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A Safety Assessment Approach Using Safety Enablers and Results

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Industrial safety is an important issue in Thailand, and attempts have been made to improve safety performance and accident records. This paper examines key criteria influencing safety improvement. Exploratory factor analysis confirms 9 safety criteria, including 5 "enablers" and 4 "results", with a total of 47 associated attributes. A safety assessment approach is developed, using those 9 key criteria, to measure an organization's current safety maturity level. Organizations can use the assessment approach to plan its safety improvement, and progress through to higher maturity levels by focusing on the weakest criteria shown in the assessment results with the lowest scores.

EFQM Excellence model enablers results safety assessment approach

1. INTRODUCTION

Safety is the condition in which risks are managed to acceptable levels [1]. It is the activity that seeks to minimize or eliminate hazardous conditions that can cause bodily injury. Occupational safety is concerned with risks in areas where people work, such as in offices, manufacturing plants, farms, construction sites, and commercial and retail facilities. Weick defined safety as a dynamic non-event that tends to be taken for granted, particularly in the face of continuous and compelling productive demands [2].

To improve safety, organizations need to measure their current status of safety and plan for safety improvements. Over the past few years, attempts have been made to measure and benchmark the organizational and behavioral variables, and to present the aggregate score as an indicator of safety performance in the organizations. Wright, Brabazon, Tipping, et al., e.g., developed so-called safety culture improvement matrix to be used as a self-assessment tool in assessing the organization's safety culture [3]. Kartam, Flood, and Koushki studied issues, procedures, and problems of safety in the Kuwait construction industry, and concluded that safety improvement, especially in areas such as management training and commitment in safety, was needed to prevent construction injuries and accidents [4]. Grau, Martínez, Agut, et al. investigated safety attitudes and their relationships with safety training, safety behavior, and generalized self-efficacy in Spain [5]. They suggested that safety training programs might be used as a mechanism for enhancing attitudes, especially to improve safety and occupational health. Molenaar, Brown, Caile, et al. identified 31 characteristics that define organizational safety culture, and their survey results served in a type of snap-shot assessment of organizational safety culture [6].

Safety has become an important issue, especially in the manufacturing industry, as the fatality rate in this industry was in the top 10 among all the industries (fatal work injury rate of 2.2 per 100 000 workers) [7]. In Thailand, the number of industrial injuries and fatalities in the manufacturing industry

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in the past 7 years were raised by 132.76 and 17.65%, respectively [8]. According to the Department of Industrial Works, most accidents derived from unsafe behavior and unsafe equipment [8]. Mohamed mentioned that accidents caused many human tragedies, de-motivated workers, and adversely affected the overall cost, productivity, and reputation of the industry [9].

Accidents may arise from a variety of causes, which can generally be classified as physical incidents posing hazardous situations and behavioral incidents caused by unsafe acts [10]. The latter have been identified as the main cause of accidents, and are viewed by many as the direct result of poor safety culture [11]. Since poor safety culture can lead to risks to human lives, much attention has been paid to developing tools for assessing health to identify areas for safety performance improvement. The establishment of a good culture of safety can undoubtedly help organizations control and reduce their construction costs, and increase the efficiency of their operations in the long term [12].

This paper, thus, aims to develop a self-assessment approach, using the European Foundation for Quality Management (EFQM) Excellence model as a basic model, to measure the safety maturity level in industrial organizations. Six safety performance levels are used to assess the current safety maturity level so that the organization can plan for its improvement to achieve higher maturity levels.

2. EFQM EXCELLENCE MODEL

The safety assessment approach is developed based on the logical assumption that by improving how the organization operates, there will be an inevitable improvement in the results. This same assumption underlies the most commonly applied model for total quality management known as the EFQM Excellence model [13]. Empirical evidence suggests that the EFQM Excellence model has a positive effect on organizational performance [13]. The EFQM Excellence model has been acknowledged as an effective way for organizations to improve the quality of their processes. It has been used in business generally as well as in specific industries, such as hospitality and education [14, 15].

The model, as shown in Figure 1, consists of nine criteria, five of which are "enablers" and four of which are "results". Enablers include Leadership, Policy and Strategy, People, Partnerships and Resources, and Processes, and results include People Results, Customer Results, Society Results, and Key Performance Results [16]. Put simply, enablers cover what an organization is doing, while results cover what an organization aims to achieve. In other words, results are brought about by enablers and enablers are improved with feedback from results. The model assumes that Leadership drives People, Policy and Strategy as well as Partnership Resources, and that these three enablers collectively influence the ability to achieve the results through the implementation and improvement of suitable processes [16].

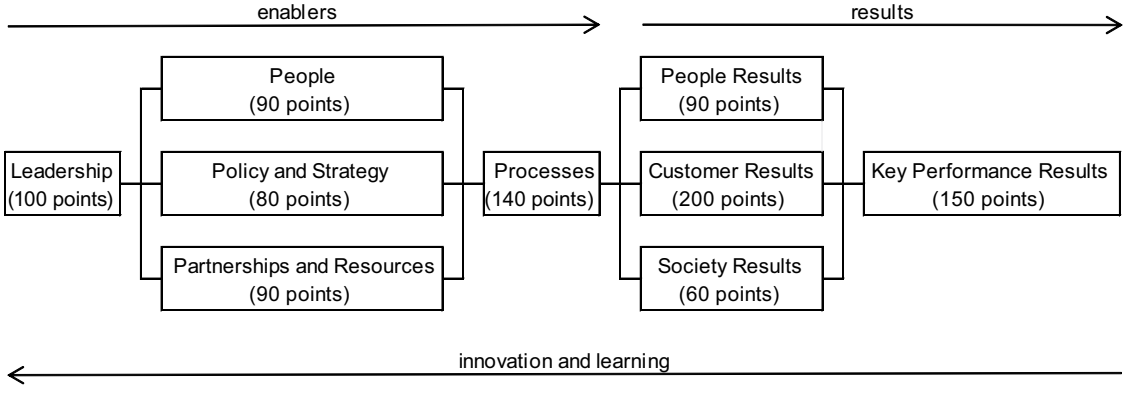

Figure 1. The European Foundation for Quality Management (EFQM) Excellence model.

In addition to the enablers and results, criterion weights are also an important part of the model. As shown in Figure 1, a total of 1000 points is evenly split (500/500) between the enablers and results. The 500 points allocated to the enablers are distributed as 100 points to Leadership, 90 points to People, 80 points to Policy and Strategy, 90 points to Partnerships and Resources, and 140 points to Processes. On the other hand, the 500 points of results are distributed into 90 points of People Results, 200 points of Customer Results, 60 points of Society Results, and 150 points of Key Performance Results [16]. These criterion weights are later used in developing the safety assessment approach.

3. FIVE ENABLERS AND FOUR RESULTS

The nine key safety criteria comprise a number of attributes, which are carefully selected from safety-related literature, to explain their constructs. The details of each criterion, along with its associated attributes, are described in the following subsections.

3.1. Enablers

3.1.1. Leadership

Leadership and management commitment to safety is recognized as a fundamental component of an organization's occupational health and safety [17]. They can be examined with five attributes:

- Leadership commitment: Organizations where top management gives high levels of safety support and commitment have better safety performance [17].
- Consultative style: Good safety performance and high productivity are linked to management consultative style [18].
- Role model: Management needs to be a role model in how to behave safely; no proper modelling leads to employees not taking developing positive safety culture seriously [19].
- Safety accountability: A safety programme cannot be successful on an individual basis, the responsibility to accomplish safety activities must be transferred from top management to lower levels of authority [20].
- Safety feedback: To achieve good safety culture, management should foster a climate that encourages feedback, as safety score in an organization with feedback is higher than that in organizations with no feedback [21].

3.1.2. Policy and Strategy

Policy and Strategy refers to how an organization implements its mission and vision of safety via clear stakeholder focused strategies, which are supported by relevant policies, plans, objectives, targets, and processes. This enabler consists of four attributes:

- Productivity and safety targets: To enhance a culture of safety, safety should have the same weight as productivity and profitability when economic decisions are made [22].
- Reward and recognition: Reward systems that compensate workers for safe working, whilst achieving desired levels of productivity, are necessary [23].
- Updated safety standards: Safety initiatives should be proactively planned to continually update and improve safety standards [24].
- Safety policy: In order for an organization to be effective in health and safety performance, leadership must include health and safety in short- and long-term business goal settings [19].

3.1.3. People

It is not just management participation and involvement in safety activities that is important, but also the extent to which management encourages involvement of the workforce [20]. The seven attributes associated with this enabler follow:

- Peer review: Sites, where workers often give suggestions to each other on how to work safely, report lower accident rates and fewer workers' distress [25].
- Safety empowerment: Positive safety culture is enhanced when employees take responsibility for their safety [26].

- Adequate supervision: A sound safety program requires employers to provide sufficient supervision to protect workers from workplace hazards [20].
- Compliance with safety rules: Not conforming to safety rules is known as a violation. The organization must provide methods for enforcing noncompliant workers to obey safety rules and regulations [20].
- Workers' involvement: Workers tend to support the activities that they themselves help create. A higher level of worker involvement will influence a positive safety behavior [27].
- Safety perception: Employees with good perceptions of safety tend to participate more in safety activities [28].
- Teamwork: Good teamwork is identified as a necessary characteristic of good safety culture [29].

3.1.4. Partnerships and Resources

This enabler describes how an organization plans and manages its external partnerships with project participants and other stakeholders, and organizes its resources to support its safety policies and strategies as well as the effective operation of its safety-related processes. The seven attributes associated with this enabler are

- Personal protective equipment: Adequate provision of personal protective equipment is crucial for safety improvement [23].
- Financial resources: Financial resources should be allocated to aid, e.g., safety training and acquiring information [3].
- Safety-related resources: A successful safety implementation can not be accomplished with no safety resources. Safety tools and signs should be provided to the staff so that they can implement safety activities safely [20].
- Partnerships' awareness of safety: Creating a culture of safety means that the employees, including stakeholders, are constantly aware of hazards in the workplace [3].
- Partnerships' involvement: Effective safety culture should be conceived of as an appropriate match between the behaviors, values, and attitudes of members of the organization and the expectations of stakeholders [3].
- Partnerships' selection: Safety must be integrated into contractors' and suppliers' selection [3].
- Safety information: Every worker should be provided with a safety booklet to be used as a guideline for safety improvement [23].

3.1.5. Processes

This enabler describes how an organization designs, manages, and improves its processes to support its policies and strategies, and to fully satisfy and generate increasing value for its customers, employees, and other stakeholders. It consists of seven attributes:

- Safety maintenance programme: Safety maintenance programs should be encouraged to improve safe work behavior [30].
- Risk assessment: Risk assessment, including all potential risks (such as accidents and injuries, regulatory issues, and environmental releases), should be included in planned safety activities [31].
- Safety documentation: Pasman identified the main elements of a safety management system as process knowledge and documentation, the records of design criteria, and the records of management decisions [32].
- Benchmarking system: Benchmarking safety management allows employees not only to analyze their own safety performance, but also to compare it with other companies [33].
- Job clarity: Lack of job clarity may have a direct effect on injuries, as this leads to the individual operating in unfamiliar situations, thus increasing the likelihood of accidents [34].
- Organizational learning: Organizations that learn from their experiences have a better safety score and safety performance [35].
- Safety training: Training is a major factor influencing safety levels, as it helps personnel carry out various activities effectively, establishes a positive safety attitude, and integrates safety with construction and quality goals [23].

3.2. Results

3.2.1. People Results

This factor measures what the organization is achieving in relation to its people. This construct is examined under four attributes:

- Communication enhancement: An organization with positive safety culture has effective face-to-face communications between management and workers [36].
- Job satisfaction: A person with a high level of job satisfaction normally has positive attitudes towards the job, which, in turn, assists in reducing work injuries [37].
- Low turnover: Plants with low accidents usually have a workforce composition that includes employees who are recruited or retained because they work safely; these work environments also have lower turnover and absenteeism [38].
- Safe work behavior: A higher level of safety climate is positively associated with a higher level of self-reported safe work behaviors [39].

3.2.2. Customer Results

This factor measures what the organization is achieving in relation to its external customers. Five attributes associated with this results factor follow:

- Customers' satisfaction: A good safety program leads to better quality and higher customer's satisfaction [40].
- Customers' relationship: Safety plays a big role in increasing productivity, thus improving customers' relationships [41].
- Customers' expectation: Customer's expectation represents a key product of safety culture [39].
- Loyal customer: Customers tend to continue working with companies with good safety records [41].
- Customers' perception: An effective safety program helps enhance customers' safety perception [40].

3.2.3. Society Results

Society result looks at what an organization is achieving in relation to a local community and society as appropriate. The four attributes associated with this factor are

- Social image: Poor safety standard may pose a poor image to both the organization and the community [42].
- Public safety: A good safety campaign raises safety awareness both to the company and to the society [43].
- Social cost reduction: The improvement of safety culture helps reduce the social costs, including cost of property losses, cost of accidents and injuries, cost of adverse publicity, and cost of environmental releases [42].
- Social co-operation: An organization with a good safety performance has a better organization image that leads to public trust and co-operation [42].

3.2.4. Key Performance Results

This factor looks at what an organization is achieving in relation to its planned performance. It consists of four attributes:

- Total cost reduction: Ignorance of health and safety commitments leads to economic risks for organizations. The improvement of safety culture helps reduce the total costs [32].
- Organizational performance: A successful safety program improves safety and organizational performance [44].
- Increased competitiveness: Safe work behavior results in cost reduction and competitive advantages for the company [45].
- Reduced number of accidents: When safety aspects are well managed, the frequency of accident occurrences may be reduced [24].

Those definitions of the nine constructs (five enablers and four results) and their 47 associated attributes are later used in developing a questionnaire survey to elicit respondents' opinions on the different attributes in the context of their current safety practices and performance. It is important

that an organization be able to assess its current safety maturity level, as the type of improvement method needed to support safety development differs as safety matures [36]. Consequently, a safety improvement method may fail if it does not match the maturity of the organization's existing safety. The next section details the development of the safety maturity levels.

4. SIX SAFETY MATURITY LEVELS

A safety maturity model, developed based on the capability maturity model, is used as a tool to assist organizations in establishing their current level of safety maturity and in identifying actions required to improve their safety [36]. The model consists of five levels of maturity. Deciding which level is most appropriate needs to be based on the average level achieved by the organization or site being evaluated. It is suggested that organizations progress sequentially through the five levels, by building on the strengths and removing the weaknesses of the previous level.

Many researchers, however, report using the safety maturity model with a number of different levels as well as respective score ranges for each level. The EFQM, e.g., divided a total of 1000 points (see Figure 1) into five levels following the safety maturity level [46]:

- uncommitted level: 0–249 points;
- drifter level: 250–499 points;
- improver level: 500–749 points;
- award winner level: 750–999 points;
- world-class level: this level has a single score of 1000 point.

Tervonen and Pahkala, on the other hand, divided the 1000 points into six levels with different score ranges [47]. They suggested that the levels were a useful way of characterizing organizations, and helping them recognize symptoms and develop plans for the future.

- uncommitted level: 0–149 points;
- drifter level: 150–249 points;
- tool pusher level: 250–449 points;
- improver level: 450–649 points;
- matured level: 650–799 points;
- world-class level: 800–1000 points.

Differently, Ahmed, Yang, and Dale allocated the 1000 points, based on the EFQM Excellence model and the interviews with senior managers and consultants, into seven levels to be used as quality self-assessment [48]:

- uncommitted level: 0–149 points;
- drifter level: 150–299 points;
- tool pusher level: 300–499 points;
- improver level: 500–649 points;
- award winner level: 650–849 points;
- world-class level: 850–999 points;
- superlative level: this level has a single score of 1000 points.

5. QUESTIONNAIRE SURVEY

5.1. Purposes

The questionnaire survey is used in this study for collecting data from industrial organizations. A written questionnaire is self-administered, and can be sent through the traditional mail system or by email. It is important that a mail survey be clearly written and self-explanatory because no one will be available to answer questions regarding the survey, once it has been mailed out. Questionnaire surveys have several advantages, e.g., they generally have less sampling bias (a tendency for one group to be over-represented in a sample) than personal interviews. They also allow the researcher to collect data on more sensitive information. Participants, who may be unwilling to discuss personal information with someone face-to-face, may be willing to answer such questions in a written survey. Further, the participants can take as much time as they need to answer the questions without feeling the pressure of someone waiting for the answers [49].

In this study, the questionnaire survey was developed for two purposes:

- to solicit respondents' opinions on the different attributes in the context of their current safety practices and performance, so that the current safety maturity level of an organization can be achieved;

- to determine the levels of safety maturity as well as their respective score ranges based on the respondents' opinions.

5.2. Questionnaire Design

To achieve the two purposes discussed in section 5.1, the questionnaire survey comprised three parts:

- Part I focused on gathering demographical information about the respondents and their respective organizations to ensure that the respondents had appropriate backgrounds.
- Part II covered 47 statements to operationally define the five enablers and four results. The respondents were asked to rate each statement using a 5-point Likert scale, with 1 representing *strongly disagree* and 5 representing *strongly agree*. The scores achieved from this part were converted to the current level of safety maturity of an organization.
- According to the safety maturity levels and score-range diversity (shown in section 4), part III asked the respondents to select the number of safety maturity levels, with the respective scores for each level, in relation to the current safety practices of their organizations.

An example of a questionnaire survey can be found in the Appendix on p. 360.

5.3. Targeted Industry, Targeted Respondents, and Questionnaire Responses

The targeted industry is this study was the food industry, as food is considered an important economic sector, constituting 14% of the country's total exports, and generating employment for 20 million people [50]. This industry, however, is ranked as number one in terms of industrial accidents [8].

According to India's Ministry of Food Processing Industries, the food industry can be divided into seven categories: meat and meat products, seafood products, milk and milk products, fruit and vegetables, starch and starch products, beverages (not including alcohols), and alcohols [51]. The targeted group for this study is in the meat and meat products category, as it is considered an important group in Thai food industry [52].

A list of Thai medium-sized meat and meat products organizations, with over 100 employees, was prepared and used as the sampling frame. The targeted survey respondents were both management and front-line employees to gain mixed perceptions of current safety practices in the organizations. The questionnaire surveys were both mailed and handed directly to targeted organizations.

One thousand questionnaires were distributed, with 745 returns representing a response rate of 74.5%. From the returned responses, 42 were deemed unusable due to data incompleteness and were dropped from the data set. As a result, 703 questionnaires provided data for the analyses.

5.3.1. Responses: part I

Among the respondents, 60% graduated with at least a bachelor's degree. Moreover, 48% of the respondents had been working for their present organization for at least 5 years. This indicates a reasonably high work experience rate of the respondents. Almost all respondents (92%) reported that their organizations had a formal safety policy, and 79% of the respondents had safety-related responsibilities. These responses proved that appropriate organizations had been surveyed.

5.3.2. Responses: part II

The respondents rated their opinions on the 47 attributes in the context of their current safety practices and performance on a 5-point Likert scale. The data gathered in this part were used with the exploratory factor analysis to gather information about the interrelationships among a set of attributes, and to yield a factor-based scale of safety implementation. The details are described in section 6.

5.3.3. Responses: part III

The respondents gave opinions on the safety maturity levels and their score ranges in this study. Most (74%) voted for six safety maturity levels with the score ranges recommended by Tervonen and Pahkala [47] (see Figure 2):

1. Level 1 (uncommitted level; 0–149 points): In this level, safety is defined in terms of technical and procedural solutions and compliance with regulations. Most frontline staff is uninterested in safety, and may only use safety as the basis for other arguments, such as changes in shift systems.
2. Level 2 (drifter level; 150–249 points): In this level, safety is seen as a business risk, and management time and effort is put into accident prevention. Managers perceive that the majority of accidents are solely caused by unsafe behaviors of frontline staff.
3. Level 3 (tool pusher level; 250–449 points): In this level, the organization is convinced that the involvement of frontline staff in health and safety is critical if future improvements are going to be achieved. Managers recognize that wide ranges of factors cause accidents, and that the root causes often originate from management decisions. A significant proportion of frontline staff is willing to work with management to improve health and safety.
4. Level 4 (improver level; 450–649 points): In this level, most staff in the organization are convinced that health and safety are important from both moral and economic points of view. Frontline staff accept personal responsibility for their own, and of others, health and safety. The organization puts a significant effort into proactive measures to prevent accidents.
5. Level 5 (matured level; 650–799 points): In this level, preventing employees' injuries or harm (both at work and at home) is a core company value. The organization uses a range of indicators to monitor performance, but it is not performance-driven, as it has confidence in its safety processes.
6. Level 6 (world-class level; 800–1000 points): In this level, the organization achieves world-class standard, and is constantly striving to improve and find better ways of improving hazard control mechanisms.

Those six safety maturity levels, with their respective score ranges, are used to identify the maturity of an organization's existing safety, and plan for safety improvement.

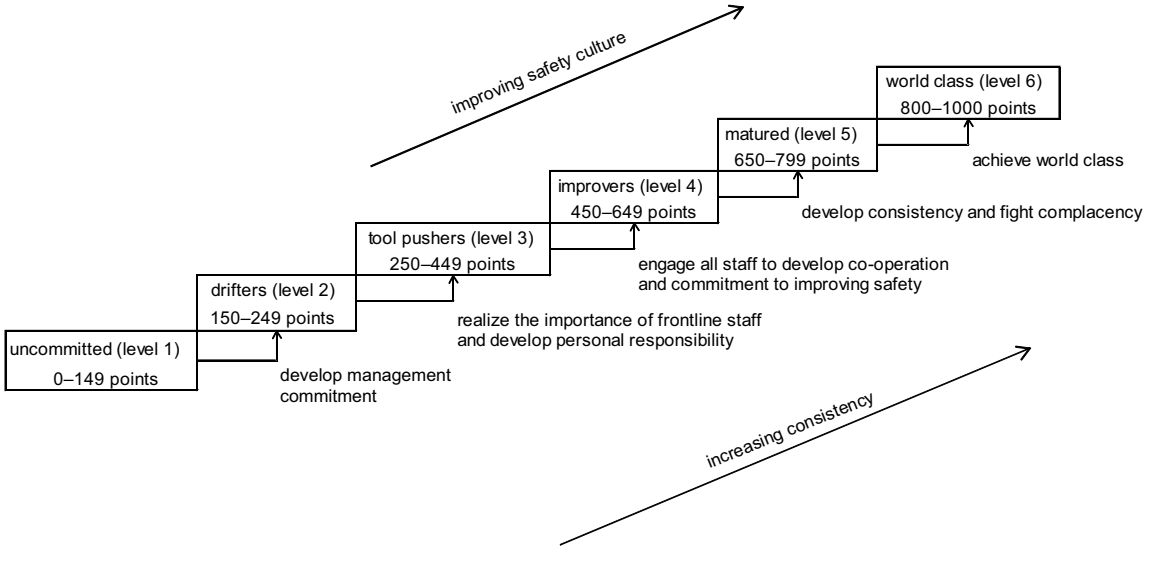

Figure 2. The 6 safety maturity levels.

6. DATA ANALYSES

6.1. Preliminary Analyses

Data collected from questionnaire survey part II were examined with a number of data examination techniques, ranging from the simple process of visual inspection of graphical displays to statistical methods. In this study, the statistical methods of the normality test, the outliers test, and the reliability test were performed to increase confidence in the data. The screening of continuous variables for normality was an important early step in almost every multivariate analysis. Two important components of normality were skewness and kurtosis [52]. According to Curran, West, and Finch [53], the values of skewness under 2 and kurtosis under 7 were acceptable. The results demonstrated that all 47 attributes showed normal distribution, thus increasing confidence in the data.

An outlier is a case with such an extreme value on one variable (a univariate outlier), or such a strange combination of scores on two or more variables (multivariate outlier), that it distorts the statistical results [52]. In this study, the 5% trimmed mean and the *z*-score test were performed to detect outliers. According to Pallant [54], a big difference (>0.2) between a mean and its 5% trimmed mean may indicate a problem with an outlier. The results showed that the mean differences of all attributes were small, providing support for the absence of outliers. The results also showed no sign of outliers when performing the *z*-score test, i.e., the *z*-scores for all the data did not exceed 3.29, at $p < .01$, two-tailed test [52].

The scale reliability, the proportion of variance attributable to the true score of latent variable, can be defined as the extent to which a measure produces similar results over different occasions of the data collection [54]. One of the main issues in scale reliability concerns the scale's internal consistency (Cronbach's α). In a good solution, $\alpha = 0–1$; the larger the value, the more stable the factors. Generally, $\alpha = .70$ is accepted as the minimum desired value of reliability [54]. In this study, the 47 attributes, within the nine criteria, were tested for internal consistency. The results were considered reliable ($\alpha = .80–.90$). This, thus, increased confidence in the contribution of the 47 attributes to the measurement of their respective constructs. To further confirm this finding, an exploratory factor analysis followed.

6.2. Exploratory Factor Analysis

Following preliminary analyses, an exploratory factor analysis (EFA) was performed to extract attributes into a number of factors that represented the interrelations among the set of those attributes [54]. In this study, the 47 attributes were analyzed with the EFA to confirm the construct validity of the five enablers and four results. The principal component, with the varimax rotation method, was used to examine the dimensionality of the 30 attributes of the five enablers and the 17 attributes within the four results. A cut-off factor loading of .4 was also applied to screen out the attributes that were weak indicators of the constructs [55].

6.2.1. EFA of five enablers

The EFA of the 30 attributes, within the five enablers, resulted in five factors, accounting for 62.25% of the total variance (see Table 1). Factor 1 was predominantly accounted for by six attributes, initially measuring Leadership; Factor 2 by four attributes, measuring Policy and Strategy; Factor 3 by seven attributes, measuring People; Factor 4 by four items, measuring Partnerships and Resources; and Factor 5 by nine attributes, initially measuring Processes. It is to note that this analysis leads to three attributes (financial resources, safety-related resources, and safety information attributes), initially assumed to be associated with a certain enabler, to strongly correlate with another enabler. To illustrate, the safety information attribute appeared to be loading on Processes not Partnerships and Resources, as initially hypothesized. This is partly supported by University of Illinois that the process of handling safety information is crucial to enhance safety performance [56].

Following the re-allocation of the three attributes, the reliability test was re-applied to ensure the appropriateness of the groupings of the

TABLE 1. 5 Enablers Extracted With Their Factor Loadings

	Factor Extracted				
Attribute	Leadership	Policy and Strategy	People	Partnerships and Resources	Processes
Leadership commitment	.76				
Consultative style	.70				
Role model	.64				
Safety accountability	.56				
Safety feedback	.50				
Financial resources[1]	.46				
Reward and recognition		.67			
Updated safety standards		.64			
Safety policy		.63			
Productivity and safety targets		.46			
Safety perception			.71		
Compliance of safety rules			.69		
Teamwork			.64		
Adequate supervision			.61		
Workers' involvement			.57		
Safety empowerment			.56		
Peer review			.52		
Partnerships' involvement				.79	
Partnerships' awareness				.75	
Partnerships' selection				.70	
Personal protective equipment				.50	
Safety training					.74
Job clarity					.71
Safety documentation					.68
Organizational learning					.66
Risk assessment					.64
Safety maintaining programme					.63
Safety-related resources[2]					.61
Safety information[2]					.58
Benchmarking system					.57

Notes. 1—the attribute is relocated from Partnerships and Resources to Leadership, 2—the attribute is relocated from Partnerships and Resources to Processes.

TABLE 2. Reliability Values of the 9 Factors

Factor	α
Enabler	
Leadership	.86
Policy and Strategy	.87
People	.84
Partnerships and Resources	.80
Processes	.91
Result	
People Results	.84
Customer Results	.89
Society Results	.88
Key Performance Results	.89

five enablers extracted: α = .80–.91, all of which were considered highly reliable (see Table 2). Besides, the new value of α of Processes was higher than the original value (α = .89–.91), proving the suitability of the relocation of the two attributes (safety-related resources and safety information).

6.2.2. EFA of four results

The EFA of the 17 attributes, within the four results, extracted four factors, accounting for 84.55% of the total variance. Factor 1 consisted

TABLE 3. 4 Results Extracted With Their Factor Loadings

	Factor Extracted			
Attribute	**People Result**	**Customer Result**	**Society Result**	**Key Performance Result**
Job satisfaction	.75			
Communication enhancement	.72			
Low turnover	.71			
Safe work behavior	.65			
Customers' relationship		.77		
Loyal customer		.72		
Customers' expectation		.71		
Customers' satisfaction		.71		
Customers' perception		.63		
Social cost reduction			.79	
Public safety			.77	
Social image			.70	
Social co-operation			.60	
Increased competitiveness				.77
Organizational performance				.71
Reduced number of accidents				.70
Total cost reduction				.67

of four attributes measuring People Results. Factor 2, Customer Results, comprised five attributes. Factor 3 was associated with four attributes measuring Society Results. Lastly, Factor 4 consisted of four attributes to explain Key Performance Results (see Table 3). It is to note that there was no relocation of the attributes, thus confirming the construct validity of the four results with their associated attributes (with $\alpha = .87–.89$, see Table 2).

The confirmed five enablers and four results, together with their 47 attributes, were then used in developing a safety assessment approach.

7. DEVELOPING SAFETY ASSESSMENT APPROACH

7.1. Multiple Weights of Nine Factors

A safety assessment approach was developed to measure the current safety maturity levels of the organizations. To define the maturity level, the score of each (five enablers and four results) was calculated based on the number of its associated attributes and the points given by the survey respondents. To explain, Leadership consisted of six attributes to operationalize this construct. Thus, the maximum score of this enabler became 30 points, i.e., six attributes with a maximum point of each attribute of five based on the 5-point Likert scale. The maximum scores of the nine factors are listed in Table 4.

TABLE 4. Maximum Scores of the 9 Factors

Factor	**Maximum Score (Points)**
Leadership	30
Policy and Strategy	20
People	35
Partnerships and Resources	20
Processes	45
People Results	20
Customer Results	25
Society Results	20
Key Performance Results	20

The scores of the nine factors were then summed to achieve a total score. Based on the EFQM Excellence model (see Figure 1), the criterion weight of each criterion was varied, e.g., 100 points for Leadership, 80 points for Policy and Strategy, and 90 points for People. A maximum score of each criterion, therefore, had to be adjusted to match with the weights assigned by the EFQM Excellence model. The multiple

weight of Leadership is explained in detail as an example.

- A maximum score of Leadership, based on the exploratory factor analyses, is 30 points (see Table 4).
- The criterion weight of Leadership, based on the EFQM Excellence model, is 100 points (see Figure 1).
- To adjust the maximum score of Leadership from 30 to 100 points, a multiple weight of 10/3 is applied (i.e., $30 \times 10/3 = 100$ points).

The multiple weights of the other eight factors were also calculated. Table 5 summarizes the multiple weights of the nine factors.

TABLE 5. Multiple Weights of the 9 Factors

Factor	Multiple Weight
Leadership	10/3
Policy and Strategy	4
People	18/7
Partnerships and Resources	9/2
Processes	28/9
People Results	9/2
Customer Results	8
Society Results	3
Key Performance Results	15/2

7.2. Safety Assessment Steps

The safety assessment approach consisted of six steps in identifying the current safety maturity level of an organization. The details of each step follow.

- Step 1: In each factor, the score of each attribute (minimum of 1 point and maximum of 5 points) is assessed and filled by the management team (see Table 6). Members of the team should come from different departments, such as human resources, safety, maintenance, and production departments, to gain mixed opinions and perceptions of safety practices in the organization.
- Step 2: In each factor, the attributes' scores are summed to achieve the total score. e.g., the total score of Leadership is 3 + 3 + 3 + 2 + 2 + 2 = 15 points (see Table 6).

TABLE 6. Safety Assessment Approach: Scores Given for the 9 Factors

Factor and Attribute	Scores
Leadership	
1. Leadership commitment	3
2. Consultative style	3
3. Role model	3
4. Safety accountability	2
5. Safety feedback	2
6. Financial resources	2
total Leadership	15
Policy and Strategy	
7. Reward and recognition	2
8. Updated safety standards	4
9. Safety policy	3
10. Productivity and safety targets	3
total Policy and Strategy	12
People	
11. Safety perception	3
12. Compliance of safety rules	4
13. Teamwork	5
14. Adequate supervision	3
15. Workers' involvement	3
16. Safety empowerment	2
17. Peer review	2
total People	22
Partnerships and Resources	
18. Partnerships' involvement	2
19. Partnerships' awareness	2
20. Partnerships' selection	2
21. Personal protective equipment	3
total Partnerships and Resources	9
Processes	
22. Safety training	3
23. Job clarity	3
24. Safety documentation	2
25. Organizational learning	2
26. Risk assessment	2
27. Safety maintaining programme	2
28. Safety-related resources	3
29. Safety information	3
30. Benchmarking system	2
total Processes	22
People Results	
31. Job satisfaction	3
32. Communication enhancement	3
33. Low turnover	3
34. Safe work behavior	2
total People Results	11

TABLE 6. (*continued*)

Factor and Attribute	Scores
Customer Results	
35. Customers' relationship	2
36. Loyal customer	2
37. Customers' expectation	3
38. Customers' satisfaction	4
39. Customers' perception	3
total Customer Results	14
Society Results	
40. Social cost reduction	2
41. Public safety	2
42. Social image	3
43. Social co-operation	2
total Society Results	9
Key Performance Results	
44. Increased competitiveness	3
45. Organizational performance	3
46. Reduced number of accidents	4
47. Total cost reduction	2
total Key Performance Results	12

- Step 3: In each factor, the total score by weight is calculated by multiplying the total score with its multiple weight (as assigned in Table 5). For instance, the total score by weight of Leadership is $15 \times 10/3 = 50$ points (see Table 7).
- Step 4: In each factor, the percentage of its score is calculated by dividing its total score by weight by its maximum score (see Table 7). The percentage of Leadership score is, e.g., 50/100 = 50%.
- Step 5: The final total score by weight is achieved by summing the total scores by weight of the nine factors (see Table 7).
- Step 6: The safety maturity level is assessed based on the final total score by weight (see Table 7).

7.3. Illustrating a Safety Assessment Approach

A medium-sized food processing company, located in Nakorn Ratchasima province (160 km to the north of Bangkok, Thailand), used the proposed safety assessment approach to evaluate the company's safety maturity, and to determine its weaknesses for future improvement. The data collection and analysis can be summarized in accordance with the steps in section 7.2:

- Step 1: The management team, including production manager, safety manager, and general manager, provided scores of each of the 47 attributes, as shown in Table 6.
- Step 2: A total score of each of the nine factors was calculated, i.e., 15, 12, 22, 9, 22, 11, 14, 9, and 12 points for Leadership, Policy and Strategy, People, Partnerships and Resources, Processes, People Results, Customer Results, Society Results, and Key Performance Results, respectively (see Table 6).

TABLE 7. Safety Assessment Approach: Safety Maturity Level Assessment

Factor	Total Score by Weight	Score (%)
Leadership	$15 \times 10/3 = 50$	50
Policy and Strategy	$12 \times 4 = 48$	60
People	$22 \times 18/7 = 56.6$	63
Partnerships and Resources	$9 \times 9/2 = 40.5$	45
Processes	$22 \times 28/9 = 68.4$	49
People Results	$11 \times 9/2 = 49.5$	55
Customer Results	$14 \times 8 = 112$	56
Society Results	$9 \times 3 = 27$	45
Key Performance Results	$12 \times 15/2 = 90$	60
Final total score by weight (max. 1000 points)	584	
Representative safety maturity level (level 1–6)	4	

- Step 3: A total score by weight of each of the nine factors was calculated, i.e., 50, 48, 56.6, 40.5, 68.4, 49.5, 112, 27, and 90 points for Leadership, Policy and Strategy, People, Partnerships and Resources, Processes, People Result, Customer Result, Society Result, and Key Performance Result, respectively (see Table 7).
- Step 4: The percentage of each factor's score was calculated (see Table 7). In this company, the percentage of People score was the highest (62.9%), while Partnerships and Resources and Society Result had the lowest percentage of 45%.
- Step 5: The final total score by weight of 584 points was achieved (see Table 7).
- Step 6: A representative safety maturity level of this company was level 4 (see Table 7).

This hypothetical assessment approach shows a total score by weight of 584 points (see Table 7); this represents that an organization is currently in the fourth maturity level of safety (as it falls in the range of 450–649 points, see Figure 2). At this level, most staff in the organization are convinced that safety is important from both moral and economic points of view. Managers and workers recognize that wide ranges of factors cause accidents, and that the root causes are likely to come back to management decisions. Workers accept personal responsibility for their own, and others, health and safety. The organization puts a significant effort into proactive measures to prevent accidents. A number of workers are willing to work with managers to improve health and safety, as seen by the high percentage (62.9%) of People score.

It is also clear that Partnerships and Resources is the weakest enabler in enhancing safety in this organization, as it achieves the lowest scores (i.e., lowest percentage, 45%) compared with the other four enablers (see Table 6). Likewise, Society Result has the lowest percentage (45%) compared with the other three results. Thus, to plan for safety improvement and progress through to higher maturity levels, the organization should pay more attention to improving Partnerships and Resources by, e.g., ensuring that the organization's partners are aware of hazards and are involved in safety-related decisions; including safety in the contractors and suppliers selection; and providing adequate personal protective equipment, such as safety belts and safety shoes, to employees and stakeholders. The organization should also focus more on achieving higher Society Result score, by, e.g., promoting and contributing good safety campaigns to the society, as well as getting local people involved in those campaigns.

8. CONCLUSION

Developing and maintaining an effective safety implementation is crucial in any organizations. This study developed a safety assessment approach based on a widely used EFQM Excellence model, to assist an organization in measuring its safety status and planning for safety improvement. The assessment approach consists of nine criteria, including five enablers (Leadership, Policy and Strategy, People, Partnerships and Resources, and Processes) and four results (People Results, Customer Results, Society Results, and Key Performance Results). Each of the nine criteria is associated with a number of attributes to explain its construct. Exploratory factor analysis confirmed these nine criteria with a total of 47 attributes. Using these nine safety criteria to improve safety is consistent with Wright, Brabazon, Tipping, et al. [57]. It is also agreed that Leadership is the main driver to effective safety implementation, and that strong commitment of leaders is crucial in promoting safety program [58].

It is to note that the analysis showed three attributes initially assumed to be associated with a certain enabler, to strongly correlate with another enabler. To explain, the financial resources was relocated from Partnerships and Resources to Leadership, while the safety-related resources and safety information were relocated from Partnerships and Resources to Processes.

A safety assessment approach was developed based on those five enablers and four results. An organization can use this approach to assess its current safety maturity level, by summing the scores of the nine criteria that were adjusted with

their criterion weights (the maximum score was, thus, 1000 points). To achieve higher maturity levels, the organization should then focus on the weakest criteria shown in the approach with the lowest scores.

There is a limitation in this study. The safety assessment approach was developed based on the questionnaire survey targeting Thai organizations, thus, it might not be a best approach to prescribe the way of developing safety in other countries.

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APPENDIX

This part contains 47 statements relating to safety improvement. 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
	Leadership	
1.	In our organization, management takes safety seriously	1 2 3 4 5
2.	Management encourages workers to give opinions and/or suggestions on safety matters	1 2 3 4 5
3.	In our organization, management acts as a role model in behaving safely	1 2 3 4 5
4.	In our organization, management makes sure that workers hold their responsibilities for their own safety	1 2 3 4 5
5.	Management acts quickly to correct safety problems when brought to his/her attention	1 2 3 4 5
	Policy and Strategy	
6.	It is our policy to give safety the same priority as production	1 2 3 4 5
7.	It is our policy to recognize workers with good safe behaviors	1 2 3 4 5
8.	Our organization has a safety policy that gets reviewed and upgraded regularly	1 2 3 4 5
9.	In our organization, safety is an integral part in formulating our business decisions and goals	1 2 3 4 5
	People	
10.	In our organization, workmates often give suggestions to each other on how to work safely	1 2 3 4 5
11.	Our project staff (including workers) fully understand their safety responsibilities	1 2 3 4 5
12.	In our organization, workers can seek advice on safety matters from their immediate boss, such as project manager, safety manager, supervisor etc.	1 2 3 4 5
13.	Our workers conform to the organization's safety rules.	
14.	In our organization, workers are involved, formally and/or informally, in safety related issues	1 2 3 4 5
15.	Our workers believe that our organization is genuinely concerned about workplace safety	1 2 3 4 5
16.	In our organization, workers work as a team to improve safety	1 2 3 4 5
	Partnerships and Resources	
17.	Our organization has sufficient personal protective equipment (PPE) available so that workers can carry out their jobs safely	1 2 3 4 5
18.	In our organization, financial resources are adequately provided to support the implementation of our safety policy	1 2 3 4 5
19.	Our organization has sufficient necessary safety resources available, such as safety signs and safety booklets, so that workers can carry out their jobs safely	1 2 3 4 5
20.	Our partnerships, such as suppliers, aware of possible accidents in the organization	1 2 3 4 5
21.	Our partnerships, such as suppliers, cooperate with us in following our safety standards	1 2 3 4 5
22.	In our organization, safety is integrated into partnerships' selection	1 2 3 4 5
23.	Our organization provides sufficient safety booklets to be used as a guideline for safety improvement	1 2 3 4 5
	Processes	
24.	In our organization, safety maintaining program is encouraged to improve safe work behavior	
25.	In our organization, risk assessment is a part of our routine safety planned activities	1 2 3 4 5
26.	Our organization keeps accidents records to investigate their causes	1 2 3 4 5
27.	Our organization has a good safety benchmarking system to compare with other construction organizations	1 2 3 4 5
28.	Our organization has a clear job description to reduce the likelihood of accidents	1 2 3 4 5
29.	Feedback on safety implementation is encouraged within the organization in order to enhance organizational learning	1 2 3 4 5
30.	In our organization, we provide adequate training for those performing new tasks safely	1 2 3 4 5

No.	Statement	Score				
	People Results					
31.	The way we currently manage safety in our organization enhances two-way communication between management and workers	1	2	3	4	5
32.	Workers are generally satisfied with the way we currently manage safety in our organization	1	2	3	4	5
33.	The way we currently manage safety in our organization reduces turnover	1	2	3	4	5
34.	The way we currently manage safety in our organization promotes safe work behavior	1	2	3	4	5
	Customer Results					
35.	The way we currently manage safety in our organization helps us increase customers' satisfaction	1	2	3	4	5
36.	The way we currently manage safety in our organization helps us build a better customers' relationship	1	2	3	4	5
37.	The way we currently manage safety in our organization helps us meet our clients' expectations	1	2	3	4	5
38.	The way we currently manage safety in our organization helps us maintain business with the existing customers	1	2	3	4	5
39.	The way we currently manage safety in our organization enhances customers' safety perception	1	2	3	4	5
	Society Results					
40.	Public perceive our organization with a good safety image	1	2	3	4	5
41.	Our safety campaign raises safety awareness, both to the company and to the society					
42.	The way we currently manage safety in our organization leads to reduction in the social costs associated with accidents	1	2	3	4	5
43.	Our safety campaign leads to public co-operation					
	Key Performance Results					
44.	The way we currently manage safety in our organization leads to reduction in the total costs associated with accidents	1	2	3	4	5
45.	The way we currently manage safety in our organization leads to better organizational performance	1	2	3	4	5
46.	The way we currently manage safety in our organization increases competitive advantages for the organization	1	2	3	4	5
47.	The way we currently manage safety in our organization helps us reduce the number of severe accidents and safety related incidents	1	2	3	4	5