether objectives or targets are being met. Measuring occupational Health and Safety (OHS) performance will help construction industry identify and evaluate OHS improvement strategies. It is critical that construction industry use this information to better understand and monitor their OHS performance. There are numerous areas within a company where performance monitoring can take place. Some examples include production, finance or costs, environmental aspects and the health and safety of workers. One of the primary objectives of measuring OHS performance is to provide feedback regarding health and safety performance for improvements in this area.

In order to measure particular aspects of a construction company's OHS performance, performance indicators are developed for areas that are to be monitored. The New South Wales Health Department (1998) defines a performance indicator as ' a statistic or other unit of information which reflects directly or indirectly, the extent to which an anticipated outcome is achieved, or the quality of processes leading to that outcome. " Performance indicators can be either:

a) Quantitative - an indicator that can be counted or measured and is described numerically. For example, number of safety audits conducted.

b) Qualitative - an indicator that would describe or assess a quality or a behaviour. For example, worker ratings of management commitment to achieving ‘ best practice’ in OHS.

The benefits associated with the introduction of a performance measurement system for OHS include:

- the ability to provide an indication of how a company is performing in relation to OHS issues;
- the ability to identify problem areas where adverse outcomes are occurring and subsequently to identify where preventive action should take place;
- the ability to document effects of attempts to improve OHS. For example, a
- measurement system could provide feedback as to whether implemented safety interventions are operating adequately;
- the ability to promote OHS reviews of existing work practices and work organisation;
- the use of performance measures for benchmarking or comparative performance assessment.

### 1.5. Types of Performance Indicators

Measurement of safety performance can involve either outcome-focused or process-focused (also known as positive) indicators of performance.

A. Outcome indicators

These indicators have typically focused on the measurement of loss, such as lost time injury frequency rates (LTIFR), workers’ compensation costs or fatality incidence

rates. Advantages of outcome indicators are:

- relatively easy to collect;
- easily understood;
- obviously linked with safety performance;
- easily compared for benchmarking or comparative purposes; and
- are able to be used to identify trends.

However, relying solely on outcome measures of OHS performance as a means of providing information regarding the performance of OHS has its limitations.

For instance:

- injuries and fatalities have a low probability of occurring, and so the absence of unlikely events alone is not a useful indicator of OHS management;
- when LTIFR is low, this rate does not provide adequate feedback for managing OHS;
- outcome indicators largely measure negative performance, i.e. failure;
- outcome indicators are subject to random variation;
- outcome indicators may involve under- or over-reporting of work-related injuries or disease;
- outcome indicators do not accurately measure long latency occupational diseases. For example, musculoskeletal disorders and cancers can be difficult to attribute to work;
- outcome indicators measure actual injury severity, not necessarily the potential seriousness of the incident; and
- outcome indicators generally reflect the outcomes of past OHS practices, because there is often a time lag before OHS outcomes reflect changes in OHS practices.

As a result of the failure of outcome indicators on their own to provide an adequate indication of how OHS is managed in a company, health and safety professionals and organisations have identified a need for additional measures of OHS performance (Ojanen et al, 1988; Aims & Booth, 1992; Kletz, 1993; NOHSC, 1994; Glendon & Booth, 1995; Shaw & Blewett, 1995). Such measures focus on the management of OHS in a company and highlight areas in health and safety where systems and procedures could be improved.

There are many health and safety activities conducted by companies that could be used to generate additional measures of OHS. These indicators would focus on how successfully an enterprise or an industry is managing and performing in relation to OHS. These indicators are often described as process or positive measures of performance.

### 1.6. Positive Performance Indicators

Positive performance indicators focus on assessing how successfully a workplace or company is performing through monitoring the processes which should produce good OHS outcomes. Positive performance indicators allow for timely and detailed information regarding the process of managing OHS to be recorded. That is, the type and frequency of health and safety activities that are undertaken by the construction company. This information can then be used to identify strategies that are working well and other areas in health and safety that require improvement. Positive indicators can be used to measure relevant OHS systems, processes, management and compliance with OHS practices in the workplace. Examples of positive performance indicators include the number of safety audits conducted; the percentage of

sub-standard conditions identified and corrected as a result of a safety audit; and the percentage of workers receiving OHS training. Advantages of utilising positive indicators of OHS performance to supplement outcome indictors include:

- the ability to measure and evaluate the effectiveness of OHS management;
- he provision of immediate feedback mechanisms regarding the management of OHS; and
- provision for immediate improvements to be made to OHS performance, if required.

A number of the positive performance indicators were identified in this research project. They relate to OHS management systems, communication, consultation and training, as well as to management processes and planning and design. These indicators reflect processes designed to maintain a high level of OHS. It is often suggested that this is best achieved by the development and implementation of the processes and systems through close consultation and agreement with workers.

The following are some of ways to use positive performance indicators:

- Firstly, the management and the workforce should collaborate and discuss the results of the indicators to help determine what needs to be done to improve health and safety in the enterprise.
- Secondly, the indicators should be used to identify areas where improvements can be made regarding health and safety.
- Thirdly, collecting positive performance data will not in itself improve the companies' performance - there is no substitute for just doing a good job.

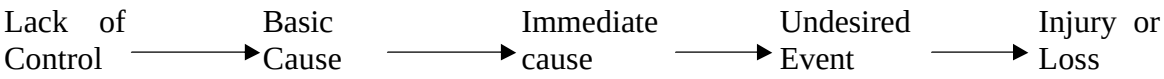
- Lastly, there is flexibility in the use of positive performance indicators. The use depends on the needs of the enterprise. For example, the selection of positive performance indicators can be targeted to the enterprise's overall priorities or needs, or they can be used to help improve the performance on particular projects.

The aim of this project research is to study the application of positive performance indicators in the Hong Kong Construction Industry and its contribution to OHS management system. Information regarding OHS performance measurement was gathered from construction companies by surveying 38 civil and building projects. This research also aims to suggest ways to develop and select appropriate positive performance indicators which can lead to improve OHS performance.

# 2 Literature Review

## 2.1 Factors Attributing to Injury

Research has shown that the development and implementation of effective safety programs reduces accidents (Liska, Goodle & Sen 1993). Heinrich (1959) performed research on the conditions and circumstances that surround industrial accidents and developed an accident-cause analysis theory. The “Domino Theory” as it is known is shown in the following figure. The "basic causes" block refers to factors such as a lack of motivation and other factors such as hazards left uncorrected. The latter is a factor for which management has much control. So, a quick assessment of the Domino Theory suggests that management is the most important factor in the accident sequence.




**Domino Theory**

Safety breaches may or may not result in work-related fatalities. Some of the well known incidents that involved breaches of safety include the Three Mile Island and Chenobyl nuclear power plant incidents, the leak of methyl isocyanate in Bhopal, the Piper Alpha oil and gas rig explosion and fire, the Challenger space shuttle explosion, and the Moura mine No. 4 and No. 2 explosions and the Longford gas explosion in Australia. The investigations conducted following incidents such as these often provide an analysis of the factors that contributed to the occurrence of the particular incident. Similarly, a number of research studies have identified factors, including organisational, workplace and workforce characteristics, that have been found to be associated with either good or poor safety performance at the workplace or organisational level (see Table 1 & Table 2).

It is apparent from the literature that there are some contradictory findings regarding what factors contribute to the successful management of health and safety in construction companies (Hale & Hovden, 1998). Findings from research studies indicate that the type of construction companies' practical application of OHS initiatives can have an influence on the outcomes for the companies (Hale & Hovden, 1998). It should also be acknowledged that there may also be a number of external influences impacting on construction companies that could influence the relationship between particular organisational factors and OHS performance. In some cases, it may not be possible to establish clear links between organisational characteristics and safety performance (Hale & Hovden, 1998).

However, many of the investigations that were conducted involving major breaches of safety found that organisational and management factors played a predominant role as the precursor to the failure of systems that resulted in the incidents occurring (Nichols & Marcus, 1990). Also, research studies found several organisational factors that were found to either be associated with good (see Table 1) or poor (see Table 2) performance regarding injury experience.

**Table 1. Organisational factors reported to be associated with lower injury experience**

| **Organisational factors** | **Research studies** |
|---|---|
| Larger firm size | Salminen, Saari, Saarela & Rasanen 1993; Wooden & Roberston, 1997 |
| Regular safety audits conducted | Smith, Cohen, Cohen & Cleveland 1978; Shannon, Mayer & Haines 1997; WorkSafe WA, 1998 |

| **Organisational factors** | **Research studies** |
|---|---|
| Top management actively involved in safety and strong commitment to safety | Simonds & Saafai-Sahrai, 1977; Cohen, 1977; Smith et al, 1978; Osborn & Jackson, 1988; Shannon et al, 1996; Shannon et al, 1997 |
| Good injury record keeping | Simonds & Saafai-Sahrai, 1977 |
| Use of accident cost analysis | Simonds & Saafai-Sahrai, 1977 |
| Use of standard operating procedures | Gun & Ryan, 1994 |
| Information regarding safety is highly organised and readily accessible | WorkSafe WA, 1998 |
| Presence of effective health and safety committees and fewer complaints and serious citations by a health and safety body | Boden et al, 1984; Gallagher, 1997; Hale & Hovden, 1998 |
| Good communication and good relations between management and workers | Cohen, 1977; Smith et al, 1978; Shannon et al, 1997; WorkSafe WA, 1998 |
| Defining health and safety in every manager' s job description | Shannon, 1998 |
| Importance of health and safety in Manager' s annual appraisals | Shannon, 1998 |
| Attendance of senior managers at health and safety meetings | Shannon, 1998 |
| Involvement of supervisor in accident prevention | Smith et al, 1978; Simard & Marchand, 1994 |
| Highly developed safety structures, comprehensive written procedures and clearly identified areas of responsibility for safety | WorkSafe WA, 1998 |
| Attitudes or perception of safety can be useful in identifying characteristics of the workforce' s safety climate | Zohar, 1980; Dedobbeleer & Beland, 1991 and 1998; Coyle et al, 1995; Shaw & Blewett, 1996; Williamson, et al, 1997; Hayes et al, 1998; WorkSafe WA, 1998 |
| Good management in the utilisation of resources and production planning and monitoring | Smith et al, 1978 |

| Organisational factors | Research studies |
|---|---|
| Some association found between safety training of management and reduced risk of injury | Gun & Ryan, 1994 |

**Table 2. Organisational factors reported to be associated with a poor record regarding injury experience**

| Organisational factors | Research studies |
|---|---|
| Hurried completion of job associated with greater injury/ incident rates | Salminen et al, 1993 |
| Accident risk greater for sub contractors than main contractors | Salminen et al, 1993; WorkSafe WA, 1998 |
| Poor correlation found between presence of a safety audit system and accident performance in South African mines | Eisner, 1993 |
| Use of safety bonuses and increased risk of injury | Gun & Ryan, 1994 |
| Existence of a health and safety policy not related to lower LTIFR | Smith et al, 1978; Shannon, 1998 |
| Status of health and safety officer in the organisation not related to lower LTIFR | Shannon, 1998 |

Two factors in the workplace (good housekeeping and provision of safety devices on machinery) were found to consistently be associated with reduced injury experience in an enterprise (see Table 3).

**Table 3. Workplace factors reported to be associated with lower injury experience**

| Workplace factors | Research studies |
|---|---|
| Good housekeeping | Simonds & Saafai-Sahrai, 1977; Cohen, 1977; Smith et al, 1978; Shannon et al, 1997; Harper & Koehn, 1998 |
| Safety devices on machinery | Simonds & Saafai-Sahrai, 1977; Shannon et al, 1997 |

The workforces of enterprises with good safety records were shown to have a number of characteristics, such as experience and workers who had received training, which distinguished them from enterprises with poor safety records (see Table 4).

**Table 4. Workforce characteristics reported to be associated with lower injury experience**

| Workforce characteristics | Research studies |
|---|---|
| More experienced workforce less likely to have an incident | Simonds & Saafai-Sahrai, 1977; Shannon et al, 1996; Wooden & Roberston, 1997; Harper & Koehn, 1998; Shannon, 1998 |
| Lower employee turnover and absenteeism | Smith et al, 1978; Shannon et al, 1997; Harper & Koehn, 1998; Shannon, 1998 |
| Trained workforce | Cohen, 1977; Gun & Ryan, 1994; Shannon et al, 1997; Harper & Koehn, 1998; WorkSafe WA, 1998 |
| Involvement of workers in decision making process | Shannon et al, 1996; Shannon et al, 1997; Harper & Koehn, 1998; WorkSafe WA, 1998; Shannon, 1998 |

## 2.2 Safety Climate and Safety Performance

Safety climate is argued to be one of the contributors to the climate in organisation, conceptualised by Zohar (1980) as a summary of the beliefs and perceptions of employees about safety in the workplace. In its original conception, it was assumed that the safety climate acts as a frame of reference which guides behaviour, such that employees develop "coherent sets of perceptions and expectations regarding behaviour-outcome contingencies and behave accordingly" (Zohar, 1980). Based on these common themes among safety climate definitions, as indicate in Table 5, a general definition can be derived that safety climate is a summary concept describing the safety ethic in an organisation or workplace which is reflected in employees' beliefs about safety and is thought to predict the way employees behave with respect to safety in that workplace.

**Table 5. Definition of Safety Climate**

| Source | Definition |
|---|---|
| Bureau of Air safety Investigation (1996) | The procedures and rules governing safety within an organization are a reflection of its safety climate, which is centered around employees perceptions of the importance of safety and how it is maintained within the workplace. |
| Cheyne, Cox, Oliver, & Thomas (1998) | Safety climate can be viewed as a temporal state measure of culture, which is reflected in the shared perceptions of the organization at a discrete point in time. |
| Dedobbeleer & Beland (1991) | Safety climate is viewed as an individual attribute, which is composed of two factors: management' s commitment to safety and workers' involvement in safety. |
| Flin, Mearns, Gordon, & Fleming (1998) | Safety Climate refers to the perceived state of safety of a particular place at a particular time. It is therefore relatively unstable and subject to change depending on features of the operating environment. |

| Source | Definition |
|---|---|
| Flin, Mearns, O'Connor, & Bryden (2000) | Safety climate is the surface features of the safety culture discerned from the workforce's attitudes and perceptions at a given point in time. |
| Griffin & Neal (2000) | Safety climate should be conceptualized as a higher order factor comprised of more specific first order factors. First order factors of safety climate should reflect perceptions of safety-related policies, procedures and rewards. The higher order factor of safety climate should reflect the extent to which employees believe that safety is valued within the organization. |
| Hofmann & Stezer (1996) | Safety climate is operationalized as perceptions regarding management's commitment to safety and worker involvement in safety related activities |
| Mearns, Whitaker, Flin, Gordon, & O' Connor (2000) | Safety climate is defined as a "snapshot" of employees' perceptions of the current environment or prevailing conditions, which impact upon safety. |
| Minerals Council of Australia (1999) | Safety climate refers to the more intangible issues in the company, such as perceptions of safety systems, job factors and individual factors. |
| Yule, Flin, & Murdy (2001) | Safety climate is defined as the product of employee perception and attitudes about the current state of safety initiatives at their place of work. |
| Zohar (1980) | Safety climate is a particular type of organizational climate, which reflects employees' perceptions about the relative importance of safe conduct in their occupational behavior. It can vary from highly positive to a neutral level, and its average level reflects the safety climate in a given company. |
| Zohar (2000) | Group level safety climate refers to shared perceptions among group members with regard to supervisory practices. |

The earliest located paper on safety climate is Keenan, Kerr & Sherman (1951). This study was based on introspective ratings from primary individuals in an automotive plant. In a review of early research, Cohen (1977) reveals that management commitment to safety was a consistent factor in successful safety programs, although

other factors were also found. Management commitment remains a key component of contemporary safety climate research (Flin, Mearns, Gordon & Fleming 1996; Marsh et al., 1998). Smith et al. (1978) determined that more safety staff, safety committees, and safety training were associated with low accident rate companies. They also confirmed Cohen's (1977) finding that management commitment to safety is important. Cohen and Cleveland (1983) found results similar to those of Cohen. Simonds and Shafai-Sahrai (1977) concluded that factors such as management involvement, selected promotional efforts, work force characteristics, and physical conditions primarily explained differences in injury frequencies.

The concept of safety climate emerged from research on organizational culture and climate. Schneider (1975) argued that a number of different climates exist within an organization. Researchers began measuring one specific type of organizational climate and safety climate. Neal, Griffin & Hart (2000) found that safety climate operated as a mediating variable between organizational climate and safety performance, as measured by self-reports of compliance with safety regulations and procedures, as well as participation in safety-related activities, which were also mediated by employees' safety knowledge and motivation. Although it was a key determinant of safety climate, Neal et al. (2000) found that organizational climate had no direct effects upon their derived measures of safety.

Seppala's work produced a three factor model of safety climate; organisatioal responsibility for safety, workers' concern about safety and workers' indifference towards safety (Seppala, 1992), as did work by Donald, Cantaer & Chalk (1991) which revealed three facets of safety attitude; people or the organizational roles which

make up the safety climate (e.g. supervisor, manager, workmates), attitude behaviour or aspects of an individual's safety behaviour (e.g., knowledge, satisfaction, actual behaviour) and safety activity or type of safety behaviour (passive, e.g., wearing safety clothing; active, e.g., attending safety meetings). A study by Cox and Cox (1991) of employee attitudes in an organization which manufactured industrial gases produced five factors; personal skepticism, individual responsibility, the safeness of the work environment, the effectiveness of arrangements for safety and personal immunity.

Various studies have revealed that safety climate factors can predict safety-related outcomes, such as accidents or injuries (Zohar, 1980; Brown and Holmes, 1986; Dedobbeleer and Beland, 1991; DeJoy, 1994; Niskanen, 1994; Hofman and stelzer, 1996; Diaz and Cabrera, 1997). Neal et al. (2000) found that safety climate influenced self-reported components of safety performance. Tomas et al. (1992) nevertheless found no direct relationship between safety climate and reported safety behaviour. In Tomas el al.'s model, safety behaviour was significantly predicted by worker attitude, co-workers' response, hazards, and supervisor's response – which was also the main mediator of safety climate. However, Hoffman and Stetzer (1996) revealed that safety climate has only indirect effects upon safety behaviour, which are mediated by other variables. The influence of safety climate upon safety performance is through the work context.

Schroder (1970) suggested that measuring employee attitudes towards safety could be a useful form of safety measurement, arguing that the more mature the safety attitudes of employees, the more likely they would search for safer environments – hence

unsafe behaviour would decrease. Safety climate overcomes many of the limitations of traditional safety measures, such as reporting biases and after the fact measurement. Ojanen et al. (1988) suggested that safety performance should be measured on multiple levels, one of them being safety attitudes, in order to determine the real safety level of an organization. They claimed that measuring safety climate can indicate changes in organizational safety behaviour and would therefore be useful for evaluating safety programs. They argued that any effort to improve safety should be perceived as such by employees, and that the only way to measure this is by using a safety climate questionnaire. Glendon and McKenna (1995) advocated triangulation in safety measurement, involving at least two independent measures to assess safety performance or to gauge safety program effectiveness.

## 2.3 Sub-Group Differences in Safety Climate

Waring (1992) maintains that differences can exist in the safety climate of different groups in an organization due to different daily work demands and experiences, which can shape safety attitudes. Mason and Simpson (1995) and Budworth (1997) identified differences between the safety climate profiles of senior and junior staff within a single organization and proposed targeted safety strategies based on such differences. Some research on different groups within organizations has focused on comparing individuals who have not suffered an injury with those who have. Brown and Holmes (1986) explored differences in safety climate perceptions of post-traumatic (accident involved) and pre-traumatic (no accident involvement) employees. The post-traumatic group perceived lower management concern and less management action than did the pre-traumatic group. The post-traumatic group was found to have a lower level of risk perception. Comparing responses on a safety attitudes questionnaire of employees

with and without injuries, Sherry (1991) found several dimensions on the safety attitudes questionnaire that could distinguish between employees who had sustained injuries and those who had not. Guest , Peccei & Thomas (1994) found differences between safety climates of high accident and low-accident gangs of UK rail workers. The high accident gangs believed that they were more safety conscious other workers were.

## 2.4 Measuring Safety Performance

One limitation associated with evaluating the effectiveness of different safety programs is the lack of an adequate measure of safety performance (Rockwell, 1959). In particular, difficulties arise where researchers use different techniques to evaluate safety programs. Safety measurement is essential for reporting safety within an organization, identifying where accident prevention resources are best allocated and evaluating safety program effects (Tarrants, 1970). However, the effectiveness of some measures of safety performance has been questioned by several researchers (Blumenthal, 1970; Grimaldi, 1970; Jacobs, 1970; Tarrants, 1970, 1980).

Traditional measures of safety performance rely primarily on some form of accident or injury data (Chhokar and Wallin, 1984). Glendon and McKenna (1995) identify 15 reasons why accident data, or similar outcome data, are poor measures of safety performance. The main problems are that such data are insufficiently sensitive, of dubious accuracy, retrospective, and ignore risk exposure.

One technique developed to overcome some of the limitations associated with traditional measures of safety is behaviour sampling. This method is based on

randomly sampled observations of workers' behaviour, and evaluating whether observed behaviours are safe or unsafe (Tarrants, 1980). Types of behaviour that have been observed include use of personal protective equipment, machinery use, and manual handling. Typically, a checklist identifies behaviours to be observed. Using the behaviour checklist, one or more trained observers systematically observe workers to determine whether they are working safely or unsafely.

Behaviour sampling has been successfully used by several researchers implementing ing behaviour modification safety programs (e.g. Komaki et al., 1978; Chhokar and Wallin, 1984; Reber and Wallin, 1984; Reber et al., 1984, 1990, 1993; Cooper et al., 994; Walker, 1995; Shannon et al., 1999). It has been suggested that behaviour observation data are superior to accident statistics as they focus on unsafe behaviour prior to accidents occurring (Reber et al., 1993). Furthermore, behavioural data are sensitive to changes in safety, allowing for immediate identification of some types of safety problems. Safety behaviour modification programs are described by several researchers (e.g. Altman, 1970; Komaki et al., 1978; Chhokar and Wallin, 1984; Earnest, 1985; McAfee and Winn, 1989; Cooper et al., 1994).

Some researchers have found that the higher the safe performance the lower the accident rate (Reber and Wallin, 1984; Reber et al., 1984), although Cooper et al. (1994) did not find a significant correlation between accidents and behavioural data. Disadvantages of behaviour sampling include the considerable expense associated with this method, while studies can only provide average results, which disregard individual behaviour differences (Grimaldi, 1970).

## 2.5 Limitation of Negative Outcome Indicators in Measuring Safety Performance

Many studies and models have been developed based on this concept of unsafe behaviour and conditions such as Staley et al (1996) and Smith et al (1991). These models agree that proactive, or pre-accident measures are the answer to producing better safety performance on site.

Rose (1994) said "If we are in the business of promoting OHS, why do we use failures as the measure of our success?" Krause and Finley (1993) also agreed that measurement of the performance of the OHS management system consequently requires assessment of the processes involved in the management system, rather than measurement of outcomes (such as incident and accident rates). Similarly, Motzko (1989) said that management of outcome instead of improvement of the system is destructive and is considered tampering.

Hopkins (1994) pointed out, LTIFR bears no relationship to injury frequency. His examination of accident data in the mining industry indicated that LTIFR data are far more indicative of changes in claiming behaviour and claims management than of changes in OHS performance. Aims and Booth, (1992) state that time off work does not correlate well with true injury severity. Therefore the reportable accident rate may vary with the known propensity for people to take different amounts of time off work for the same injury in different parts of the country.

Rose, (1994) further stated that "Lost time is abused. One of the things you could do if you want to improve it is to stop the practice of regarding people who come back into

work to do some other job as not being lost time. ... If you cannot do your normal job fully it's lost time whether you come back in or not." Shaw (1992) examined the prospect that outcome measures like LTIFR may deserve a place in the OHS management system but she warns that they need to be balanced with other measures of performance.

Problems with LTIFRs as a measurement of OHS performance reflect problems with traditional approaches to the measurement of productivity. Green (1994) described debates regarding the measurement of productive performance. Simple measures of productivity or labour efficiency based on inputs, outputs and labour costs tend to be inaccurate because of measurement bias. The outcomes are highly dependent on the process and ignore the effect of issues such as OHS in production processes. Further, the conventional, historical accounting approach gives no information about what is happening today as it always measures past performance (Green, 1994).

Similarly a focus on outcomes in OHS performance measurement means that what is measured is largely a matter of chance as lost time injuries are statistically insignificant events, and if there is no loss there is no measurement; that is, much important data on near misses or minor outcomes incidents can be glossed over or lost (Hopkins, 1994).

Kletz (1993) states: " senior managers pay great attention to the Lost time Accident rate and nothing else they are sending out the message that they do not really know why accidents occurs and what should be done and, if this is so, safety cannot be very important… we obviously need some measure of performance in order to show up trends and compare one point with another but no one parameter is adequate."

Copping (1993) provides a telling example of the inadequacies of LTI based statistics in this respect. "After a run of nearly two years accident free a company employee slipped on a step and was unlucky enough to fracture a small bone in his foot. He was unable to work for several weeks and an LTI was recorded with a subsequent loss of safety awards to staff. At about the same time a container was dropped during an off-shore lifting operation. This latter incident had tremendous potential for injury but as luck would have it no-one was hurt. There is no doubt that the lifting incident was much more serious." This passage not only demonstrates the inadequacies of LTI statistics but also highlights the negative consequences of using 'days since last lost-time injury' as an indicator of safety. The longer the period free of injury the greater the level of disappointment and frustration when a lost time injury finally occurs, which statistically speaking is bound to happen.

Hopkins (1995 & 1999) warns of the dangers of focusing on the LTIFR as the only indicator of safety performance because the LTIFR can also be influenced by factors other than improvements in safety-for example, by improvements in injury management. For instance, injured workers may return to work after experiencing a serious injury, still injured, but continue to work by performing alternative, light duties or through attending training courses. This has the effect of reducing the lost time injuries recorded without a reduction in the number of injuries that are occurring.

As a result of the failure of outcome indicators on their own to provide an adequate indication of how OHS is managed in an enterprise, health and safety professionals and organisations have identified a need for additional measures of OHS performance (Ojanen et al, 1988; Aims & Booth, 1992; Kletz, 1993; NOHSC, 1994; Glendon &

Booth, 1995; Shaw Blewett, 1995). Such measures would focus on the management of OHS in an enterprise and highlight areas in health and safety where systems and procedures could be improved. There are many health and safety activities conducted by construction companies that could be used to generate additional measures of OHS. These indicators would focus on 'how successfully ' an enterprise or an industry is managing and performing in relation to OHS. These indicators are often described as process or positive measures of performance.

## 2.6 Development of Positive Performance Indicators

Most safety measures are post-mortem or ' after-the-fact' in nature and provide data which has little historical value. If the safety record is good, most managers will choose to reduce the emphasis on safety and conversely, management will give strong support following a severe or fatal accident. Waldram (1991) claims that a simple measure of performance in terms of accident frequency rate incidence is not a reliable guide to the safety performance as there is no correlation between such measurement and the work conditions, injury potential or the severity of injuries that have occurred. As a result, the reactive measures can give a misleading picture. Low reported accident rates, even over a period of years, is no guarantee that risks are being effectively controlled, nor will it ensure the absence of injuries or ill health in the future. This is true for organisations that have a low probability of accident occurrence but where major hazards are present. In such areas, the historical incidence of reported accidents could be an unreliable and deceptive indicator of safety performance.

Unlike reactive measures, proactive ones deal with data from current safety situations. Lindsay (1992) states that proactive measures provide essential feedback on

performance before injury or incidents occur and involve compliance with performance standards and objectives - active participation of all levels of management. With proactive measures, appraisal is constantly carried out such that they are recommended as a sensitive and reliable indicator of safety performance. Chhokar & Wallin (1984) added that proactive measures must be able to:

- identify all contributing factors;
- indicate positive steps that can be taken by both management and workers;
- identify loss-potential problems at the no-loss stage; and
- help predict, control and reduce accident losses.

In addition Anderson (1992) states that proactive safety performance is assured by providing the following:

- plant and equipment (hardware) which is ‘ fit for the purpose’ of reducing risks from identified hazards as far as is reasonably practicable;
- systems and procedures (software) to operate and maintain that equipment in a satisfactory manner and to manage all associated activities; and
- people who are competent, through knowledge, skills and attitudes, to operate the plant and equipment and to implement the systems and procedures.

The literature reviews indicated a strong safety culture in the petrochemical engineering industry compared with that of the general construction industry. Du Pont, a world leader in safety, claimed that 96% of lost workday and restricted workday cases are caused by unsafe acts of people who created unsafe conditions (Hubler 1995). The overall construction industry is still looking at positive ways to change to a safer working environment, with many researchers including Hinze et al (1996),

Bentil (1990) and Staley et al (1996), trying to understand the causes of accidents. In general the objective of these studies of accident causation is to prevent accidents. These accident causation theories have gone through various changes based on the foundation of the domino theory. Over the years the domino theory has been updated with an emphasis on management as a primary cause in accidents.

Many factors help to activate the concern for safety such as trade unions, consumerism, technology and others. With the influence of safety activism factors, safety is becoming everyone's concern – not just the worker or individual. Safety is looking beyond accidents and more towards human behaviour and culture. Measurement will enable comparison and benchmark performance and track progress from time to time. Once the principle and the practice of measurement become the norm, this will facilitate the transformation of motivations, attitudes and choices in every construction company.

## 2.7 Application of Positive Performance Indicators

Numerous organizational indicators have been proposed to reflect an organization' s safety culture with some estimates ranging from as few as two to as many as 19 (Flin, Mearns, O' Connor & Bryden, 2000). In summary, the following six main areas that are considered to have an impact on occupational health and safety performance in the construction industry. PPIs are designed and selected subject to these main areas.

- Organizational commitment and management involvement
- an effective OHS management system;
- risk management and control of hazards;
- auditing of both management systems and physical hazards;

- training and education; and
- communication and consultation.

Further investigation of these six areas and their impact on OHS across industries was conducted through a brief survey of the following research literature.

### 2.7.1 Organisational Commitment and Management Involvement

#### a) Organisational Commitment

An organization's upper-level management has long been recognized as playing a critical role in promoting organizational safety culture (Dedobbeleer & Beland, 1991; Flin, Mearns, Fleming, & Gordon,, 1996; Flin et al., 2000; Meshkati, 1997; Yule, Flin, & Murdy, 2001; Zohar, 1980). Organizational commitment to safety refers to the extent to which upper-level management identifies safety as a core value or guiding principle of the organization. An organization's commitment to safety is therefore reflected in the ability of its upper-level management to demonstrate an enduring, positive attitude toward safety, even in times of fiscal austerity, and to actively promote safety in a consistent manner across all levels within the organization. When upper-level management is committed to safety, it provides adequate resources and consistently supports the development and implementation of safety activities (Eiff, 1999). An organization's commitment to safety is therefore ultimately reflected by the efforts put forth to ensure that every aspect of its operations, such as equipment, procedures, selection, training, and work schedules, are routinely evaluated and, if necessary, modified to improve safety.

**b) Management Involvement**

Construction companies where management are interested, show commitment to and are involved in their enterprise ’s OHS performance have been demonstrated to have better safety performance records than firms where senior management is not interested in OHS performance (Cohen,1977; Simonds & Saafai-Sahrai,1977; Smith et al,1978; Shannon et al, 1997; Shannon, 1998).

Within the context of safety culture, “management involvement” refers to the extent to which both upper- and middle-level managers get personally involved in critical safety activities within the organization. Management involvement in safety, therefore, is reflected, by managers’ presence and contribution to safety seminars and training, their active oversight of safety critical operations, their ability to “stay in touch” with the risks involved in everyday operations and the extent to which there is good communications about safety issues, both up and down the organizational hierarchy. Through participation in the day to day operations, both upper- and middle-level management communicate to their employees an attitude of concern for safety that subsequently influences the degree to which employees comply with operating rules and with safe operating practices (Eiff, 1999).

Simonds and Saafai-Sahrai (1977) argued that senior management produce construction companies with better safety records than their competitors when these managers are involved in safety in terms of:

- attendance at safety meetings;
- chairing safety meetings;
- regularly receiving safety reports;

- being members of a safety organisation;
- regularly attending safety meetings or conferences outside the company;
- emphasising plans for achieving certain safety objectives;
- actively participating in the execution of safety plans;
- encouraging reviews of safety plans against objectives; and
- including safety figures, reports and achievements on the agenda of company board meetings.

Active support by management for safety programs and the attitude and commitment of senior management towards safety were cited by Cohen (1977) as being some of the dominant factors in the success of occupational safety programs. The commitment and support of management for health and safety were also characteristics of construction companies with good safety performance records (Cohen, 1977). Cohen (1977) measured management commitment in terms of whether:

- the safety officer holds a high staff rank;
- top officials are personally involved in safety activities. For example, top officials make safety tours and give personal attention to accidental injury reports;
- a high priority is given to safety in company meetings and in decisions on work operations; and
- management sets clear safety policy and goals.

Cohen (1977) reported that senior management in construction companies with good safety performance records placed the same emphasis on safety as on the quality and quantity of the enterprise's production and profits. In a review of the literature, Shannon et al (1997) concluded that Construction companies where senior

management played an active role in health and safety consistently had lower injury rates than Construction companies whose managers were not actively involved in safety.

Shannon (1998) found in several construction companies that management factors that were associated with lower injury rates in the manufacturing industry included:

- defining health and safety in every manager ’s job description;
- the inclusion of information regarding health and safety performance in annual appraisals of managers; and
- the attendance of senior managers at health and safety meetings.

### 2.7.2 Effective OHS Management System, Risk Management and Control Of Hazards

A number of research studies have argued that an established system to manage OHS and a system to control hazards at the workplace were associated with good safety records (Simonds & Saafai-Sahrai,1977; Boden et al,1984; Gun & Ryan,1994; WorkSafe WA,1998).

Construction companies with good safety performance records had cleaner, better designed and better environmental qualities (for example, noise, dust, heat, fumes, lighting)at their work sites than Construction companies with poor safety records (Smith et al, 1978). Construction companies with highly developed safety structures (WorkSafe WA, 1998), comprehensive, written standard operating procedures (Gun & Ryan, 1994; WorkSafe WA, 1998) and clearly identified areas regarding the responsibility of safety (WorkSafe WA,1998)were found to have good safety

performance records compared with Construction companies who did not have these items in place.

Gallagher (1997) found that Construction companies with more highly developed health and safety management systems were more likely to:

- ensure health and safety responsibilities are identified and known;
- have senior mangers taking an active role in health and safety;
- encourage supervisor involvement in health and safety;
- have health and safety representatives who are actively and broadly involved in health and safety management system activity;
- have effective health and safety committees;
- have a planned approach to hazard identification and risk assessment;
- give high priority and consistent attention to control of hazards at the source;
- have a comprehensive approach to workplace inspections and incident investigations; and
- have developed purchasing systems.

The presence of a trained, effective health and safety committee was associated with fewer serious hazards at the workplace (Boden et al, 1984; Gallagher, 1997; Hale & Hovden, 1998). Reilly et al (1995) found that Construction companies in the UK who had a joint consultative committee set up exclusively for health and safety (where all employee representatives were chosen by unions) had, on average, fewer employee injuries compared with Construction companies where management deals with health and safety matters, without consulting with workers. However, there is no clear evidence to suggest that just the presence of a health and safety committee was

associated with good safety performance in an enterprise (Hale & Hovden, 1998).

Good injury recording systems, one of the components of an effective OHS management system, were associated with lower work-related injury rates in construction companies (Simonds & Saafai-Sahrai, 1977; Hale & Hovden, 1998). construction companies where good housekeeping procedures were employed were found to have better safety performance records than those Construction companies with poor general housekeeping (Simonds & Saafai-Sahrai, 1977; Cohen, 1977; Smith et al, 1978; Shannon et al, 1997; Harper & Koehn, 1998).

The provision of safety devices and controls on machinery and equipment was consistently related to lower injury rates in Construction companies (Simonds & Saafai-Sahrai, 1977; Shannon et al, 1997).

### 2.7.3 Auditing of Both Management Systems and Physical Hazards

The completion of regular safety audits has generally been associated with construction companies that have lower injury rates and/or successful approaches to health and safety (Smith et al, 1978; Shannon et al, 1997; WorkSafe WA, 1998). However, Eisner (1993) in a study of safety rating systems in South African gold mines, found a poor correlation between the presence of a safety audit system and accident performance.

### 2.7.4 Training and Education

Several research studies indicate that safety training is associated with good safety performance in construction companies (Cohen, 1977; Gun & Ryan, 1994; Shannon et

al, 1997; Harper & Koehn, 1998; WorkSafe WA, 1998).The provision of regular safety training was found to be a common feature of good safety performers (Shannon et al,1997; WorkSafe WA,1998). In Construction companies that were not performing as well as their counterparts, training and induction procedures were found to be haphazardly arranged and poorly organised (WorkSafe WA,1998). The induction of new workers at the workplace and induction in safe working procedures was also commonly associated with successful safety performance (Cohen, 1977; Harper & Koehn,1998).

### 2.7.5 Communication and Consultation

Good communication and good relations between management and workers, enabling open communication on safety as well as other work-related matters, have been associated with good safety performance records in Construction companies (Cohen, 1977; Smith et al, 1978; Shannon et al, 1997; WorkSafe WA, 1998). Further, Smith et al (1978) found that Construction companies who had good safety performance records had more frequent and more positive contacts between management and employees, while management from Construction companies with poor safety records had tended to use the health and safety committee meetings as their only means of interacting with employees.

Construction companies where there were opportunities for workers to participate, to be involved in the consultation process and who were able to be involved in negotiations on health and safety issues were more likely to have good safety performance records (Shannon et al, 1996; Shannon et al, 1997; Harper & Koehn, 1998; WorkSafe WA, 1998; Shannon, 1998).

### 2.7.6 Design and Planning

Although not initially indicated as an area that has an impact on OHS performance in the construction industry, design and planning was found to be an important area during the process. Limitations in the design of machinery, equipment and other devices have been demonstrated to contribute in some way to several types of incidents, involving both near misses and fatalities (Casey, 1993). Many of these incidents occur "because of incompatibilities between the way things are designed and the way people perceive, think, and act " (Casey, 1993).

The design of a building or structure is an area that has not generally been considered in detail in Hong Kong construction industry as a risk factor for injury. Bramber (1994) argues that it is vitally important to "ensure that health and safety is built in, rather than bolted on " in the design and planning of new construction projects. In Europe, research has indicated that injurious incidents are occurring in the construction industry due to shortcomings in design (such as architectural choices and decisions on materials and equipment) (European Foundation for the Improvement of Living and Working Conditions,1991; Mac Kenzie et al, 1999).

Churcher and Alwani-Starr (1996) considered the design process when determining the causes of construction injuries and fatalities in the UK. They identified that 36%of incidents were traceable to the nature of the design of the structure and that 27%of incidents were traceable to the lack of planning of the construction process.

European Foundation for the Improvement of Living and Working Conditions (1991) stated that many injurious incidents are preventable and consideration should be given

to highlighting awareness of the risks involved in construction work to architects, engineers and designers who may be in a position to ‘ design out ’ some of the risks in the construction process to aid both the initial construction and later maintenance of the structure. An example of the ability to design out hazards or potential injury risks may be through prefabricating large elements of the project off site (Neale, 1995; Hinze et al, 1999) or through completing permanent stairways early in the construction of structures to minimise the risk of falls (Hinze et al, 1999).Ensuring that items such as anchorage sockets for brackets and safety harnesses are included in the design of structures will aid in later maintenance of the structure (European Foundation for the Improvement of Living and Working Conditions, 1991).

## 3 Aims & Objectives

The aim of this project is to study the application of positive performance indicators in the Hong Kong Construction Industry. At the end of this study, it is hoped that the following objectives can be achieved.

a. To identify that Hong Kong construction industry is developing the positive safety performance indicators.

b. To identify that positive safety performance indicators are proactive measures which can effectively measure OHS management system and improve workers' safe behaviour.

c. To identify that positive safety performance indicators can provide guidelines for employers to improve their safety on site.

d. To develop the principles of improving current performance indicators in Hong Kong Construction Industry

# 4. Methodology

## 4.1 Interview and Survey Method

This research commenced by reviewing the relevant literature on construction safety published by text books as well as Academic Journals. This was followed by exploratory interviews which took place with two operatives, two site managers and one safety officer. The interview discussions were focused on the application of positive safety performance indicators and its contribution to effective management of OHS. After the exploratory interviews, a pilot study questionnaire was designed and discussed with twenty personal (including the five in the exploratory interviews). Lists of names and addresses were obtained from personal contacts and through the Government List for Works Bureau in List I Group B and C and List II contractors. Certain modification were made to the pilot study questionnaire and the final version was used in the interview to the management of selected sites.

Quantitative approach was used as the interview and survey method in this research. It attempts to numerically measure safety performance using procedures that are often highly standardized and calibrated, such as highly structured interviews, surveys and questionnaires (Wreathall, 1995). In quantitative measurement strategies, organization members usually serve as respondents who react to a standard set of stimuli or questions provided by the researchers (Rousseau, 1990). Quantitative methods are relatively easy to use in cross-sectional comparisons, generally simple to implement in different organizations and by other researchers, and straightforward to interpret according to a common, articulated frame of reference (Wreathall, 1995).

Data collection was taken into two parts. The first part involved interviews with the

site management of selected construction companies. The interviews followed a 22-questions questionnaire and the worksheet (see Appendix 2 & 3). The questions related to the research variables, namely, commitment by management to safety, an effective OHS management system, risk management and control of hazards, auditing of both management systems and physical hazards, training and education, communication and consultation. The workshop worksheet relates to questions of the way how a company develops positive performance indicators. Data collection took place over a five month period, using a combination of data collection tools to obtain reliable and valid information. The tools were:

- semi structured interviews using open ended questions;
- review and analysis of secondary data sources such as OHS documentation maintained by the construction companies.

Data collection of the second part was to send self-administered questionnaires to the workers for those construction sites in which their management had attended the interview conducted by author of this research project. Sixteen questions related to their safety behaviour were prepared with stamped returned envelopes.

## 4.2 The Sample

In carrying out the interview and questionnaire survey, 100 construction companies were preliminarily selected through the List I Group B & C and List II contractors on the Government's list for Works Bureau projects and the contractors in the approved list of Building Contractors for Housing Authority projects and main contractor list from the Hong Kong Construction Association. Thirty-eight construction companies agreed to attend the interview. Among the 38 construction sites, 20 of which are in

public projects (13 in civil projects and 7 in building projects) and the remaining are in private projects (3 in civil projects and 15 in building projects).

At the same time, questionnaires were sent by mail to workers of these construction companies. In order to obtain better response from the surveyed group, it was necessary to minimize the inconvenience to the respondents. Hence, return envelopes were enclosed and the completed questionnaires were collected either by fax or by mail. A letter was also sent three weeks later after mailing the questionnaires to remind them to promptly submit the information.

## 4.3 Questionnaires

### 4.3.1 Questionnaires Designed for Management

A questionnaire with a total of 22 questions (see Appendix 1) was designed to measure the six main areas namely: organizational commitment and management involvement; an effective OHS management system; risk management and control of hazards; auditing of both management systems and physical hazards and training and education. These areas were considered to have impact on OHS performance in construction industry. The response to each attitudinal question was measured on a five-point Likert scaling, under categories of `Excellent', `Good', `Average', 'Poor', `Very poor". Respondents were invited to discriminate favorably or unfavourablely against statements of opinion, ordered under differerent headings. For example, the attitudinal statements such as ``How would you rate the management statements includes Occupational Health and Safety (OHS)?" was assessed by giving a score of 'Excellent' to those who strongly agree with the statement and were given a score of 'Very Poor' to those who strongly disagree. Workshop worksheet (see Appendix 2)

were also developed to collect the data of their performance indicators during the interview to the management.

### 4.3.2 Questionnaires Designed for Workers

Target groups for the survey are the workers of the 38 construction sites. Identities of the respondents were kept strictly confidential. A self-administered questionnaire consisting of 16 questions (see Appendix 3) was designed for the respondents to rate their responses to these statements against a Yes/No choice. The questions mainly focused on their safety behaviour and management commitment.

## 5. Results and Findings of the Survey

### 5.1 Result Collected from Management

The survey was conducted from March to August 2002. Management of 38 construction sites were interviewed and the results of data analysis are summarized in Table 6 and Figure 7. Information are collected for data analysis in six main areas, namely: organizational commitment and management involvement; an effective OHS management system; risk management and control of hazards; auditing of both management systems and physical hazards and training and education (see Table 7 & Figure 8). A total of 826 participants participated in the survey, in which there were 45 managers, 60 supervisors and 721 workers. The number of people employed by the 38 participating sites ranged from 56 to 450 and the results were noted as follow.

#### 5.1.1 Commitment by Management to Safety

The perceived level of organizational commitment to health and safety is a major influence on health and safety performance in practice. Strong personal commitment to OHS by senior management and other key personnel was identified as a key driver for OHS in 13 construction sites. The competence, experience, personal commitment and preparedness to follow through when displayed by the project managers and other senior managers played a critical role in the effectiveness of on-site OHS management. These construction companies had a positive response to organizational commitment and communication. They had a clear policy statement and management performance review and published company report.

Fifteen companies made their sub-contractors' periodic payments reliant on the outcomes of OHS audits and nature of the non-compliance. Their payment was held if

their safety performance is not satisfactory. Five companies considered that such a move might have industrial relations implications and, although they liked the idea in theory, could not see it being put into practice. In four companies, management reported that subcontractors chose to work for their company because “of the emphasis the company places on safety. Further, they chose not to work with some other companies “because of their cavalier approach to OHS”. Eight companies were concerned with public image in relationship to OHS. It was perceived as important to be seen to be “doing the right thing”, as well as being reputable and completing business on time without OHS problems. Four companies found that ‘cowboy’ sub-contractors who take shortcuts on safety were also usually not professional in terms of quality of work. Good OHS was considered useful as a marketing tool.

About 10 sites allowed adequate budget for the OHS and 8 sites did not allow any budget in their estimate. The findings also indicated that more than 20 companies held their safety committee meetings regularly and 8 sites did not have any such meeting to be developed. The remaining held the meetings on ad-hoc basis.

Only thirteen sites had created, or planned to create, leadership roles in OHS. In four sites, the person designated as OHS manager or coordinator also had another management role in the organisation. The allocation of the responsibility for OHS was aimed at facilitating improvement in OHS performance. It was complemented by an OHS committee or through including OHS as an agenda item of all management and construction meetings, which provided a forum for the debate and resolution of OHS issues.

To demonstrate management commitment to OHS and to also raise knowledge and awareness of OHS at executive management levels, senior executives in four sites were required to attend site safety committee meeting. Thirteen sites had developed safety policy statement and responded to the statement “Management performance reviews include occupational health and safety”. It was surprising to note that there were eight sites which did not show any management commitment.

### 5.1.2 An Effective OHS Management System

Formal OHS management system were in place in fifteen sites. Their OHS management system were in a continuous process of review and was updated as required. They emphasized , however, that the systems were only of value to the extent of their implementation on site. They suggested that the mere presence of written procedures constituting an OHS system was less useful as a measure of performance than the effectiveness of the system. The translation of systems and infrastructure provided by the companies into safe work practices and safe working environments was a theme at these sites, and they each demonstrated different activities aimed at achieving this. These ranged from site-based to enterprise level activities. In ten sites, OHS was a regular agenda item for executive meetings and was a standard item in Board reports, although the nature and complexity of reports varied considerably. OHS responsibilities and accountabilities were included in duty statements and OHS was included in management and supervisor performance reviews.

Using planning processes to ensure that risks and hazards were understood and eliminated or controlled before work on that stage, area or task begins was a strategy

by twelve sites. Safety manager and/or safety officers reviewed the specific OHS management plan for the project. The plan may have been generic, but specific procedures have been developed to meet particular requirements of the project. The relevance of this documentation and the extent to which people on site were able to implement it were regarded as key markers of good OHS performance. About twelve sites used templates for project safety management plan and project safety procedures which could be adapted to meet the needs of different projects, forming a project safety management plan. The templates included a number of specific procedures, e.g. working at heights, toolbox meetings, and workplace hazard inspections.

Sub-contractor management was cited as the most important strategy for managing OHS on sixteen sites. Sub-contractor management was initially considered at the tender evaluation stage (through evaluating OHS capabilities and management systems) and then throughout the life of the project by monitoring and supervising the subcontractors' OHS performance. Sub-contractors in these companies were treated as if they were company employees and were also included in all OHS management activities. Sub-contractors who behaved badly on site, or who demonstrated repeated OHS problems, were removed from site. Ten sites identified that their biggest problem was "getting sub-contractors to take safety seriously. Attitudes can be improved if the main contractor leads by example, e.g. run toolbox meetings for sub-contractors". They did not believe their sub-contractors were as committed to OHS as necessary. This was explained as the result of lower levels of OHS knowledge, budget pressure and communication difficulties, particularly language barriers. They also reported that sub-contractors generally perceived that OHS was the responsibility of the main contractor. In particular, addressing OHS from the beginning of the selection process,

providing support in developing effective OHS management and ongoing surveillance were cited as being of critical importance across public projects.

On the contrary, five sites avoided problems with sub-contractors by adopting a policy of direct employment rather than contracting out work. This was regarded as a sure way of maintaining more effective control over OHS. Four companies employed an on-site works manager whose specific role was to monitor the work undertaken by contractors, in an open and supportive way. Ten companies specified formal requirements for contractors with respect to OHS management, and then audited their performance over the course of projects.

Systematic preventive maintenance of plant and equipment was regarded as a critical component of planning at only sixteen sites. They had introduced both job safety analysis and a preventative maintenance program for electrical equipment of subcontractors. However, they reported difficulty involving sub-contractors in these processes.

They expressed the view that industry benchmarking was effective as a learning activity to help identify better ways to identify and control hazards, manage OHS and assess their own performance. Seven companies considered the quality of their relationship with their sub-contractors important to smooth functioning of their business. They expressed the fear that by putting too many demands on their sub-contractors, the sub-contractors may choose to work for another company that did not have such stringent requirements. They also stated that in boom times “it’s easier for sub-contractors to go and work for someone else” than to comply with the OHS

demands of a particular enterprise. However, only seven sites expected sub-contractors to sign an agreement covering the OHS requirements of working on their sites and provided them with information on unusual hazards on site, prior to commencement of work. Twenty sites complained that, on site, sub- contractors were managed by a supervisor who usually had responsibility for a number of sites. Six companies had scheduled their sub-contractors to attend OHS programs run by the approved training bodies.

### 5.1.3 Risk Management and Hazard Control

Activities in the hazard control area and risk management were a primary focus in twelve sites. Activities of particular importance included inspections of varying frequency and focuses, use of Job Safety Analyses and Standard Work Procedures and reporting of hazards and incidents. Hazards at only twelve projects were identified via collaboration between management and workers through conducting risk assessments, completing job safety analyses (JSAs) and safe operating procedures (SOPs), incident reports and, in some instances, through pre-start planning meetings. They reported conducting inspections (including of equipment and machinery) regularly during the project, especially at critical stages of construction. In six sites, although they had SOPs in place, they questioned the value of written SOPs, stating that instead they placed a high value on people who could use their experience and knowledge to solve problems.

In general, hazard management was reported to be undertaken informally. Hazards tended to be dealt with immediately or conveyed to the supervisor if this was not possible. Ten sites reported that supervisors completed daily visual inspections and

also formal inspections quarterly. They also planned to make random formal inspections fortnightly in the future. In six companies, although the hazard management was very collaborative, there was little formal system imposed on it. Instead there was reliance on supervisors and workers to reassess site conditions each day and throughout the day based on changes in soil types or the weather as they occurred. The whole crew operated with vigilance, using their combined skills, knowledge and experience in order to keep the worksite safe.

The work activity briefing was a primary tool for collaborative hazard assessment in twelve sites. Held on a weekly basis or whenever there was a change in work activity, the briefing required the supervisor and workers involved in doing the work, to identify potential hazards and how they would control them. While personal protective equipment (PPE) was regarded as an important part of risk control in twenty sites, it was clearly seen as a measure of last resort and the comprehensive hazard identification, risk assessment and control procedures contained in the site safety plans of the companies were explicitly based on the hierarchy of control.

Job safety analyses (JSAs) were an important part of hazard management and these were developed collaboratively, including with contractors in some instances. Mostly JSAs were formally prepared and written down by fifteen sites. They kept such paperwork to a bare minimum in recognition of the fact that it was not possible to have JSAs to cover every conceivable contingency. They also recognised that in reality few people on site would refer to them. 10 sites were overt in maintaining an active and friendly relationship with inspectors and other staff of the OHS agencies. These organisations were regarded as important sources of reliable information that

could help to improve OHS performance.

The need for design to include constructability, operability and maintainability as a means of reducing injury and illness. Only twelve sites have put input into construction design, all planning stages (from overall construction to work activities) and scheduling was seen as critical to ensuring that OHS is actively managed from the outset. It was reported by one case study enterprise that they had often "got a situation which is difficult to change and very expensive to achieve in a safe way." At the time, control over design was usually used to contain costs rather than improve safety. Improving design in the domestic sector could have a significant impact on this sector's ability to manage OHS.

About twelve sites had developed processes in place for workers to report hazards in the workplace. There were 5 sites which did not develop such procedures and workers did not report any hazards to the line management.

### 5.1.4 Auditing

Twenty-six construction sites undertook Independent audit (cross-auditing by project managers in the same company but from different sites) and twenty construction sites undertook external audits (by OHS agencies or consultants). It was noted that 3 sites did not use formal audit systems that relied on checklists, but conducted intensive, informal audits of site activities. These were regarded as more efficient and flexible as they were adapted to each site and changing site conditions. They were conducted by the OHS coordinator as an in-house 'expert' but were also a feature of the daily activity of site supervisors and plant operators. Visual inspections were carried out on

a daily and weekly basis and during the day when conditions changed.

### 5.1.5 Training and Education

Attitude, approach and capabilities of the workforce, i.e. a workforce that is, "competent, capable, will help identify problems, and work safely", ensuring that the right people are in place was only identified by fourteen sites as a critical strategy for effective OHS management. Training was cited as an important strategy for effective OHS management. As well as specific OHS training. Effective briefing and training of supervisors, leading hands and team leaders (including contractors and sub-contractors) before the start of a project was regarded as critical to good OHS performance. This could be very difficult when the project lead-time was short. However, it was regarded as imperative that supervisors were trained and their role development managed so they were able to take an active role in promoting and managing OHS. Having competent, trained and experienced people on the job and in management roles was seen as the first demand that needed to be met if health and safety were to be accorded proper priority in fourteen sites. However, ten sites did not provide such training to their supervisors.

Induction training of workers (including contractors and sub-contractors) for the site and for their work activity was regarded as very important. About fifteen sites regarded Induction Training of workers to the site as a fundamental requirement and they provided Induction Training to their workers and this was the preferred mode of delivery. Six sites did not provide such training to their employees.

Hand in hand with management and workforce capabilities went a sound selection

process “so you are getting capable people to work with”, also identified by 12 sites as important factors in building a safe working environment were supporting training and continuing education processes, which needed to be practical and fit for purpose. They also reported that it was important that supervisors were competent and both understood and used safe building practices.

### 5.1.6 Communication and Consultation

Effective communication, especially where activities interfaced, was another key strategy in successfully managing OHS performance. This facilitated teamwork and involved communications at individual and group levels throughout the project. It enabled the uptake of workforce suggestions by management and the reciprocal uptake of management systems by the workforce with no “resentment factors” present. A key aspect of participation was the development of a ‘culture’ of safety and of reporting incidents or potential incidents, with everyone understanding that OHS was needed and had to be fundamental to the way work was done.

Consultation and communication was identified by thirteen sites as critical to ensuring effective OHS management. Effective participation and consultation were encouraged through the OHS committee and through formal toolbox meetings and team briefings which provide opportunity for problem solving. Informal, daily communication on site was regarded as critical to supporting OHS and as the most effective way to communicate with the workforce about OHS because it was frequent and low key - just part of normal daily conversation.

Collaborative approach was also used by these sites to develop detailed OHS policies

and procedures. This was done by the management and workforce working together on the OHS committee. This type of collaboration works when employee members of the committee are given the opportunity to talk through the issues with the people they represent outside of the meetings.

Ten sites used a system of site-based OHS committees to guide the application of their policies and procedures at site level by the OHS committee monitoring and reviewing the use of the site safety plan and monitoring hazard control actions. This was considered very effective, particularly when the project manager attends site OHS committee meetings as well as company level OHS meetings. This way site-based problems could be brought to the attention of senior management, and company level issues could be brought back to the site. OHS committee meetings in more than 50% construction sites were held regularly (monthly/bi-monthly) and received feedback about current issues from the sites.

**Table 6: Information of the Selected Construction Sites**

| | | Contractor | | | | Type of Project |
|---|---|---|---|---|---|---|
| Site | Staff employed | Manager | Supervisor | Workers | Total | |
| 1 | 220 | 1 | 2 | 25 | 28 | Public Project Civil Engineering |
| 2 | 90 | 1 | 2 | 20 | 23 | Public Project Civil Engineering |
| 3 | 115 | 1 | 3 | 12 | 16 | Public Project Civil Engineering |
| 4 | 95 | 1 | 2 | 10 | 13 | Public Project Civil Engineering |
| 5 | 150 | 2 | 1 | 26 | 29 | Public Project Civil Engineering |
| 6 | 110 | 1 | 1 | 12 | 14 | Public Project Civil Engineering |
| 7 | 85 | 1 | 1 | 9 | 11 | Public Project Civil Engineering |
| 8 | 120 | 1 | 2 | 7 | 10 | Public Project Civil Engineering |
| 9 | 100 | 2 | 2 | 8 | 12 | Public Project Civil Engineering |
| 10 | 92 | 1 | 1 | 15 | 17 | Public Project Civil Engineering |
| 11 | 56 | 1 | 1 | 5 | 7 | Public Project Civil Engineering |
| 12 | 89 | 1 | 1 | 10 | 12 | Public Project Civil Engineering |
| 13 | 97 | 1 | 2 | 21 | 24 | Public Project Civil Engineering |
| 14 | 80 | 1 | 2 | 17 | 20 | Public Project Building Engineering |
| 15 | 150 | 2 | 2 | 21 | 25 | Public Project Building Engineering |
| 16 | 170 | 1 | 1 | 26 | 28 | Public Project Building Engineering |
| 17 | 108 | 1 | 1 | 18 | 20 | Public Project Building Engineering |
| 18 | 250 | 2 | 2 | 20 | 24 | Public Project Building Engineering |
| 19 | 190 | 1 | 1 | 25 | 27 | Public Project Building Engineering |
| 20 | 142 | 1 | 2 | 21 | 24 | Public Project Building Engineering |
| 21 | 115 | 1 | 1 | 28 | 30 | Private Project Civil Engineering |
| 22 | 390 | 1 | 2 | 25 | 28 | Private Project Civil Engineering |
| 23 | 350 | 1 | 2 | 22 | 25 | Private Project Civil Engineering |
| 24 | 290 | 1 | 2 | 27 | 30 | Private Project Civil Engineering |
| 25 | 85 | 1 | 1 | 12 | 14 | Private Project Civil Engineering |
| 26 | 330 | 1 | 2 | 25 | 28 | Private Project Civil Engineering |

| | | Contractor | | | | Type of Project |
|---|---|---|---|---|---|---|
| Site | Staff employed | Manager | Supervisor | Workers | Total | |
| 27 | 260 | 1 | 1 | 21 | 23 | Private Project Civil Engineering |
| 28 | 310 | 2 | 2 | 28 | 32 | Private Project Building Engineering |
| 29 | 260 | 2 | 2 | 22 | 26 | Private Project Building Engineering |
| 30 | 150 | 1 | 1 | 12 | 14 | Private Project Building Engineering |
| 31 | 380 | 1 | 1 | 32 | 34 | Private Project Building Engineering |
| 32 | 450 | 2 | 3 | 25 | 30 | Private Project Building Engineering |
| 33 | 300 | 1 | 2 | 30 | 33 | Private Project Building Engineering |
| 34 | 356 | 1 | 1 | 25 | 27 | Private Project Building Engineering |
| 35 | 260 | 1 | 1 | 19 | 21 | Private Project Building Engineering |
| 36 | 180 | 1 | 1 | 16 | 18 | Private Project Building Engineering |
| 37 | 86 | 1 | 1 | 9 | 11 | Private Project Building Engineering |
| 38 | 120 | 1 | 2 | 15 | 18 | Private Project Building Engineering |
| | | | | | | |
| **Total** | | **45** | **60** | **721** | **826** | |

**Table 7 : Statistical Data Collected through Interview to Management at 38 Construction Sites**

| Item | Excellent | Good | Average | Poor | Very Poor |
|---|---|---|---|---|---|
| **A. Commitment by Management to Safety** | | | | | |
| How would you rate the management statements includes Occupation Health and Safety (OHS)? | 6 | 7 | 14 | 4 | 7 |
| How would you rate the management performance reviews include Occupation Health and Safety? | 5 | 7 | 11 | 8 | 6 |
| What do you think the OHS policy and/or information regarding OHS performance included in public company reports? | 6 | 7 | 11 | 7 | 7 |
| What is your budget allowance for OHS?(contextual information would be needed for this indicator)? | 10 | 5 | 7 | 8 | 8 |
| What is the frequency of OHS committee meetings are attended by senior managers? | 7 | 6 | 10 | 7 | 8 |
| Do you think your sub-contractors periodic payments reliant on outcomes of OHS audit? | 7 | 7 | 8 | 7 | 9 |
| | | | | | |
| **B. An Effective OHS Management System** | | | | | |
| Do you think the purchasing policy includes OHS requirement? | 7 | 7 | 12 | 6 | 6 |
| How would you rate the sub-contractors contracts and/or tenders adherence to OHS practice? | 10 | 5 | 8 | 9 | 6 |
| Do you think the Company have an effective OHS management system in place? | 12 | 8 | 3 | 10 | 5 |
| How would you rate the safe operating procedures which are developed for work tasks? | 11 | 6 | 6 | 5 | 10 |
| Do you think the preventative maintenance program is in place for equipment and/or machinery. | 8 | 5 | 1 | 4 | 12 |

| Item | Excellent | Good | Average | Poor | Very Poor |
|---|---|---|---|---|---|
| **C. Risk Management and Control of Hazards** | | | | | |
| Do you think that the major hazards are controlled and is there demonstrated use of risk assessment methods? | 10 | 6 | 5 | 9 | 8 |
| Do you think that injuries are incurred for identified major hazards? | 12 | 5 | 4 | 10 | 7 |
| How would you rate the employer in having any input regarding OHS in the design of the structure? | 7 | 8 | 6 | 7 | 10 |
| Do you think that there is process in place for workers to report hazards in the workplace? | 7 | 8 | 11 | 7 | 5 |
| Do you think that hazards identified through OHS committee meetings have been rectified? | 10 | 6 | 5 | 10 | 7 |
| | | | | | |
| **D. Auditing of Both Management system and Physical hazards** | | | | | |
| Do you think number of sub-standard conditions identified and corrected as a result of safety Audits? | 9 | 5 | 12 | 6 | 6 |
| Do you think number, regularity, quality and outcomes of independent assessments conducted (i.e. independent audits)? | 10 | 6 | 4 | 6 | 12 |
| **E. Training and Education** | | | | | |
| How would you rate the attendance of workers for induction training? | 9 | 6 | 8 | 9 | 6 |
| Do you think your supervisors/forepersons have received OHS training? | 12 | 4 | 5 | 8 | 1 |
| | | | | | |
| **F. Communication and Consultation** | | | | | |
| Do you think training and operating instructions take into account non-literate worker? | 14 | 2 | 7 | 6 | 1 |
| How would you rate the Organisation communicate to the workforce? | 13 | 3 | 5 | 6 | 3 |

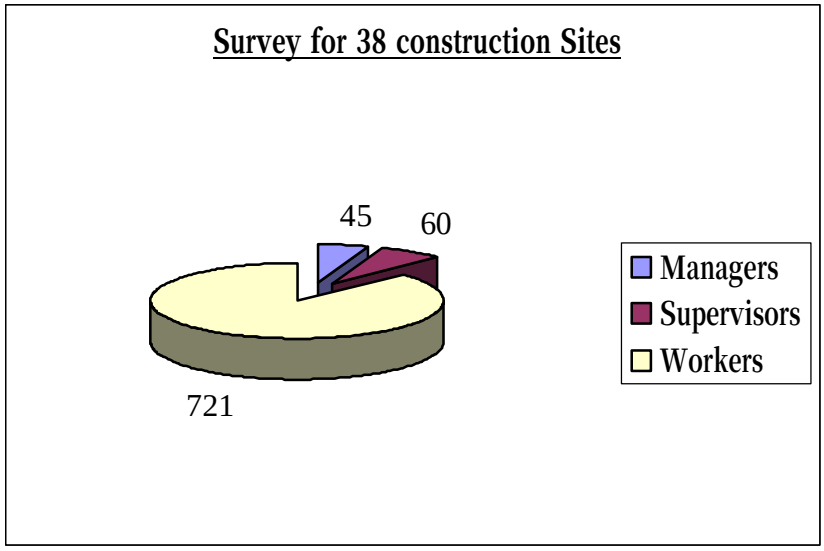



Figure 6: Number of Respondents to Join the Survey

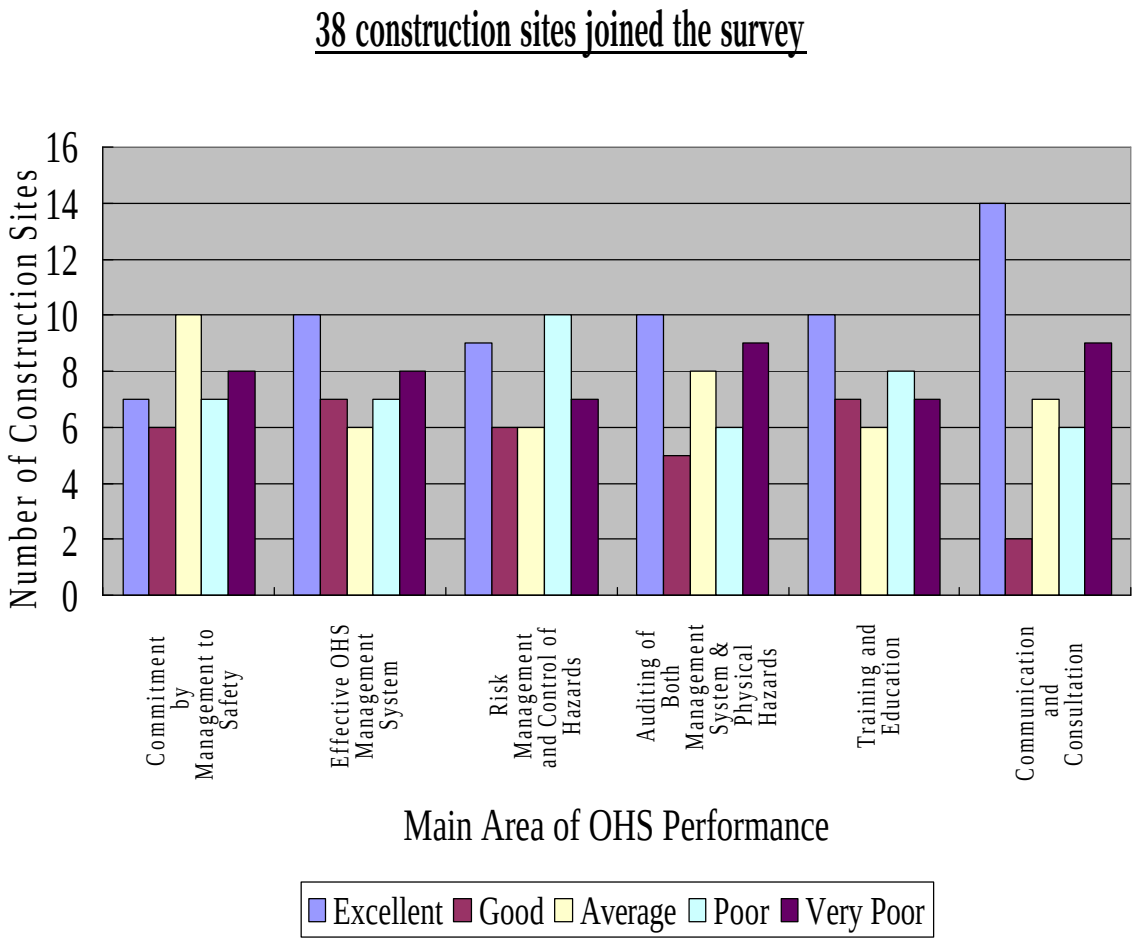



Figure 7: Overview of Safety Performance Achieved by Construction Site

## 5.2 Results of Workers' Safe Behaviour

Information was collected form the workers and the results (see Table 8 & Figure 8) were analysed as follow.

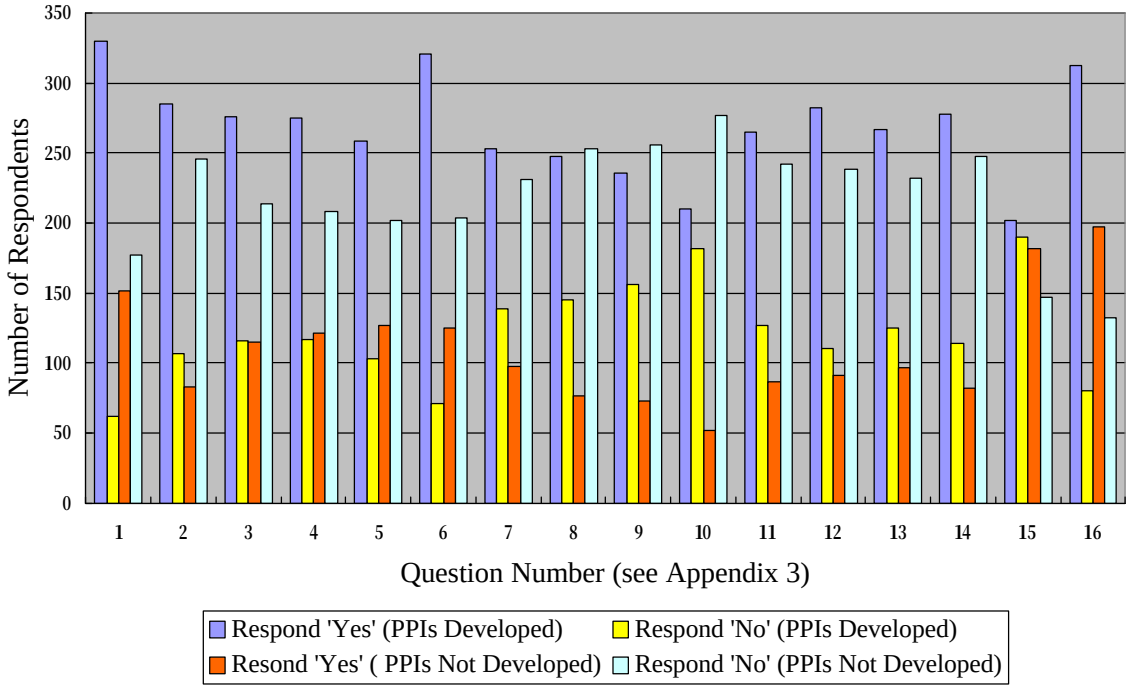



**Figure 8 : Statistical Analysis of Safe Behaviour of Workers**

84% of workers (for sites developed PPIs) showed a positive response that their companies had developed a written safety policy statement in which the general intentions, approach, objectives of the organization in enhancing safety and health in the workplace has been stated. However, only 40% of workers (for sites not yet developed PPIs) agreed that there was a written safety policy in place.

An important indicator of an organisation' s commitment to health and safety is how people regard the importance their immediate boss places on health and safety. 70% of workers (for sites developed PPIs) agreed with the question "I think my immediate

boss does enough to ensure health and safety". Only 25% of workers (for sites not yet developed PPIs) agreed with this statement.

Supervisors have an important part to play in promoting safe behavior. About 70% of workers (for sites developed PPIs) agreed that their supervisors were good at detecting unsafe behaviour and the statement of ' supervisors here are very effective at ensuring health and safety.' However, most workers (for sites not yet developed PPIs) felt their supervisors were not good at detecting unsafe behaviour and not effective at ensuring health and safety.

Personal protective equipment is the last resort to protect workers against risks if hazards cannot be eliminated. Most workers (for sites developed PPIs) recognized the importance of using personal protective equipment and they wore appropriate ones when hazards encountered. However, only 38% of workers (for sites not yet developed PPIs) showed positive response in this respect.

Sustained success in ensuring health and safety at work demands that everyone recognizes the importance of health and safety, and actively supports the health and safety effort. 64% of workers (for sites developed PPIs) had their own contributions and recognized the relative importance of health and safety. They followed the safety procedure / instruction given the risks associated with the jobs. Only 30% of workers (for sites not yet developed PPIs) followed the safe procedures.

An influence on the way individuals behave at work is their immediate workmates or peer group. 60% of workers (for sites developed PPIs) had a positive response to the

importance which their workmates gave to health and safety. This can be reinforced by the statement “safety attitude is affected by my workmates”. About 53% (for sites developed PPIs) reported that “my workmates would react strongly against people who break health and safety procedures/ instructions/ rules”. However, most workers (for sites not yet developed PPIs) did not have any positive response to those who breached the safety procedures. Less than 20% of workers showed positive response in this respect.

With regard to exploring people’ s views of their health and safety training, and level of understanding which they think they have achieved, 68% of workers (for sites developed PPIs) had very positive responses in this factor such as clear about their health & safety responsibilities and fully understand the health & safety procedures. However, only 26% of workers (for sites not yet developed PPIs) have positive action in this respect.

With regard to explore some issues on the extent to which people consider others to take risks or behave unsafely at work, and some reasons why such practices may take place, about 72% (for sites developed PPIs) paid safety high attention to their work and had full understanding of the risks in their work. However, only 27% of workers (for sites not yet developed PPIs) paid high attention to safety.

In response to exploring people’ s views of the relevance and practicality of the health and safety rules and procedures, as well as people’ s ability and willingness to comply with them. Surprisingly, about 70% of workers (for sites developed PPIs) showed positive response in this section. About 75% of workers (for sites not yet developed

PPIs) showed negative response in this respect. There were actually many obstacles to advocate safe behaviour like difficulties in following some safety rules and procedures.

About 79% of workers (for sites developed PPIs) recognised the importance of reporting accidents and they would immediately reported accidents to their supervisors. Surprisingly, only 60% of workers (for sites not yet developed PPIs) realized the importance of reporting accident.

In summary, it is noted that degree of management commitment and hazard control are quite different in the 38 construction sites (see Figures 10 to 25). Those sites which apply positive performance indicators have strong management commitment and well-developed OHS management system. Safe behaviour of workers at these sites are much better. Those sites which have not developed positive performance indicators have weak management commitment and ineffective OHS management system. Safe behaviour at these sites are much poorer. Finding revealed that there were 12 construction sites that have developed positive performance indicators, 13 construction sites are developing now and 14 construction companies have not yet developed (see Figure 9).

**Table 8: Statistical Data Collected from workers at 38 construction Sites**

| Item | Question | Respondants | | | |
|---|---|---|---|---|---|
| | | Sites with PPIs Developed | | Sites with PPLs Not Developed | |
| | | Yes | No | Yes | No |
| 1. | Does your company have a written safety policy statement in which the general intentions, approach, objectives of the organization in enhancing safety and health in the workplace has been stated? | 330 (84%) \ | 62 (16%) | 152 (40%) | 177 (54%) |
| 2. | Does your company deliver health and safety information to you after the safety meeting? | 285 (73%) | 107 (27%) | 83 (25%) | 246 (75%) |
| 3. | Do you think your immediate boss does enough to ensure health and safety? | 276 (70%) | 116 (30%) | 115 (35%) | 214 (65%) |
| 4. | Do you think your supervisors are good at detecting unsafe behaviour? | 275 (70%) | 117 (30%) | 121 (37%) | 208 (63%) |
| 5. | Do you think your supervisors are very effective at ensuring health and safety? | 289 (74%) | 103 (26%) | 127 (39%) | 202 (61%) |
| 6. | Do you wear appropriate personal protective equipment in course of work? | 321 (82%) | 71 (18%) | 125 (38%) | 204 (62%) |
| 7. | Do you follow the safety procedure / instruction given the risks associated with the jobs for which you are responsible? | 253 (64%) | 139 (36%) | 98 (30%) | 231 (70%) |
| 8. | Do you participate the site safety committee meeting? | 247 (63%) | 145 (37%) | 76 (23%) | 253 (77%) |
| 9. | Do your safety attitude be affected by your workmates? | 236 (60%) | 156 (40%) | 73 (22%) | 256 (78%) |
| 10. | Will your workmates strongly react with you if you breach health and safety procedure? | 210 (53%) | 182 (47%) | 52 (16%) | 277 (84%) |
| 11. | Do you think the safety training covering all the health and safety risks associated with the risk? | 265 (68%) | 127 (32%) | 87 (26%) | 242 (74%) |
| 12. | Do you pay safety at high attention to your work? | 282 (72%) | 110 (28%) | 91 (27%) | 238 (73%) |
| 13. | Do you have full understanding of the risks associated with your work? | 267 (68%) | 125 (32%) | 97 (29%) | 232 (71%) |
| 14. | Do the safety procedure / instruction reflect how the job is done? | 278 (71%) | 114 (29%) | 82 (25%) | 247 (75%) |

| Item | Question | Respondants | | | |
|---|---|---|---|---|---|
| | | Sites with PPIs Developed | | Sites with PPLs Not Developed | |
| | | Yes | No | Yes | No |
| 15. | Do safety procedure / instructions are difficult to follow? | 202 (51%) | 190 (49%) | 182 (55%) | 147 (45%) |
| 16. | Do you immediately report the accident to your supervisor? | 312 (79%) | 80 (21%) | 197 (60%) | 132 (40%) |

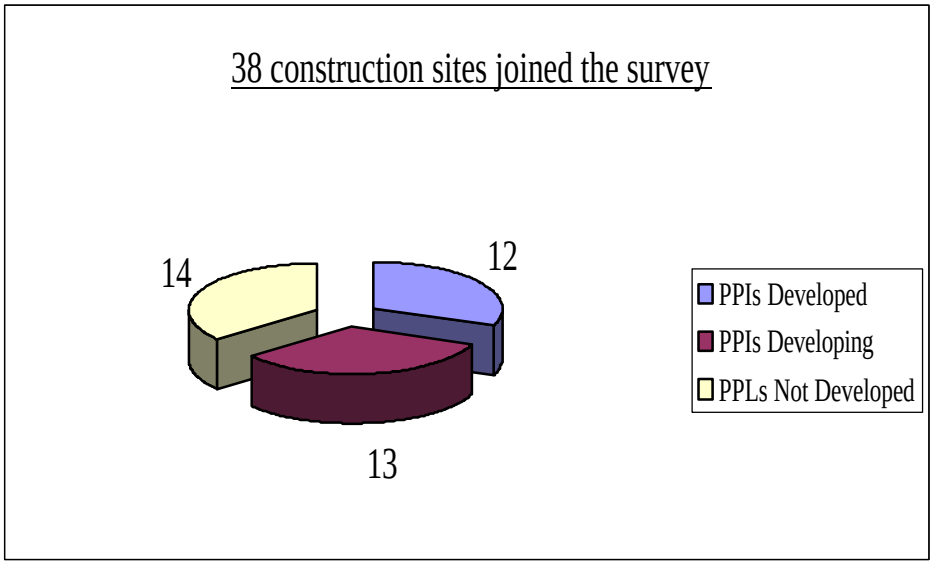



**Figure 9: Status of Development of Positive Performance Indicators**

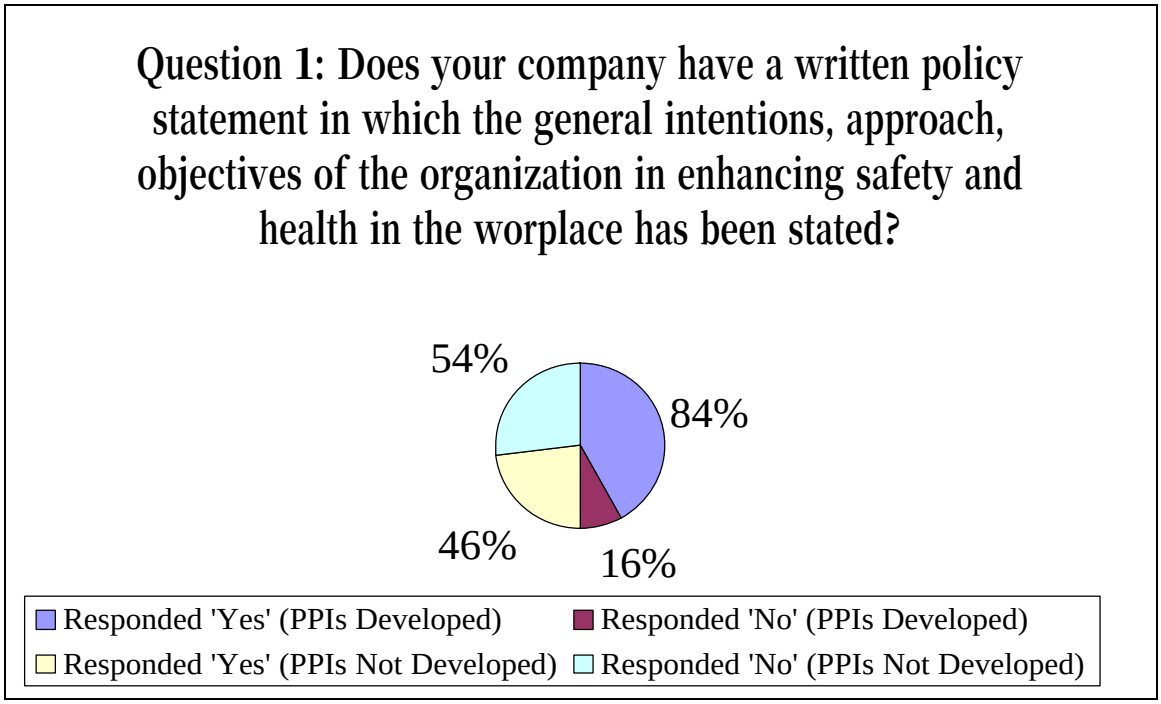



**Figure 10: Safe Behaviour of Workers Responded to Individual Question 1**

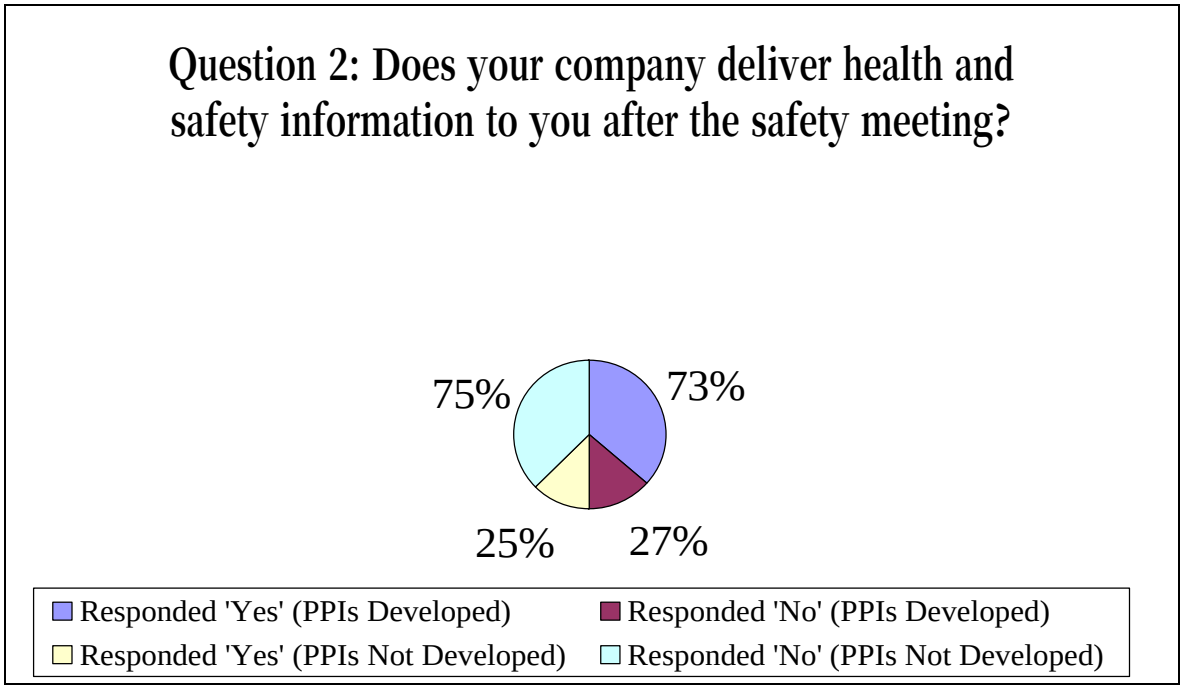



**Figure 11: Safe Behaviour of Workers Responded to Individual Question 2**

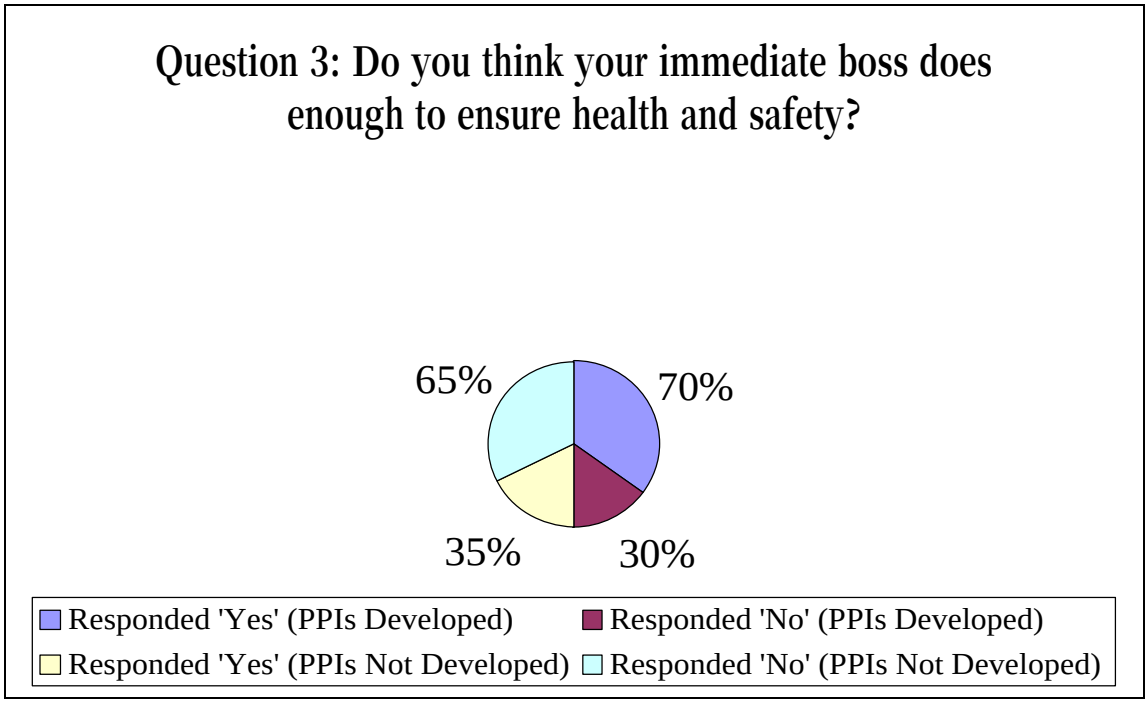



**Figure 12: Safe Behaviour of Workers Responded to Individual Question 3**

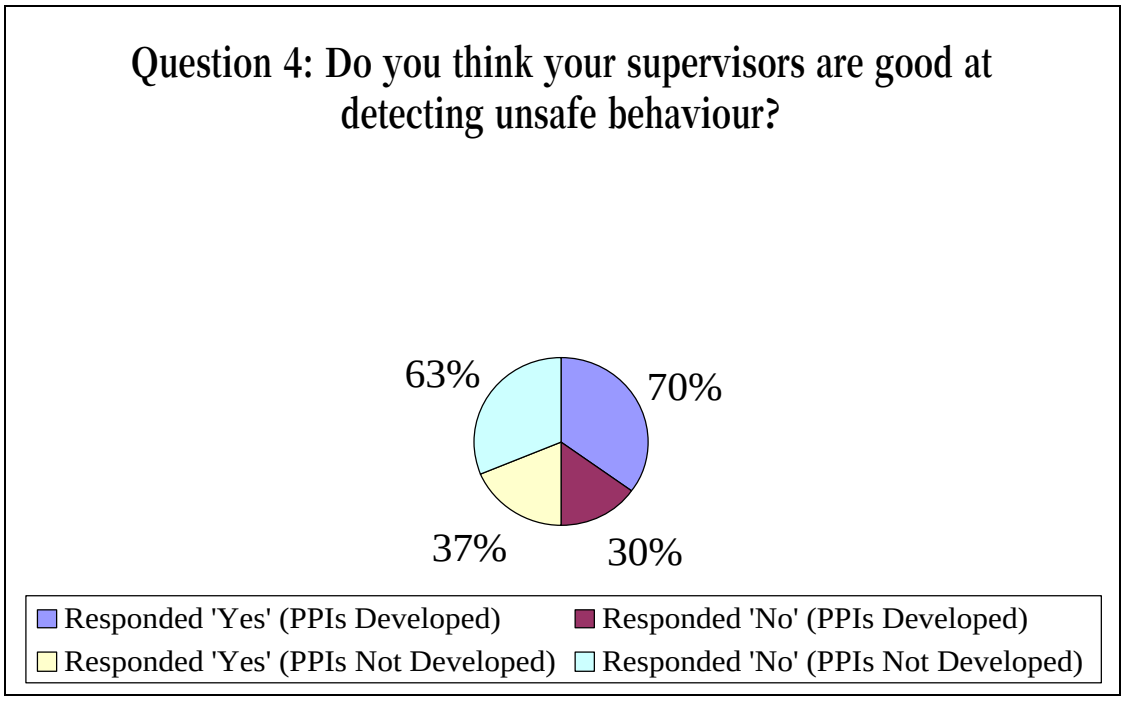



**Figure 13: Safe Behaviour of Workers Responded to Individual Question 4**

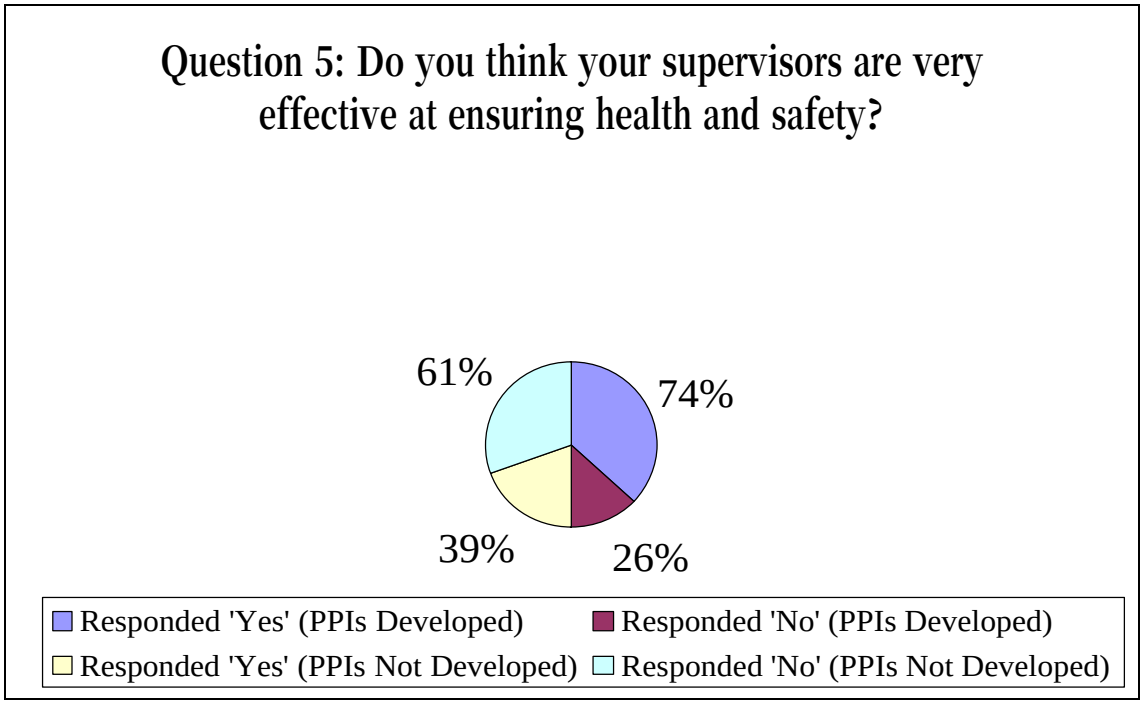



**Figure 14: Safe Behaviour of Workers Responded to Individual Question 5**

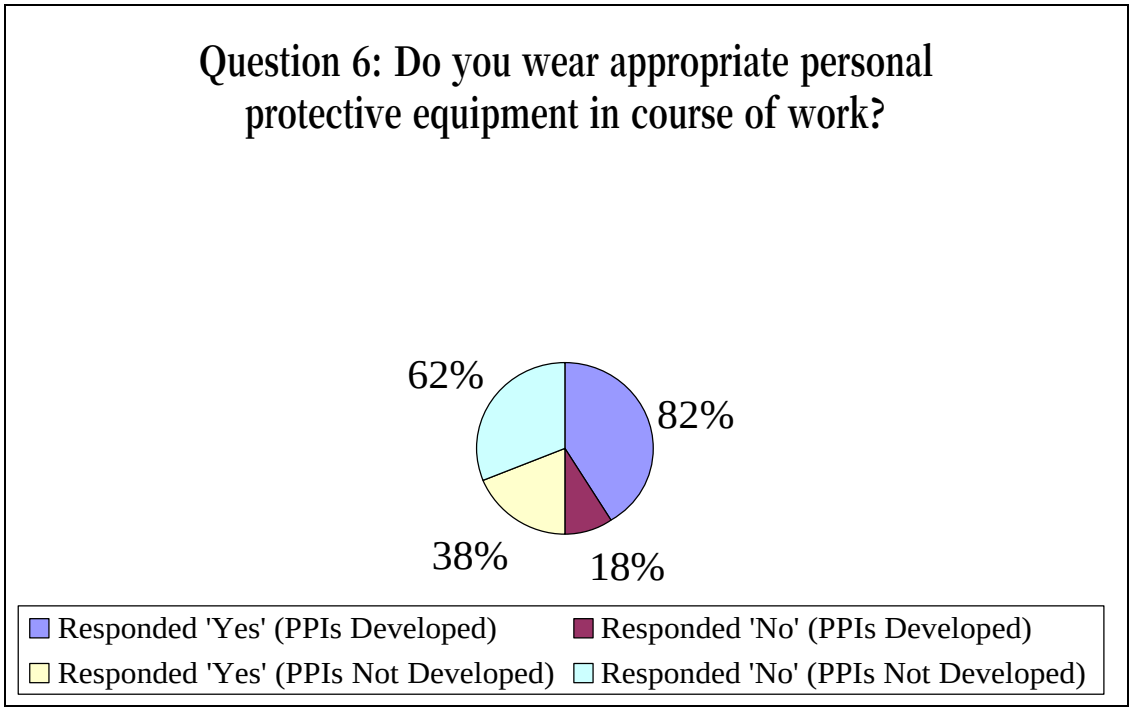



**Figure 15: Safe Behaviour of Workers Responded to Individual Question 6**

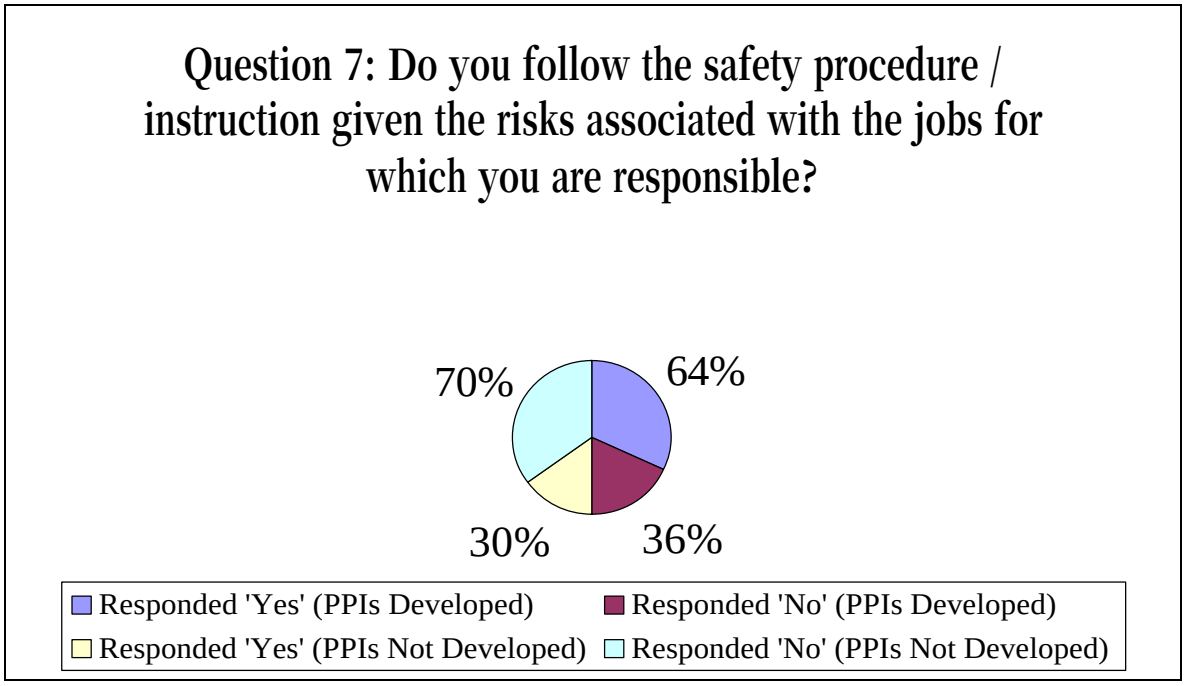



**Figure 16: Safe Behaviour of Workers Responded to Individual Question 7**

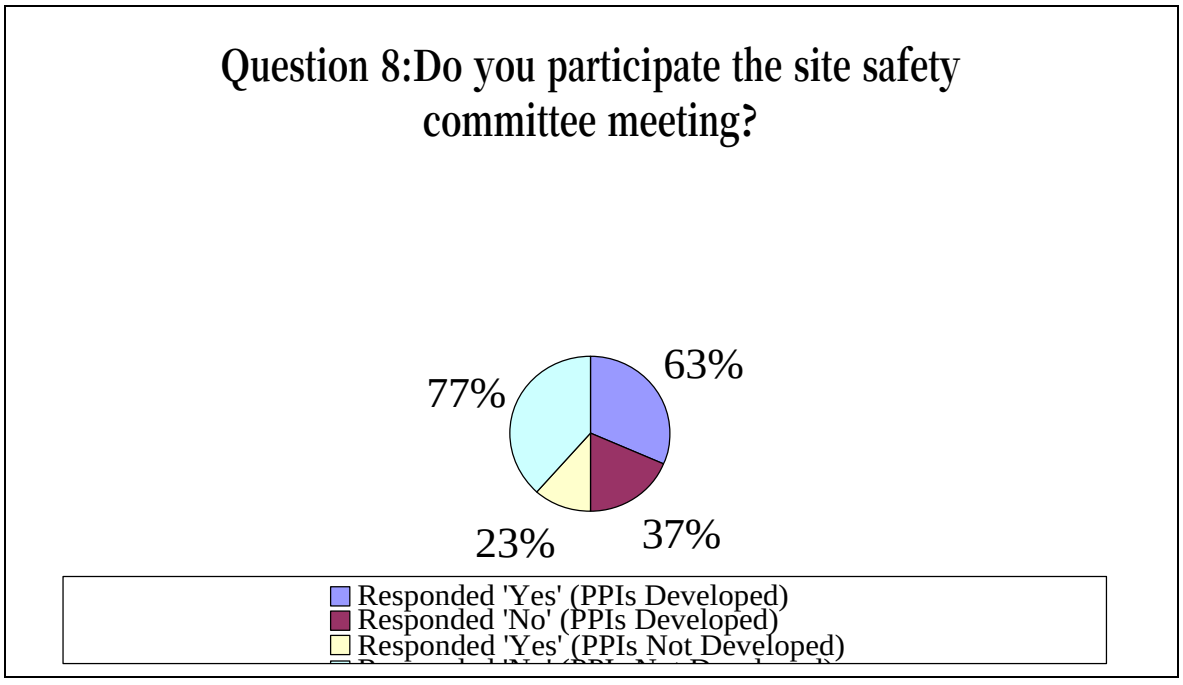



**Figure 17: Safe Behaviour of Workers Responded to Individual Question 8**

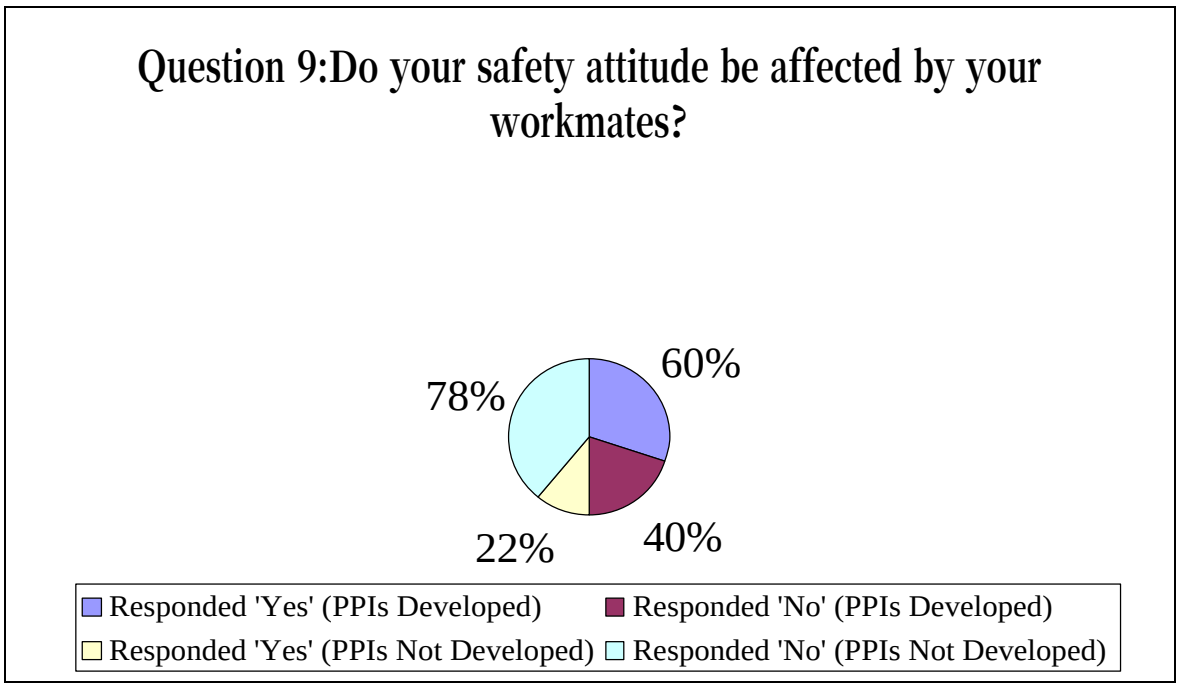



**Figure 18: Safe Behaviour of Workers Responded to Individual Question 9**

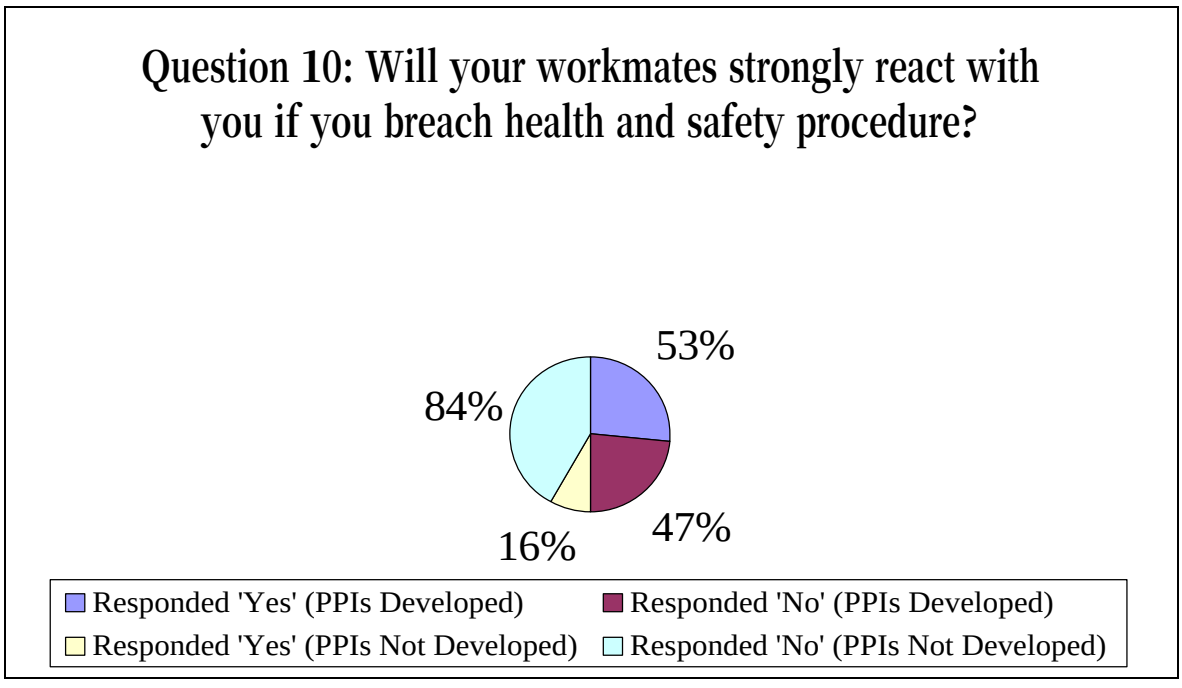



**Figure 19: Safe Behaviour of Workers Responded to Individual Question 10**

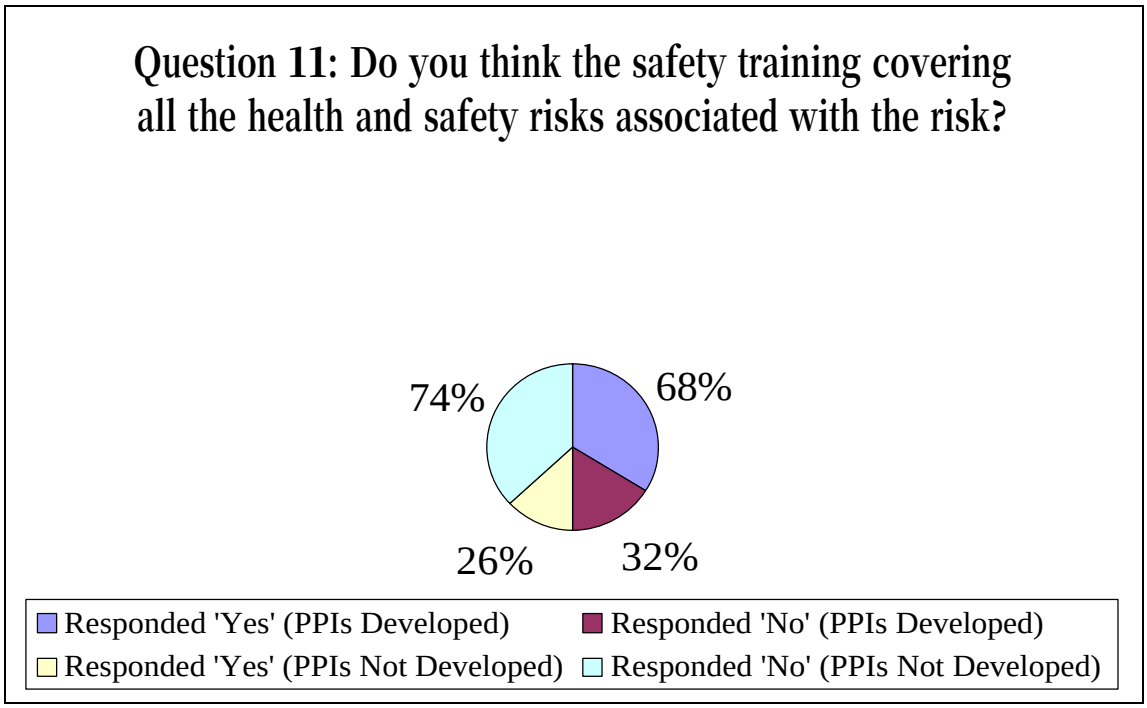



**Figure 20: Safe Behaviour of Workers Responded to Individual Question 11**

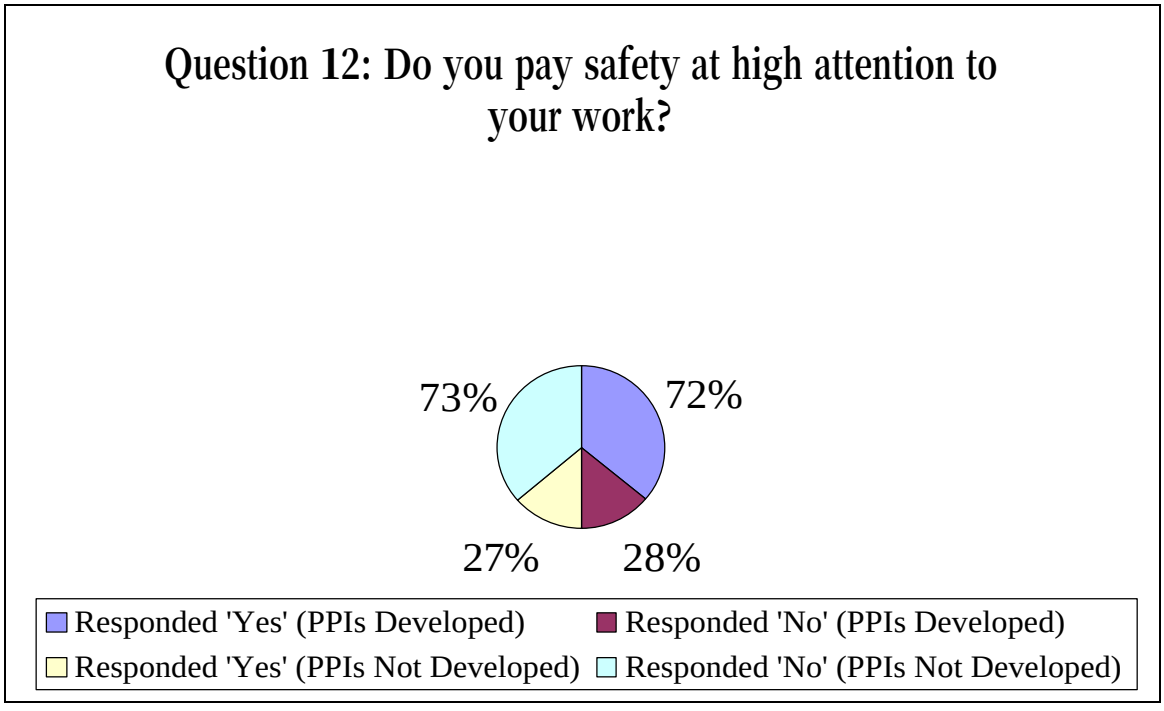



**Figure 21: Safe Behaviour of Workers Responded to Individual Question 12**

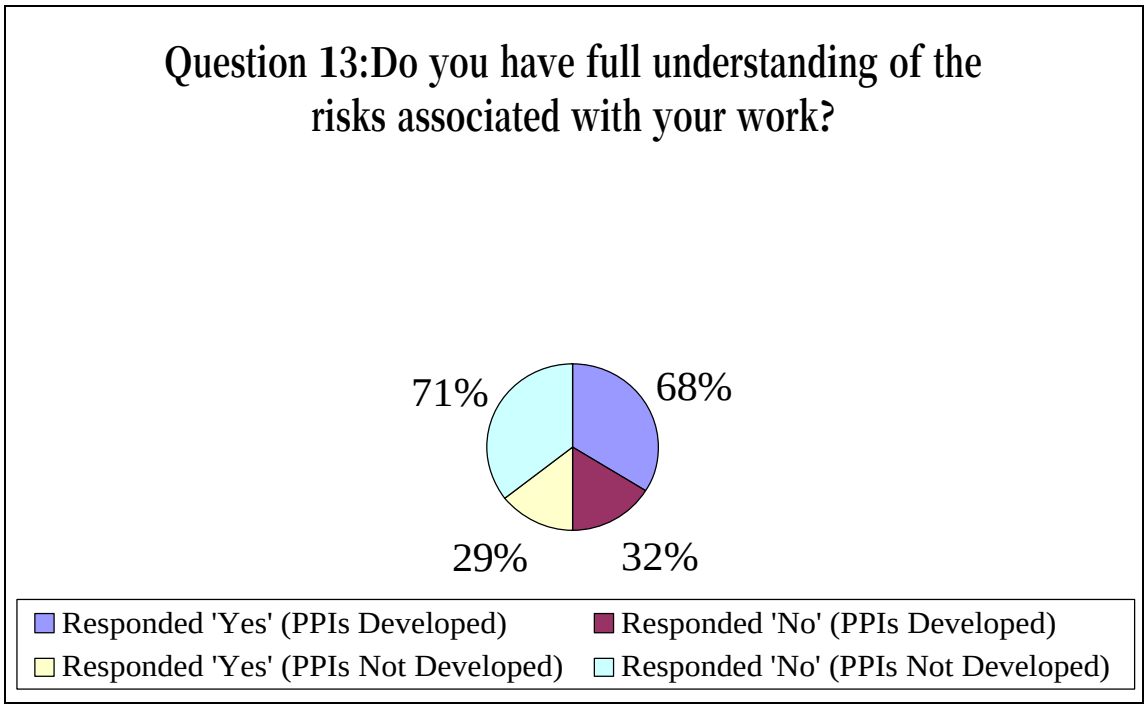



**Figure 22: Safe Behaviour of Workers Responded to Individual Question 13**

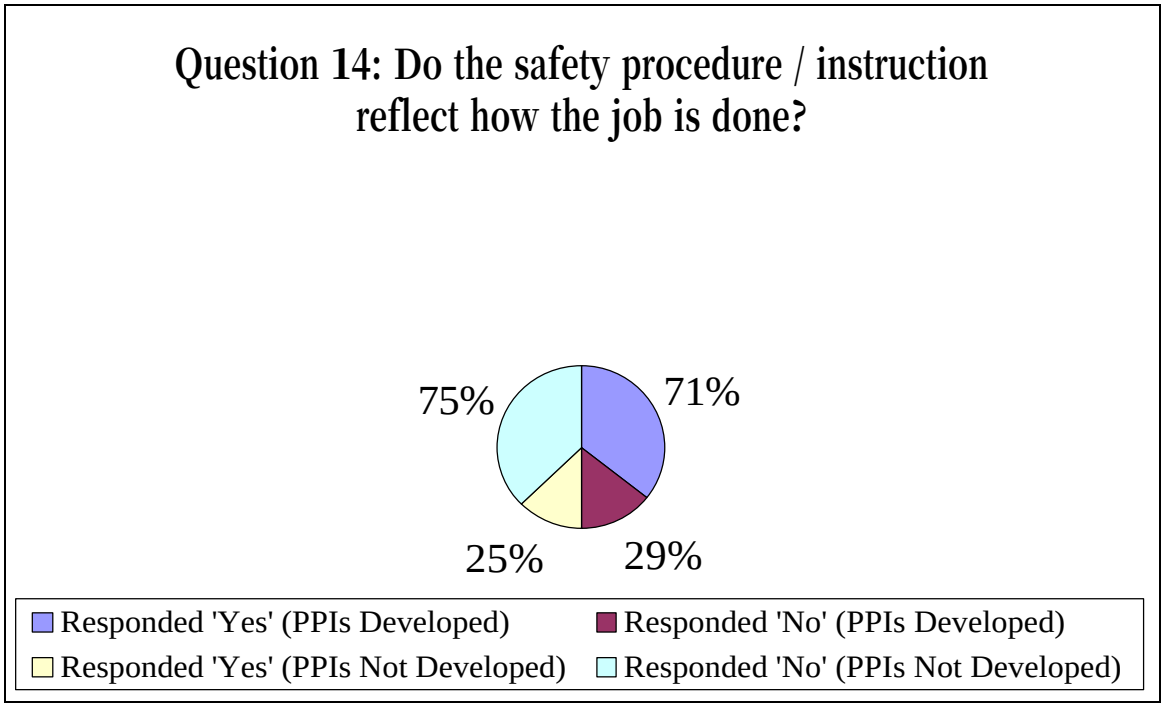



**Figure 23: Safe Behaviour of Workers Responded to Individual Question 14**

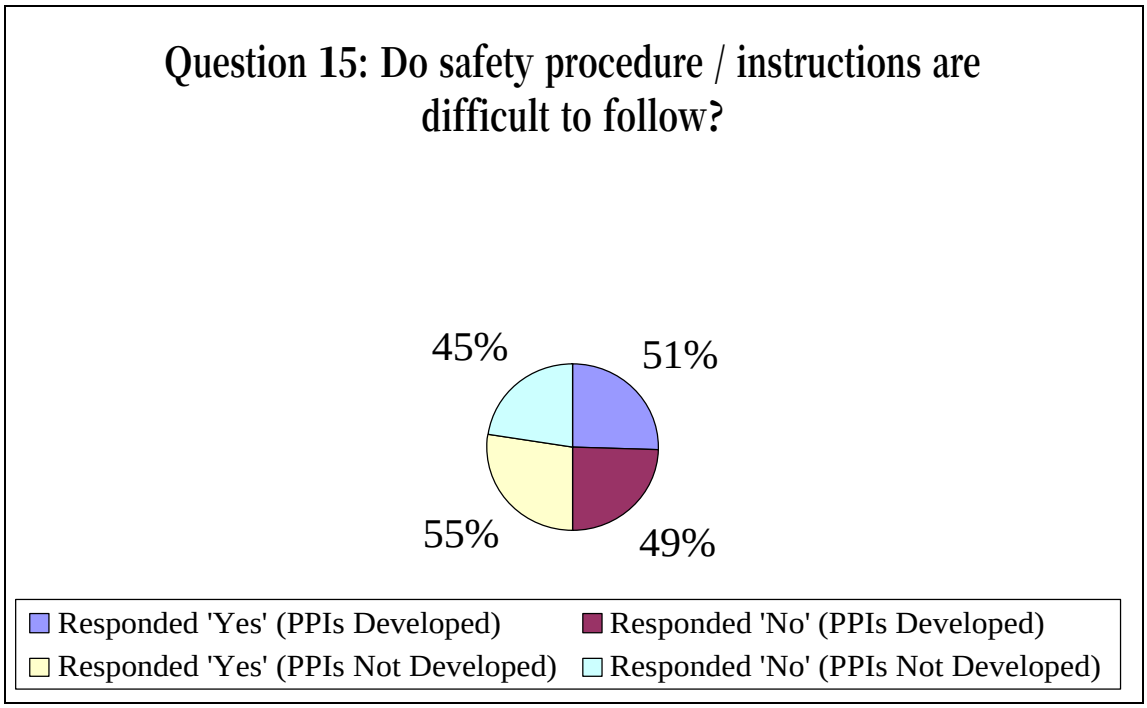



**Figure 24: Safe Behaviour of Workers Responded to Individual Question 15**

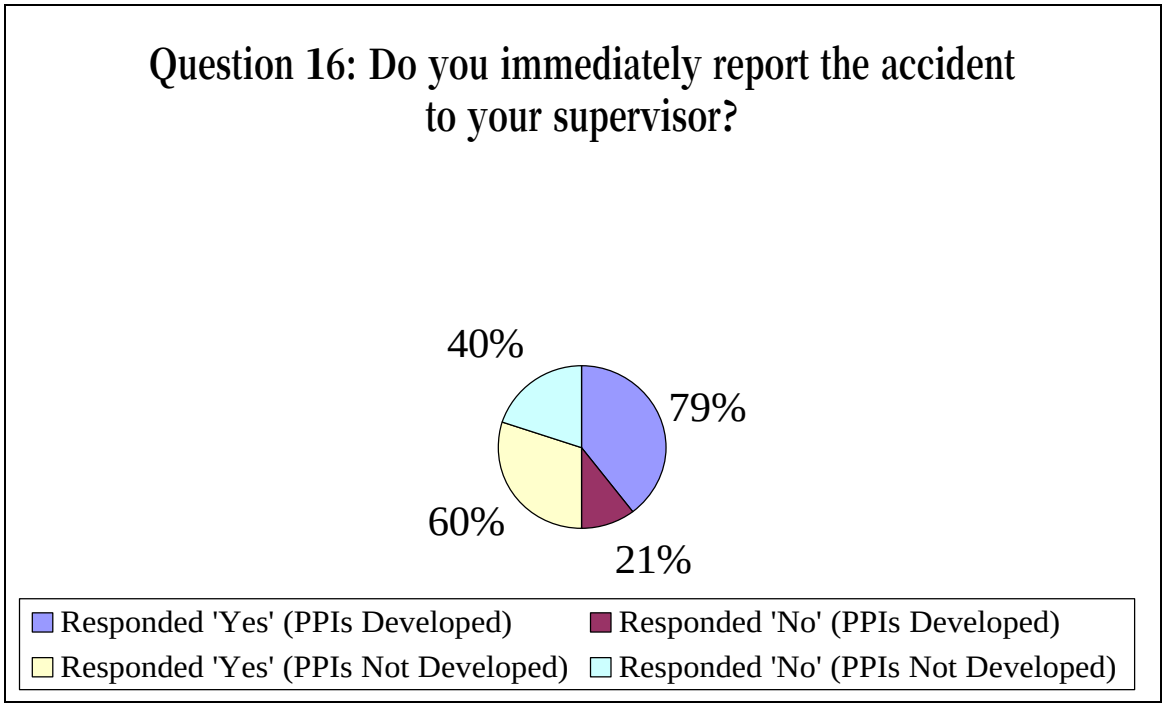



**Figure 25: Safe Behaviour of Workers Responded to Individual Question 16**

# 6 Discussion

## 6.1 Application of Positive Performance Indicators

This study of application of safety positive performance indicators in Hong Kong Construction Industry is successful and gives a clear picture of current development and application of positive performance indicators. The outcome of this study provides valuable data in the application of positive performance indicators. This study will add value to the work by providing useful guidance to other areas in which positive performance indicators may be useful and by supporting greater industry coordination in positive performance measurement. Below are some inspirations and recommendations aroused from this survey.

1. Most senior management acknowledged that reliance on basic accident data was of limited value to the management of OHS. They had previously identified that outcome data was of limited validity and was actively using or seeking positive performance indicators to help them improve their OHS management. Some safety personnel described negative outcome indicators as “a barrier to focussing on the root causes of accidents”. Most of senior management reported that accident data is of limited usefulness in managing OHS, because it is negative and also does not reveal the potential severity of accidents. At a site level, accident data is difficult to collect because many site workers are only on site for a short period and therefore it is difficult to collect accurate data. Neither the project manager nor the safety manager believed that the accident data they collected was either statistically meaningful nor reflective of OHS performance of the site. This means that the positive safety performance indicators will be able to provide timely support to the industry, encouraging other companies to also

improve their data collection and analysis.

2. Hong Kong Construction Industry has been developing positive performance indicators to measure effectiveness of the OHS management system. This study reveals that 68% of construction companies have developed and/or have been developing these positive indicators (see Figures 26 to 31). Some companies (mostly are private projects) still use the negative outcome indicators and safety performance of these sites are generally unsatisfactory (by returned questionnaires) .

3. In summary, the following six main areas which are considered to have impact on OHS performance are discussed regarding their application of positive performance indicators.

**Commitment by Management to Safety**

1. The overall results showed that senior management (for projects developing PPIs) generally gave positive responses in their commitment to safety. A clear and comprehensive safety policy was in place. They allowed budget for implementation and promotion of occupational health and safety. Senior management set good example in safety by attending site safety committee meeting. However, senior management (for projects not developing PPIs) showed a negative response of management commitment. Neither a comprehensive safety policy was in place nor budget was allowed for implementing safety.

2. Effective enforcement was seen as critical to improving OHS performance in the projects which are developing PPIs. Senior management in these sites believed that the most effective results from enforcement would occur if enforcement was universal, with all contractors and subcontractors facing equal likelihood of action and if enforcement was tailored to the needs of the sector, with an education first approach. Enforcement should also be directed to where the responsibilities and control lie. For example, it was argued that legal responsibility should also be placed where the finances were - with the owner.

3. Most construction sites (for projects developing PPIs) made sub-contractors' periodic payments reliant on the outcomes of OHS audits. Payments could be withheld, especially in relation to supply and installation of contracts, dependent on the nature of the non-compliance. However, some sites considered that such a move might have industrial relations implications and, although they liked the idea in theory, could not see it being put into practice. There was a view that using money as a control mechanism was not the best way of managing sub-contractors – It' s more important to have subbies involved in the system - on the OHS Committee, in toolbox meetings, etc. Another important aspect of commitment was the active involvement of front line managers in OHS systems implementation and communication. Active safety advisors - demonstrating the process on site, picking up on poor behaviour, communicating effectively - were also found to impact positively on safety performance

4. Senior management in projects which are not developing PPIs did not consider OHS a priority, although awareness seemed to be increasing. There was also a

lack of sector cohesion around OHS and this acted as a barrier to improvement. Cost-benefit of OHS issues was a major consideration when determining the implementation of OHS strategies. To some extent, OHS was considered the next step forward - cost, productivity and quality workmanship being the dominant considerations at present. They were prepared to cut costs by taking risks in order to obtain work and that the creation of a ‘level playing field’ was seen as imperative to raising the priority of OHS across the board. Stronger industry networks around OHS would be a useful strategy for improving OHS performance of the sector as a whole.

**Effective OHS Management System**

1. Over recent years, as increasing amount of work have been contracted out, work with OHS risks have tended to be shifted to contractors. Not all contractors have included the costs of covering these risks in contract bids. This supports price undercutting in an attempt to win tenders, which can increase the pressure to take short-cuts with safety. Stronger industry cohesion around improving OHS could be an important driver of further improvement throughout the industry by reducing the temptation to cut safety as a way to increase margins. A good OHS management record was regarded as an important competitive advantage for government-funded work but of less importance in privately-funded work. Stronger industry cohesion around the uptake and improvement of OHS would help the industry as a whole by reducing the temptation to cut safety as a way to increase margins. Industry networks and benchmarking could assist this to happen. The adoption of appropriate positive performance indicators throughout the industry would support increased industry cohesion by redefining ‘good OHS

performance' through process rather than through traditional outcome indicators.

2. Most senior management emphasized the importance of managing subcontractors' OHS performance. They stressed that the effectiveness of sub-contractor management was the main determinant of OHS performance. This was considered to be particularly true for smaller contractors where the OHS was more likely to be poorly managed and less well understood. Some companies had official or unofficial 'blacklists' of contractors who are known to be 'cowboys'. Such lists were operated at site level and/or at company level, and were an effective way of controlling unsatisfactory contractors. The fact that the industry needs to compete on cost was identified as a major contributor to such contractors remaining in the industry. Balancing the need to meet safety requirements with budgetary constraints and short timelines could at times compromise the attention which was paid to the safety performance of contractors. Some site personnel reported that they went to considerable lengths to reduce the likelihood that subcontractors with inadequate OHS management would be engaged on their project.

**Risk Management and Hazard control**

1. Collaboration between management and the workforce was regarded as critical in identifying major hazards by most of the management (for projects applying PPIs) . This was manifest in most companies principally as a very clear focus on seeking to control hazards at their source. Informal approaches to identifying hazards were encouraged on a 'see and fix' basis, with hazards which could not be rectified immediately being reported to the site supervisor for rectification.

This was coupled with a structured inspection regime. Weekly safety walks were undertaken by project personnel on a roster basis, although with particularly risky work processes, safety walks occurred daily.

**2.** In general, hazard management was reported to be undertaken informally. Hazards tended to be dealt with immediately or conveyed to the supervisor if this was not possible. However, most of senior management (for projects applying PPIs) reported that supervisors completed daily visual inspections and also formal inspections monthly. They also planned to make random formal inspections weekly in the future.

3. The design of the project makes a significant difference to the safety of the construction process for the contractor. A safer design would create a safer construction process. To help support this, it would be far better to have those who will actually build the project involved in the design process early enough to influence the design. However, time pressures mean that the opportunity to change things is not always available. Changing this approach, by building the opportunity to make changes into the project time lines, would have significant positive impact on the contractor's ability to manage OHS.

4. Only about half of senior management identified that the design of the building has considerable influence on OHS performance. They put input into construction design, all planning stages (from overall construction to work activities) and scheduling. This went beyond hazard and risk identification to ensuring that problems were designed out of construction, operation and maintenance stages in

so far as was possible or otherwise controlled. It also encompassed site set up and scheduling of activities to facilitate safety in construction, operation and maintenance. In addition, having specific safety management plans in place and adhered to them from the outset of construction was viewed as an important means of achieving effective OHS performance. It was reported that the design of the residence made a significant difference to the safety of the construction or renovation process. Renovations and additions could provide a problem, because control over the design was much smaller.

They identified that improving the education of design professionals (i.e. architects and engineers) to include OHS would have major benefits for OHS in the industry. In this context, it is revealing that only six sites explicitly reviewed the project's design for OHS consequences.

5. Control over design is generally directed towards keeping costs down rather than towards construction safety. In the private sector, control over design was much lower. Integration of OHS considerations into the design process in education of engineers and architects on an industry basis as well as consideration of constructability during the design of residences requires focus in the future.

**Auditing**

1 Auditing was seen as an opportunity to evaluate OHS activity in detail, as well as to assess the overall performance of a division. Performing well on an audit was seen as a driver of continuing good OHS performance. For example, consistently good internal and independent audit results and achieving targets acted as positive reinforcement and motivation. Fifteen sites regarded independent audits as useful,

as they found them an important way to assess their OHS performance and also as an opportunity to learn new ways of approaching OHS problems. All projects in the public sectors undertook both Independent and External Audits.

2 Independent audits provided a critical incentive to improve OHS management on site. They drove OHS performance and provided important feedback on possible improvement strategies. Independent audits not only provided an incentive to meet required standards, but also revealed opportunities for improvement. One enterprise reported particular value in inviting independent audit of its operations because it meant that the organization was scrutinized by people with ‘ fresh eyes’ .

**Training and Education**

5. Training was regarded as an important strategy. In the context of “training and education”, most projects in applying PPIs provided Induction Training to their employees. Training was regarded as an important strategy. However, there were serious criticisms of the quality of industry training with respect to OHS. The issues included the content of courses and concerns that people were not trained to cope with real life environments. Some site supervisors complained that persons have hired come along with a certificate of competence but they have never worked on site before. They might know how to operate the equipment, but they do not understand about working around pedestrians and near other working equipment. They are a danger to themselves and others because they think they know what they are doing, but they do not do really.

6. A related requirement is for change in the education and development curriculum

for architects and design engineers to ensure that OHS considerations form part of the design task and solutions. Concern with the effects of changes to industry standards and the nature of industry training extended to training provided to the workforce.

7. Senior management expressed the view that changes in competency requirements as well as changes to the practical hands-on nature of former training schemes have left individuals and their work mates exposed to unnecessary risk. For example, it was possible to obtain an advanced rigging certificate in ten days. Previously, people underwent a staged and mentored on-the-job program that provided practical skills along with the knowledge to do the job competently and safely. The current training program required significant catch up once people had the qualification, to equip them with a similar level of capability to those who qualified under the previous system. Increased flexibility had been obtained at the expense of safety.

8. Most senior management indicated that OHS needed to be addressed in the training and registration requirements of building personnel so that it became an industry-wide issue rather than a enterprise-driven issue. This was seen as critical by management in the building sector because there are many small operators who are prepared to cut costs by taking risks in order to obtain work. In this environment good OHS could be a competitive disadvantage, unless an industry-wide stance was taken to improve OHS practices. It was also suggested by some management that incentives for OHS training in the building sector could be linked to a tangible benefit such as a reduction in workers'

compensation premiums and that the different associations should tailor courses to meet the needs of their members. Some senior management reported that generic OHS induction should be available through external training bodies so that only site-specific material was required to be provided by them. This would limit the time taken for induction purposes with contractors who are used frequently, minimise the length of the enterprise induction, and reduce the cost of the program.

**Communication and participation**

1. Effective communication, especially where activities interfaced, was another key strategy in successfully managing OHS identified by the case study enterprises. This facilitated teamwork and involved communications at individual and group levels throughout the project. It enabled the uptake of workforce suggestions by management and the reciprocal uptake of management systems by the workforce with no "resentment factors" present. A key aspect of participation was the development a ' culture' of safety and of reporting incidents or potential incidents, with everyone understanding that OHS was needed and had to be fundamental to the way work was done: "no shonkies – if the job' s unsafe no-one will do it".

2. It was reported that due to the fluctuating nature of the workforce, it was not considered feasible to have a formal OHS committee but also that "the basis of good performance in any aspect of the enterprise, including OHS, is good two-way communication". However, in most companies, general communication depended on the presence of supervisors and management passing on or receiving information on site. It seems that evaluation of the effectiveness of

communication in the projects not adopting PPIs require further investigation and improvement in the future. Nevertheless, all companies (for projects developing PPIs) had developed their safety committee meetings but not many workers participated in the meetings.

3. Formal processes such as site safety committees were nominated as significant, but ensuring that consultation and communication was part of everyday management processes, such as development of work procedures, was even more important. For example, one OHS manager believed that workforce participation in OHS management is critical to success. He was working to encourage management to change the current top-down approach to one which recognises that "participation is the key".

## 6.2 Workers' Safe Behaviour

6.2.1 The overall results show that workers (for projects applying PPIs) support that company management has commitment to safety and health at work. This indicates that the perceived level of organizational commitment to health and safety has a major influence on cultivating a positive health and safety culture. On the other hand, the safety communication was poor in private projects (not applying PPIs) . It is suggested that organizations can reinforce safety by the use of notices, posters, handbills or safety bulletins and newsletters to inform employees about particular OHS issues, such as results of inspections, outcome of accident investigations and committee meetings etc. Planned meetings can also give opportunities to employees to have face-to-face discussions, which give support to other communication activities and enable

them to make a more personal contribution. Examples of meetings suitable for promoting safety include orientation meetings for new comers, problem-solving meetings, toolbox meetings and regular safety committee meetings etc.

6.2.2 Line management and supervisors have an important part to promote health and safety, and react to health and safety issues which may be raised. More than 70% of workers (for sites developed PPIs) advised that line management/supervisors are good and effective at ensuring health and safety at work. However, only 50% workers (projects not developed PPLs) agreed with that. It is our view that that the usual role of "supervisors" should be changed to "team-leaders" so as to promote effective team working. They can plan, direct, help, coach and guide the workers to work together in the pursuit of team objectives. A particularly important aim is to improve their understanding of the risks involved in the work and how these risks can be eliminated or better controlled. Supervisors can communicate powerful signals about the importance of health and safety if they lead by example through positive safety behaviour. Subordinates soon recognize what their supervisors regard as important and act accordingly.

6.2.3 If all employees are to make a maximum contribution to health and safety, there must be proper arrangements in place to ensure that they are competent. The results of the survey indicate that some of the workforces show uncertainty in ensuring health and safety at work. It is suggested that systems should be developed to identify health and safety training needs arising from

recruitment, changes in staff, plant, substances, technology, processes or working practices. The Green Card safety training for construction workers should be enhanced by including hands-on training and impressing on workers the hazards from their working situations. Besides providing training, experience of applying skills and knowledge is another important ingredient and needs to be gained under adequate supervision. Line managers and supervisors need to be aware of relevant legislation and receive appropriate training on site safety management to enable them to perform an effective management role. Safety professionals should also be required to maintain or enhance competence by taking refresher training.

6.2.4 When exploring the issue on the extent to which people take risks or behave unsafely at work, it is surprisingly to reckon that workes often take risks when they are at work, and workmates are often influenced by these behaviours. Overconfidence, over-optimism or over-familiarity may act to reduce their appraisal rating of a hazard as significant. Some of the main obstacles identified in the survey to advocate safe behaviour are “some health and safety procedures/instructions/rules did not reflect how the job was done and were difficult to follow”, and “influence of unsafe behaviour by the workmates”.

6.2.5 Sometimes arrangements for controlling particular risks make it necessary for people to behave in a certain way, e.g. to follow a specific procedure or to wear PPE. In high risk situations such reliance on individual behaviour is recommended as “last resort” control measure. It is better to eliminate or control the hazard in ways which are not reliant on human behaviour. Besides,

worker behaviour is only one factor affecting safety and should not be dealt with in isolation but rather within an effective health and safety management system. A number of ways which can successfully influence safe behaviour at work, especially for the sites not developed PPIs are suggested as follows:

6.2.5.1 Poor procedures can be a reason for people not following recommended actions. Besides being technically accurate, procedures need to be well-written, understandable to employees involved and revised periodically to ensure that they reflect current operations. Some issues need to think about in writing better procedures such as considering both the difficulty and importance of the task to be documented; finding out how often the task is carried out and the potential hazards involved; and thinking about who will use the procedure and the level of information they need. It should be noted that providing too much information may lead to less use of the procedure if users find it too detailed and hard to follow.

6.2.5.2 Belief and knowledge are important determinants of safe behaviour. Organizations must raise awareness among construction workers of safety hazards on site and urge them to take responsibility for their personal safety. Education and training are therefore vital. Training should cover such key aspects as knowledge of the work-related health and safety risks; proper use of safety-related equipment and procedures; awareness of the benefits of carrying out safe behaviour; and the views of managers and co-workers on risk-taking. Managers

and supervisors should also be aware that group social norms for safe behaviour exist. They need to set a good example and positively influence such standards of behaviour.

6.2.5.3 To ensure the success of a behavioural change, organizations can utilize techniques of goal-setting and performance feedback. With the support of the Works Bureau and the Hong Kong Housing Authority, the Occupational Health and Safety Council has taken the lead to encourage construction companies in Hong Kong to practice “Safe Working Cycle” at their construction sites. The Safe Working Cycle is a well-planned and scheduled program of events either daily, weekly, or monthly that has specific target or goal. It involves reinforcement of safety awareness of workers and monitoring in preventive approach to ensure that any unsafe behaviour or unsafe condition are detected and resolved before it attributes to an accident.

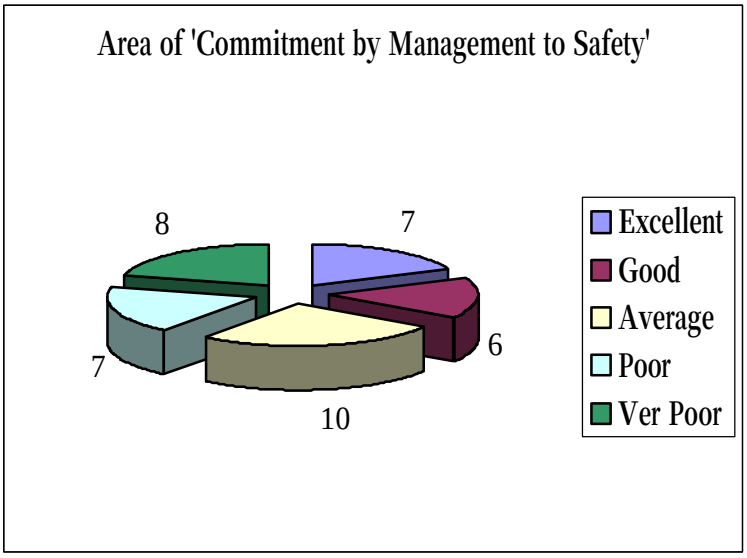



**Figure 26 : Safety Performance Achieved by Construction Sites at Individual Area**

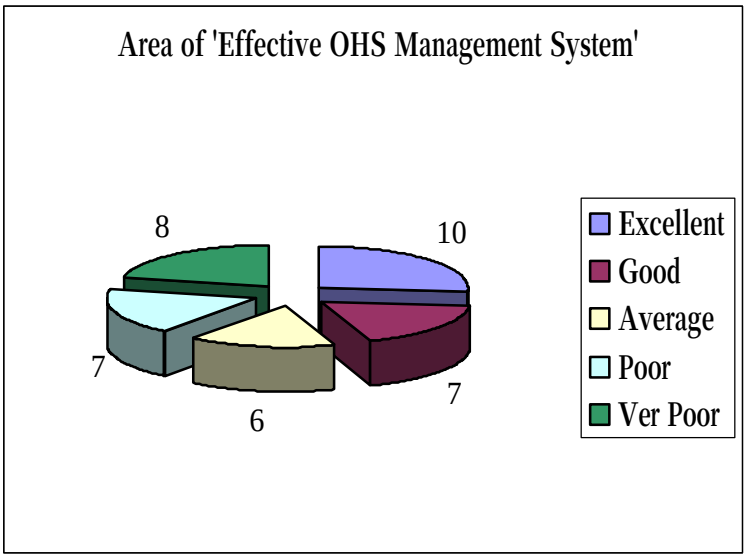



**Figure 27 : Safety Performance Achieved by Construction Sites at Individual Area**

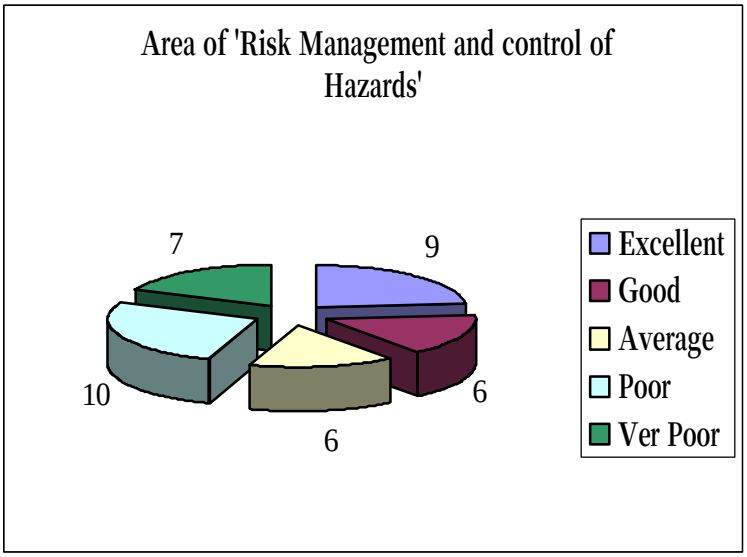



**Figure 28 : Safety Performance Achieved by Construction Sites at Individual Area**

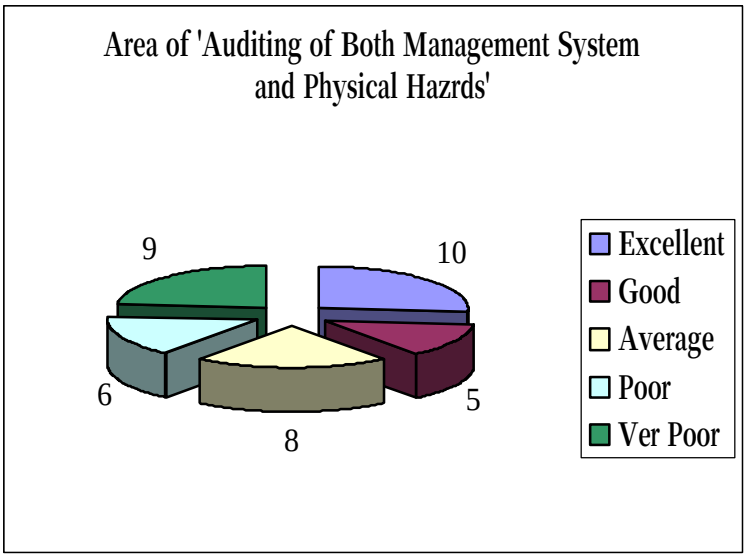



**Figure 29 : Safety Performance Achieved by Construction Sites at Individual Area**

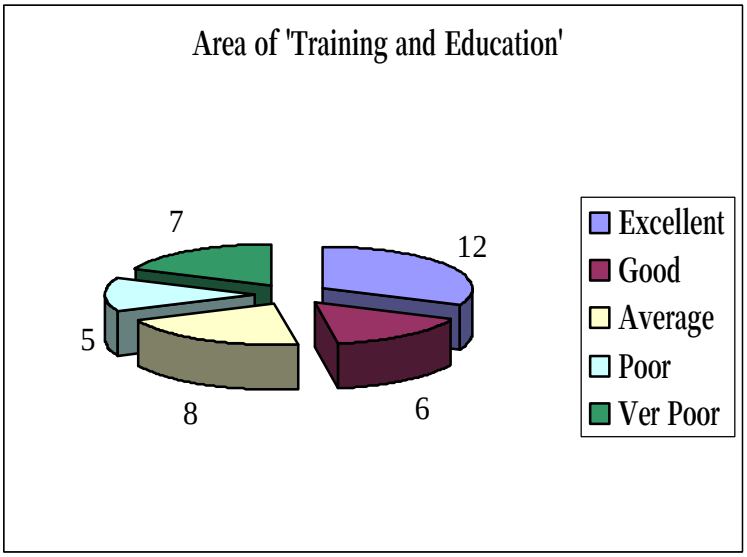



**Figure 30 : Safety Performance Achieved by Construction Sites at Individual Area**

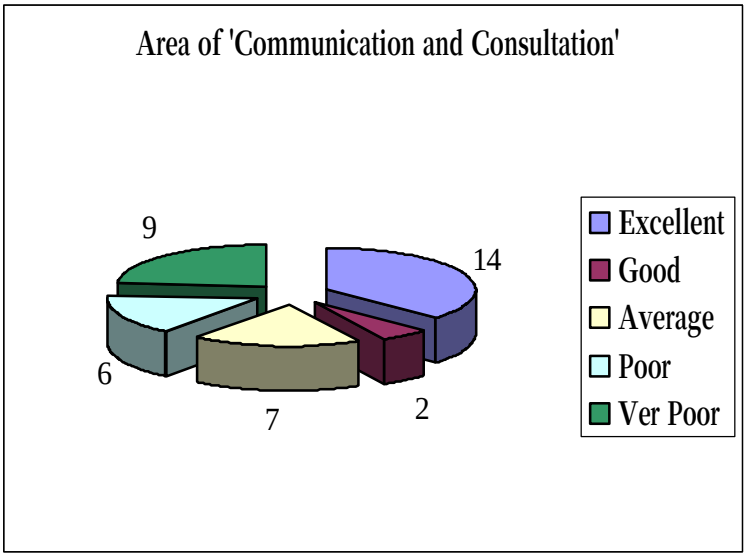



**Figure 31 : Safety Performance Achieved by Construction Sites at Individual Area**

# 7 Development of Positive Performance Indicators

## 7.1 Positive Performance Indicators Currently Used in Hong Kong Construction Industry

Most senior management acknowledged that there were limitations in using outcome measures to assess OHS performance. Consequently, most enterprises used a combination of outcome measures and positive performance indicators to monitor their OHS performance, although one company used only outcome measures.

PPIs is developed based on thirty safety control measures (SCMs). These SCMs have undergone rigorous validation to ensure that only the important factors are chosen for Safety Performance Measurement Tools. The SCMs chosen best represent generic safety factors affecting safety performance on site and should form the basis of any measurement system. Below are the SCMs:-

- Safety audit
- Up-to-date safety documentation
- Pre-tender risk assessment
- Procedures for reporting accidents/incidents
- Procedures for reporting near misses
- Up-to-date safety policy
- Safety meeting with supervisors
- Safety meeting with sub-contractors
- Selection of sub-contractor based on safety Issues
- Health & Safety Committee
- Safety officer
- Induction training
- Site inspection
- Method statements
- Permit-to-work system
- Machinery & equipment in safe working condition
- Good housekeeping
- Material Safety Health Data Sheet
- Emergency response system
- Suggestion system
- Communication
- Safety promotion
- Training
- Safe behaviour
- Safe working environment
- Effective health care

- Tool-box talks
- Construction risk analysis
- Motivation to safe behaviour
- Recruiting the right person

## 7.2 Various Types of Positive Performance Indicators

Performance indicators tend to fulfil three different functions; dials, alarm bells and can openers (Carter et al, 1992). The worksheet (see Appendix 2) also refers to these types of indicators.

**Dials** are indicators that can be "read off". They are quantitative. An example of a dial indicator is – "the percentage of planned management visits to site conducted over a specified time frame".

**Alarm bells** are indicators of events that should never happen. They give an alert that something is very wrong. These tend to be outcome measures such as the number of injuries that occur.

**Can openers** are indicators that lead to the right questions or further investigation in the right direction. An example is "average time taken to rectify high risk hazards". This information would need to be analysed to determine the reasons for any delays. Alternatively, analysis might determine why there is a reduction in the time taken, so that the process can be done right all of the time.

Some indicators only give information about how busy the company has been rather than how effective the strategies have been. An example of a busy-ness indicator is 'the number of people attending a training course'; this tells nothing about the effectiveness of the training program. Busy-ness indicators might be important at

some stages, particularly if the company's OHS program is not yet mature, in order to ensure that basic activities are happening at the planned pace. They can also make accountability more transparent, busy-ness indicators made the actions expected of people in the workplace very clear. However, busy-ness indicators need to be balanced with other types of indicators to get the best assessment of the companies' OHS performance.

## 7.3 How Positive Performance Indicators Can Be Used

The suggested indicators for the construction industry can be used in different ways, depending on the needs of the enterprise. Consider the following indicator:

- The extent to which the design of the structure enables safe construction, rated on a scale of one to six:

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Safety neglected | | | | Safety effectively built-in | |

This might be used to compare how different design companies perform in designing for constructability. Alternatively, it could be used to see how the same design company performs over time or over a number of projects. This information might help in making decisions about which projects to tender for, which design company to use, or how a given design company might be approached, based on the performance of the design companies.

## 7.4 Factors that may affect the collection of information on OHS Performance

There are some factors which may affect the way in which information about the companies' or contractors' OHS performance is collected. Some small enterprises may not keep records and they might need to be given good reasons to encourage them to participate in collecting information relating to OHS. They may not perceive any financial-benefit in collecting data and they would want to be convinced that on-going data collection was useful to both the enterprise and the industry. They might also need guidance on how to collect information and what to collect.

Short-term contracts may not be suitable for data collection purposes, especially if statistically meaningful information is being sought. For similar reasons, it may be difficult to compare safety performance between projects due to their diverse nature. For example, the number and type of the on-site workforce may vary depending on the stage of the construction process. It might be like comparing apples and pears. However, for some performance measures, this will not be a problem.

## 7.5 Selecting a range of performance indicators

The chosen range of indicators should include a selection of 'dials', 'alarm bells' and 'can openers' to help balance the understanding of the OHS performance of the enterprise. Different positive performance indicators are relevant at different times. For example, this might vary according to the stage of the construction process or the complexity of the project. As the enterprise's OHS program matures, different positive performance indicators will be needed to help identify the next stage in the development of the company.

The choice of performance indicators will vary depending on the maturity of the OHS program in the company. For example, during the early stages, a higher number of 'busy-ness' indicators might be needed to show that certain basic things are being done. As the program matures and OHS becomes part of the organisational culture, these activities can be expected to become more reliable, so the focus can shift to their effectiveness and how to refine them. Positive performance indicators can help in this process.

The following list of positive performance indicators has been developed specifically for use within the construction industry. These positive performance indicators should be used to assist the industry and to assess the effectiveness of OHS improvement strategies and could be used either within an enterprise or across enterprises.

The list is based on a distillation of the results of the 38 construction sites and the indicators that were currently used by them were grouped under five main headings:

1. planning and design;
2. management processes;
3. risk management;
4. psycho-social working environment; and
5. monitoring.

The list of indicators was then refined using the approach described in the worksheet (see Appendix 2) and the number of indicators was reduced. The list is not exhaustive. The best approach to developing performance indicators in the construction industry is to use the worksheet to develop indicators of OHS performance specific for the company or project.

## 8 Conclusion

Senior management had identified limitations with traditional OHS performance measurement and was seeking to improve their approach. A number of construction companies, especially for the public projects, could see value in positive performance indicators. The positive performance indicators chosen for the industry need to meet the needs of 'new starters in OHS' so that they are encouraged to continue along the path and are led by their indicators of performance. This study concluded that the Hong Kong construction industry has started developing and applying positive performance indicators which are proactive measures to effectively measure OHS management system. Positive performance indicators (PPIs) also provide guidelines for the construction industry to improve their safety. Statistics also revealed that positive performance indicators can improve workers' safe behaviour: workers' safe behaviour at the sites applying PPIs are much stronger than those sites without applying PPIs.

However, statistical reports on outcome measures were still regarded as important and useful in the private sector. There was of concern that at this stage, most senior management in this sector rely on outcome measures. They were in the process of implementing OHS systems to varying degrees. In general, the work they were doing was not as sophisticated as that done in the other sectors of the construction industry. This was a result of many factors, including the smaller size of the enterprises, lower levels of risk, knowledge levels in the sector, perceived need and the drivers acting in the industry.

Notwithstanding the identified limitations, the elements reflected in the preliminary

positive performance indicators were accepted as contributing to the effective management of OHS. Construction Industry recognized shortcomings in a reliance on outcome measures and had moved to varying degrees to initiate and monitor OHS processes or positive performance. The development of this project should continue to be informed by, and contribute to, that effort.

## 9 Recommendation

There are also weaknesses if only positive indicators of performance are used to monitor OHS performance, as:

- they may not directly reflect actual success in preventing injury or disease;
- they may be difficult to compare for benchmarking or comparative purposes;
- they may not be easily measured and may be time consuming to collect;
- they are subject to random variation;
- the measurement system may introduce incentives to mis-reporting. For example, under- or over-reporting; and
- often the relationship between positive performance indicators and outcome measures is not known.

Based on the findings and limitations of the study, it is recommended that:

- Companies should adopt a combination of both outcome-oriented (for example, LTIFR) and positive-oriented (for example, percentage of workers completing OHS training) indicators of OHS performance so that a more comprehensive view of OHS performance can be provided.
- Senior Management at private projects should be encouraged to apply positive performance indicators in measuring their OHS management system
- Sufficient time and adequate sampling size should be provided in further study
- A study of applying a combination of both positive and negative performance indicators should be conducted for further evaluation.
- A systematic observation should be conducted in the further study to ascertain any change of attitude and behaviour of workers after these sites are developed with positive performance indicators.

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**Appendix 1**

# Questionnaire for Management

This questionnaire is designed to collect data from the management of construction sites to study their application of positive performance indicators. Information are collected for the research purpose only and will not be disclosed to others. You are required to complete this questionnaire accordingly and return to the interviewer.

**Part A : Particulars of the Project**

Name of Company : _____

Contract No. : _____

Name of Project : _____

No. of employees employed : _____

**Part B : Questions**

| Item | Excellent | Good | Average | Poor | Very Poor |
|---|---|---|---|---|---|
| **A. Commitment by Management to Safety** | | | | | |
| How would you rate the management statements includes Occupational Health and Safety (OHS)? | | | | | |
| How would you rate the management performance reviews include Occupation Health and Safety? | | | | | |
| What do you think the OHS policy and/or information regarding OHS performance included in public company reports? | | | | | |
| What is your budget allowance for OHS? (contextual information would be needed for this indicator)? | | | | | |
| What is the frequency of OHS committee meetings are attended by senior managers? | | | | | |
| Do you think your sub-contractors periodic payments reliant on outcomes of OHS audit? | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **B. An Effective OHS Management System** | | | | | |
| Do you think the purchasing policy includes OHS requirement? | | | | | |
| How would you rate the sub-contractors contracts and/or tenders adherence to OHS practice? | | | | | |
| Do you think the Company have an effective OHS management system in place? | | | | | |
| How would you rate the safe operating procedures which are developed for work tasks? | | | | | |
| Do you think the preventative maintenance program is in place for equipment and/or machinery. | | | | | |
| | | | | | |
| **C. Risk Management And Control Of Hazards** | | | | | |
| Do you think that the major hazards are controlled and is there demonstrated use of risk assessment methods? | | | | | |
| Do you think that injuries are incurred for identified major hazards? | | | | | |
| How would you rate the employer in having any input regarding OHS in the design of the structure? | | | | | |
| Do you think that there is process in place for workers to report hazards in the workplace? | | | | | |
| Do you think that hazards identified through OHS committee meetings have been rectified? | | | | | |
| | | | | | |
| **D. Auditing of Both Management system and Physical hazards** | | | | | |
| Do you think number of sub-standard conditions identified and corrected as a result of safety Audits? | | | | | |
| Do you think number, regularity, quality and outcomes of independent assessments conducted (i.e. independent audits)? | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **F. Training and Education** | | | | | |
| How would you rate the attendance of workers for induction training? | | | | | |
| Do you think your supervisors/forepersons have received OHS training? | | | | | |
| | | | | | |
| **G. Communication and Consultation** | | | | | |
| Do you think training and operating instructions take into account non-literate worker? | | | | | |
| How would you rate the Organisation communicate to the workforce? | | | | | |

**Appendix 2**

# WORKSHOP WORKSHEET

*NOTE: It should be noted that the workshop worksheet presented in this research was not developed as part of this project. It provides an example of an approach to developing positive performance indicators and should not be considered as the only means for the development of positive performance indicators.*

## Developing key performance indicators for OHS

## How to use this workshop

You will get the best results from this workshop if management and employees work collaboratively to determine your OHS performance indicators. The OHS committee for your enterprise or project is usually a good group to use. Consider involving other key personnel, too, such as representatives of major contractors. Simply work through the steps on the worksheet described below.

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### Step 1 - Establish your goal for OHS

What is your goal for OHS management on this site?

(Steer away from measures masquerading as goals. For example, zero injuries is not a goal, it is a measure. Ask "what have you achieved when you have achieved zero injuries?. You will get something like, "a safe and healthy work environment".)

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### Step 2 - Determine the objectives that will let you fulfil the goal

What will you have to do to achieve this goal – i.e. what are your objectives?

(These might be things like, “provide everyone with the competencies they need to perform their job effectively” or “establish more effective consultation”.)

Choose one of your objectives to work on:

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### Step 3 - Develop a list of Key Performance Indicators

Brainstorm your answers to the following questions about the chosen objective:

- How would we know if we have achieved that objective?

- What tells us that we are performing well or badly in getting there?

## Step 4 - Refine your Key Performance Indicators

Next, refine that list:

- Cross off any silly or irrelevant items.
- Compare the list to the ACCURATE checklist for good performance indicators and cross off any which don' t have the necessary features.

**ACCURATE:**

**A**ssessable or measurable;
**C**ontrollable - able to be changed by what you do in health and safety management;
**C**entral and relevant to what you are trying to achieve;
**U**nderstandable and clear;
**R**eliable - providing the same measures when assessed by different people;
**A**cceptable to the users as true indicators of performance;
**T**imely; and
**E**fficient to monitor.

Do you have the right balance of dials, alarm bells and can openers?

**Dials** - are indicators that you can ' read off' . They are quantitative. An example of a dial indicator is "the percentage of planned management visits to site conducted, over a specified time frame".

**Alarm bells** - are indicators of events that should never happen. They alert you that something is very wrong. These tend to be outcome measures such as the number of injuries that occur.

**Can openers** - are indicators that lead you to ask the right questions or investigate further in the right direction. An example is ' average time taken to rectify high risk hazards". This information would need to be analysed to determine the reasons for any delays. Alternatively you might want to work out why there is a reduction in the time taken so that you can do it right all of the time.

- Is the item only telling you how busy you are, not how effective you are?
- Will the performance indicators you have left help you to improve your performance?
- Do you have too many performance indicators?
- Do you have enough performance indicators?

### Step 5 - List your Key Performance Indicators

Write down the performance indicators you have left. These become your Key Performance Indicators.

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### Step 6 - Determine how to measure your Key Performance Indicators (KPIs)

Use the following table to summarise your answers to the following questions:

- How can our KPIs be measured?
- What do we need to set up a measurement system?
- What is our current measurement against each KPI?

| KPIs | How measured? | What do we need to do? | Current measure |
|---|---|---|---|
| | | | |
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**Appendix 3**

# Questionnaire for Workers

This questionnaire is designed to collect data from the workers of construction sites to study their safe behaviour. Information are collected for the research purpose only and will not be disclosed to others. You are required to complete this questionnaire accordingly and return to the interviewer with enclosed stamped-envelopes.

**此問卷主要搜集工人安全行為資料，資料主要作研究用途，不會向外界洩露。請填妥問卷，寄回問卷負責人，內附回郵信封。**

Part A : Particulars of the Project
**A部 地盤資料**

Name of Company : _____
**公司名稱**

Contract No. : _____
**合約編號**

Name of Project : _____
**合約名稱**

1. Does your project have a written safety policy statement in which the general intentions, approach, objectives of the organization in enhancing safety and health in the workplace has been stated?
   **地盤是否有一套齊全的安全政策，包括公司怎樣加強及推廣地盤安全。**
   - ☐ Yes **是**
   - ☐ No, please state the reason_____
     **否，請說明原因**_____

2. Does your project deliver health and safety information to you after the safety meeting?
   **安全會議完畢後，地盤是否傳達有關安全資訊給員工。**
   - ☐ Yes **是**
   - ☐ No, please state the reason_____
     **否，請說明原因**_____

3. Do you think your immediate boss does enough to ensure health and safety?
**你覺得你的上司是否提供足夠安全措施給員工？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

4. Do you think your supervisors are good at detecting unsafe behaviour?
**你認為地盤監工是否適合監察不安全行為？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

5. Do you think your supervisors are very effective at ensuring health and safety?
**你覺得你的地盤監工是否有效地確保地盤安全？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

6. Do you wear appropriate personal protective equipment in course of work?
**在工作時，你是否配戴適當個人保護措施？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

7. Do you follow the safety procedure / instruction given the risks associated with the jobs for which you are responsible?
**你是否會遵從公司所頒佈之工作安全指引 / 指示。**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

☐ No such safety procedure arrangement **沒有提供此類指引**

8. Do you participate the site safety committee meeting?
**你是否有參與地盤安全委員會？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

9. Do your safety attitude be affected by your workmates?
**你的工作態度是否會受其它同事影　響？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

10. How will your workmates react with you if you breach health and safety procedure?
**如果你不遵從公司所頒佈之工作安全指引，你的同事會怎樣對待你？**

☐ Yes, React strongly against you　**是，強烈反應**

☐ No, Same as usual　**否，沒有反應**

11. Do you think the safety training covering all the health and safety risks associated with the risk?
**你覺得現現時公司所提供之安全訓練，是否包括地盤日常預見之危機？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

12. Do you pay safety at high attention to your work?
**你工作時，是否會特別注意安全？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

13. Do you have full understanding of the risks associated with your work?
**你是否完全明白你現時工作上遇到之危害？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

14. Do the safety procedure / instruction reflect how the job is done?
**你覺得現現時公司所提供之安全指引，是否足夠反　工作上遇到之危害？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

15. Do safety procedure / instructions are difficult to follow?
**你覺得現現時公司所提供之安全指引，是否十分困難遵守？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____

16. Do you immediately report the accident to your supervisor?
**當意外發生時，你是否會立刻呈報給你的上司？**

☐ Yes **是**

☐ No, please state the reason_____
**否，請說明原因**_____