Original research article

Structural Equation Model of Safety Implementation and Productivity in the Textile Industry

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ABSTRACT

The textile industry is considered one of the industries with high accident rates that lead to less job satisfaction, high compensation cost, bad industry image, and low productivity. To reduce the number of accidents, a sound and practical safety implementation must be encouraged. Since management and employees are key input to enhance productivity, this study investigates the relationships between safety implementation and productivity. A total of 28 items associated with three key factors, namely the People, People Results, and Productivity factors, are used for a questionnaire survey development. Three hundred questionnaires are distributed, with 130 questionnaires returned, representing a 43.3 response rate. The exploratory factor analysis confirms four key factors with their associated items. The structural equation modelling proves a significant relationship between the People (Management) and People (Employee) factors. It is also found that these two factors have no direct relationship with the Productivity factor, but an indirect relationship through the People Results factor. To enhance the productivity, hence, management has to empower employees with a practical safety implementation plan, establish a safety committee, and enhance safety communication in the workplace. Employees, on the other hand, should participate in safety activities, help each other in improving safety, and comply with safety rules. All of these lead to higher job satisfaction, lower turnover, less rework, and eventually increased productivity.

Keywords: Productivity; Safety implementation; Structural equation modeling; Textile industry

Introduction

The textile industry is one of the major contributors to many Asian economies, and one of the main revenue-generating sectors [1]. In Thailand, textile and clothes have been the major export items since 1980s with high production, employment, and export value [1]. The industry, however, involves many hazards that can cause injury to workers, e.g. the

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transportation in the workplace, the work equipment, and the dangerous working environment [2]. Calvin and Joseph [3] commented that many workers ignored using any safety devices at work, and managed stress improperly. This poor safety implementation leads to injuries and deaths [4]. A strong safety culture is, thus, essential in reducing injuries, lost work hours, and accident-related compensation costs. In addition, the reduction of workplace injuries may increase the motivation of employees, improve the quality of products, reduce the employees' turnover, and enhance the productivity [5].

According to Chinda [6], productivity is defined as the ratio of outputs (in terms of goods created) to inputs (usually per hour), and that, to improve this ratio, continuous improvement must be performed in the organization. To enhance productivity, the organization may either consider reducing inputs while keeping outputs constant, or increasing outputs while keeping inputs constant [7]. This study investigates the improvement of safety implementation in enhancing the company's productivity.

The Conceptual Model of Safety Implementation and Productivity

It is apparent that the enhancement of safety helps organizations to reduce the number of accidents, improve the industry's image, increase productivity, and enhance safety performance [8, 9]. Eskildsen and Dahlgaard [10] mentioned that the employee is the most crucial asset in driving continuous improvement. Turnbeaugh [11] noted that there is a link between safety and other business outcomes, such as productivity at the organizational culture level. For instance, education and job training can enhance workers' motivation; this is a prime factor in increasing workers' health, safety and well-being, as well as productivity. This is consistent with the European Foundation for Quality Management view [12] that people are a key to achieve the key performance results (see Fig. 1).

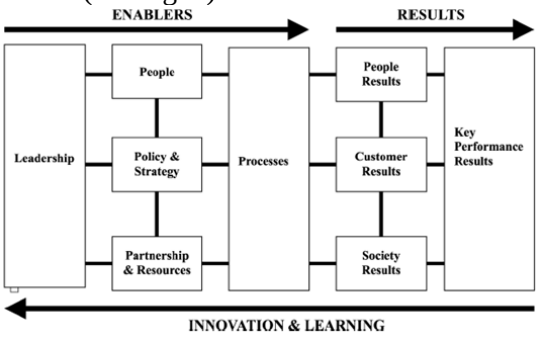

Fig. 1. The EFQM excellence model.

The EFQM Excellence Model illustrates that excellent results, with respect to performance, customers, people and society, are achieved through leadership, people management and development, effective use of partnerships and resources, clear and well directed policy and strategy, and effective processes [12]. The model is applied in many safety-related researches. Wright et al. [13], for example, developed a self-assessment tool for assessing safety performance based on the EFQM Excellence model. Mbuya and Lema [14] investigated the relationships between the EFQM Excellence model and the safety management system, and found that such a model is appropriate for the safety improvement. In this study, the model is adjusted to examine, in particular, the relationships between the implementation of safety and the enhancement of productivity (see Fig. 2).

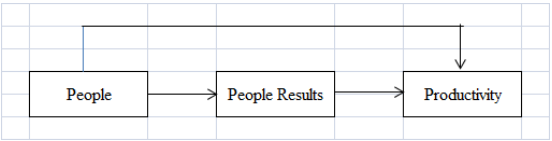

Fig. 2. The conceptual model of safety implementation and productivity.

Based on a number of safety- and productivity-related literatures, a total of 28 items associated with safety implementation and productivity are extracted. Details are given below.

People factor

The People factor describes how an organization manages, develops, and releases safety knowledge and full potential of its people at an individual, team-based, and organization-wide level, and plans these activities to support its safety policies and strategies and the effective operation of its processes [12]. There are 13 items associated with this factor. A brief description of each is presented below.

1. *Employees' participation in safety:* Ali et al. [5] mentioned that employees' participation in safety helps reducing injury rates in organizations.
2. *Emergency preparedness:* Having an emergency plan mitigates the accidents through a quick response [15].
3. *Perceived risk:* The amount of risk perceived by a worker dictates his/her work action [16].
4. *Use of ergonomics application:* Physical and mental fatigue affects health safety and ergonomics. Good work design helps in improving safety [17].
5. *Training:* Cheng et al. [18] stated that education and training programs are of vital importance for the dissemination of information and improvement of health behavior, and safety consciousness.
6. *Peer review:* To improve safety performance, workmate interventions must be encouraged [19].
7. *Accident experience:* Work accident experience has a positive correlation with external causal attributions and unsafe behavior [20].
8. *Safety compliance:* A safe workplace is achieved through employees complying with safety regulations, taking proper safety measures, and participating actively in safety meetings and activities [21].
9. *Stress:* Donald et al. [22] stated that workers with less stress will perform better and achieve better productivity.
10. *Employees' involvement:* A higher level of workers' involvement in safety produces a better safety performance [23].
11. *Teamwork:* Safety performance is significantly influenced by organization team members and on-site safety communication [24].
12. *Employees' empowerment:* Employees have unique abilities, skills, and knowledge that can be used to empower them to create a safe work environment [25].
13. *Incident report:* The incident reports should be used for the organizational learning [25].

People results factor

This factor looks at what an organization is achieving in relation to its own employees. It is the results people achieved from safety implementation. This factor is associated with seven items, as follows:

1. *Job tenure:* The reduction of workplace injuries may reduce employee turnover [5].
2. *Work attitudes:* Employees working in a safe workplace seem to have better work attitudes [26].
3. *Job satisfaction:* The perception of danger and risk is related to job satisfaction. Maintaining the health and safety of workers, and offering the appropriate levels of job satisfaction lead employees to higher productivity levels [17].
4. *Motivation:* Ali et al. [5] stated that the reduction of workplace injuries may increase the motivation of employees.

5. *Absenteeism:* A workplace with few accidents usually has lower absenteeism [27].
6. *Workforce morale:* Employees with excellent safety implementation have high workforce morale [28].
7. *Communication enhancement:* Two-way communication is achieved through employees' involvement in safety [18].

Productivity factor

The Productivity factor looks at what an organization is achieving in relation to its planned performance. It reflects the company's overall performance. It is examined under eight items, as presented below.

1. *Working environment:* Mitropoulos and Cupido [29] suggested that a positive safe behavior results in a good working environment and higher productivity.
2. *Work speed:* The enhancement of safety culture will lead to an increase in the working speed [29].
3. *Material damage:* Fernandez-Muniz et al. [30] claimed that the improvement of safety culture lowers the amount of rework.
4. *Quality of product:* Boraiko et al. [31] confirmed that safe operating practice can reduce risk to employees while they are performing tasks. This then contributes to high process and product quality.
5. *Compensation cost:* According to Pasman [32], the positive safety culture helps reduce the compensation cost.
6. *Reputation:* High rates of severe injuries in organizations have detrimental effects on the reputation, as well as performance of organizations [5].
7. *Customers' perception:* Accidents and poor service quality are primarily rooted in socio-technical human factors, and can translate into loss of customers, and loss of market share [33].
8. *Accident rate:* Accident rates are reduced with better safety performance [32, 34].

The above 28 items are used in questionnaire survey development to gather data for the exploratory factor analysis and structural equation modeling to investigate the relationships of the three factors.

Questionnaire Survey and Responses

Questionnaire survey development

The questionnaire survey is used in this study for data collection from the textile-related organizations. A list of mid- and large-sized textile firms located mainly in Bangkok and nearby areas was used as a sampling frame. Both upstream and downstream firms are considered to gain the understanding of safety implementation in the textile supply chain.

To gain mixed perceptions of safety and productivity, both lower and higher working levels, such as managers, engineers, project supervisors, and frontline employees, were set as the target respondents.

The questionnaire survey comprised five parts. The first part was aimed to gather demographical information about the respondents and their respective organizations to ensure their appropriate backgrounds. The second, third, and fourth parts covered 13, seven, and eight statements to operationally define the People, People Results, and Productivity factors, respectively. Examples of the statements are "participations of employees in safety activities encourage safety implementation in the organization", "better safety implementation lowers the turnover rate", and "better safety implementation

leads to healthier working environment". Full details of the questionnaire survey are listed in the Appendix.

The respondents were asked to score each statement using a five-point Likert scale, with point 1 representing 'strongly disagree' and point 5 representing 'strongly agree'. The scores achieved from these three parts were used for the exploratory factor analysis and the structural equation modeling.

Questionnaire responses

Three hundred questionnaires were launched, with 130 questionnaires returned. This represented the response rate of 43.3%. Three out of the 130 responses were incomplete, thus, they were discarded, resulting in a total of 127 responses for the analyses.

The ratio between the management and frontline levels was 2:3. Around 70% of them have more than five years working experience, both in their present organizations and the textile-related industry. Moreover, half of them were in their current positions for more than five years. This indicates the appropriateness of the respondents involved in the survey.

Preliminary analyses

Data collected from the questionnaire survey were screened with a number of data examination techniques, including the normality and outliers tests, to increase confidence in the data. The normality test revealed no skewness and kurtosis values over the cut-off value of ±2.58 as recommended by Pallant [35], thus concluding the normal distribution. The outlier test also showed no signs of outliers. These, thus, increased confidence in the data to be used in the exploratory factor analysis prior to the structural equation modeling.

Exploratory factor analysis

The exploratory factor analysis was performed to examine how underlying constructs influence the responses on a number of measured variables [35]. In this study, the 28 items were analyzed to confirm their respective constructs, i.e. People, People Results, and Productivity factors.

Before performing the exploratory factor analysis, the Kaiser-Meyer-Olkin (KMO) and the Bartlett's test of Sphericity were examined to measure the sampling adequacy and check that the original variables were sufficiently correlated [36]. The KMO value should be greater than 0.5 for a satisfactory factor analysis to proceed, and the Bartlett's test of Sphericity should be significant ($p < 0.05$) for factor analysis to be considered appropriate [36]. The results, as shown in Table 1, proved the suitability of the data for the exploratory factor analysis.

Table 1. The results of the KMO and Bartlett's test of sphericity.

Test	Suggested value	Computed value
Kaiser-Meyer-Olkin (KMO)	> 0.50	0.87
Bartlett's Test of Sphericity	< 0.05	0.00

To extract the number of factors that best represent the interrelationships among the set of variables, this study utilized the generalized least squares method, with a cut-off factor loading of 0.4, and varimax rotation, for the exploratory factor analysis [37]. The first run of the 28 items resulted in removing two items, namely the "use of ergonomics application" (under the People factor) and the "compensation cost" (under the Productivity factor) items as they failed to make the cut-off of 0.4.

The second run of the remaining 26 items extracted four factors, as depicted in Table 2. It is noted that the People factor is now extracted into two factors, namely the People (Employee) factor (with 11 associated items) and the People (Management) factor (with four associated

items), while the People Results and the Productivity factors consist of nine and four items, respectively.

Table 2 reveals four items (the "reputation", "accident rate", communication enhancement", and "working environment" items) initially assumed to be associated with a certain factor, to correlate with another factor. For instance, the "communication enhancement" item appeared to be loading on the People (Management) factor, not the People Results factor as was firstly hypothesized. This is partly confirmed by Cheng et al. (2013) that two-way communication, between management and employee levels, is a criterion to improve project performance.

To ensure the appropriateness of groupings of four factors extracted, the reliability test with the Cronbach alpha was performed. According to Flynn et al. [38], the alpha value of 0.6 or more is considered reliable. Table 3 shows all alpha values higher than 0.6, hence all are considered highly reliable. The four factors, with their 26 associated items, then represent the baseline model of this study (see Fig. 3).

Table 2. The exploratory factor analysis of the 26 items.

Item	Factor			
	People (Employee)	People (Management)	People Results	Productivity
Employees' participation in safety	0.706			
Emergency preparedness	0.699			
Safety compliance	0.652			
Reputation*	0.606			
Perceived risk	0.574			
Training	0.573			
Employees' involvement	0.562			
Peer review	0.556			
Accident rate*	0.487			
Accident experience	0.472			
Stress	0.404			
Use of ergonomics application	0.307			
Compensation cost	0.247			
Employees' empowerment		0.561		
Teamwork		0.560		
Communication enhancement*		0.530		
Incident report		0.448		
Job satisfaction			0.798	
Motivation			0.766	
Workforce morale			0.572	
Work attitudes			0.559	
Working environment*			0.481	
Absenteeism			0.510	

Job tenure	0.442	
Quality of product		0.938
Material damage		0.594
Customers' perception		0.445
Work speed		0.414

Note: * Items relocated from one factor to another factor.

Table 3. The reliability test results.

Factor and item	Alpha value	Alpha if item deleted
People (Employee)	0.856	
Employees' participation in safety		0.840
Emergency preparedness		0.834
Safety compliance		0.838
Reputation		0.841
Perceived risk		0.841
Training		0.841
Employees' involvement		0.843
Peer review		0.838
Accident rate		0.852
Accident experience		0.856
Stress		0.854
People (Management)	0.726	
Employees' empowerment		0.513
Teamwork		0.620
Communication enhancement		0.726
Incident report		0.692
People Results	0.870	
Job satisfaction		0.843
Motivation		0.849
Workforce morale		0.856
Work attitudes		0.849
Working environment		0.865
Absenteeism		0.847
Job tenure		0.850
Productivity	0.812	
Quality of product		0.700
Material damage		0.766
Customers' perception		0.791
Work speed		0.794

Structural Equation Modeling of Safety Implementation and Productivity

Basically, structural equation modeling (SEM) comprises two types of models: measurement and structural models. The former is concerned with how well the observed variables measure the latent factors, addressing their reliability and validity. The latter is concerned with modelling the relationships between the latent factors, by describing the amount of explained and

unexplained variance, which is akin to the system of simultaneous regression models [39].

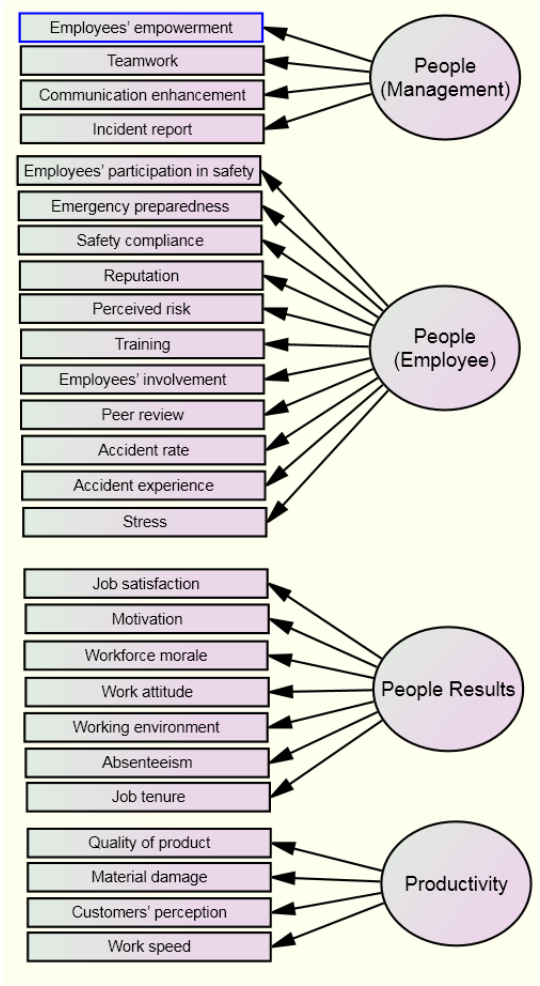

Fig. 3. Baseline model of safety implementation and productivity.

In this study, a confirmatory factor analysis was conducted to increase confidence in the measurement model. The confirmatory factor analysis allows for the assessment of fit between observed data and a priori conceptualized, confirming correlations between latent factors and their observed indicator variables [40, 41].

The common fit indices used to assess the model fit are the ratio of chi-square to the degrees of freedom (CMIN/DF), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA) [42, 43, 44]. The model fit results of the baseline model, as illustrated in Table 4, revealed a need to modify the model to further improve the model fit.

To improve model fit, the paths with low correlations should be eliminated, while the paths and/or correlations with high computed modification indices should be added [45]. In this study, three correlations were added as suggested by the modification indices, including the "job satisfaction" item with the "motivation" item, the "emergency preparedness" item with the "work speed" item, and the "absenteeism" item with the "job tenure" item. This is partially confirmed by Wu et al. [15] that having an emergency preparedness increases work speed. Adding the stated correlations led to the best-fit measurement model with the fit indices (see Table 4).

Having established confidence in the measurement model, a structural equation model was developed to test the directions of relationships between the four factors (People (Management), People (Employee), People Results, and Productivity), as reflected by the arrows connecting them. As shown in Fig. 2, the Productivity factor was assumed to be influenced by the People (Management), People (Employee), and People Results factors. The People (Management) and People (Employee) factors, at the same time, have an indirect effect on the Productivity factor through the People Results factor. To prove these relationships, and improve the overall model fit, a number of model runs (with different arrow directions connecting the three factors) were executed, and the fit indices were recorded. The model with the best fit should prove the directional influences [46]. The best-fit structural model (see Figs. 4 and 5), with the fit indices (see Table 4) was considered the final model of safety implementation and productivity.

Table 4. Model fit results.

Fit index	Recommended value	Baseline model	Best-fit measurement model	Best-fit structural model
CMIN/DF	< 2.00	2.03	1.92	1.89
CFI	> 0.80	0.79	0.82	0.83
RMSEA	< 0.10	0.09	0.08	0.07

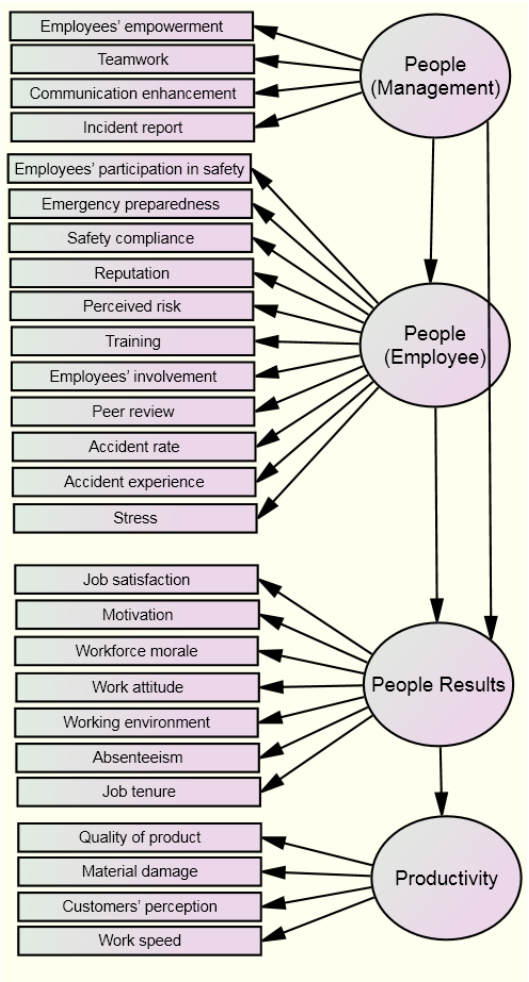

Fig. 4. The best-fit structural model.

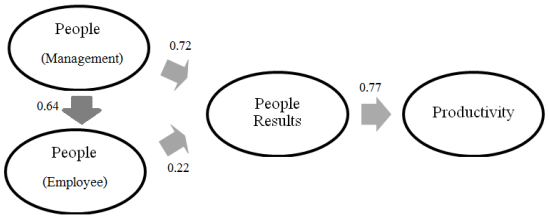

Fig. 5. The final model of safety implementation and productivity.

The final model of safety implementation and productivity indicates that the People (Management) factor drives the People Results factor (with path coefficient = 0.72), while the People Results factor strongly influences the Productivity factor (with path coefficient = 0.77). The People (Management) factor also has a direct relationship with the People (Employee) factor. No direct relationships, however, were found between the People factors and the Productivity factor (see Table 5).

An indirect relationship between the People (Management) and Productivity factors could imply that proper safety empowerment with good teamwork lead to higher job satisfaction and productivity. More employees' participation in safety activities also helps reduce accidents, turnover, and absenteeism, thus resulting in a higher productivity [5, 27]. Involvement with safety also enhances the two-way communication; employees hence make fewer mistakes and have less rework [30].

Table 5. Direct and indirect path coefficients

Latent factor	Correlation coefficient	R^2
People (Employee)	0.64 * People (Management)	0.41
People Results	(0.72 * People (Management)) + (0.22 * People (Employee)) + (0.14 * People (Management) * People (Employee))	0.78
Productivity	(0.77 * People Results) + (0.55 * People (Management) * People Results) + (0.17 * People (Employee) * People Results)	0.60

Discussion and Conclusion

The textile industry is one of the industries with high incident and accident rates. To improve its safety record and eventually increase the productivity, a conceptual model, based on the three key factors (the People, People Results, and Productivity factors), was developed. A total of 28 items associated with the three factors were extracted from the literature, and were used in the questionnaire survey for data collection. One hundred and thirty responses were received from 300 surveys sent, representing 43.3% of the response rate. Around half of the respondents are in management position, and have been working in their current organizations for more than five years. These reflect the appropriateness of the data collected.

The exploratory factor analysis was then used to confirm the proposed factors' structures, as well as their associated items, of the conceptual model. Afterward, the structural equation modeling was performed to gain insights into the interactions and associations among the three key factors.

The results reveal that the productivity in the company can be enhanced through a successful safety implementation, as there is a strong link from the People Results factor to the Productivity factor. It is hence clear that higher job satisfaction, motivation, and morale through safety implementation raise the productivity.

Management plays an important role in enhancing the productivity. This could be seen from strong relationships between the People (Management), the People Results, and the Productivity factors. The management should, therefore, encourage the implementation of safety activities, set appropriate safety roles for the employees, support adequate safety training, ensure safety compliance, enhance two-way communication to achieve positive safety results, and finally enhance the company's productivity.

Forcing the safety implementation, without real employees' involvement and empowerment, could result in not achieving higher productivity. This is confirmed by the absence of a direct effect between the People (Employee) and the Productivity factors, indicating no statistically significant relationship between the two factors.

A practical action plan should be initiated to encourage safety implementation. A safety committee should be established by selecting a representative from each department to elicit various perspectives regarding a safety implementation plan. Safety activities should be promoted and supported by management, both physically and financially. The activities should be monitored, and feedback sent back to the safety committee to improve the safety plan to achieve higher productivity in long term.

This research study provides a number of benefits to the Thai textile industry, as discussed below.

- Employees' participation and compliance in safety, together with proper safety training, leads to better safety results in relation to the company's own employees, such as safety communication

enhancement, better work attitudes, and higher motivation in safety implementation. These people, individually and collectively, lead the company to higher productivity in terms of better quality of product, less material damage, less compensation cost, and higher work speed.

- Forcing the safety implementation, without real employees' involvement and empowerment, could result in not achieving safety record improvement. This is consistent to Calvin and Joseph (2006) that without a clear understanding and acknowledgement of safety implementation from employees, a reduced injury rate cannot be achieved.
- Better quality of product could be achieved from successful safety implementation, as less absenteeism and turnover rate, higher job satisfaction and better working environment are achieved.

The limitations of this study are listed below:

- The data used were based on input provided only by medium-to-large textile companies located mainly in Bangkok, Thailand. Both lower and higher working levels were, however, set as the target respondents to gain mixed perceptions of safety and productivity.
- The number of items used to operationalize the three constructs (People, People Results, and Productivity) were extracted from the international literature review, and were not specifically limited to the Thai practices.
- The relationships of the three constructs were analyzed based on the questionnaire surveys targeting Thai textile firms, thus, it might not fully be applied in other countries.

For future research, a comparative study may be performed between developed and developing countries (Thailand, for example) to investigate the differences in safety implementation and productivity enhancement. A comparison study between top management and workers' perceptions of safety could also be performed to capture the macro-level, as well as micro-level perspectives, of safety implementation.

Appendix

This part contains 28 statements relating to safety and productivity. Please complete this part by circling the score that best reflects the level of your agreement or disagreement with each statement. The meaning of each score is shown below.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

No.	Statement	Score
	People	
1.	Participation of employees in safety activities helps improve safety implementation in the organization.	1 2 3 4 5
2.	Having employees with emergency preparedness skill helps improve safety implementation in the organization.	1 2 3 4 5

3.	Having employees with risk awareness helps improve safety implementation in the organization.	1	2	3	4	5
4.	The use of ergonomics application helps improve safety implementation in the organization.	1	2	3	4	5
5.	Receiving appropriate safety training helps improve safety implementation in the organization.	1	2	3	4	5
6.	Cooperation among employees in safety matters helps improve safety implementation in the organization.	1	2	3	4	5
7.	Having employees with accident experiences helps improve safety implementation in the organization.	1	2	3	4	5
8.	Compliance on safety rules helps improve safety implementation in the organization.	1	2	3	4	5
9.	Having employees with less work pressure helps improve safety implementation in the organization.	1	2	3	4	5
10.	Assignment of safety responsibilities helps improve safety implementation in the organization.	1	2	3	4	5
11.	Good teamwork helps improve safety implementation in the organization.	1	2	3	4	5
12.	Proper safety empowerment helps improve safety implementation in the organization.	1	2	3	4	5
13.	Having incident reports helps improve safety implementation in the organization.	1	2	3	4	5
	People Results					
14.	Good safety implementation leads to less turnover rate.	1	2	3	4	5
15.	Good safety implementation leads to better work attitudes.	1	2	3	4	5
16.	Good safety implementation leads to higher job satisfaction.	1	2	3	4	5
17.	Good safety implementation leads to better work motivation.	1	2	3	4	5
18.	Good safety implementation leads to less absenteeism.	1	2	3	4	5
19.	Good safety implementation leads to higher workforce morale.	1	2	3	4	5
20.	Good safety implementation leads to communication enhancement.	1	2	3	4	5
	Productivity					
21.	Good safety implementation improves working environment in the organization.	1	2	3	4	5
22.	Good safety implementation increases work speed.	1	2	3	4	5
23.	Good safety implementation reduces rework.	1	2	3	4	5
24.	Good safety implementation enhances work quality.	1	2	3	4	5
25.	Good safety implementation reduces compensation cost.	1	2	3	4	5
26.	Good safety implementation increases organization's image.	1	2	3	4	5
27.	Good safety implementation enhances customer's perception..	1	2	3	4	5
28.	Good safety implementation reduces number of accident in the organization.	1	2	3	4	5

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