INVESTIGATION OF SAFETY PERCEPTIONS OF MANAGEMENT AND WORKERS IN THAI CONSTRUCTION INDUSTRY

Ploypailin Pungvongsanuraks and Thanwadee Chinda*

Received: Apr 23, 2010; Revised: Jun 3, 2010; Accepted: Jun 6, 2010

Abstract

There are several unique characteristics that differentiate the construction industry from other industries. Most of the construction projects are, for example, normally conducted outdoors and have relatively short durations. The construction final product is usually unique and differs from one to another. The industry consists of many parties involved, ranging from top (management) to bottom (workers) levels. The construction owner is also deeply involved in the process, while the purchaser of manufactured goods is not. While based on these distinctive characteristics, the construction industry is considered, by many, as having a poor safety record. To improve this record, a better understanding of safety culture divergences between different working levels is desired to enhance and improve safety. This paper, thus, aims at investigating safety culture perceptions among the 2 working groups (management and workers) in the Thai construction industry. Five key safety enablers, being Leadership, People, Partnerships and Resources, Policy and Strategy, and Processes, with a total of 25 associated attributes, are confirmed with the exploratory factor analysis. A Pearson correlation is then performed to examine the relationships between the 5 enablers. The ANOVA test is also performed to examine the similarities and/or differences of safety culture perceptions between the 2 levels. Management and workers are found having safety culture divergences on 3 enablers (People, Policy and Strategy, and Processes), but bear similar viewpoints on the other 2 enablers, including Leadership and Partnerships and Resources. Accordingly, it is suggested that to align safety perceptions and enhance safety culture, an organization should focus on its Leadership and Partnerships and Resources implementation, as they positively facilitate the implementation of Processes, as well as the other 2 enablers.

Keywords: Analysis of variance, construction industry, enablers, factor analysis

School of Management Technology, Sirindhorn International Institute of Technology, Thammasat University, 131 Tiwanont Road, Bangkadi, Muang, Pathumthani 12000, Thailand, Tel: 66-2-5013505 ext. 2111, Fax: 66-2-5013524, E-mail: thanwadee@siit.tu.ac.th

* *Corresponding author.*

Introduction

The construction work site can be regarded as a work place without a roof, where all weather conditions have free access (Singh *et al.*, 1999). The location of the work site varies continuously according to each building project. The physical workload is generally heavy and the psychosocial work stress is high, as operations often have to be undertaken in inherently hazardous environments, and within the confines of low margins (Lunt *et al.*, 2008). These lead to the construction industry having a high number of accidents. To improve the safety record and reduce the number of accidents, safety culture must be considered (Dester and Blockley, 1995). According to Mearns *et al.* (2001), safety culture is defined as the attitudes, values, norms, and beliefs which a particular group of people share with respect to risk and safety. A good safety culture can help to control and reduce the construction costs, as well as increase the efficiency of the operations. To achieve a positive safety culture, it is important that safety culture perceptions among different levels in the organization are aligned (Fung *et al.*, 2005). This paper, thus, aims at investigating safety culture divergences between the 2 working groups (management and workers) in the Thai construction industry. To achieve this aim, the basic model for safety culture is developed based on one of the widely used quality models, the European Foundation for Quality Management (EFQM) Excellence model.

The European Foundation for Quality Management Excellence Model

The EFQM Excellence model is a non-prescriptive framework (Figure 1), which has a key role play in enhancing the effectiveness and efficiency of organizations, by reinforcing the importance of quality in all aspects of their business activities, stimulating, and assisting the development of quality improvement as a basis for their achievement of organizational excellence (EFQM, 2000). It is used for measuring the strength and areas where the improvement can be achieved. Further, it is used in measuring an organization's performance in business generally, as well as in specific industries, such as healthcare, hospitality, and construction (Camison, 1996; Fung *et al.*, 2005; Vallejo *et al.*, 2006). The model consists of 2 parts: enablers and results. The enablers cover what an organization does, while the results cover what an organization aims to achieve (EFQM, 2003). In this study, however, the focus is on the 5 enablers, as it is believed that the better implementation of enablers gives better results. This is seen by

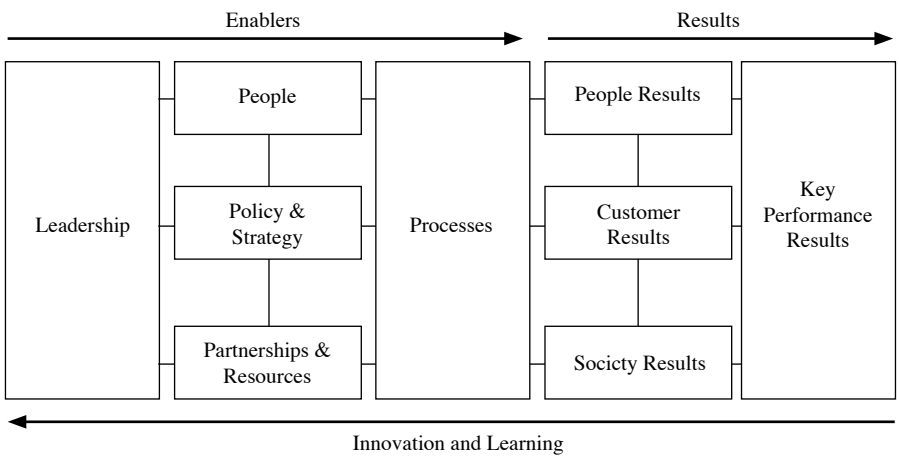

Figure 1. The EFQM excellence model (EFQM, 2003)

the arrows pointing from enablers to results (Figure 1).

The 5 enablers, Leadership, People, Policy and Strategy, Partnerships and Resources, and Processes, are associated with a number of attributes to explain their construct. The details are explained next.

Leadership

Leadership, the first enabler, consists of 5 attributes to explain its construct. The details of each attribute are described below:

1. *Commitment* (LCOM): Akiner and Tijhuis (2008) stated that a successful safety culture program requires commitment of management.

2. *Consultative style* (LCST): Hinze and Parker (1978) suggested that a good safety performance and high productivity are linked to the management consultative style.

3. *Encouragement* (LENC): Safety managers should see their functions as a management resource dedicated to helping and encouraging all members of the company to create and cultivate a safe and healthy workplace (Dilley and Kleiner, 1996).

4. *Role model* (LROL): Langford *et al.* (2000) indicated that supervisors and managers, who have positive safe behavior and are a role model in safety, influence positive operatives' attitudes.

5. *Safety accountability* (LACC): To develop positive safety cultures, senior managers should allocate safety responsibilities throughout the project organization from the senior down to various team members (Lingard *et al.*, 2009).

People

The People enabler consists of 6 attributes as detailed below.

1. *Peer review* (HPRV): To create a safe environment, the employees should care about safety, not only for themselves, but also for others (Geller *et al.*, 1996).

2. *Safety awareness* (HAWN): Dilley and Kleiner (1996) suggested that creating a culture of safety means that the employees are constantly aware of hazards in the workplace, including the ones that they create themselves.

3. *Safety empowerment* (HEMP): It becomes second nature to the employees to take steps to improve safety. When employees take their safety responsibility, safety culture increases (Dilley and Kleiner, 1996).

4. *Workers' competence* (HWCO): Andi (2008) stated that workers with adequate safety knowledge, skills, and ability are likely to minimize accidents.

5. *Workers' involvement* (HINV): A higher level of workers' involvement gives a positive influence to safe behavior (Andi, 2008).

6. *Work pressure* (HPRE): Hinze and Parker (1978) concluded that excessive pressures by company head office on-site superintendents, and by superintendents on the labor force, are likely to increase injury frequency and reduce production.

Policy and Strategy

Four attributes are associated with this enabler, which are:

1. *National safety law* (SNAT): Langford *et al.* (2000) claimed that safety laws and regulations are a part of safety's infrastructure.

2. *Rewards system* (SRWD): A rewards system that compensates workers for safe working, whilst achieving desired levels of productivity, is required (Langford *et al.*, 2000).

3. *Safety audit strategy* (SAUD): Dester and Blockley (1995) suggested that audits of unsafe acts should be used in a way that goes beyond the straightforward audit-corrective action process, but as a part of a safety improvement policy.

4. *Safety rules and procedures* (SRUL): Andi (2008) concluded that clear safety rules and procedures facilitate a positive safety culture.

Partnerships and Resources

Four attributes are extracted to explain the Partnerships and Resources enabler.

1. *Stakeholders' collaboration* (RCOL): Lingard *et al.* (2009) stated that success in occupational health and safety management can only be achieved through teamwork with employees, clients, contractors, and subcontractors.

2. *Human resources* (RHRS): Abudayyeh *et al*. (2006) claimed that adequate, as well as capable (skilled), workers are required for an effective safety program.

3. *Provision of personal safety equipment* (RPSE): The adequate provision of safety equipment and personal protective equipment are prerequisites for an improved safety performance (Langford *et al*., 2000).

4. *Provision of safety document* (RPSD): Every worker should be provided with a safety booklet to be used as a guideline for safety improvement (Langford *et al*., 2000).

Processes

Lastly, the Processes enabler consists of 8 attributes, as described below.

1. *Accident investigation* (PAIN): Oklahoma Department of Labor (1998) suggested that accident investigation helps in determining the causes of accidents, thus, enhancing organizational learning.

2. *Benchmarking* (PBEN): Having a benchmarking system of safety on site helps in improving the safety performance (Lingard *et al*., 2009).

3. *Job clarity* (PJCL): Hemingway and Smith (1999) stated that a lack of job clarity may have a direct effect on injuries, as this leads to the individual operating in unfamiliar situations, hence, increasing the likelihood of accidents.

4. *Housekeeping* (PHKP): Suitable mechanical plant on site is a recipe for safety (Langford *et al*., 2000).

5. *Feedback* (PFED): Safety performance is enhanced when clear feedback of safety performance-related information is provided (Algera, 1990).

6. *Risk assessment* (PRAS): To improve safety, risk assessment should be performed and protective measures should be provided (Ruhl *et al*., 2002).

7. *Safety data collection* (PDCO): The inadequacy of safety data leads to the lack of focus in safety campaigns, and the inability to measure the effectiveness of their efforts (Chan *et al*., 2004).

8. Training (PTRA): Training should be used to motivate and assist workers to work safely (Langford *et al*., 2000).

The above 27 attributes explain the 5 enablers in the safety context. These attributes are then used in the questionnaire development to elicit respondents' opinions on the different attributes in the context of their current safety practices and performance.

Questionnaire Survey and Preliminary Analyses

The questionnaire survey comprises 3 parts. The first part is devoted to gathering demographical information about the respondents and their respective organizations to ensure that the respondents have the appropriate backgrounds. The second part covers the 27 statements to operationally define the five enablers. Each statement is designed to elicit respondents' opinions on the different attributes in the context of their current safety practices and performance using a five-point Likert scale, with point 1 representing 'strongly disagree' and point 5 representing 'strongly agree'. The last part asks for opinions and suggestions.

A total of 800 questionnaires have been launched to medium-to-large construction companies, with 548 returns, representing a 68.5% response rate. From the returned responses, 138 are unusable due to data incompleteness, resulting in a total of 410 questionnaires for further analysis. More than half of the respondents have high work experience, and are involved in safety related activities. This gives confidence in the suitability of the responses in reflecting the current practices in the Thai construction industry.

To further increase the confidence in the data collected, a number of preliminary analyses are performed, including the normality test, the outlier test, and the reliability test. The results demonstrate that all 27 attributes show normal distribution. However, the outlier test shows 7 data cases that are potential outliers; consequently, they are deleted from the data

file, leading to the remaining 403 data sets going forward for further analysis. The reliability test (Table 3) shows that all 5 enablers have a higher alpha value than the minimum value of 0.7 (Pallant, 2005). However, it is found that the alphas if item deleted of the LCST, HINV, HPRE, and SRUL attributes are higher than those of their group values, showing that the stated attributes might not belong to their respective groups; thus, this needs further investigation. The confirmed 27 attributes, within the 5 enablers, are then examined with exploratory factor analysis (EFA) to confirm the construct validity of those 5 enablers. The details are explained next.

Exploratory Factor Analysis

The EFA is employed to confirm the 5 safety culture enablers with a total of 27 attributes. The generalized least squares method, together with the eigenvalue over 1, factor loading of 0.4, and varimax rotation are used to perform the EFA (Raubenheimer, 2004; Garson, 2009). The first run gives the results as shown in Table 1. Factor loadings of the SRUL and HINV attributes are less than the minimum value of 0.4; therefore, they are deleted from the data file. The second run extracts the remaining 25 attributes into 5 enablers, in which the attributes in each enabler represents the characteristics of their respective enablers (Table 2). As shown in Table 2, Factor 1 consists of 8 attributes that explain mainly process, thus, it is called the 'Process' enabler. Factor 2 comprises 4 attributes concentrated mainly on people; hence, it is called the 'People' enabler. There are 6 attributes in Factor 3; most of them relate to leadership, therefore, this factor is called the 'Leadership' enabler. The HPRE attribute, however, is relocated from People to Leadership. This relocation is supported by Langford *et al*. (2000), who stated that supervisors and managers are likely to turn a blind eye to unsafe practices to achieve set targets. This, in turn, leads to a high risk of accidents. Factor 4 covers 4 attributes on partnerships and resources, therefore, it is called the 'Partnerships and Resources' enabler. Lastly, 8 attributes are grouped in Factor 5, and they explain mainly about policy and strategy, thus it is called the 'Policy and Strategy' enabler.

These 5 extracted enablers are next examined with the reliability test to further confirm their construct (Table 3). It is obvious that the new alpha values of all 5 enablers are at least the same, or even better than, their original values. Also the relocation of the HPRE attribute from the People enabler to the Leadership enabler results in a higher alpha value for both enablers, proving the suitability of the relocation of the HRRE attribute.

The HINV and SRUL attributes are also deleted during the analysis process (Table 3), resulting in higher alpha values for both the People and the Policy and Strategy enablers. These, thus, increase confidence in the contribution of the 25 attributes to the measurement of their respective constructs. To examine the inter-correlations among the 5 safety enablers, the Pearson correlation is next performed.

Pearson Correlation

Lane (2007) stated that the correlation between 2 variables reflects the degree to which the variables are related. The most common measure of correlation is the Pearson Product Moment Correlation (also known as Pearson correlation). The University of Scranton (2010) suggested that the Pearson correlation is used to find a correlation between at least 2 continuous variables. The value for a Pearson's can fall between -1 (negative perfect correlation) to +1 (positive perfect correlation), with the value of 0 indicating no correlation (Green and Salkind, 2008). Pearson correlations of the 5 safety enablers are shown in Table 4. The results show that all 5 safety enablers are positively correlated, with the strongest relationship (value of 0.76) being between Policy and Strategy and Processes. This indicates that a good safety policy facilitates a successful process implementation (EFQM,

2000). Apart from that, the relationship between Partnerships and Resources and Processes also gives a strong positive correlation, illustrating that adequate safety resources and collaboration with the project partners lead to better process implementation (EFQM, 2000). The results also show a positive relationship between Leadership and Processes, which is not explicitly stated in the EFQM Excellence model. This may be explained by the work from the Council of Engineers of Thailand (1999) and Bureau of Labor Statistics (2010) stating that engineers, who are considered as a part of the management level, have the responsibilities covering planning schedules, clarifying works, and assessing risks (which are attributes of the Processes enabler).

To investigate safety culture divergences between the management and workers groups within 5 safety areas (i.e. the 5 safety enablers), the analysis of variance (ANOVA) is next performed.

Analysis of Variance

ANOVA is a general technique that can be used to test the hypothesis that the means among 2 or more groups are equal, on the

Table 1. Factor analysis results of the 27 attributes

Attributes	Factors				
	1	2	3	4	5
PDCO	0.75				
PRAS	0.70				
PAIN	0.69				
PJCL	0.67				
PFED	0.62				
PBEN	0.61				
PTRA	0.57				
PHKP	0.46				
SAUD	0.43				
SRWD	0.41				
SRUL					
HINV					
HWCO		0.73			
HEMP		0.73			
HPRV		0.66			
HAWN		0.65			
LENC			0.72		
LROL			0.70		
LCOM			0.58		
LACC			0.56		
HPRE			0.56		
LCST			0.49		
RPSD				0.71	
RHRS				0.56	
RPSE				0.51	
RCOL				0.47	
SNAT					0.65

condition that the assumption of normal distribution of the sampled population is defended (Sematech, 2010). One-way ANOVA is a statistical technique carried out to compare the means of more than 2 groups (The University of Vermont, 2010). This technique is applied in many researches, including those into the healthcare, food, and construction industries (Huang, 2004; Fung *et al*., 2005; Kittivachra e*t al*., 2007). Consequently, it is used in this paper to investigate safety culture divergences between the 2 levels. The results are explained next.

ANOVA Results of the Five Enablers

The 5 safety culture enablers are tested with ANOVA to examine safety divergences between management and workers levels. The results in Table 5 show that the significance values of the People, Policy and Strategy, and Processes enablers are smaller than the significance value of 0.05, while both the Leadership and Partnerships and Resources enablers report significance values greater than 0.05. According to Brandvold and McLemore (1998), significance values less than 0.05 indicate the differences among the samples.

Table 2. Factor analysis results of the remaining 25 attributes

Attributes	Factors				
	Processes	People	Leadership	Partnerships and resources	Policy and strategy
PDCO	0.74				
PRAS	0.70				
PAIN	0.69				
PJCL	0.66				
PFED	0.60				
PBEN	0.59				
PTRA	0.56				
PHKP	0.46				
HEMP		0.74			
HWCO		0.72			
HAWN		0.66			
HPRV		0.64			
LENC			0.73		
LROL			0.71		
LCOM			0.59		
HPRE[a]			0.57		
LACC			0.55		
LCST			0.49		
RPSD				0.70	
RHRS				0.58	
RPSE				0.51	
RCOL				0.47	
SNAT					0.54
SRWD					0.48
SAUD					0.45

[a] *Item relocated to another enabler.*

Table 3. Reliability test

Initial reliability test			Final reliability test		
Enablers	**Alphas**	**Alphas if item deleted**	**Enablers**	**Alphas**	**Alphas if item deleted**
Leadership	0.81		**Leadership**	0.84	
• LCOM		0.76	• LCOM		0.80
• LCST[a]		0.82	• LCST[a]		0.84
• LENC		0.74	• LENC		0.79
• LROL		0.75	• LROL		0.79
• LACC		0.79	• LACC		0.82
			• HPRE[b]		0.81
People	0.83		**People**	0.85	
• HPRV		0.78	• HPRV		0.83
• HAWN		0.78	• HAWN		0.82
• HEMP		0.8	• HEMP		0.81
• HECO		0.78	• HWCO		0.81
• HIVA[a]		0.83			
• HPRE		0.83			
Policy and Strategy	0.82		**Policy and Strategy**	0.83	
• SNAT		0.73	• SNAT		0.75
• SRWD		0.75	• SRWD		0.75
• SAUD		0.78	• SAUD		0.80
• SRUL[a]		0.83			
Partner's and Resources	0.83		**Partner's and Resources**	0.83	
• RCOL		0.80	• RCOL		0.80
• PHRS		0.77	• PHRS		0.77
• RPSE		0.79	• RPSE		0.79
• RPSD		0.76	• RPSD		0.76
Processes	0.91		**Processes**	0.91	
• PAIN		0.89	• PAIN		0.89
• PBEN		0.89	• PBEN		0.89
• PJCL		0.89	• PJCL		0.89
• PHKP		0.90	• PHKP		0.90
• PFED		0.89	• PFED		0.89
• PRAS		0.89	• PRAS		0.89
• PDCO		0.89	• PDCO		0.89
• PTRA		0.89	• PTRA		0.89

[a] *Items having alpha value if item deleted higher than their group values.*

[b] *Relocated item.*

The explanation for this is that management and workers hold different safety perceptions in 3 areas, including People, Policy and Strategy, and Processes, but take corresponding viewpoints on the issues regarding Leadership and Partnerships and Resources.

Milczarek and Najmiec (2004) concluded that desirable organizational behavior and

enhanced safety culture can be realized with the 'commitment' of managers (an attribute of Leadership) to safety and that the substantial contribution and voices of workers, who are discouraged by cultural norms, are essential to minimize accidents in workplaces and improve safety management (Hofmann and Stetzer, 1996; Barling *et al*., 2002). Moreover, Oxford University Careers Service (2007) stated that 'stakeholders' collaboration' (an attribute of Partnerships and Resources) is considered as critical in achieving a particular goal in a workplace for almost every occupation. Apart from that, the survey's respondents (both management and workers levels) also suggest that the adequate 'provision of personal safety equipment' is crucial in improving safety performance.

A deeper analysis of attributes constituting People, Policy and Strategy, and Processes, in which both working groups hold conflicting opinions, is described next.

Table 4. Pearson correlations of the 5 enablers

		Leadership	People	Policy and stategy	Partnerships and resources	Processes
Leadership	Pearson Correlation	1.00	0.56(**)	0.59(**)	0.59(**)	0.61(**)
	Sig. (2-tailed)	.	0.00	0.00	0.00	0.00
People	Pearson Correlation	0.56(**)	1.00	0.62(**)	0.56(**)	0.57(**)
	Sig. (2-tailed)	0.00	.	0.00	0.00	0.00
Policy and Strategy	Pearson Correlation	0.59(**)	0.62(**)	1.00	0.68(**)	0.76(**)
	Sig. (2-tailed)	0.00	0.00	.	0.00	0.00
Partnerships and Resources	Pearson Correlation	0.59(**)	0.56(**)	0.68(**)	1.00	0.73(**)
	Sig. (2-tailed)	0.00	0.00	0.00	.	0.00
Processes	Pearson Correlation	0.61(**)	0.57(**)	0.76(**)	0.73(**)	1.00
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	.

** *Correlation is significant at the 0.01 level (2-tailed).*

Table 5. Significance values of the five enablers

Enablers	Significance values
Leadership	0.282
People	0.004
Policy and Strategy	0.001
Partnerships and Resources	0.066
Processes	0.026

ANOVA Results of People, Policy and Strategy, and Processes

People Results

Table 6 illustrates the significance values of the 5 attributes associated with the People enabler. The results show that 'peer review' (HPRV) and 'workers' competence' (HWCO) have higher alpha values than 0.05, indicating the similarities in the safety perceptions among management and workers. On the other hand, 'safety awareness' (HAWN) and 'safety empowerment' (HEMP) present smaller significance values, denoting that the 2 working groups do not agree on these 2 attributes. One of the reasons is due to the fact that Thailand is considered to be a high power distance nation, giving rise to the clear separation between inferiors (workers) and superiors (management). This entails a concentration of power at the top of an organization, while from the workers' perspective, empowerment has rarely been given by the top level for fear of loss of power (Denham *et al*., 1997; Greasley *et al*., 2005; Usunier and Lee, 2005).

Policy and Strategy Results

The ANOVA results of the Policy and Strategy's attributes are displayed in Table 7. The results show the significance values of 'national safety law' (SNAT), 'rewards system' (SRWD), and 'safety audit strategy' (SAUD), none of which are greater than 0.05. Therefore, the harmonious perception of the management and workers levels in these 3 attributes is not portrayed in the construction companies. This is supported by Hinze and Godfrey (2003) who stated that rewards can generally be used as a tool to influence both groups' behavior to increase safety performance; however, it might not be practical in real life, as the use of a reward policy makes the workers reluctant to report accidents for fear of not getting the incentive.

Additionally, the favorable attitude towards 'national safety law' is taken by both sides but management recognizes the role of such law to be more important than workers (ThaiLaws, 2003). Work of management, including engineers, is predominantly conditioned by the national laws and regulations, and is exercised more seriously than by workers. This can be seen from the strict rules under the Criminal Code B.E. 2499/ Section 227, which states that "whoever, having the profession of design, control or construction, reparation or removal of a building or structure, failing to comply with the rule or method to be duly carried out in such undertaking in a

Table 6. Significance values of the 4 attributes of People enablers

Attributes	Significance values
HPRV	0.117
HAWN	0.000
HEMP	0.008
HWCO	0.168

Table 7. Significance values of the 3 attributes of Policy and Strategy enablers

Attributes	Significance values
SNAT	0.006
SRWN	0.004
SAUD	0.005

manner likely to cause danger to another person, shall be imprisoned not more than 5 years or fined not more than ten thousand baht, or both" (ThaiLaws, 2003).

Processes Results

The ANOVA results of the Processes enabler are shown in Table 8. Three attributes, 'job clarity' (PJCL), 'safety data collection' (PDCO), and 'training' (PTRA), portray safety divergences between the 2 groups, while these 2 groups agree on the other 5 attributes.

The different perceptions on training may be explained by Seppala (1995) and Langford *et al.* (2000) that management is optimistic about safety training, while the workers express such opinions to a lower degree, as they perceive that the safety training is immensely academic and lacks practical implications of what should have been improved. Workers also hold less optimistic opinions in the 'safety data collection' attribute. Workers tend to ignore rules, regulations, and procedures to achieve the production goal (Mearns *et al.*, 2001). In other words, workers apparently pay little attention to the data collection procedures, since following such regulations inevitably comes at the expense of a decline in productivity.

Discussion

The ANOVA results of the 5 enablers show similar perceptions of management and workers upon the Leadership and the Partnerships and Resources enablers. Management is, thus, required to provide a clear commitment throughout the organization, encourage workers to improve safety, and be a role model to achieve a successful safety implementation (Dilley and Kleiner, 1996; Langford *et al.*, 2000; Akiner and Tijhuis, 2008). Besides, management should provide adequate safety-related resources for improving safety (Langford *et al.*, 2000).

Furthermore, the results of the Pearson correlation also show strong positive correlations between Leadership and Processes, as well as between Partnerships and Resources and Processes. To align and enhance safety culture, therefore, the focus should be on the Leadership and the Partnerships and Resources enablers, as improving these 2 enablers leads to better implementation of Processes, especially in the areas of 'accident investigation', 'benchmarking', 'housekeeping', 'feedback', and 'risk assessment', since the 2 working groups already hold similar safety perceptions on these 5 attributes. This is confirmed by Abudayyeh *et al.* (2006) who stated that a clear management commitment in safety can be achieved, for example, by management providing a sufficient safety budget, ensuring appropriate safety training, and encouraging workers' feedback, as reliable feedback helps management in improving the safety programs and techniques. Langford *et al.* (2000) and Pasman (2000) also claimed that clear safety documentation, including

Table 8. Significance values of the 8 attributes of Processes enablers

Attributes	Significance values
PAIN	0.062
PBEN	0.127
PJCL	0.011
PHKP	0.096
PFED	0.765
PRAS	0.256
PDCO	0.008
PTRA	0.038

site accident logbooks, eases the accident investigations.

Conclusions

The construction industry has a poor safety record, and safety culture has an important role in improving safety in this industry. This paper investigates the key enablers for safety culture improvement in the Thai construction industry. Five enablers, Leadership, People, Partnerships and Resources, Policy and Strategy, and Processes, with a total of 25 attributes are extracted from factor analysis. These 5 enablers are key factors influencing safety culture development.

To improve safety culture, it is important that safety culture perceptions among the 2 working levels (i.e. management and workers) are aligned. The ANOVA test reveals that the 2 groups hold safety divergences in 3 areas, People, Policy and Strategy, and Processes. For the People area, the discrepancy originates from different perspectives in 'safety awareness' and 'safety empowerment'. It must be noted that, as far as the power distance is concerned in the organization, the unskilled workforce will place a lower value on 'safety empowerment'.

The 2 groups do not agree on all attributes in the Policy and Strategy enabler. Much of the divergence in perceptions regarding 'rewards system' can be explained because rewards could trigger an unwillingness to report, due to a fear of not receiving incentives. The same truth goes with the 'national safety law', which can be explained by management exerting a more noticeable positive effect on this attribute, since the management's profession is highly subject to more strict governmental supervision and severe impositions.

Among the Processes attributes, 'job clarity', 'safety data collection', and 'training' depict safety divergences between the 2 groups. The less optimistic opinions on 'training' have been cast from the unskilled laborers, as the complication of training content fails to demonstrate applicable knowledge related to work safety. A different perspective in 'safety data collection' has its roots in the long-standing productivity and breaches of rules dilemma. The preference of workers in keeping up their productiveness leads to the less favorable attitude on this attribute.

To create a positive safety culture, the organization should firstly focus on Leadership and Partnerships and Resources, since the 2 working groups hold similar safety perceptions on these 2 enablers. The improvement of these 2 enablers also aids better Processes implementation, as seen by strong positive correlations between them.

All in all, safety culture, the primary indicator of injury and loss, is disproportionately assimilated and variously appreciated by management and workers in the construction industry. To create a positive safety culture, therefore, it is important that both the management's and workers' perceptions are aligned.

References

Abudayyeh, O., Fredericks, T.K., Butt, S.E., and Shaar, A. (2006). An investigation of management's commitment to construction safety. Int. J. Proj. Manag., 24:167-174.

Akiner, I. and Tijhuis, W. (2008). Cultural variables and the link between managerial characteristics in construction industry: reflections from Turkish and Dutch examples. Proceedings of the International Conference on Multi-national Construction Projects - Securing High Performance through Cultural Awareness and Dispute Avoidance; November 21-23, 2008; Shanghai, China.

Algera, J.A. (1990). Feedback system in organizations. In: International Review of Industrial and Organizational Psychology. Cooper, C.L. and Robertson, I.T., (eds). John Wiley & Sons, London, UK, p. 169-193.

Andi, A. (2008). Construction workers perceptions toward safety culture. Civil Engineering Dimension, 10(1):1-6.

Ruhl, R., Auffarth, L.E., and Hamm, G. (2002). The development of process-

specific risk assessment and control in Germany. British Occupational Hygiene Society, 46(1):119-125.

Barling, J., Loughlin, C., and Kelloway, K. (2002). Development and test of a model linking safety transformational leadership and occupational safety. J. Appl. Physiol., 87:488–496.

Brandvold, L.A. and McLemore, V.T. (1998). A study of the analytical variation of sampling and analysis of stream-sediments from areas contaminated by mining and milling. J. Geochem. Explor., 64:185-196.

Bureau of Labor Statistics. (2010). Construction Managers. Available from: http://www.bls.gov/oco/ocos005.htm. Accessed date: Apr 2, 2010.

Camison, C., (1996). Total quality management in hospitality: an application of the EFQM model. Tourism Manage., 17(3): 191-201.

Chan, A.H.S., Kwok, W.Y., and Duffy, V.G. (2004). Using AHP for determining priority in a safety management system. Ind. Manage. Data Systems, 104(5):430-445.

Council of Engineers of Thailand. (1999). Engineers Act B.E. 2542. Available from: http://www.coe.or.th/_coe/_coenew/mainIndex.php?aMenu=102#. Accessed date: Dec 16, 2009.

Denham, N., Ackers, P., and Travers, C. (1997). Doing yourself out of a job? How middle managers cope with empowerment. Employee Relations, 19(2):147-159.

Dester, W.S. and Blockley, D.I. (1995). Safety-behaviour and culture in construction. Engineering Construction and Architectural Management, 2(1):17-26.

Dilley, H. and Kleiner, B.H. (1996). Creating a culture of safety. Work Study, 45(3):5-8.

EFQM. (2000). Introducing Excellence. The European Foundation for Quality Management, EFQM, Brussels, Belgium.

EFQM. (2003). EFQM Excellence Model. Available from: http://www.emeraldinsight.com/InsightviewContentItem.do?contentType=Article&hdAction=lnkhtml&contentId=1612474. Accessed date: Dec 23, 2009.

Fung, I.W.H., Tam, C.M., Tung, K.C.F., and Man, A.S.K. (2005). Safety cultural divergences among management, supervisory and worker groups in Hong Kong construction industry. Int. J. Proj. Manag., 23:504-512.

Garson, G.D. (2009). Factor Analysis. Available from: http://faculty.chass.ncsu.edu/ garson/PA765/factor.htm. Accessed date: Dec 14, 2009.

Geller, E.S., Roberts, D.S., and Gilmore, M.R. (1996). Predicting propensity to actively care for occupational safety. J. Safety Res., 27(1):1–8.

Greasley, K., Bryman, A., Dainty, A. Price, A., Soetanto, R., and King, N. (2005). Employee perceptions of empowerment. Employee Relations, 27(4):254-268.

Green, S.B. and Salkind, N.J. (2008). Using SPSS for Windows and Macintosh. 5th ed. Pearson Education International, Upper Saddle River, NJ, USA.

Hemingway, M. and Smith, C.S. (1999). Organisational climate and occupational stressors as predictors of withdrawal behaviours and injuries in nurses. J. Appl. Psychol., 84:286-296.

Hinze, J. and Godfrey, R. (2003). An evaluation of safety performance measures for construction projects. J. of Construction Research, 4(1):5-15.

Hinze, J. and Paker, H.W. (1978). Safety: productivity and job pressures. J. of the Construction Division, 104(1):27-34.

Hofmann, D. and Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behavior and accidents. Pers. Psychol., 49:307–339.

Huang, J.H. (2004). Nonprofit senior care organizations operations study. Master's Thesis, Tunghai University, Taichung, Taiwan, Republic of China.

Kittivachra, R., Sanguandeekul, R., Sakulbumrungsil, R., and Phongphanphanee, P. (2007). Factors affecting lactose

quantity in raw milk. Songklanakarin Journal of Science and Technology, 29(4):937-943.

Lane D.M. (2007). Pearson's Correlation. Available from: http://davidmlane.com/hyperstat/ A34739.html. Accessed date: Feb 2, 2010.

Langford, D., Rowlinson, S., and Sawacha, E. (2000). Safety behavior and safety management: its influence on the attitudes of workers in the UK construction industry. Engineering, Construction and Architectural Management, 7(2):133-140.

Lingard, H., Blismas, N., Cooke, T., and Cooper, H. (2009). The model client framework: resources to help Australian government agencies to promote safe construction. International Journal of Managing Projects in Business, 2(1): 131-140.

Lunt, J., Bates, S., Bennett, V., and Hopkinson, J. (2008). Behavior Change and Worker Engagement Practices within the Construction Sector. Health and Safety Executive, United Kingdom. Available from: http://www.scribd.com/doc/8592939/Behaviour-Change-and-Worker-Engagement-Practices-Within-the-Construction-Sector. Accessed date: Jul 12, 2009.

Mearns, K., Flin, R., Gordon, R., and Fleming, M. (2001). Human and organizational factors in offshore safety. Work Stress, 15(2):144-160.

Milczarek, M., and Najmiec, A. (2004). The relationship between workers' safety culture and accidents, near accidents and health problems. International Journal of Occupational Safety and Ergonomics (JOSE), 10:25–33.

Oklahoma Department of Labor. (1998). Essential Elements of an Effective Safety and Health Program. Available from: http://www.state.ok.us/~okdo/peosh/stee.pdf. Accessed date: Sep 6, 2009.

Oxford University Careers Service. (2007). Personal Development: Teamwork. Available from: http://www.google.com/url?sa=t&source=web&ct=res&cd=1&ved=0CAgQFj AA&url=http%3A%2F%2Fwww.careers.ox.ac.uk%2Fpublicdocuments%2Fleaflets%2Fpersonaldevelopmentteamwork%2F&rct=j&q=oxford+university+career+service%2C+audit%2C+teamwork&ei=LB2FS4bOCceyrAe04bTiAg&usg=AFQjCNGjkli4CzOENoRIBF0DcRL2U0CGSQ. Accessed date: Feb 23, 2010.

Pallant, J. (2005). SPSS Survival Manual: A Step by Step Guide to Data Analysis using SPSS for Windows (Version 12). Allen & Unwin, Crows Nest, New South Wales, Australia.

Pasman, H.J. (2000). Risk informed resource allocation policy: safety can save costs. J. Hazard. Mater., 71:375-394.

Raubenheimer, J.E. (2004). An item selection procedure to maximize scale reliability and validity. S. Afr. J. Ind. Psychol., 30(4):59-64.

Sematech. (2010). Engineering Statistics Handbook: Are the Mean Equal? Semiconductor and Emerging Technology. Available from: http://www.itl.nist.gov/div898/handbook/prc/section4/prc43.htm. Accessed date: Feb 10, 2010.

Seppala, A. (1995). Promoting safety by training supervisors and safety representatives for daily safety work. Saf. Sci., 20:317-122.

Singh, A., Hinze, J., and Coble, R.J. (1999). Implementation of Safety and Health on Construction Sites. A.A. Balkema, Rotterdam, Netherlands.

ThaiLaws. (2003). Criminal Code, B.E. 2499 (1956) as Amended by Code (No. 17), B.E. 2547 (2003). Available from: http://www.thailaws.com/index_thai_laws.htm. Accessed date: Feb 23, 2010.

The University of Scranton. (2010). SPSS Tutorial. Available from: http://academic.uofs. edu/department/psych/methods/cannon99/level2a.html. Accessed date Feb 2, 2010.

The University of Vermont. (2010). Comparing Means Using One Way ANOVA. Available

from: http://www.uvm.edu/~dhowell/fundamentals/SPSSManual/SPSSLongerManual/ SPSSChapter8.pdf. Accessed date: Feb 7, 2010.

Usunier, J.C. and Lee, J.A. (2005). Marketing across Cultures. 4th ed. Pearson Education, Harlow, UK.

Vallejo, P., Saura, R.M., Sunol, R., Kazandjian, V., Ureña, V., and Mauri, J. (2006). A proposed adaptation of the EFQM fundamental concepts of excellence to health care based on the PATH framework. International Journal for Quality in Health Care, 18(5):327-335.