การประเมินวัฒนธรรมความปลอดภัย: กรณีศึกษาในโครงการก่อสร้างแห่งหนึ่งในประเทศไทย

Safety Culture Assessment: The Case Study of One Construction Project in Thailand

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บทคัดย่อ

จากอัตราการเกิดอุบัติเหตุที่สูงในอุตสาหกรรมก่อสร้างนั้นทำให้เป็นที่กังวลทุกครั้งเมื่อมีโครงการก่อสร้างเกิดขึ้นในแต่ละพื้นที่ ซึ่งแสดงให้เห็นว่าผู้ที่ทำงานในอุตสาหกรรมการก่อสร้างนั้นยอมรับสภาพการทำงานที่มีความเสี่ยงอันตรายสูงกว่าอุตสาหกรรมประเภทอื่น ๆ เนื่องจากลักษณะการทำงานมีสภาพแวดล้อมอันตรายกว่าอุตสาหกรรมอื่น และเป็นที่ยอมรับกันโดยทั่วไปว่าต้องมีการควบคุมอย่างเข้มงวดในการทำงานแต่ละวัน การศึกษานี้มีความสนใจในการประเมินวัฒนธรรมความปลอดภัยในโครงการก่อสร้างโดยใช้วิธีการประเมินที่เคยใช้ในอุตสาหกรรมอื่น ซึ่งมีความแตกต่างกันที่โครงการก่อสร้างนั้นเป็นพื้นที่รวมตัวกันของผู้ทำงานที่มาจากหลากหลายองค์กร และมีพื้นฐานระดับการศึกษาและสาขาวิชาชีพที่แตกต่างกัน การศึกษานี้เป็นการศึกษาภาคตัดขวาง โดยใช้แบบสอบถามการรับรู้บรรยากาศความปลอดภัยของหน่วยงานสุขภาพและความปลอดภัยของประเทศอังกฤษในกลุ่มผู้ทำงานทั้งหมด 440 คน โดยมีผู้ที่ผ่านเกณฑ์การคัดเลือกเข้าร่วมการวิจัยทั้งสิ้น 321 คน คิดเป็นร้อยละ 72.9 ผลจากการศึกษาพบว่าสาเหตุพื้นฐานที่จะนำไปสู่พฤติกรรมเสี่ยงคือการยอมรับที่จะเสี่ยงอันตราย ตามมาด้วยความเคร่งครัดในการปฏิบัติตามกฎระเบียบ และแนวคิดต่อสภาพแวดล้อมการทำงานที่อันตราย ปัจจัยเหล่านี้แสดงให้เห็นว่าผู้ที่ทำงานในโครงการก่อสร้างส่วนใหญ่ พร้อมที่จะเสี่ยงต่อการบาดเจ็บและละเลยการปฏิบัติต่อกฎความปลอดภัย การศึกษานี้สรุปว่าการบังคับใช้กฎระเบียบอย่างเคร่งครัด เป็นสิ่งที่จำเป็นที่สุดเพื่อยับยั้งการยอมรับความเสี่ยงในจิตใต้สำนึกของผู้ทำงานในโครงการก่อสร้าง

คำสำคัญ: *วัฒนธรรมความปลอดภัย ก่อสร้าง การยอมรับความเสี่ยง*

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Abstract

High accident rates in the construction sector are a concern whenever construction activities take place. It implies that those who work on the construction site have a unique attitude toward health and safety due to higher health and safety risks than other industries. These omnipresent safety issues appear to be norms on construction activity that need to be addressed daily. This study examines whether safety culture on construction sites can be assessed by the tools that had been carried out by other industries, where multiple contractors with different educational backgrounds and professionals are hired to perform specific tasks as part of the construction project. This study is a cross-sectional study that utilizes UK Health and Safety Executive (HSE)'s safety climate assessment tools. There are 440 employees on the construction site with 321 eligible respondents which account to 72.9 %. This study finds that personal risk acceptance appear to be the leading cause of unsafe behavior follow by rules and procedures compliance issues and workers' perception of the work environment in construction. These factors imply that most of the workers on the construction site are willing to take risks and are reluctant to obey safety rules. This study concludes that enforcement of safety rules is essential to prevent personal risk acceptance which is embedded in the mindset of most workers in this construction site.

Keywords: *Safety culture, Construction, Risks acceptance*

Introduction

Among the total 10,865,828 formal workers in Thailand, construction sector employs 656,526 workers, increased over decades, accounting for 6.04% of total employment. Table 1 showed on average, 138 workers killed in construction (2017-2021). Whilst the fatal occupational injury rate in the construction sector was relatively high, accounting for 23.12% of total fatal occupational injuries. Nevertheless, the fatal injury rate per 100,000 workers in construction was 21.05 despite tightening law enforcement, according to the Thai Ministry of Labor (Social Security Office, Ministry of labor. 2022).

Table 1: Occupational fatal injuries in Thailand

Year	Total Employees in Thailand	Workers Employed in the Construction sector	Percentage of Workers Employed in the Construction Sector	Total Occupational Fatalities in Thailand	Fatalities in Construction sector	Percentage the of Fatalities in the Construction Sector	The fatality rate per 100,000 workers in Construction Sector
2017	9,777,751	560,703	5.73	570	139	24.39	24.79
2018	10,537,238	685,380	6.50	568	132	23.24	19.26
2019	11,710,823	696,197	5.94	639	186	29.11	26.72
2020	11,153,697	662,492	5.94	588	119	20.24	17.96
2021	11,149,632	677,856	6.08	602	112	18.60	16.52
Average	10,865,828	656,526	6.04	593	138	23.12	21.05

Source: Social Security Office, Ministry of labor Thai Ministry of Labor (2022)

The unpopular reputation of high accident rate in the construction sector implied that when the company is involved in construction activities on its site, a higher level of safety monitoring is required during the construction phase until the end of the project. As the owner of the project, it is an obligation to make sure the area is safe for everyone including construction contractors being employed on site. Even though the safety training provided to make sure that safety rules compliance needs to be carried out by contractors, explained and fully understood. Safety behavior issues of the construction worker, a well-recognized problem, should be monitored very closely by the project owner and each contractor company.

On the other hand, any non-compliance with the client's safety rules would affect their safety performance for the construction firms that got the contract to do the job on-site. Additionally, it affects the contractor's business profitability particularly disruptions and project delays by fatal injury, fire incidents, or collapsed structures. Nevertheless, the reputation that would disrupt the business opportunity for the current or potential clients which an accident record and non-compliance issues to be used for the contractor's evaluation and selection process.

From the project owner's point of view, as the landlord by law, the executive management must responsible for solving safety problems that occur on-site. Thus, this could be achieved only by effective joint consultation which pools leadership from all contractors required (Zohar D. 1980). The vital factor that affects overall the workers' safety behavior is the management support (Cooper, M. D. 2000) to provide enough resources, including time, to meet the need to work safely. The day-to-day

on-site interaction, among workers and supervisors, contributed to forming a safety culture (Guldenmund. 2000) that can be assessed by valid safety climate measurement tools (Cox & Cheyne. 2000). The reliable measurable tools should cover all aspects of the safety culture that underpin the perception and the attitude of all members of the construction worksites.

This study applied the concept of the UK Health and Safety Executive (HSE) study6 to understand the construction safety culture and where is an opportunity for the HSE to intervene to prevent risk taking behavior because of the culture influence on perception of safety, analyzed by HSE's approach to identify the difference in cultural dimensions. Regarding construction as labor-intensive and widely accepted that latent safety risks in construction activities are inevitable such as the use of heavy equipment, working at height, dynamic work environment, and severe hot and humid weather. Thus, making the construction site safe daily relied on the individual's attitude. However, as the project's owner or client, the obligation is to be involved (Cox, Sue & Cheyne, Alistair. 2000) with the contractors by providing valid measure indicators to share with the contractors.

Objective

1. The study aimed to assess the safety culture of construction worksites (Cooper, M. D. 2000; Guldenmund F. 2000) in the electronic manufacturing factory in Ayutthaya province Thailand.

2. This study aimed to find an opportunity to intervene to prevent risk taking behavior that influenced by the safety culture

3. This study aimed to analyze the difference in safety cultural dimensions in the construction project context.

Material and Method

This research was a cross-sectional study that utilized the UK Health and Safety Executive's (HSE) safety climate assessment toolkit, the system-based model of safety culture developed to incorporate appropriate safety climate indicators for the offshore environment (Cox & Cheyne. 2000; Health and Safety Executive (HSE). 2019; The Keil Centre, Health and Safety Executive (HSE). 2001), to gauge the safety culture in the construction.

The UK HSE's questionnaire was distributed to 400 workers who work in the construction industry for at least six months, eligible to participate in this study. 400 samples distributed by simple stratified type which breaking the interest population into all strata's Role in the Construction project: site manager, engineer, supervisor,

safety officer, workers, and sub-contractor workers (outsourced).

The UK HSE's questionnaires consisted of 43 questions to measure broad aspects of the safety culture. This aspect of safety culture consists of four parts as follows;

1. Organizational Context
   1.1 Management commitment (7 questions)
   1.2 Communication (5 questions)
   1.3 Priority of Safety (4 questions)
   1.4 Safety Rules & Procedures (3 questions)
2. Social Environment
   2.1 Supportive Environment (6 questions)
   2.2 Involvement (3 questions)
3. Individual Appreciation
   3.1 Personal Priorities & Need for Safety (5 questions)
   3.2 Personal Appreciation of Risk (4 questions)
4. Work Environment
   4.1 Physical Work Environment (6 questions)

The questionnaire was answered on a 5-point Likert scale, rating value of 5 in the "strongly agree" category, 4 in the agree category, 3 in the neither agree nor disagree category, 2 in the "disagree" category and 1 in the strongly disagree response. The formatted questionnaire items are in random order, including the covering letter distributed to all employees on construction sites where individuals are given time to complete the questionnaire.

The reliability of this questionnaire secured by Cronbach's alpha coefficient is 0.96.

Scores need to be averaged for each dimension and there were two types of questionnaire items, positive and negative. For the negative words type of question, the score needs to be reversed by subtracting the item score from 6 to reverse the scoring as follows;

- Positive Question, from score 1 - 5 (respond score) = Actual score
- Negative question can calculate the score by (6 – respond score) = Actual score

These averaged scores of each dimension, which have different numbers of items, can be achieved by dividing the actual score by the total possible score of each dimension. The dimension scores need to be standardized before plotting to compare all nine dimensions, by converting the scores to a 1 to 10 scale by multiplying the average score by 10 as follows. Then the score of all nine dimensions can be presented graphically on the radar diagram.

$$\text{Dimension score} = \frac{[\text{Summation of average score}] \times 10}{\text{Total of the full score}}$$

The full questionnaire returns were anonymous and confidential to this study. The survey data were analyzed using an excel spreadsheet with the formula for each calculation preset.

Results

In the questionnaire survey of all employees on the same construction sites, a five-point Likert-type scale ranging from strongly agree to strongly disagree allows respondents to indicate the extent of their agreement with each question statement. 321 respondents (80%) were categorized into six categories: site manager, engineer, supervisor, safety officer, workers, and sub-contractor workers (outsourced). The construction site manager was an individual with the highest authority in each contractor company, to handle day-to-day activities as part of the project, accountable for managing occupational health and safety in this construction site.

Table 2: Employee's role in the construction site

Position		%
Site Manager	6	1.9
Engineer	33	10.3
Supervisor	29	9
Safety officer	19	5.9
Worker	198	61.7
Sub-contractors (outsource)	36	11.2
Total	**321**	**100**

The safety climate among construction employees working on the construction sites in several positions, Table 2 shows that most of the respondents were 198 construction workers (61.7%), followed by 36 sub-contractor (outsource) workers (11.2%), 33 engineers (10.3%), 29 supervisors (9%), 29 safety officers (5.9%), and 6 site managers (1.9%).

The average score calculated based on the UK HSE assessment tool (Health and Safety Executive (HSE). 1999) which the reliability is secured by Cronbach's alpha coefficient is 0.96. These scores can be transferred to a graph. The average score of 0 to 5.0 points, lower part of the scale can be interpreted as that opportunity for improvement required. While the average score of 5.01 to 8.00 points, can be interpreted

as involving level, convinced that involvement of front-line workers in health and safety is exist. The average score of 8.01 to 10 points can be interpreted as cooperative level, convinced that both managers and front-line workers are accepting personal responsibility for their own and others health and safety (The Keil Centre, Health and Safety Executive (HSE). 2001). Thus, the better the profile the closer scores are to the outside of the radar chart (Health and Safety Executive (HSE). 1999).

The results of the survey revealed that the perception of personal priorities and need for safety dimension have the highest average score of 8.64 which is considered a cooperative level as well as the priority of safety dimension (8.06). While other dimensions, communication (7.95), the involvement of employees in health and safety (7.92), management commitment (7.65), and supportive environment (7.40), can be considered as involving level (The Keil Centre, Health and Safety Executive (HSE). 2001).

Table 3: The safety climate in the construction site

Dimensions of Safety Climate measurement	Overall		
	Average	Rank	SD
Management commitment	7.65	5	0.98
Communication	7.95	3	1.10
Priority of Safety	8.06	2	1.02
Safety Rules & Procedures	6.77	8	1.94
Supportive Environment	7.40	6	0.97
Involvement	7.92	4	1.30
Personal Priorities & Need for Safety	8.64	1	1.03
Personal Appreciation of Risk	6.11	9	1.11
Work Environment	6.95	7	1.26

The radar chart shown in Figure 1 depicted that the lowest score dimensions were personal appreciation of risk (6.11 points) and safety rules and procedures (6.77 points). These indicated that the construction contractor workers were found to have a high appreciation of risk. This dimension includes the negative-word questions which need to subtract the total score from 6 to obtain a positive dimension score. The questions included in this dimension were:

Question Item

6 I am sure it is only a matter of time before I am involved in an accident

18 I am rarely worried about being injured on the job

24 In my workplace the chances of being involved in an accident are quite large

34 I am clear about what my responsibilities are for health and safety

The total score of the personal appreciation of risk dimension was converted to a 1 to 10 scale which was achieved by dividing the actual score of these five questions by the total possible score of 20 and then multiplying by 10 as the following formula:

[(6 - Item 6) + Item 18 + (6 - Item 24) + Item 34]/20 x 10

The average score of this dimension of 6.11 as shown in Table 1 and illustrated in Figure 1 was the lowest, representing the prominent issues of people's mindsets where further investigation and remedial actions are required.

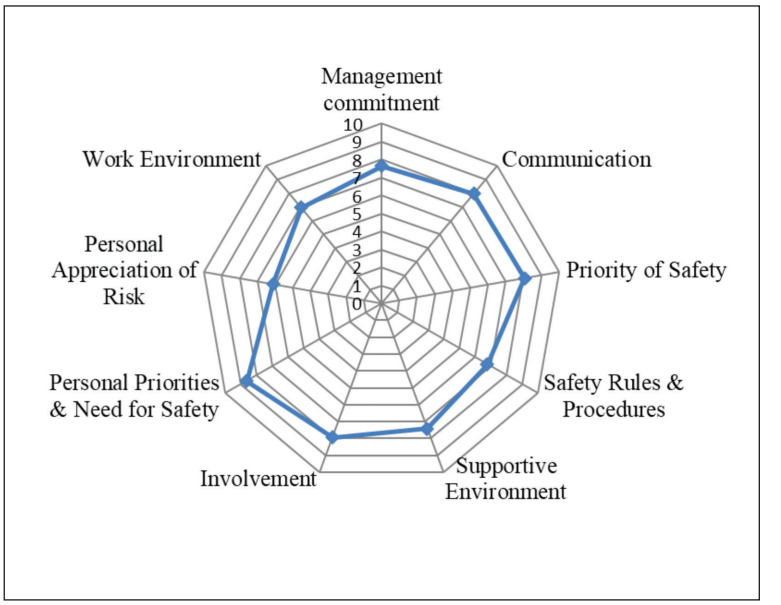

Figure 1 The safety climate radar

The second-lowest dimension was safety rules and procedures of 6.77, as shown in Table 1 and illustrated in Figure 1 indicating that the construction contractor workers were found to be reluctant to rule compliance. This dimension includes the negative-word questions which need to subtract the total score from 6 to obtain a positive dimension score. The questions included in this dimension were:

Question Item

17 Some safety rules and procedures do not need to be followed to the job done safely

21 Some health and safety rules and procedures are not practical

35 Sometimes it is necessary to depart from safety requirements for production's sake

The total score of the safety rules and procedures dimension was converted to a 1 to 10 scale which was achieved by dividing the actual score of these three questions by the total possible score of 15 and then multiplying by 10 as the following formula:

[(6 - Item 17) + (6 - Item 21) + (6 - Item 35]/15 x 10

The average score of this dimension of 6.77 was the second-lowest, representing the prominent disciplinary issues where further investigation and remedial actions are required.

The average score of perception of the unsafe physical work environment as shown in Table 1 and illustrated in Figure 1, was the third-lowest although priority given to safety issues was high. The questions involved in the analysis of this dimension were:

Question Item

7 Managers and supervisors express concern if safety procedures do not adhere

14 Management considers the safety of employees of great importance

27 I am never involved in the ongoing review of safety

30 I feel that safety issues are not the most important aspect of my job

37 I am clear about what my responsibilities are for health and safety

43 This is a safe place to work than other companies I have worked for

The third-lowest total score was the work environment dimension was converted to a 1 to 10 scale which was achieved by dividing the actual score of these three questions by the total possible score of 30 and then multiplying by 10 as the following formula:

[(6 - Item 7) + Item 14 + (6 - Item 27) + (6 - Item 30) + Item 37 + (6 - Item 43)]/30 x 10

The average score of this dimension of 6.95 was the third-lowest, representing the prominent unsafe condition issues where further investigation and remedial actions are required.

Discussion

The HSE's Safety Climate Assessment Toolkit is a practical instrument for in-house use, this assessment technique is based on which underwent a series of tests, designed to gauge the safety climate/culture in offshore organizations and has been shown to offer practical benefits to the construction organizations. The safety climate measurement is an attitude toward safety issues that this study applied to the construction site. The respondents were workers from multiple construction contractors containing subcultures (Health and Safety Executive (HSE). 1999; Gillen, Goldenhar, Hecker, & Goldenhar. 2014; Chen & Jin. 2013) of different contractor companies that come to work together over some time.

Among the nine dimensions of safety climate measurement, personal appreciation of risks and safety rules and procedures dimensions appreared to be lower than other dimensions.

First, the low score of the personal appreciation of risks dimension, can be interpreted that most of the workers on the construction site are willing to take risks. Thus, this human factor was revealed and reflected how they think which obstructed the attempt to make the construction site a safer workplace.

Second, there were rooms for improvement in safety rules and procedures dimension, to review that whether there are tasks which really cannot be proceduralized and thus have an en product which is not practical. In addition, the relationship between the safety rules and disciplinary actions should be reviewed to find non-compliance issues in this construction project context that the construction contractor workers were found to be reluctant to rules compliance (Lou Tongyuan. 2020).

This challenge is to put an effort to combat this disciplinary issue. Safety behavior factors are embedded in the ways they see to make a living and get the job done. Thus, enforcing the safety rules may weigh over safety training in a construction site setting because training in the construction context heavily depend on dynamic schedule and timeline of the project. Encouraging workers' safety behavior may not be enough since they unconsciously appreciate risks still on their minds. The safety climate showed in this study demonstrated that construction workers are aware of the safety risks present on the construction sites, even though, properly managed and committed by management on site. However, they admitted that they would take risks even if they were knowledgeable about them.

This study has shown that workers on construction sites take risks for their reasons and not because of a lack of knowledge of safe work procedures. The challenge is to find the reason that could change their risk-taking mindset and find the way to incremental change in the construction workers' community since all of them cannot be changed their attitudes at the same time.

Perception of the unsafe physical work environment is common across all groups on the same construction sites exerts the way people think (Hecker & Goldenhar. 2014) and form the safety culture. Those who work on construction sites knew and were aware that things around them were dangerous. Furthermore, this perception of an unsafe work environment supported the holistic safety culture on construction sites as high risks workplaces and they accepted that. Thus, there is essential for the elimination of cognitive biases in risk perception that influence safety climate in this construction context (Lou Tongyuan. 2020).

Further Study

There is a need to conduct a study to understand why construction workers continue to take safety risks on construction worksites, should they have multiple cultures or subcultures in the construction. The perceptions of the work environment on a particular construction project at a given time may be a product of the multiple safety climates from the different contractors involved in the project including the project owner (Health and Safety Executive (HSE). 1999; Gillen, Goldenhar, Hecker, & Goldenhar. 2014; Chen & Jin. 2013). Thus, to develop appropriate interventions, the reasons behind why the workers knowingly take risks may be heavily influenced by a group safety climate, a local condition such as project delivery time, or a tight schedule, which is the strongest influencer (Bandura. 1886; Christian, Bradley, Wallace, & Burke. 2009) for the risk-taking mindset.

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