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Understanding the Relationship Between Safety Satisfaction and Total Recordable Incident Rate (TRIR), and Their Relevant Processes Through Self-Determination Theory

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Abstract: Although previous studies identified safety indicators and their significant correlations, some construction projects still fail to comply with this pattern. Furthermore, the past literature has rarely explored this issue. To address this gap, this study examined (1) the relationship between safety satisfaction and TRIR, (2) factors influencing safety satisfaction, and (3) factors affecting TRIR. Data from 195 safety officers were analyzed using self-determination theory and safety performance measures. Correlation analysis showed a weak correlation and non-significant link between satisfaction and TRIR, challenging common assumptions. To explore objectives (2) and (3), projects were divided into small-scale and large-scale categories using latent profile analysis and one-way ANOVA, identifying three officer profiles per category. These profiles were compared based on support from managers, motivation, and engagement, with in-depth interviews validating the quantitative findings. For small-scale projects, three safety officer characteristics emerged: (1) realistic officers, (2) perfectionistic officers, and (3) undemanding officers. Large-scale projects revealed similar characteristics for realistic and perfectionistic officers, while a third type, learning officers, emerged. This study revealed hidden characteristics linking safety satisfaction and TRIR in both project scales, emphasizing the need for tailored safety initiatives to enhance officers' capabilities (i.e., in managing conflicts and unexpected events).

Keywords: autonomous motivation; self-determination theory; safety management; safety performance; total recordable incident rate; safety satisfaction; latent profile analysis (LPA)

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1. Introduction

Self-determination theory (SDT) has been used as an efficient approach to yielding positive organizational outcomes in domains including academia [1], the management of construction productivity [2], and safety management [3]. SDT has also been universally adopted by practitioners and researchers to generalize about particular phenomena and provide better explanations of the most likely causal relationships between an organizational leader's support and key followers' motivations [4]. In the context of safety management on construction sites, two key parties, namely project managers and safety officers, are expected to intensively collaborate under the slogan "safety first" to ensure positive safety outcomes [3,5]. The logical sequence is that project managers offer autonomy-oriented support (providing choices, supporting competence, and embracing a sense of belonging) that enhances the autonomous motivation of safety officers, which leads to an intensive engaged effort during the safety program that ultimately yields positive safety outcomes [3].

Safety outcomes can be measured by employing various indicators (e.g., the accident rate on construction sites [6–8], the safety climate [9,10], and job site audits [11]). Theoretically and logically, it is most likely that measuring at least two safety outcomes will yield a significant and positive correlation between these outcomes. In addition, past studies have confirmed a significant and positive relationship between different safety performance indicators. Research conducted by Kim et al. in 2002 revealed that increased satisfaction among employees with the implementation of an organizational safety program can decrease the accident rate in an organization [12]. In contrast, decreased satisfaction will worsen the accident record. The evidence has remained convincing for decades: the aforementioned relationship is plausible due to its logical connection to the phenomenon. For example, when the accident rate is low, the safety climate on a construction site is likely satisfactory, and vice versa. Furthermore, previous research has emphasized that applying SDT can enhance safety performance [3]. Thus, underlying the confidence in SDT and its connection with safety performance can ensure the quality of safety outcomes and increase confidence in the safety program [3].

Nevertheless, construction is complex since it involves participants with different levels of power and authority, knowledge, ethnicities, and beliefs, among other characteristics [13,14]. The system can be dynamic rather than static, and many aspects can change over time [14,15]. Although the previous literature has proposed various safety-related standards to assist practitioners [6,16,17], such as fostering strong commitment from management, offering safety training, and establishing clear safety objectives, it is still challenging to manage those tasks, since each construction site has unique characteristics. Consequently, the relationship between safety outcomes may be the opposite, and confidence in utilizing SDT may be reduced. This corresponds to a gap in the previous literature, which may reduce the trust in an application of SDT. However, to gain a core understanding of to what degree current knowledge about SDT can be applied to the domain discussed here, namely safety management in construction projects, a further investigation is needed.

The objectives of this research were (1) to analyze the relationship between two safety performance indicators (safety satisfaction and TRIR), (2) to identify the process that yields safety satisfaction, and (3) to identify the process that yields the TRIR. The SDT is mainly utilized to extract core features of the authors' focus. This research offers novelty by revealing concealed factors contributing to scenarios where safety satisfaction is high despite a poor TRIR, and vice versa, across both small and large construction projects.

This research hopes to address the perceptions of key participants in safety outcomes, as safety is an important aspect of construction. The use of SDT will pave the way for safety programs in the construction domain by generalizing specific and dynamic phenomena to offer a sound explanation of the SDT perspective. This study will shed light on the causal relationships among central safety-related factors, ultimately providing construction projects with proactive measures so they do not have to undertake reactive measures when safety is not properly observed. In addition, the research findings should provide guidelines for the revision of safety training programs in construction projects so that safety programs are more likely to be effective.

We also identify limitations and propose areas for future research. Initially, government inspections are infrequent, with large projects typically visited annually, emphasizing paperwork over site conditions, while small projects are rarely assessed by inspectors. Enhanced oversight could improve safety programs, suggesting further investigation into the government's role. Additionally, this study focuses on safety officers' perspectives; incorporating views from other stakeholders may provide a more comprehensive understanding. Furthermore, although distinct safety officer profiles were established, investigating possible subgroups within these profiles may uncover factors like unforeseen incidents, contributing valuable insights to strengthen decision-making strategies. Lastly, the study's findings may vary with data from other countries due to differing safety laws, offering practitioners broader decision-making options.

The rest of this paper is organized as follows. First, the research methodology is outlined to provide an overview of this study. Subsequently, a review of the relevant literature is provided, encompassing self-determination theory (SDT) and safety performance. The data collection process is reviewed to evaluate relevant project data. The data analyses and results are then presented, followed by the framework for an in-depth interview. The discussion is then presented to yield valuable insights from both the quantitative analysis and in-depth interview, in which the practical implications are subsequently delineated. The last section of this paper provides the conclusions, along with limitations and potential future research.

2. Research Methodology

This research was designed as illustrated in Figure 1 to cover two main parts: (1) an analysis of the quantitative data and (2) the development of an in-depth interview.

Regarding the first part, Section 3 presents the related literature to comprehend the necessary elements, including a review of self-determination theory (SDT) and safety performance. First, SDT was reviewed to gain a better understanding of its application in this particular domain. Second, this research reviewed safety performance, which covers two safety performance indicators, namely safety satisfaction and TRIR, to properly measure the performance of the safety program at the construction site. Section 4 delineates how the data were gathered for the quantitative analysis, which involved two main stages: questionnaire design and target respondent. Section 5 provides the details of the data analyses and results based on the identified objectives. This process encompasses the following two steps:

1. An analysis of the correlation between safety satisfaction and the TRIR by applying correlation analysis, which indicates that there is a low correlation between two safety performance indicators.
2. Classification of project samples into subpopulations, which includes the following steps:
   - ➢ Dealing with project samples based on the TRIR, for which the initial dataset is 195 project samples.
   - ➢ Classification of satisfaction by using latent profile analysis (LPA).
   - ➢ Classification of the TRIR by using latent profile analysis (LPA).
   - ➢ Combination of satisfaction and the TRIR to identify each group of subpopulations.
   - ➢ Comparison of the budget across subpopulations by applying one-way analysis of variance (one-way ANOVA), in which the outliers in terms of project budget were removed so that the final dataset is 133 project samples.
   - ➢ Consideration of the small-scale profiles and large-scale profiles by applying one-way ANOVA to compare the level of autonomy-oriented support from project managers, the motivation of safety officers, and the engagement of safety officers across all small- and large-scale profiles.

For LPA, this research utilized the RStudio software (version 2024) to analyze the gathered data. Other statistical analyses, such as correlation analysis and one-way ANOVA, were analyzed via IBM SPSS Statistics 26.

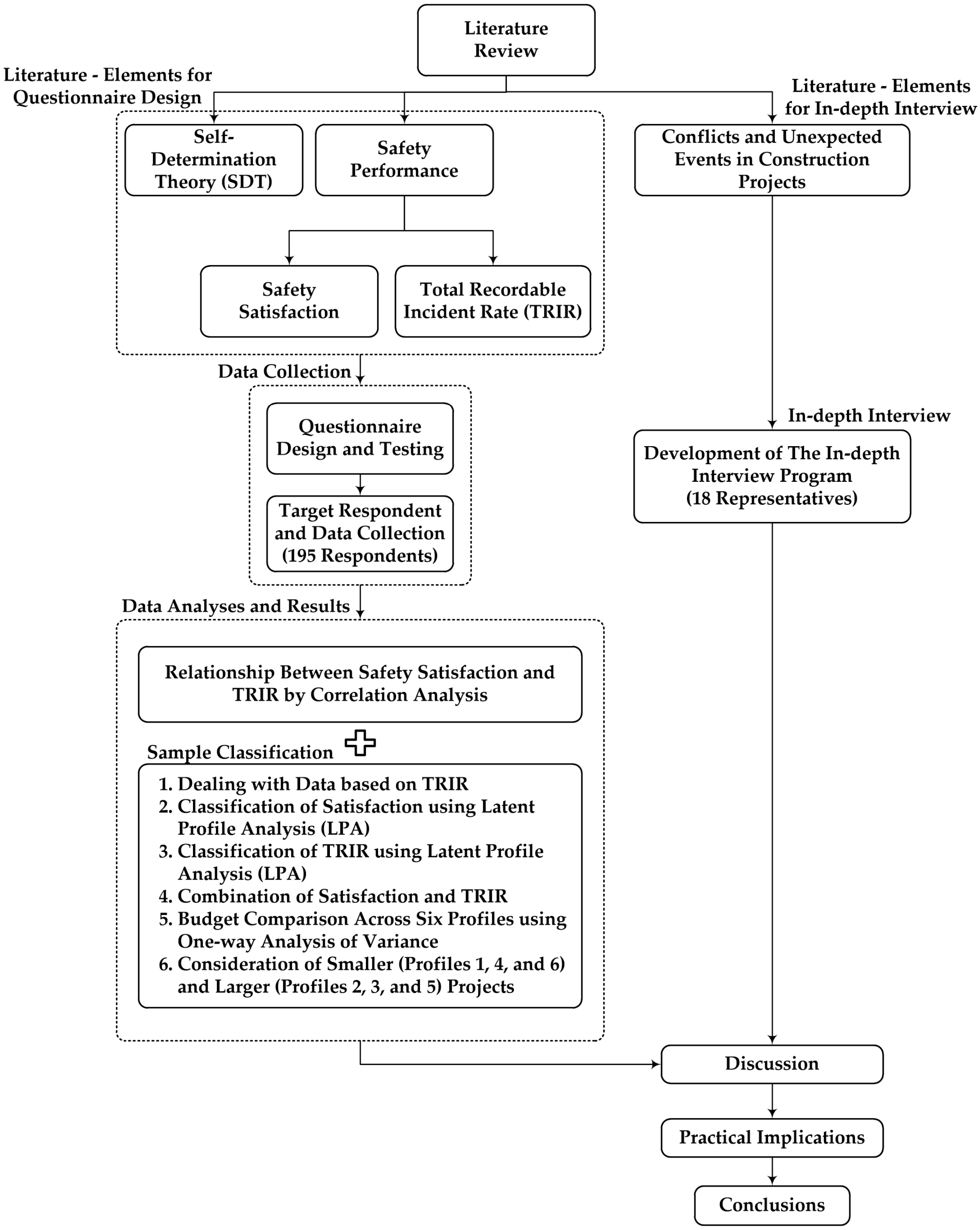

Figure 1. Schematic framework for research methodology.

For the second part, the in-depth interview program, Section 6 provides a subsequent review of the literature, helping the researchers to comprehend the potential aspects that may interrupt the processes that shape safety satisfaction and the TRIR. This encompasses the presence of conflicts and unexpected events in construction projects. The aforementioned aspects were then utilized to develop the in-depth interview program with the representatives from each identified subpopulation.

After achieving the first and second parts, the results from both parts are used in the discussion process in Section 7 to yield insights into the current practice of safety programs in the construction sector. The practical implications (Section 8) are subsequently provided to make a proper suggestion to the construction industry regarding each particular characteristic of safety officers. Finally, the conclusion section, Section 9, offers an overview of this research, along with the limitations and future recommendations.

3. Literature Review

3.1. Self-Determination Theory

SDT is a broad motivational theory that has been utilized globally in various domains to bridge the gap between empirical practice and theory. Theoretically, the motivational state concerns three major types of motivation: amotivation, controlled motivation, and autonomous motivation.

Amotivation refers to a state of motivation in which an action is performed without a goal. Controlled–motivated individuals act in response to various external reasons, such as avoiding a punishment, earning money or a reward, or protecting their ego. Autonomous–motivated individuals tend to perform their job because of its importance and because they have an interest in the subject. Controlled motivation and autonomous motivation are the main focuses in this research, since they have been recognized as the prevalent forms of motivation embedded within an organization. In the context of organizational management, individuals tend to transition from a state of controlled motivation to autonomous motivation when three features are displayed at the workplace: (1) support for autonomy, such as providing choices in the decision-making process; (2) support for competency, such as complimenting employees when a task is performed well; and (3) support for relatedness, which embraces the idea that each individual is an important part of the organization. Various domains of research have adopted this theory to effectively frame particular phenomena within practicable paradigms, such as airline management, waste management in Vietnam, and the management of construction productivity.

Accordingly, this research adopted SDT to generalize and simplify a complex system into an easy-to-digest framework and investigated the extent to which the theory can be applied by focusing on the implementation of safety programs on construction sites. In this context, two central parties, namely project managers and safety officers, were identified as the key features for the developed framework, as these two parties are predominantly involved in safety initiatives.

3.2. Safety Performance

Two indicators were employed to measure safety performance at construction sites: (1) safety satisfaction and (2) TRIR. The details of each indicator are as follows: Satisfaction refers to an inner reality that aims to measure the difference between "how much of something there should be" and "how much there actually is". The robustness of the measurement of satisfaction with safety programs was effectively discussed in [3]. In terms of the TRIR, this indicator refers to an objective measurement of safety outcomes (by focusing on the number of recorded incidents during safety programs) developed by the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor [11,18].

$$\text{TRIR} = \frac{\text{Number of Incident Cases}}{\text{Total Working Hours}} \times 200,000 \quad (1)$$

The TRIR is calculated based on Equation (1), in which a lower TRIR refers to a better safety outcome, and vice versa. The workplace is thus supposed to have a low TRIR or even zero incidents to represent an appropriate safety outcome.

4. Data Collection for Quantitative Analysis

Data were systematically collected through two major processes: (1) designing and testing a questionnaire and (2) identifying the target respondents and collecting the necessary data. The details of each process are provided below.

4.1. Questionnaire Design and Testing

The questionnaire had five sections. Section I gathered demographic information. Section II inquired about autonomy-oriented support from project managers, wherein each respondent denoted their perception of the autonomy-oriented support from project managers, using a five-point Likert scale (1 = no support at all, 2 = slight support, 3 = moderate support, 4 = high support, and 5 = extensive support). Section III was concerned with the degree of motivation of safety officers, covering autonomous motivation, controlled motivation, and amotivation. Section IV asked about the degree to which safety officers were engaged in safety programs. Respondents were required to rate their engagement level based on the Likert scale from 1 to 5 (1 represents no engagement, 2 represents slight engagement, 3 represents moderate engagement, 4 represents high engagement, and 5 represents strong engagement). Section V required data on safety performance, covering safety satisfaction and the TRIR. For safety satisfaction, respondents were required to rate the level of satisfaction with safety programs based on the Likert scale from 1 to 5 (1 represents not at all satisfied, 2 represents slightly satisfied, 3 represents moderately satisfied, 4 represents very satisfied, and 5 represents extremely satisfied). In terms of the TRIR, respondents were required to provide the historical accident record in their projects.

To ensure that the questionnaire was fit for its purpose, two processes were carried out: (1) the questionnaire was evaluated through item–objective congruence (IOC), and (2) a pilot survey was conducted. IOC was applied to ensure that the questions represented the intended objective of each factor, and three academic- and practice-based professionals assisted in the evaluation. The pilot survey aimed to ensure the questionnaire's reliability. In this process, 15 safety officers were asked to respond, after which a reliability test was performed. The Cronbach's alpha values for the reliability test varied between 0.74 and 0.95, so they were greater than 0.70, indicating that the designed questions were relevant and consistent and confirming the practicality of the questionnaire.

4.2. Target Respondent and Data Collection

Safety officers at the professional level were identified as the target respondents in this research, since they are the key actors in safety initiatives and tend to interact with other parties regarding safety-related matters. Therefore, the author assumed that they were capable of providing the necessary data. The total population size was determined using data from the 2013 to 2021 *Yearbook of Labour Protection and Welfare Statistics*, which compiles survey results from the Department of Labour Protection and Welfare [19]. In Thailand, construction projects employing at least 100 workers are mandated to hire professional-level safety officers. Based on statistical records from the past nine years (2013–2021), the analysis covered four main categories of construction project sizes: 684 projects with 100 to 299 employees, 111 projects with 300 to 499 employees, 57 projects with 500 to 999 employees, and 18 projects with 1000 or more employees. This resulted in a total of 870 construction projects being included in the research sample. The required sample size was calculated using Equation (2), indicating a need for approximately 274 respondents for this study.

$$n = \frac{N}{1 + N(e^2)} \quad (2)$$

In the equation above, n denotes the sample size, N indicates the total population, and e refers to precision at a 95% confidence level (e = 0.05), following [20]. An online questionnaire was used to target the respondents. The authors attempted to contact more respondents than the suggested number. However, many respondents could not participate in the questionnaire survey due to the confidential issues with the project data. As a result, 195 safety officers voluntarily participated in the survey. This was deemed an effective sample size that can yield meaningful results for current practice, as suggested by [21]. The gathered data were then analyzed, as presented in the next section.

5. Data Analyses and Results

5.1. Relationship Between Satisfaction with the Safety Program and TRIR

The research began with the concept that a high correlation should exist among safety performance indicators [5,22]. Two dimensions of safety performance were then considered: satisfaction and TRIR. For the first, the satisfaction of three parties was considered, namely safety officers, project managers, and owner representatives. The authors then considered integrating the satisfaction of the three parties into a single and holistic view to represent the term "satisfaction". Before the three components were integrated, a correlation analysis was conducted to ensure the compatibility of the gathered data. Table 1 presents the results of the correlation analysis, which indicates that the three variables are positively and significantly associated. This analysis confirmed that the satisfaction of the three parties could be integrated into a single view.

Table 1. Correlation analysis of satisfaction with safety programs among the key parties.

Variables	$\overline{X}$	SD	Safety Officers' Satisfaction	Project Managers' Satisfaction	Project Owners' Satisfaction
Safety officers' satisfaction	4.036	0.770	1.000		
Project managers' satisfaction	3.886	0.797	0.748 **	1.000	
Project owners' satisfaction	4.120	0.761	0.717 **	0.682 **	1.000

Note: ** = $p < 0.01$.

A correlation analysis was then performed to investigate the relationship between satisfaction and the TRIR. The results are presented in Table 2.

Table 2. Correlation analysis between satisfaction with safety programs and TRIR.

Variable	$\overline{X}$	SD	Satisfaction	TRIR
Satisfaction	3.976	0.717	1.000	
TRIR	237.107	3247.503	0.102	1.000

As shown in Table 2, the degree of correlation between satisfaction and the TRIR is relatively low, at 0.102 (sig. = 0.155), indicating that the expected relationship in the current practice of safety programs on construction sites does not exist. Notably, the correlation in Table 2 considered all 195 samples to analyze the data. Even when outliers in terms of the TRIR were excluded, the correlation between satisfaction with safety programs and the TRIR was still relatively low. Therefore, the concept that a high level of association exists between satisfaction with safety programs and the TRIR was rejected, and this analysis implied that there is not always a strong association between the two. Given the results of this analysis, the author formulated the following question to further investigate the gathered data to simplify this complexity: why does satisfaction with safety programs not necessarily appear to be a reliable indicator of TRIR?

The next section presents how the gathered data were further analyzed to yield valuable conclusions about the particular circumstances around the process that yields safety satisfaction and shapes the TRIR.

5.2. Classification of Project Samples into Subpopulation

5.2.1. Dealing with Data Based on TRIR

The first variable of interest was TRIR, since it provides an objective measurement. The value of TRIR in 195 projects was thoroughly scrutinized. Regarding the process of outlier identification, one study investigating safety performance through the lens of incident rates reported a maximum observed incident rate of 69.13 cases per million working hours [6]. Assuming that the aforementioned incident rate is the highest rate of incidents that can occur on a construction site, the authors adopted this numerical threshold as a standard criterion to identify an extreme TRIR value during data analysis. Given that the TRIR was derived from the calculation of incidents per 200,000 working hours, the initial threshold of 69.13 cases/million hours was transformed, yielding a standardized threshold of approximately 14.00 cases per 200,000 working hours. Consequently, sample projects characterized by a TRIR surpassing the established threshold of 14.00 cases per 200,000 working hours were identified as outliers. Thus, 14 outlier projects were identified in the dataset.

Essentially, considering TRIR yielded three major groups of samples: 166 projects identified as forming a normal group, 14 projects identified as outliers, and 15 projects in which fatalities occurred. The authors attempted to consider all the samples by assuming that each observation must yield valuable information for both practitioners and researchers. The groups of 14 projects with extreme TRIR values and 15 projects where fatalities occurred were kept for later consideration (see Section 5.2.4). The safety performance of the 166 projects with a TRIR of less than or equal to 14 was categorized based on two dimensions: satisfaction and TRIR. Next, Section 5.2.2 presents how satisfaction was categorized.

5.2.2. Classification of Satisfaction

Three models were trialed to determine which was most effective in revealing satisfaction with safety programs (Table 3). Firstly, concerning the fit indices, this study considered four indices: the Akaike information criterion (AIC), the Bayesian information criterion (BIC), entropy, and the bootstrap likelihood ratio test (BLRT) [23]. The effectiveness of a model is theoretically established based on low values for AIC and BIC; a model with higher values of these indices is deemed less effective.

Table 3. Three trial models for satisfaction and their associated fit indices.

Model	AIC	BIC	Entropy	BLRT
1-class model	355.000	361.220	1.000	
2-class model	351.830	364.280	0.670	0.030
3-class model	330.730	349.400	0.900	0.010

Entropy serves to indicate how accurately a model defines the number of classes, with an entropy value around 0.80 considered theoretically acceptable. Entropy values of less than 0.80 suggest that a model may not properly classify the number of characteristics within the sample. The BLRT value of the selected model should be lower than 0.05 to indicate the model's appropriateness. As a result, a three-class model was selected to represent the variety of satisfaction levels within the sample projects (AIC = 330.730, BIC = 349.400, entropy = 0.900, and BLRT = 0.010).

The descriptive statistics for a three-class model (Table 4) are as follows: 38 samples in class 1, 87 samples in class 2, and 41 samples in class 3. Therefore, the satisfaction was classified into three groups: group (1) consists of projects with low satisfaction (1.67–3.33), group (2) consists of projects with moderate satisfaction (3.67–4.33), and group (3) consists of projects with high satisfaction (4.67–5.00).

Table 4. Descriptive statistics for the three-class model underlying satisfaction.

No.	N	Mean	SD	Minimum	Maximum
Low satisfaction	38	3.000	0.347	1.667	3.333
Moderate satisfaction	87	4.038	0.206	3.667	4.333
High satisfaction	41	4.902	0.154	4.667	5.000
Total	166	4.014	0.699	1.667	5.000

This classification is considered in an identical framework of TRIR (Section 5.2.4), while Section 5.2.3 below presents how the TRIR was classified into different groups.

5.2.3. Classification of TRIR

For the classification of TRIR, a three-time classification process was implemented to ascertain the most suitable grouping for the project samples. In the initial stage, nine trial experiments were conducted to examine the fit indices of AIC, BIC, entropy, and BLRT (Table 5). When the fit indices were evaluated, the nine-class model demonstrated favorable values for AIC (606.084), BIC (662.100), and BLRT (0.010).

Table 5. Nine trial models for TRIR and their associated fit indices (first-round classification).

Model	AIC	BIC	Entropy	BLRT
1-class model	798.192	804.416	1	
2-class model	696.959	709.407	0.946	0.010
3-class model	700.958	719.630	0.457	0.010
4-class model	704.959	729.855	0.309	1.000
5-class model	637.357	668.477	0.491	0.010
6-class model	641.356	678.700	0.422	0.010
7-class model	617.812	661.379	0.499	0.010
8-class model	621.812	671.604	0.454	1.000
9-class model	606.084	662.100	0.533	0.010

Nevertheless, the entropy value (0.533) associated with this model fell notably below the recommended threshold of 0.80. Consequently, the nine-class model was not considered to be an appropriate representation of the optimal number of classes for the TRIR. Similarly, models ranging from a three-class to an eight-class configuration displayed favorable values for AIC and BIC; however, their entropy and BLRT failed to meet the specified criteria. Consequently, a two-class model emerged as the most fitting choice for the initial classification of the TRIR. This decision was substantiated by the model's fit indices falling within an acceptable range for both entropy (0.946) and BLRT (0.010).

For the selected two-class model, the TRIR means for class 1 and class 2 were observed to be 0.839 (146 samples) and 8.031 (20 samples), respectively. However, given the substantial (146) sample size of and notable variety in class 1, a comprehensive exploration of potential class numbers was undertaken to identify the most fitting number of classes within the project samples.

Consequently, the samples in class 1 were scrutinized to determine the optimal number of classes. Subsequently, a second classification was executed based on the 146 project samples derived from the initial classification (Table 6). Nine trial models were systematically applied to discern the most fitting number of classes within this subset of samples. Similar to the findings from the initial TRIR classification, the two-class model exhibited the most favorable values for fit indices, with an AIC of 377.101, a BIC of 389.036, entropy of 0.955, and a BLRT of 0.010.

Table 6. Nine trial models for TRIR and their associated fit indices (second-round classification).

Model	AIC	BIC	Entropy	BLRT
1-class model	451.085	457.053	1	
2-class model	377.101	389.036	0.955	0.010
3-class model	381.11	399.012	0.454	1.000
4-class model	324.692	348.561	0.677	0.010
5-class model	328.692	358.528	0.565	0.762
6-class model	289.142	324.945	0.668	0.010
7-class model	283.988	325.758	0.694	0.020
8-class model	287.985	335.723	0.657	0.059
9-class model	292.024	345.728	0.674	0.980

Table 7 provides an overview of the descriptive statistics associated with the samples categorized into three distinct groups based on the TRIR. Specifically, the dataset encompasses 129 samples originating from the projects characterized by a low TRIR, 17 samples representing projects featuring a moderate TRIR, and 20 samples derived from projects exhibiting a high TRIR.

Table 7. Descriptive statistics for a 3-class model after the 2nd round of classification of TRIR.

TRIR	N	Mean	SD	Minimum	Maximum
Low TRIR	129	0.398	0.567	0.000	2.080
Moderate TRIR	17	3.332	0.879	2.260	4.630
High TRIR	20	7.712	2.563	4.840	13.390
Total	166	1.580	2.654	0.000	13.390

Both the categorized satisfaction and TRIR were then treated in an identical framework so that these two dimensions of safety performance could be simultaneously considered. Next, Section 5.2.4 demonstrates how the categorized satisfaction and TRIR were considered in this research.

5.2.4. Combination of Satisfaction and TRIR

Previously, safety performance indicators encompassing both satisfaction and TRIR were classified into distinct groups or classes. Regarding satisfaction, the classification yielded three discernible groups: (1) projects with low satisfaction, (2) projects with moderate satisfaction, and (3) projects with high satisfaction. Simultaneously, the TRIR samples were categorized into three groups, namely those with (1) the lowest TRIR, (2) a moderate TRIR, and (3) the highest TRIR.

Thereafter, a combination chart depicting the relationship between satisfaction and the TRIR was generated and is presented in Figure 2. It indicates the respective sample counts within each combination. Although nine unique combinations emerged from the intersection of satisfaction and the TRIR, the limited number of samples within each combination rendered them inadequate for robust statistical analysis. Consequently, a strategic decision was made to merge certain components to increase the sample sizes in each group and ensure a more robust foundation for subsequent data analysis.

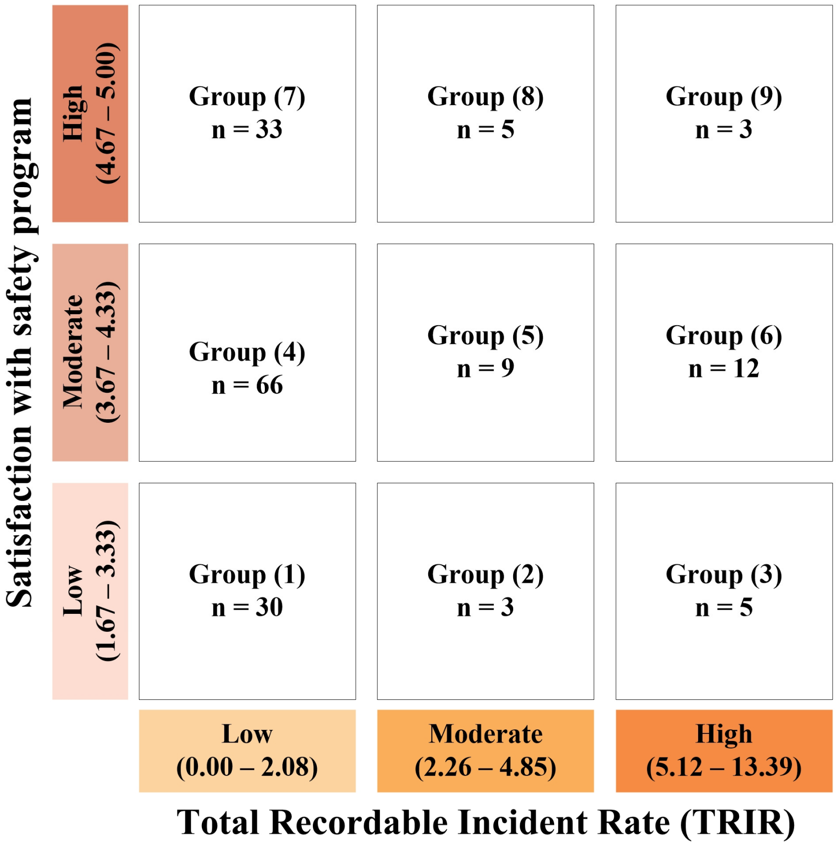

Figure 2. Nine combinations of satisfaction and TRIR with their associated numbers of samples.

Consequently, the projects were systematically grouped into quadrants: Groups 5, 6, 8, and 9 collectively formed Quadrant 1, denoted as Group 1; Groups 4 and 7 were amalgamated into Quadrant 2, identified as Group 2; Group 1 was allocated to Quadrant 3, designated as Group 3; and Groups 2 and 3 were consolidated within Quadrant 4, named Group 4.

Figure 3 presents the final four combinations of performance profiles (satisfaction and TRIR) along with the numbers of project samples categorized in each performance combination. As per the regular rule of graph plotting, the quadrants run from 1 to 4 in a counterclockwise direction. Regarding satisfaction, two traits were considered: (1) projects with which the involved parties were more satisfied and (2) projects with which the involved parties were less satisfied. This consideration should be valid, since the definition of satisfaction levels remains as follows: high satisfaction ranges from 3.67 to 5.00, while low satisfaction ranges from 1.67 to 3.33. Similarly, the two predominant characteristics of TRIR were revealed: (1) projects with a lower TRIR and (2) projects with a higher TRIR. The moderate and high TRIRs were roughly combined into the same definition based on the TRIR record of the U.S. Bureau of Labor Statistics, according to which the average TRIR value in 2023 was 2.4 cases per 100 full-time workers (200,000 working hours) [24]. In addition, these strategic groupings facilitated quantitative analysis to increase the number of samples in each profile, and the statistical analysis was thus robust.

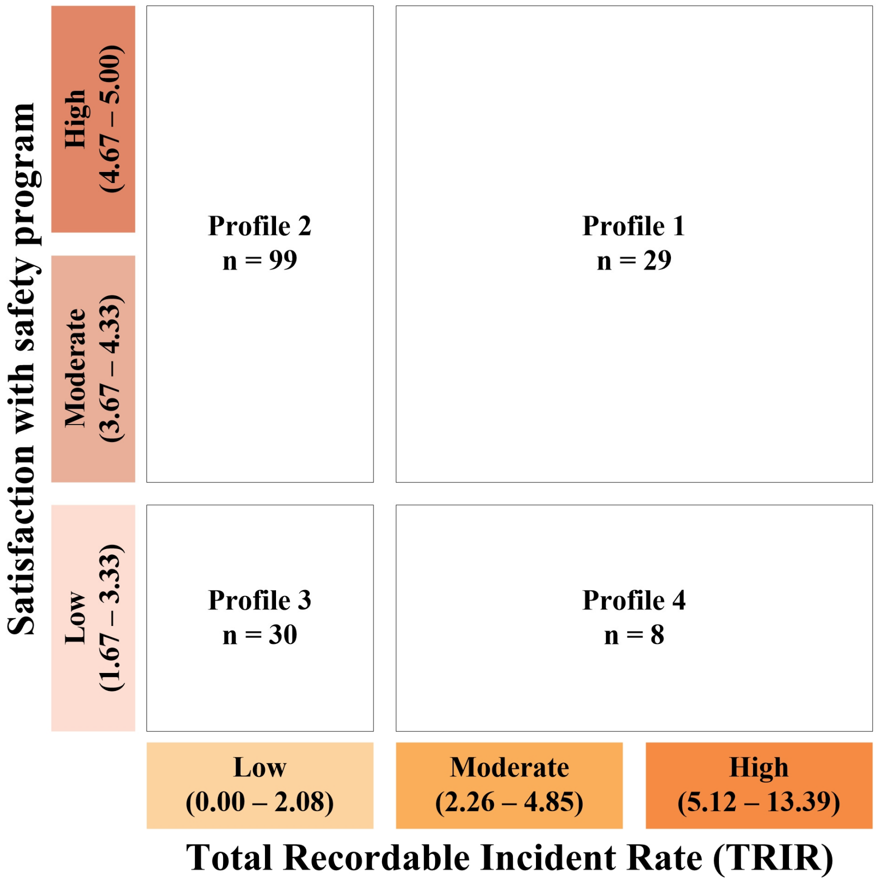

Figure 3. Reduced combinations of satisfaction and TRIR with their associated number of samples.

Consequently, each profile is named based on its performance as follows: Profile 1 = higher satisfaction with a higher level of TRIR; Profile 2 = higher satisfaction with a lower level of TRIR; Profile 3 = lower satisfaction with a lower level of TRIR; and Profile 4 = lower satisfaction with a higher level of TRIR. Notably, higher TRIR means a higher incident rate, indicating a poorer performance in terms of TRIR.

As mentioned earlier (Section 5.2.1), two groups of sample projects (15 with fatalities and 14 with outliers in terms of TRIR) were kept for later consideration. The two sample groups were then included in the developed framework. As illustrated in Figure 4, for the 15 projects with fatalities, the mean satisfaction was 3.689. This group was thus placed in Profile 5, depicting “higher satisfaction and fatalities”. For the 14 projects identified as TRIR outliers, the mean satisfaction was 3.833. This group was treated as Profile 6, displaying “higher satisfaction and extreme TRIR values”.

Figure 4 indicates the final combinations of six particular profiles: Profile 1 represents “higher satisfaction and higher TRIR”, Profile 2 shows “higher satisfaction and lower TRIR”, Profile 3 represents “lower satisfaction and lower TRIR”, Profile 4 represents “lower satisfaction and higher TRIR”, Profile 5 refers to “higher satisfaction and fatality”, and Profile 6 refers to “higher satisfaction and extreme TRIR”.

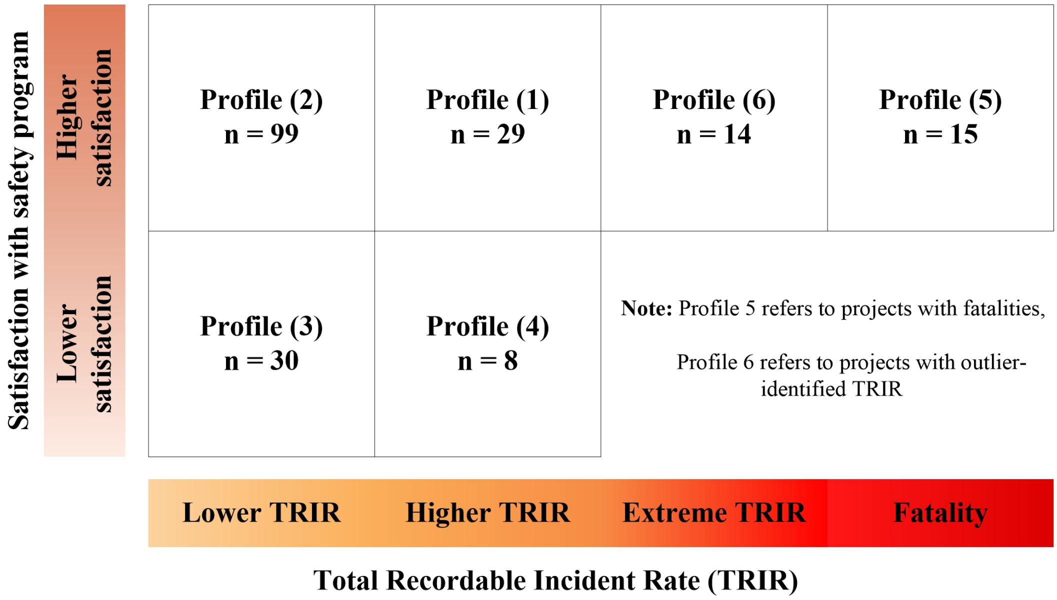

Figure 4. Final six profiles for further analysis; x-axis refers to TRIR, and y-axis denotes satisfaction.

5.2.5. Budget Comparison Across Six Profiles

For further consideration, the project budgets of the six designated profiles were preliminarily considered to consider the size of construction projects. Since there is no consensus classification to identify project size, this research relies on empirical data and assumes that each data point can represent an overview of the current trend. Thus, the authors employed statistical analysis to differentiate project size according to budget among the designated profiles [25]. In this process, the outliers regarding project budget in each profile were excluded, and the average project budget of each profile was then statistically compared by using a one-way ANOVA test. Table 8 presents the results of the comparison of the project budget across the six profiles. The project budget was then used to differentiate the project size across the six profiles. Profiles 2, 3, and 5 represent larger construction projects, while Profiles 1, 4, and 6 represent smaller ones.

Table 8. Comparison of the mean values of project budgets across the six designated profiles.

Variables	Profile 1 (n = 18)	Profile 2 (n = 67)	Profile 3 (n = 21)	Profile 4 (n = 7)	Profile 5 (n = 12)	Profile 6 (n = 8)	ANOVA (sig.)
Project budget (Million USD)	4.187	19.265	10.608	5.984	67.357	0.937	0.000

Note: This calculation was conducted by assuming that USD 1 is equal to THB 35. Profile 5 experienced fatal cases.

Figure 5 demonstrates each profile, with its designated project size based on the project budget.

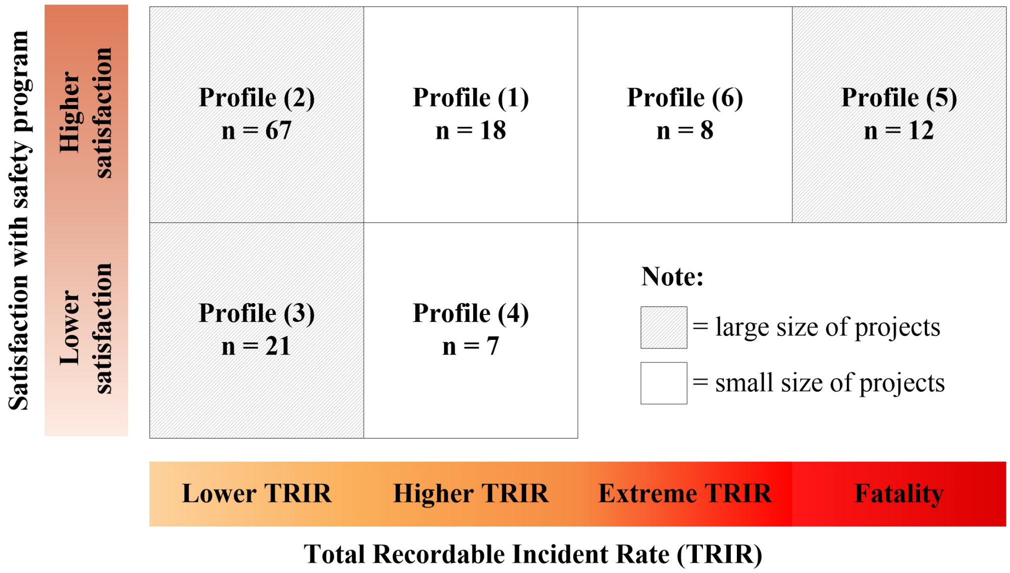

Figure 5. Two distinct sizes of construction projects, large and small, based on project budget.

According to Figure 5, the average value of the safety performance in each profile is demonstrated in Table 9, covering the mean satisfaction and TRIR.

Table 9. Summary of the mean values of the safety performance of the six identified profiles.

Variables	Profile 1 (n = 18)	Profile 2 (n = 67)	Profile 3 (n = 21)	Profile 4 (n = 7)	Profile 5 (n = 12)	Profile 6 (n = 8)
Satisfaction	4.259	4.363	3.016	2.905	3.583	3.917
TRIR	5.399	0.358	0.715	6.334	5.374	51.445

Note: The unit of TRIR is cases per 100 full-time workers (200,000 working hours).

5.2.6. Consideration of Smaller (Profiles 1, 4, and 6) and Larger (Profiles 2, 3, and 5) Projects

Based on the designated profile of construction projects, each type of construction project was separately considered to yield an understanding of the data characteristics. For both large and small construction projects, three dimensions from each profile were considered: autonomy-oriented support from project managers, motivation of safety officers, and engagement of safety officers in safety initiatives.

Three types of autonomy-oriented support were considered: support for autonomy, support for competency, and support for relatedness. The motivation of safety officers was regarded as autonomous motivation (valuing the importance of the tasks), controlled motivation, and amotivation.

The engagement of safety officers was then considered based on the literature, resulting in 19 considered items [3]. These items were reidentified into six major tasks to facilitate our interpretation: planning for safety programs, execution for workers, execution for supervisors, execution for all individuals, safety evaluation, and safety act/regulation. Table 10 demonstrates the items that constitute each major task for further consideration.

Table 10. Details of the elements in each safety-related task for the engagement of safety officers.

Point of View	Safety-Related Tasks	Items	Sources
Plan	1. Planning safety programs	➢ Setting up clear and realistic goals	[6,17]
Do	2. Execution for workers	➢ Acquiring safety equipment and maintenance	[6,17,26]
		➢ Developing safety education and training	[14,27,28]
		➢ Identifying a safety promotion policy	[27,28]
		➢ Encouraging personal motivation	[6,14,17,27]
		➢ Improving personal attitudes	[6,16,17]
		➢ Encouraging the participation of workers	[6,16,17,29]
		➢ Providing safety knowledge	[27]
	3. Execution for supervisors	➢ Supporting supervisors to provide adequate resources	[6,17]
		➢ Motivating supervisors to allocate a proper workforce	[6,17]
		➢ Encouraging the appropriate supervision of supervisors	[6,17]
	4. Execution for all individuals	➢ Arranging safety meetings	[14,17,30]
		➢ Encouraging teamwork among all individuals	[6,17]
		➢ Supporting safety communication	[26,28]
		➢ Building positive group norms	[6]
		➢ Delegating authority in safety initiatives	[6,14,17,28]
		➢ Demonstrating management support	[6,17,28]
See	5. Safety evaluation	➢ Conducting program evaluation	[14,31]
Rule	6. Safety act/regulation	➢ Identifying effective enforcement schemes	[6,17,27,31]

Figure 6 presents the framework for the smaller projects (Profiles 1, 4, and 6).

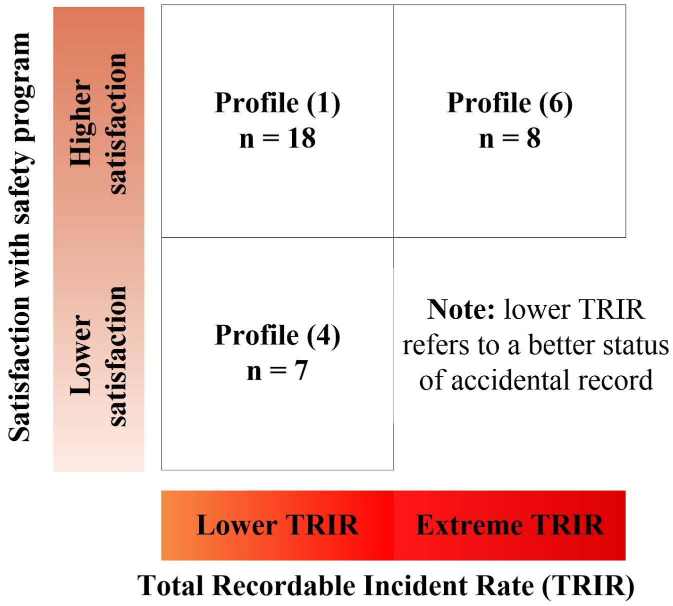

Figure 6. Framework for considering the smaller construction projects (Profiles 1, 4, and 6).

Generally, the two performance indicators should be associated [12,32]. In this research, when the safety satisfaction is high, the TRIR should be low, and vice versa. According to Table 9 and Figure 6, Profile 1 appears to demonstrate the correct scenario since it possesses higher satisfaction (4.259) and a better accident record (TRIR = 5.399). Nevertheless, Profiles 4 and 6 do not comply with this notion; hence, the following questions are raised:

Qsmall-(1): *Why do the projects in Profile 4 have low safety satisfaction but a strong TRIR record?*

Qsmall-(2): *Why do the projects in Profile 6 have a poor accident record but high safety satisfaction?*

To answer these questions, the following aspects of the three small-scale profiles were compared: autonomy-oriented support from project managers, autonomous motivation, and engagement level in the safety-related activities. Table 11 provides a comparison of average support, average motivation, and average engagement across three profiles (Profiles 1, 4, and 6) by employing a one-way ANOVA. The results show that the factors in focus (autonomy-oriented support, autonomous motivation, and engagement level) are greatest in Profile 1, followed by Profile 6, while Profile 4 shows the smallest value among the three small-scale projects.

Regarding autonomy-oriented support, previous studies have identified that a high level of autonomy-oriented support from the leader can lead to strong performance in an organization or a community, and vice versa [33,34]. However, Profiles 4 and 6 do not appear to bear out this explanation in terms of the relationship between autonomy-oriented support and TRIR. Regarding autonomous motivation, it is believed that a high level of this should lead to better outcomes in various domains [23,35]. Nevertheless, this does not exist in Profiles 4 and 6, underlying the trend of autonomous motivation and TRIR. Underlying the engagement level, research in various domains has proven that intensive engagement in any particular program will yield a higher level of project outcomes, such as construction safety [6,29,30]. This circumstance does not seem to exist in Profiles 4 and 6, as the results show that Profile 4 engaged in safety programs at the lowest level but achieved project success in terms of TRIR. Profile 6 devoted immense effort to engagement in the safety initiative but did not appear to be successful in terms of TRIR.

Table 11. Comparison of support, motivation, and engagement in small-scale project.

	Variables	Profile 1 (n = 18)	Profile 4 (n = 7)	Profile 6 (n = 8)	ANOVA (sig.)
Support	Autonomy support	4.037	3.000	3.375	0.021
	Competency support	3.907	2.857	3.500	0.056
	Relatedness support	4.056	3.095	3.667	0.069
Motivation	Autonomous motivation	4.403	3.714	4.141	0.017
	Controlled motivation	3.269	2.548	3.188	0.100
	Amotivation	1.444	1.714	1.750	0.546
Engagement	Safety plan	4.407	3.524	4.042	0.004
	Implementation for workers	4.566	3.701	3.946	0.001
	Implementation for site supervisors	4.611	3.413	4.056	0.001
	Implementation for all individuals	4.587	3.855	4.215	0.003
	Safety evaluation	4.574	3.381	3.875	0.000
	Safety regulation	4.759	4.190	4.792	0.036

The framework for the large-scale projects is demonstrated in Figure 7, covering Profiles 2, 3, and 5.

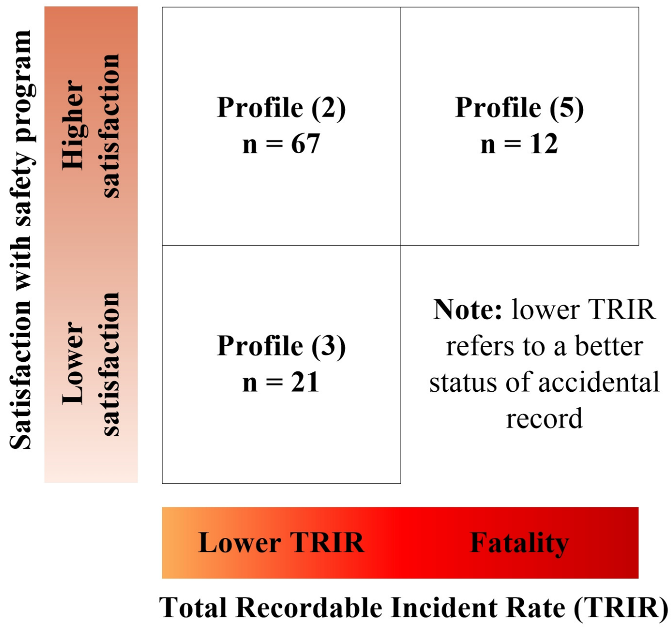

Figure 7. Framework for considering the larger construction projects (Profiles 2, 3, and 5).

The average autonomy-oriented support, average motivation, and average engagement effort of safety officers were compared among three designated profiles (Profiles 2, 3, and 5). Table 12 presents the comparison results.

Table 12. Comparison of support, motivation, and engagement in the large-scale projects.

	Variables	Profile 2 (n = 67)	Profile 3 (n = 21)	Profile 5 (n = 12)	ANOVA (sig.)
Support	Autonomy support	4.264	3.444	3.667	0.000
	Competency support	4.244	3.270	3.583	0.000
	Relatedness support	4.338	3.175	3.583	0.000
Motivation	Autonomous motivation	4.500	4.089	4.573	0.001
	Controlled motivation	3.082	2.992	2.820	0.703
	Amotivation	1.786	1.779	1.361	0.452
Engagement	Safety plan	4.612	4.270	4.500	0.084
	Implementation for workers	4.579	4.163	4.234	0.004
	Implementation for site supervisor	4.491	4.026	3.935	0.003
	Implementation for all individuals	4.622	4.159	4.281	0.003
	Safety evaluation	4.632	3.889	4.000	0.000
	Safety regulation	4.736	4.444	4.278	0.020

Regarding safety satisfaction and TRIR, although Profile 3 appears to possess a strong accident record (TRIR), it did not achieve high satisfaction with safety programs. On the other hand, Profile 5 achieved satisfaction with safety despite a poor accident record in terms of TRIR. Therefore, the questions below were raised.

Qlarge-(1): *Why do the projects in Profile 3 have low safety satisfaction but a strong TRIR record?*

Qlarge-(2): *Why do the projects in Profile 5 have a poor accident record (fatalities) but high safety satisfaction?*

As seen with the small-scale projects, the results in Table 12 indicate that Profiles 3 and 5 demonstrate an unusual status in terms of autonomy-oriented support from project managers. In terms of autonomous motivation, Profile 3 has a strong accident record, but its safety officers have the lowest level of autonomous motivation. Profile 5 experienced fatalities, but the safety officers' autonomous motivation remained high. For the engagement effort, Profile 3 demonstrates the lowest level of engagement among safety officers but has a strong accident record. In contrast, Profile 5 shows a high level of engagement, but its projects did not appear successful in terms of TRIR.

According to the questions raised about both the small- and large-scale projects, the authors further reviewed the literature to find ways to explain the unusual circumstances that affected both groups. The next section presents the conceptual idea behind the explanation for Profiles 4 and 6 in the small-scale project group, and Profiles 3 and 5 in the large-scale project group.

6. Framework for In-Depth Interview

6.1. Conflicts and Unexpected Events in Construction Projects

This section presents two important factors that are most likely associated with the process that shapes satisfaction and TRIR in unusual profiles (Profiles 4 and 6 from small-scale projects, and Profiles 3 and 5 from large-scale projects): (1) conflicts and (2) unexpected events in construction projects. When these aspects are identified, in-depth interview programs are developed and conducted to explore their cause(s) in construction projects. Detailed explanations of each of the two aspects are provided in subsequent subsections.

Construction projects can be classified as complex adaptive systems involving various individuals, such as project managers, project engineers, site supervisors, and safety officers [14]. In addition, in some construction projects, clients may embed themselves by being actively integrated into the team during the course of construction [14], thus increasing diversity and reflecting the dynamic system of construction projects. The different educational backgrounds and ethnicities of these individuals reflect the differences in their attitudes and beliefs. In addition, the hierarchy levels in construction projects demonstrate distinct levels of authority among individuals. Such a complex system tends to suffer from errors, misunderstandings, and conflicts across multiple parties on a regular basis. Nevertheless, such a system is still capable of achieving safety and innovation [15].

Various parties can contribute to the achievement of a safety program, depending on their descriptions of the construction project. As identified from the previous literature, the following five parties significantly influence safety programs: (1) construction clients, (2) general contractors, (3) subcontractors, (4) safety management teams, and (5) construction workers. These parties must collaborate under various sources of pressure, such as budget and schedule constraints. Construction clients can contribute to safety programs by imposing an incentive on the general contractors [5], avoiding imposing extremely strict constraints on the contractors [36,37], considering a performance-based method that values the safety programs rather than the lowest-bid method [38], and encouraging general contractors to include subcontractors in designing safety measures [39].

For general contractors, the main contributions may include selecting subcontractors with an informed ability to work safely [40]; integrating a safety program and productivity management [41–43]; possessing a strong perspective on the value of the safety program [44]; involving subcontractors in designing the safety program [5,39], investing in in-house safety [45,46]; avoiding assigning long working hours for workers [47]; being cautious in applying a harsh penalty for the violation [44]; and identifying possible and significant risks arising from corrective actions [48].

Subcontractors are supposed to assist in safety programs, such as collaborating with contractors in designing the safety program [5,39]; integrating safety programs and productivity management [41–43]; negotiating with contractors on an acceptable area of safety [49], including lessons learned from accidents in the training [5,47]; collaborating with managers to identify significant risks [5,48]; negotiating with site supervisors on the slogan "safety first" [47]; and creating an in-house safety program based on workplace uniqueness [50]. Construction workers can contribute to safety programs by designing safety programs [51]; negotiating with supervisors in circumstances in which excessive tasks are assigned [22]; and ensuring safety without compromising it by prioritizing productivity, for example, by taking shortcuts [38].

Table 10 presents the contributions of each party that strengthen safety programs; neglecting these contributions can be highly deleterious for safety initiatives. Although every party can contribute to successful safety programs, achieving such a feat may not be easy because each party has its own unique focus. In some projects, expending effort to design and implement safety programs is thought to be exhaustive, and it may involve overlooking the safety initiatives of the individuals involved. Meanwhile, some parties, such as project managers, may have to focus on productivity and budgets, while the implementation of safety programs may be the lowest on the priority list of an organization. By the time safety programs are implemented, the different points of view of each party regarding safety programs may have given rise to safety-related conflicts. In such cases, most conflicts underlying safety-related tasks may occur between safety officers and other parties, severely affecting their satisfaction with the safety program in question.

Furthermore, the construction project consists of several phases, from the pre-project planning phase to the demolition phase. However, this study considered the context of the construction phase, which is more likely to be a practically relevant phase in terms of safety initiatives. During the implementation of safety programs, unforeseeable unfavorable circumstances may arise, such as a change in construction technique [52]; harsh weather conditions or a seasonal change [53,54]; a structural collapse resulting from an error in design [55]; or an unfamiliar risk, such as an outbreak [40]. Such unexpected events create the possibility of a poor record of a construction project's accidental rates [56–58].

6.2. Development of the In-Depth Interview Program

Following the previous discussion regarding conflicts and unexpected events in construction projects, these provide the valuable guidelines for developing the interview program to solicit more data from the safety officers. For this purpose, a series of questions was developed to collect qualitative data to gain insights into the emerging themes. For construction conflicts, the individuals who were most likely to face conflicts with safety officers during the safety programs were selected, including site supervisors (site engineers and foremen) and construction workers. The following questions were constructed to gather data about the conflicts and their corresponding resolutions between the safety officers and other identified parties.

1. Could you explain the conflicts that occurred between you as a safety officer and site supervisors (site engineers and foremen) during the safety programs, and the strategies used to resolve them?
2. Could you explain the conflicts that arose between you as a safety officer and the workers, and the strategies used to resolve them?

Subsequently, in terms of unexpected events, the following question was constructed to gather the details regarding unexpected events during safety programs and the strategies that safety officers used to resolve them:

3. Could you explain unexpected or unplanned events that occurred in your project and the strategies employed to resolve them?

Finally, the following questions address additional factors that cover the qualitative data regarding perceived autonomy-oriented support from the project manager and additional comments from each respondent regarding their experiences when working on their project:

4. How would you explain the support that you received from the project manager in your project underlying safety program?
5. Would you like to comment on or share experiences that you encountered during the safety programs in your project?

Thereafter, three respondents from each designated profile were contacted for an in-depth interview consisting of previously developed questions. The details of the interview framework are as follows:

- ✓ Three respondents were selected from each profile (Profiles 1–6), thus involving 18 safety officers who were willing to provide further information about their project data.
- ✓ One face-to-face interview was conducted online with each respondent.
- ✓ Informed consent was obtained from all 18 respondents.
- ✓ The purpose of the interview was clearly explained.
- ✓ Each respondent was interviewed based on the constructed questions.

✓ Each interview lasted for 40 min, of which 5 min was devoted to introducing the interview's purpose, and the rest of the 35 min was allocated to the respondents to explain their project details.

The results from an in-depth interview are presented in Appendix A, with Appendix A.1 (Tables A1–A6) presenting the interview results for small-scale profiles and Appendix A.2 showing the interview results for large-scale profiles. The next section provides a discussion that thoroughly considers the results from both quantitative analysis (Section 5) and in-depth interview programs (Section 6) to provide the audience with the current status of real-world safety practices in the construction industry.

7. Discussion

This section demonstrates two primary parts of the discussion in detail: (1) small-scale projects and (2) large-scale projects. The subsequent subsections provide details and explanations pertaining to them.

7.1. Discussion About Small-Scale Projects

7.1.1. Safety Officers' Engagement Levels in Small-Scale Profiles (Profiles 1, 4, and 6)

According to Table 11, the engagement levels from all categories were combined, and their average was evaluated as one main factor, as presented in Table 13. A one-way ANOVA was used to compare the average engagement levels among the three small-scale profiles (Profiles 1, 4, and 6). To discuss the engagement levels of safety officers in each profile, the following two aspects were considered in the in-depth interviews: (1) conflict resolution and (2) management of unexpected events. For Profile 1, the average engagement level (Table 11) was 4.407 for the safety plan, 4.566 for managing workers, 4.611 for dealing with supervisors, 4.587 for managing all individuals, 4.574 for safety evaluations, and 4.759 for safety regulations. In addition, the overall engagement level of safety officers in Profile 1 was 4.562, indicating a high engagement score. Table 14 presents a summary of the conflicts between safety officers and site supervisors and the strategies used by safety officers to solve the conflict in small-scale projects. A full transcript of the detailed information on conflicts between safety officers and supervisors is provided in Appendix A (Table A1). In this research, site supervisors included site engineers and foremen in the construction project. Some safety officers appeared to have conflicts with site supervisors, for example, for not securing prior permission before bringing outside equipment to the construction site (Project 25) and trust issues in terms of safety officers' abilities (Project 154). Moreover, some conflicts with workers (summary in Table 15 and full transcript in Table A2) occurred during the implementation of safety programs, such as miscommunication (Project 154) and misconceptions about safety issues (Projects 25 and 128). However, this profile seemed to employ appropriate strategies to cope with those conflicts by safety officers, for example, encouraging learning while closely monitoring the site supervisor (Project 154; Table 14), explaining the rationale to site supervisors (Project 25; Table 14), and warning workers associated with jokes (Projects 25 and 128; Table 15). Unexpected events mainly encompassed the presence of untrained workers at the construction site, the COVID-19 pandemic, and harsh weather conditions. A summary of the strategies used to deal with unexpected events for the small-scale profiles is provided in Table 16. Projects 25 and 128 (full details in Table A3) primarily introduced a proactive strategy to manage the presence of untrained workers, such as providing the ID card after the training session. Project 25 attempted to manage the COVID-19 pandemic (full transcript in Table A4) through a reactive plan, providing a quarantine area for construction workers after being infected with COVID-19. Understandably, the reactive strategy was utilized because this issue was relatively new to the industry. In terms of harsh weather conditions, Projects 25 and 154 coped with the weather conditions via proactive strategies, such as checking the weather forecast during the starting phase of the construction project (full transcript in Table A5). To resolve the conflicts and unexpected events, safety officers in this profile used proper strategies and predominantly relied on a proactive plan, demonstrating their effective skills in executing safety programs (Tables 14–16).

Table 13. Comparison of overall engagement levels of safety officers in small-scale projects.

	Profile 1 (n = 18)	Profile 4 (n = 7)	Profile 6 (n = 8)	ANOVA (sig.)
Engagement score	4.562	3.709	4.106	0.001

Table 14. Conflicts and resolutions between safety officers and supervisors of small-scale projects.

No.	Cause of Conflict	Resolution by Safety Officers
Profile 1 #25	Permission to work	Explain the rationale and negotiate with the owner
	Exposure to hazards	Facilitate by overseeing and monitoring the situation
Profile 1 #128	No conflict	NA
Profile 1 #154	Reliance on safety officer's expertise	Encourage learning while closely monitoring
Profile 4 #41	Engineering supervision	Discuss and attempt to understand
	Permission to work	Facilitate by negotiating with the project owner
Profile 4 #124	Reliance on safety officer's expertise	Discuss and gently remind, and understand the nature
	Compromise of safety with productivity	Discuss and gently remind, and understand the nature
Profile 4 #222	Reliance on safety officer's expertise	Discuss with reason supported by owner statement
Profile 6 #38	Engineering supervision	Fight with supervisors, and refute a supervisor's argument by referring to the law
	Gender discrimination	Fight with supervisors, and refute a supervisor's argument by referring to the law
Profile 6 #96	No conflicts	NA
Profile 6 #98	No conflicts	NA

Table 15. Conflicts and resolutions between safety officers and workers for small-scale projects.

No.	Cause of Conflict with Workers	Resolution by Safety Officers
Profile 1 #25	Safety issues-related understanding	Discuss by providing reasons
Profile 1 #128	Safety issues-related understanding	Warn by using humor
Profile 1 #154	Miscommunication	Discuss by providing reasons
Profile 4 #41	PPE issue	Warn by using humor
Profile 4 #124	PPE issue	Warn and attempt to understand
Profile 4 #222	PPE issue	Warn, inform supervisors, be flexible, and create strong relationships with workers
Profile 6 #38	No issue	NA
Profile 6 #96	PPE issue	Let the site engineer/foreman deal with the conflict resolution
Profile 6 #98	Improper working style	Discuss by providing reason, try to be flexible, and retrain workers

Table 16. Summary of resolutions used to resolve unexpected events during small-scale projects.

Respondent	Presence of Untrained Workers	COVID-19	Weather Conditions
Profile 1 #25	Proactive strategy	Reactive strategy	Proactive strategy
Profile 1 #128	Proactive strategy	NA	NA
Profile 1 #154	Reactive strategy	NA	Proactive strategy
Profile 4 #41	Proactive strategy	Reactive strategy	NA
Profile 4 #124	Proactive strategy	NA	Proactive strategy
Profile 4 #222	Proactive strategy	Reactive strategy	Proactive strategy
Profile 6 #38	Reactive strategy	NA	Reactive strategy
Profile 6 #96	Reactive strategy	NA	NA
Profile 6 #98	Reactive strategy	Reactive strategy	Reactive strategy

The average engagement level of safety officers in Profile 4 (Table 11) was 3.524 for implementing a safety plan, 3.701 for managing workers, 3.413 for dealing with supervisors, 3.855 for managing all individuals, 3.381 for safety evaluations, and 4.190 for safety regulations. In addition, the overall engagement of safety officers in Profile 4 (Table 13) was 3.709, demonstrating the lowest level of engagement among all profiles. The safety officers in Profile 4 occasionally appeared to experience some conflicts with supervisors (Table 14); for instance, this arose in the context of engineering supervision in Project 41, compensating safety for productivity in Project 124, and the trust issue related to the ability of safety officers in Project 222. The safety officers in Profile 4 also happened to have some issues with construction workers (Table 15), such as the personal protective equipment (PPE) issue in Projects 41, 124, and 222. However, most conflicts between site supervisors and workers were effectively managed through the strategy of compromising. Respondent 41, for example, occasionally found that the site engineers did not supervise the construction site during an urgent period. Later, the safety officer attempted to discuss and compromise with the site engineers, indicating that the conflict was fully resolved by the safety officers. Respondent 41 (Table 15) stated that he/she rarely observed an occurrence of workers not wearing PPE at the site; the warning was given with a dash of humor to make workers feel comfortable. Thus, proper strategies were used to cope with the conflicts.

For unexpected events, Respondents 41, 124, and 222 (Table 16, and full transcript in Table A3) stated that their project dealt with the presence of untrained workers, such as by issuing ID cards for workers who have been correctly trained. Regarding the COVID-19 pandemic, a new scenario, Projects 41 and 222 (Table 16, and full transcript in Table A4) managed it through the reactive strategy, such as by suspending the construction activity in Project 41 and providing the quarantine area in Project 222. For the weather conditions, Projects 124 and 222 (Table 16, and full transcript in Table A5) stated that they monitored the weather conditions in order to be aware of the rainy season, demonstrating that they employed a proactive plan. Most unexpected events in Profile 4 were effectively managed through a proactive strategy. Therefore, the safety officers in Profile 4 appeared to rely primarily on proactive strategies to cope with unexpected situations. Tables 14–16 suggest that the safety officers in Profile 4 solved and managed safety-related issues and unexpected events properly.

In contrast, the engagement levels of the safety officers in Profile 6 are as follows: safety plan = 4.042, managing workers = 3.946, dealing with supervisors = 4.056, managing all individuals = 4.215, safety evaluation = 3.875, and safety regulation = 4.792. These values represent a higher level of engagement when compared to that of Profile 4. However, conflicts with supervisors and construction workers were not always resolved appropriately. For example, Project 38 (Table 14) appeared to generate conflicts with site supervisors in terms of engineering supervision and gender discrimination; however, the safety officers chose to escalate the conflicts by arguing with their supervisors.

Project 96 (Table 15) permitted site supervisors to deal with workers whenever they had conflicts with them. Regarding the unexpected events, the safety officers in Profile 6 (Table 16, and full details in Table A3) tended to employ the reactive strategy to deal with the issue of untrained workers, as provided by Respondents 38, 96, and 98. In terms of the COVID-19 pandemic (Table 16, and full transcript in Table A4), given that this issue was relatively new to the construction industry, the reactive plan was employed. For the issues with weather conditions, Profile 6 (Projects 38 and 98) relied on the reactive strategy to cope with the harsh weather conditions (Table 16, and in-depth information in Table A5). Thus, the safety officers in Profile 6 did not necessarily solve the problems or unforeseeable issues effectively (Tables 14–16).

7.1.2. Autonomy-Oriented Support and Autonomous Motivation (Profiles 1, 4, and 6)

For the small-scale project, the qualitative data in Appendix A (Table A6) regarding autonomy-oriented support from project managers provide explanations from the respondents, encompassing autonomy support, competency support, and relatedness support. After the interview transcripts from each respondent were considered, a comparative analysis was conducted by employing content analysis. The keywords for analyzing three types of support were identified as follows: the keywords for autonomy support included listening to the suggestions; the keywords for competency support included providing positive feedback/compliments/reasonable rewards; and the keywords for relatedness support included embracing the importance of a safety program. Respondents' verbal data involving the mentioned keywords indicated that the respondents received support from project managers, and vice versa. Table 17 provides the comparative results of the qualitative data.

Table 17. Comparative analysis of support from the project manager for small-scale projects.

Respondent	Autonomy	Competency	Relatedness	Counting	Percentage of Support
Profile 1 #25	Yes	Yes	Yes	3/3	100%
Profile 1 #128	Yes	Yes	Yes	3/3	
Profile 1 #154	Yes	Yes	Yes	3/3	
Profile 4 #41	Yes	Yes	Yes	3/3	100%
Profile 4 #124	Yes	Yes	Yes	3/3	
Profile 4 #222	Yes	Yes	Yes	3/3	
Profile 6 #38	Yes	Yes	Yes	3/3	66.667% (partial support)
Profile 6 #96	Yes	No	No	1/3	
Profile 6 #98	Yes	Yes	No	2/3	

Note: "Yes" indicates that the respondents perceived adequate support from project managers, while "No" means that the respondents perceived the little support from project managers.

The average values for perceived support in Profile 4 were 3.000 for autonomy support, 2.857 for competency support, and 3.095 for relatedness support, displaying the lowest level of support among the three profiles. However, the content analysis from an in-depth interview in Table 17 shows that the respondents in this profile appeared to receive sufficient support. Respondent 124, for example, explained that they received strong support from the project managers, which included listening to opinions, providing positive feedback, and considering safety programs as an important aspect. The following question arises: "Why did the safety officers in this profile perceive the level of autonomy-oriented support to be much lower than the other profiles?" This reflects that the safety officers in Profile 4 may have had high expectations for the safety programs. This can be supported by the statement from the safety officers in this profile that they attempted to fix every single aspect at the construction site, even if it was a minor issue, such as a small discussion with project managers about balancing safety and productivity, which was also mentioned by Respondent 222. Respondent 222 appeared to wish to remove those minimal issues to create a flawless workplace. In this profile, the mean value of the autonomous motivation of safety officers was 3.714, as demonstrated in Table 11, exhibiting the lowest motivational level among the three profiles. According to one study [34], the autonomy-oriented support from the leader largely affects the autonomous motivation of the followers. With this concept, the autonomous motivation of safety officers in this profile was most likely affected by perceived autonomy-oriented support; thus, their level of autonomous motivation was rated lower than the other profiles. Consequently, the lowest levels of autonomous motivation and autonomous-oriented support may also reflect high expectations of the safety program (and support from project managers). Although Profile 4 displays the lowest level of autonomous motivation, their evaluation indicated that at least the safety officers in this profile still possessed a high level of autonomous motivation (3.714).

Focusing on Profile 6, the autonomy-oriented supports in Profile 6 were 3.375 for autonomous support, 3.500 for competency support, and 3.667 for relatedness support, corresponding to a higher level of support when compared to Profile 4. However, the accidental record (TRIR) of this profile was 51.446 cases per 200,000 working hours, which was higher than the TRIR of Profile 4. Based on Table 17, some respondents in Profile 6 stated that their project did not receive substantial attention from project managers. Respondent 96, for example, explained that since it was a small-scale project, it did not focus extensively on safety programs. Compared to Profile 4, the safety officers in Profile 6 may have perceived the flexibility of safety programs to be higher than the other profiles. In other words, they might not have had as high expectations of safety programs as the safety officers in Profile 4, resulting in a high level of perceived support from project managers. To this point, the safety officers in Profile 6 might have perceived that the safety program can be flexible; thus, this profile displayed a higher level of perceived support from project managers. Profile 6 had an average autonomous motivation of 4.141, demonstrating a higher level of motivation than Profile 4. Nevertheless, the safety performance in terms of TRIR was not well achieved (51.445 cases per 200,000 working hours, Table 9). This may be the consequence of perceived autonomy-oriented support. Respondent 96, for example, stated that the manager placed some emphasis on safety programs but not full support, since it was a small-scale project. The safety officers may have perceived that the safety programs can be flexible, and they may not have had high expectations for the safety programs, resulting in a higher level of autonomous motivation compared to Profile 4. In other words, the safety officers in this profile might have perceived such conflicts as normal in the construction industry; therefore, they could be flexible and compromise.

For Profile 1, the autonomy-oriented support levels were 4.037 for autonomous support, 3.907 for competency support, and 4.056 for relatedness support. The support in this profile was significantly higher than the support in Profile 4 (Table 11). In addition, Table 17 shows that this profile received elevated levels of support from project managers. In this case, it did not mean that the safety officers in this profile possessed an expectation of safety programs that was not as high as that of safety officers in Profile 4, since the TRIR in this profile was 5.679 cases per 200,000 working hours, confirming that the safety programs were well implemented among all small-scale profiles. Instead, this rating tended to represent a fair expectation of safety programs. For Profile 1, the average autonomous motivation of safety officers was 4.403, which was significantly higher than the autonomous motivation of Profile 4. As an explanation emphasizing the impact of perceived support on autonomous motivation, this profile appeared to receive strong cooperation from the project managers, both in terms of quantitative and qualitative scales—leading to the highest level of perceived support. Consequently, their autonomous motivation was largely maintained through this circumstance, resulting in the highest level of autonomous motivation and reflecting realistic expectations of safety programs from safety officers.

7.1.3. Summary of Specific Characteristics in Small-Scale Projects (Profiles 1, 4, and 6)

Table 18 summarizes the previously discussed specific characteristics of safety officers in each profile. Regarding Qsmall-(1), the underlying reason why the projects in Profile 4 had a low satisfaction level while having a good TRIR was that the safety officers in this profile harbored high expectations regarding the implementation of safety programs with their sufficient problem-solving skills in terms of managing safety-related issues and unexpected events, thus resulting in the lowest satisfaction and a high TRIR. For Qsmall-(2), the reason why the projects in Profile 6 had a poor accidental record while having a high satisfaction level for safety programs was that safety officers in this profile tended to have low expectations regarding the flexibility of safety programs, along with their improper problem-solving skills in managing safety-related issues and unexpected events—resulting in a high satisfaction level and poor record of TRIR. For Profile 1, the safety officers in this profile demonstrated a fair rating for the associated aspects, which represented realistic expectations toward safety programs with their problem-solving skills in coping with safety-related issues and unexpected events.

Table 18. Summary of the characteristics of safety officers in each of the small-scale profiles.

		Profile 1 (n = 18)	Profile 4 (n = 7)	Profile 6 (n = 8)	ANOVA (sig.)
Engagement score		4.562	3.709	4.106	0.001
Strategy to solve conflict		Effective	Effective	Ineffective	–
Management of unexpected events		Appropriate (Proactive)	Appropriate (Proactive)	Inappropriate (Reactive)	–
Support	**Autonomy**	4.037	3.000	3.375	0.021
	Competency	3.907	2.857	3.500	0.056
	Relatedness	4.056	3.095	3.667	0.069
% of support by interview		100%	100%	66.7% (partial)	–
Rating		Fair	Underrating	Overrating	–
Characteristics		Realistic	High expectation	Perceived flexibility	–

As demonstrated in Figure 8, the safety officers in each profile were given their associated characteristics based on the previous discussion. To this point, the safety officers in Profile 4 arguably exhibited the characteristics of a perfectionist who regularly attempts to engage in a perfect experiment and tries to address all safety-related issues by implementing safety programs. In addition, the safety officers in Profile 4 tended to possess sufficient skills to manage the safety programs (conflict resolution and management of unexpected events). Notably, the average TRIR of representatives from Profile 4 (Projects 41, 124, and 222 is 3.086) was 3.086, while the average TRIR of representatives from Profile 1 (Projects

25, 128, and 154) was 7.208. However, an independent t-test indicated that there was no statistical difference in the average TRIR between representatives from these two profiles (sig. = 0.094), implying that the representatives from Profile 4 tended to engage in a perfect experiment and effectively manage safety programs at the construction sites, since their average TRIR (3.086) was substantially lower than that of the representatives from Profile 1 (7.208).

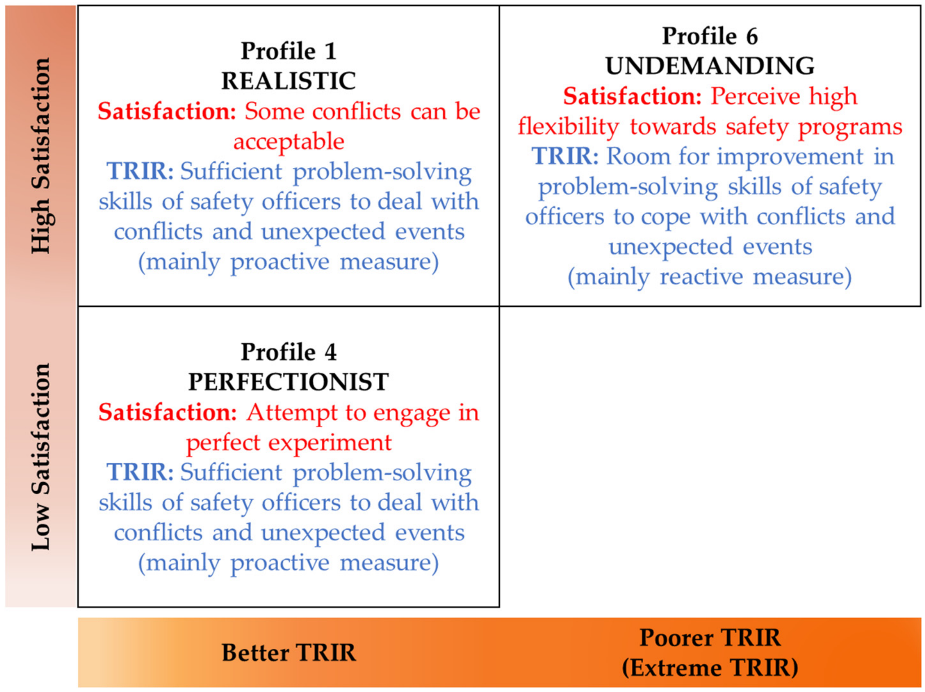

Figure 8. Characteristics of safety officers working on small-scale projects (Profiles 1, 4, and 6).

In contrast, the safety officers in Profile 6 were determined, displaying the nondemanding characteristic, perceiving the flexibility of the safety program, and normalizing safety-related conflicts. However, they seemed to require improvements in their problem-solving skills to manage safety programs. Conversely, the safety officers in Profile 1 tended to represent realistic characteristics of being receptive to some conflicts and understanding that conflicts may arise in real-world practice. In addition, safety officers in this profile demonstrated sufficient problem-solving skills to manage the safety programs at the construction sites.

7.2. Discussion for Large-Scale Projects

7.2.1. Engagement of Safety Officers in Large-Scale Profiles (Profiles 2, 3, and 5)

The discussion on the process shaping satisfaction and TRIR in small-scale projects reveals that a similar scenario is likelier to occur in large-scale projects than in small-scale ones. However, the safety officers in Profile 5 mentioned one aspect that can be associated with this profile: the particular situation after the occurrence of a fatal case. The respondents in this profile were interviewed in depth, and they provided detailed information regarding the level of involvement of project managers and project owners after the harsh incident occurred; the detailed information is presented in Table 19.

Table 19. Situation of safety programs after the occurrence of fatal incidents for large-scale projects.

No.	Did Fatalities Occur?	Reaction from Project Managers	Reaction from Project Owners
Profile 2 #48	No	NA	NA
Profile 2 #79	No	NA	NA
Profile 2 #97	No	NA	NA
Profile 3 #24	No	NA	NA
Profile 3 #54	No	NA	NA
Profile 3 #199	No	NA	NA
Profile 5 #17	Yes	**Stricter rules:** "After the incident, stricter measures were designed in the project. If we were to move the crane, we would have to have a mechanical engineer on site until the work was completed. The project manager ordered that the project engineer, who is involved in the mechanical side, must be stationed to supervise work, such as the installation of the Tower Crane."	**Frequent inspection:** "The owner also came to supervise the work. He came to check how work was all the time. Regarding the training for the card, it was more intensive. He came to check before going up to work every time until the work was finished or until the project was finished."
Profile 5 #26	Yes	**Frequent inspection and reform safety training course:** "Action from the project manager action is better; there are more frequent site inspections, and there is also training, better site walking, and more attention. And then the correctness of safety equipment and training, it's like it's more intensive."	**Intensive involvement in safety requests from the contractor side:** "The project owners became more involved after the death rate on construction sites increased. Requests from contractors are well received."
Profile 5 #32	Yes	**Appointing authority to support safety officers:** "Both the owner and my project manager play a role in appointing the authorities to support the safety work I was doing."	**Support statement of safety officers:** "I demanded that both the owner and my project manager appoint the authorities to support the safety work that I was doing. I was able to use the owner's or project manager's requirements as a reason for the workers and foreman to follow the safety requirements." **Finding the root cause of accidents and soliciting opinions about safety:** "The project owner also became more involved and dedicated more attention to the details of the safety aspects, as shown by his attempt to investigate and have more conversations about safety."

Similar to small-scale projects, the engagement level of safety officers in large-scale projects was represented as their overall level of effort (Table 20). A comparison of engagement was performed between three large-scale profiles by conducting one-way ANOVA.

Table 20. Comparison of overall engagement level of safety officers in large-scale projects.

	Profile 2 (n = 67)	Profile 3 (n = 21)	Profile 5 (n = 12)	ANOVA (sig.)
Engagement score	4.585	4.132	4.221	0.002

As performed for the discussion on small-scale projects, two aspects were incorporated into the discussion on the level of engagement: (1) conflict resolution and (2) the management of unexpected events. Profile 2 demonstrates a similar characteristic to Profile 1 of the small-scale project. The engagement levels of safety officers (Table 12) were measured as follows: 4.612 in planning safety programs, 4.579 in facilitating workers, 4.491 in facilitating site supervisors, 4.622 in facilitating all individuals, 4.632 in evaluating safety programs, and 4.736 in regulating safety programs. Additionally, the overall engagement level (Table 20) was 4.585, representing the highest effort in managing safety programs among all three large-scale profiles. Table 21 presents an overview of the conflicts between safety officers and site supervisors alongside the strategies employed by safety officers to resolve them in large-scale projects. In-depth-interview details can be found in Appendix A (Table A7). Table 22 summarizes the conflicts between safety officers and construction workers and conflict resolution in large-scale projects (for the full transcript, see Table A8). Some conflicts occurred in this profile, such as personal protective equipment (PPE) issues with both supervisors and workers in Projects 48 (Table 21) and 97 (Table 22), engineering supervision issues with supervisors in Project 79 (Table 21), budget issues in Project 97 (Table 21), and misconceptions on safety matters with workers in Project 79 (Table 22). However, these conflicts were appropriately treated and solved by the safety officers. Respondent 97, for example, attempted to assist site supervisors in searching for affordable safety equipment that fits the budget for their project (Table 21). In one case, Respondent 79 (Table 21) attempted to have a proper discussion with supervisors and gently warned them about the issue of improper engineering supervision. Thus, a majority of strategies used to solve the conflicts are appropriate in this project.

Table 21. Conflict between safety officers and supervisors and resolution for large-scale projects.

Respondent	Conflict with Supervisors	Solution of Safety Officers
Profile 2 #48	PPE issue	Request a supervisor to bring PPE while another member helps mediate the situation
Profile 2 #79	Engineering supervision	Request a supervisor to stop; warnings in minor cases
Profile 2 #97	Safety budget (expensive equipment)	Support some parts while helping in the search for effective equipment
Profile 3 #24	Improper working styles	Discuss and negotiate with a supervisor
Profile 3 #54	No conflict	NA
Profile 3 #199	Improper working style	Discuss a supervisor
Profile 5 #17	Working conditions (extra installation)	Recommend choices to a supervisor but no cooperation
Profile 5 #26	Compromising safety for productivity	Take picture and wait for the meeting
	Improper working style	Report to PM and request to terminate the contract
Profile 5 #32	Trust in the ability of safety officers	Negotiate with a supervisor
	Compromising safety for productivity	Terminate the contract

Table 22. Conflict between safety officers and workers, as well as resolutions for large-scale projects.

Respondent	Conflict with Workers	Solution by Safety Officers
Profile 2 #48	No issue	No action
Profile 2 #79	Issue regarding understanding of safety	Warn workers and reject if necessary
Profile 2 #97	PPE issue	Discuss rationally
Profile 3 #24	PPE issue	Discuss rationally
Profile 3 #54	PPE issue	Understand the nature of the issue and support workers
Profile 3 #199	PPE issue	Claiming the agreement and providing sufficient training
Profile 5 #17	PPE issue	Warning
Profile 5 #26	Misconception on safety	Providing high-quality care
Profile 5 #32	Communication with foreign workers	Fighting back
	Addiction to drugs	No action

Three unexpected events were primarily considered: the presence of untrained workers, the COVID-19 pandemic, and weather conditions. Projects 48 and 79 issued employee ID cards to prevent the presence of untrained workers, indicating that a proactive strategy was employed in these projects. Project 79 implemented its safety programs during the COVID-19 pandemic, resulting in a reactive action being employed. Proactive strategies were also employed to deal with adverse weather conditions: for example, planning in advance to perform construction activities such that they are unaffected by rain or storms. Although some projects employed reactive strategies to cope with unexpected events, the safety officers in Profile 2 primarily designed a proactive plan to cope with such occurrences. Detailed strategies to deal with conflicts and unforeseeable events (Tables 21–23) indicate that safety officers in Profile 2 effectively managed the safety programs and mainly relied on a proactive strategy to prevent unexpected events from occurring.

Table 23. Summary of resolution used to solve unexpected events in large-scale projects.

Respondent	Presence of Untrained Workers	COVID-19	Weather Condition
Profile 2 #48	Proactive strategy	NA	Reactive strategy
Profile 2 #79	Proactive strategy	Reactive strategy	Proactive strategy
Profile 2 #97	Reactive strategy	NA	Reactive strategy
Profile 3 #24	Proactive strategy	Proactive strategy	Proactive strategy
Profile 3 #54	Reactive strategy	Reactive strategy	Reactive strategy
Profile 3 #199	Proactive strategy	Proactive strategy	Proactive strategy
Profile 5 #17	Proactive strategy	Reactive strategy	Reactive strategy
Profile 5 #26	Proactive strategy	NA	Reactive strategy
Profile 5 #32	Reactive strategy	Proactive strategy	Reactive strategy

The scenario in Profile 3 is similar to Profile 4 for small-scale projects. The engagement levels identified in Profile 3 were 4.270 for safety plan, 4.163 for execution for workers, 4.026 for execution for supervisors, 4.159 for execution for all individuals, 3.889 for safety evaluation, and 4.444 for safety regulation. Additionally, overall engagement for this profile was 4.132 (Table 20), representing the lowest level of engagement among all large-scale profiles. Some conflicts with supervisors (Table 21) occurred, such as those involving an improper working style, as mentioned by Respondents 24 and 199. Minor conflicts with workers occurred (Table 22), such as the PPE issues mentioned in Projects 24, 54, and 199. However, these conflicts were always properly addressed by the safety officers. The safety officers in this profile always determined whether there was room for improvement in future implementation, and, therefore, their opinion of engagement was that future safety programs must be able to resolve conflicts, such as PPE issues, among individuals. The safety officers in this profile appeared to employ proper strategies to solve unexpected events (Table 23). Respondents 24 and 199, for example, attempted to cope with the issue of untrained workers by issuing an ID card to every employee who had been trained through the specific programs (in-depth interview in Table A9). Respondents 24 and 199 introduced a proactive strategy to manage the COVID-19 pandemic, although this was relatively new to the construction industry. They attempted to support construction workers during the pandemic by stringently following provincial measures, providing workers with necessary kits, and providing weekly workplace cleaning (full details in Table A10). Respondents 24 and 199 furthermore mentioned that their project designed a specific plan for coping with harsh weather conditions by, for example, checking weather forecasts in advance (full details are available in Table A11). Although some projects employed reactive measures to deal with unforeseeable scenarios, most projects in this profile still relied on proactive strategies; thus, they tended to expend substantial effort implementing safety programs. Notably, the safety officers in Profile 3 demonstrated effective problem-solving skills in regard to coping with both conflicts and unexpected events.

Profile 5 involves two stages of engagement: (1) the early stage of engagement, and (2) the later stage of engagement after a fatal case has occurred. As presented in Table 19, a particular context underlies the proper reaction from project managers and clients. This implies that the safety programs underwent a dynamic change, from receiving little attention to being the subject of close attention. In the early stage, safety officers may not properly engage in safety programs, resulting is issues with supervisors on working conditions, as mentioned by Respondent 17 (Table 21); issues with supervisors on compromising safety with productivity in Project 26 (Table 21); and communication issues with foreign workers in Project 32 (Table 22). The conflicts mentioned were not properly managed by a proper strategy at the early stage. The issue of productivity versus safety with supervisors in Project 26, for example, was solved only by taking pictures to report at meetings. In reality, safety officers should take immediate action, such as by having discussions with supervisors, so that issues can be fixed in a timely manner. Similarly, Respondent 32 opted to solve communication issues with workers by escalating an argument rather than gently warning workers. Conflicts may be solved optimally after the individuals in this profile encounter fatal cases (Table 19). As seen in Table 19, project managers and owners devoted greater attention to safety programs after a fatal case occurred, implying that the conflicts can be properly solved by safety officers after the conflicts receive close attention from influential parties, leading the safety officers to possess a high level of overall engagement (4.221). Therefore, the safety officers in this profile tended to develop their problem-solving skills to cope with conflicts and unexpected events after the occurrence of fatality cases.

Although conflicts occurred in Profile 2 (Tables 21 and 22), the safety officers in the profile managed to solve them properly. When compared to managers in Profile 3, Profile 2's managers may understand that minor conflicts are acceptable while still maintaining their high expectations of safety programs. Safety officers in Profile 2 were capable of coping with conflicts as they occurred. However, safety officers in Profile 3 demonstrated an attempt to engage in a perfect experiment in which every aspect of the project must be optimally implemented.

7.2.2. Autonomy-Oriented Support and Autonomous Motivation (Profiles 2, 3, and 5)

Table 24 presents the results of the content analysis underlying the qualitative data on the perceived autonomy-oriented support from project managers in large-scale projects—this encompasses autonomy support, competency support, and relatedness support.

Table 24. Comparative analysis of the support from project managers for large-scale projects.

Respondent	Relatedness	Autonomy	Competency	Total Count	Percentage of Support
Profile 2 #48	Yes	Yes	Yes	3/3	100%
Profile 2 #79	Yes	Yes	Yes	3/3	
Profile 2 #97	Yes	Yes	Yes	3/3	
Profile 3 #24	Yes	Yes	Yes	3/3	100%
Profile 3 #54	Yes	Yes	Yes	3/3	
Profile 3 #199	Yes	Yes	Yes	3/3	
Profile 5 #17	Yes	Yes	Yes	3/3	88.889% (partial support)
Profile 5 #26	Yes	Yes	No	2/3	
Profile 5 #32	Yes	Yes	Yes	3/3	

Note: "Yes" indicates that the respondents perceived adequate support from their project managers, while "No" means that the respondents perceived little support from their project managers.

The next aspect is the autonomy-oriented support from project managers, as perceived by safety officers during the implementation of safety programs. The average levels of support underlying Profile 3 (Table 12) were 3.444 for autonomy support, 3.270 for competency support, and 3.175 for relatedness support. This profile indicated the lowest level of support among all large-scale profiles, as determined by the quantitative analysis; despite this, however, Profile 3 demonstrated a better accident record in comparison to Profile 5. Qualitative data provided by the respondents in Profile 3 (Respondents 24, 54, and 199) via in-depth interviews suggest that safety officers receive autonomy-oriented support (i.e., autonomy, competency, and relatedness) from project managers at a sufficient level (a detailed transcript is available in Table A12). Safety officers in this profile may expect to receive high levels of support from their project managers. Overall, one of the main reasons why projects in Profile 3 perceived the lowest support among the three profiles is that safety officers in this profile may possess high expectations for the safety programs. In other words, safety officers in this profile regularly found room for improvement. The average autonomous motivation of safety officers in Profile 3 was 4.089 (Table 12), the lowest level of motivation. This situation can potentially be viewed as the result of the high expectations safety officers exhibit for these safety programs. Since the safety officers in Profile 3 perceived that there would always be room for improvement regarding underlying support, this perception potentially affected the safety officer's autonomous motivation. Although Profile 3 displays the lowest level of autonomous motivation among the profiles, safety officers in this profile still possess a high level of autonomous motivation (4.089). Safety officers in this profile tended to urge the safety officers to continue improving the safety programs to fulfill their high standards. Thus, close attention from project managers may be required to resolve certain minor issues.

The autonomy-oriented support levels for Profile 5 were 3.667 for autonomy support, 3.583 for competency support, and 3.583 for relatedness support. This profile displayed a higher level of support (as evidenced by the quantitative data) compared to Profile 3, although Profile 5 appears to have a harsher accidental record. The content analysis (Table 24) of the in-depth interviews and qualitative data indicate that the respondents in this profile presented a slightly lower level of support than in Profile 3. Respondent 26 mentioned that project managers were primarily focused on time and quality management (detailed transcript in Table A12). Nevertheless, the respondents in this profile mentioned another aspect underlying the reaction of project managers after the occurrence of fatal cases, as demonstrated in Table 19. Project 25's managers (Table 19), for example, had an extreme reaction to fatal cases: they more frequently inspected construction sites and reformed the training courses for the project, indicating a more intensive involvement in safety programs after fatal cases. In other words, this contributed to a higher level of autonomy-oriented support compared to conditions before the fatality. As a result, the safety officers in this profile perceived a high level of autonomy-oriented support from project managers after the fatality. The project managers in Profile 5 were likelier to learn from fatal experiences compared to those in other profiles. Therefore, while the projects managers in this profile did not perform well in terms of autonomy-oriented support in an early stage, they tended to learn from valuable experiences (i.e., fatal incidents), leading the project to achieve a high level of autonomy-oriented support. The average autonomous motivation in Profile 5 was 4.573 (Table 12). This seems to be the result of a particular characteristic of safety officers: They perceive the flexibility of safety programs at an early stage but perceive high support from project managers after the occurrence of fatalities, thus shifting the safety officers' autonomous motivation from a low level to a high level. Therefore, the autonomous motivation of safety officers in this profile is believed to cover two stages: (1) perceived flexibility, resulting in low autonomous motivation at an early stage; and (2) high-level autonomous motivation after the occurrence of fatal incidents.

In line with the data on autonomy-oriented support in Profile 2 (Table 12), the average level of support in this profile was 4.264 for autonomy support, 4.244 for competency support, and 4.338 for relatedness support. The content analysis (Table 24) indicates that the safety officers in this profile received a high level of support; their opinions were listened to, and they were provided with positive feedback and compliments. Moreover, safety programs were treated as an important aspect of work. This indicates that their expectations were met, resulting in a high level of support and a high level of autonomous motivation.

7.2.3. Summary of Specific Characteristics in Large-Scale Projects (Profiles 2, 3, and 5)

Profile 2 appears to present a reasonable level of satisfaction in relation to TRIR. This characteristic is manifested in almost all of its facets, such as the conflicts with workers and strategies for dealing with unexpected events. It emphasizes the fact that the safety officers in Profile 2 accept that some conflicts or unexpected events can occur and that they can be resolved as long as they possess sufficient skills to cope with these scenarios, resulting in a high level of safety satisfaction.

The average satisfaction level in Profile 3 was 3.016, which is lower than the average safety satisfaction in Profile 5 (Table 9). As previously discussed, Profile 3 established intensive criteria in its safety programs, resulting in a lower level of satisfaction. In this case, safety officers wish to eliminate all conflicts, including small ones, that prevent them from managing safety programs, such as conflicts with supervisors (e.g., improper working styles in Projects 24 and 199) and conflicts with workers (e.g., PPE issues in Projects 24, 54, and 199). In addition, the presence of unexpected events may restrict them from effectively managing construction sites, such as untrained workers (Projects 24, 54, and 199), the COVID-19 pandemic (Projects 24, 54, and 199), and harsh weather conditions (Projects 24, 54, and 199). Therefore, should these conflicts and unexpected events be eliminated, satisfaction toward safety programs can be improved in Profile 3.

The average safety satisfaction level for Profile 5 was 3.583 (Table 9), indicating greater satisfaction compared to Profile 3. Table 19 shows that the dynamic change underlying attention from significant parties contributes to this scenario. As previously discussed, the safety officers in Profile 5 have learned from valuable experiences (i.e., fatal incidents). In the early stage, the safety program was not adequately implemented; however, the program rapidly improved after the occurrence of fatal incidents; thus, conflicts, such as conflicts with supervisors (e.g., working conditions in Project 17 or balancing safety with productivity experienced in Projects 26 and 32) and conflicts with workers (e.g., misconception on safety in Project 26 and communication with foreign workers in Project 32), might lead to improvements in working conditions. In addition, strategies for coping with unexpected events (i.e., the presence of untrained workers, the COVID-19 pandemic, and weather conditions) would be effectively improved after fatal cases occur. This confirms that safety programs are developed after fatal incidents, from poor-quality to high-quality safety programs, yielding high safety satisfaction with the wound in terms of fatal records in the project.

Table 25 details the summary of safety officer characteristics in each large-scale profile. Focusing on Qlarge-(1), the reason why Profile 3 possesses the lowest safety satisfaction but a high accidental record is that, in Profile 3, the characteristics of safety programs must be optimally implemented, and all safety-related issues should be removed, resulting in a lower level of safety satisfaction. For Qlarge-(2), the reason the safety officers in Profile 5 possessed a poor accidental record is that Profile 5 did not devote much attention in the early stage but instead developed the quality of safety programs through their poor experiences (fatality), resulting in a poor accident record but high satisfaction.

Table 25. Summary of the characteristics of safety officers in each of the large-scale profiles.

<table>
<tr><th colspan="2"></th><th>Profile 2
(n = 67)</th><th>Profile 3
(n = 21)</th><th>Profile 5
(n = 12)</th><th>ANOVA
(sig.)</th></tr>
<tr><td colspan="2">Engagement score</td><td>4.585</td><td>4.132</td><td>4.221</td><td>0.002</td></tr>
<tr><td colspan="2">Strategy to solve conflicts</td><td>Effective</td><td>Effective</td><td rowspan="2">Develop problem-solving skills through fatality cases</td><td>--</td></tr>
<tr><td colspan="2">Management of unexpected events</td><td>Appropriate (mainly proactive)</td><td>Appropriate (mainly proactive)</td><td>--</td></tr>
<tr><td rowspan="3">Support</td><td>Autonomy</td><td>4.264</td><td>3.444</td><td>3.667</td><td>0.000</td></tr>
<tr><td>Competency</td><td>4.244</td><td>3.270</td><td>3.583</td><td>0.000</td></tr>
<tr><td>Relatedness</td><td>4.338</td><td>3.175</td><td>3.583</td><td>0.000</td></tr>
<tr><td colspan="2">% of support by interview</td><td>100%</td><td>100%</td><td>88.889% (partial)</td><td>--</td></tr>
<tr><td colspan="2">Rating</td><td>Fair</td><td>Underrated</td><td>Dynamic change</td><td>--</td></tr>
<tr><td colspan="2">Characteristics</td><td>Realistic</td><td>High expectations</td><td>Learning characteristics</td><td>--</td></tr>
</table>

As demonstrated in Figure 9, each large-scale profile is named based on its associated trait. Profile 3 describes perfectionist safety officers who always find room for improvements in safety programs, attempt to engage in optimized experiments, and possess adequate problem-solving skills to deal with safety-related issues. On the other hand, Profile 2 depicts a realistic safety officer who can accept some flaws and understand that conflicts can arise whenever the associated individuals interact. Safety officers in Profile 2 also possess the necessary problem-solving skills to manage construction safety programs.

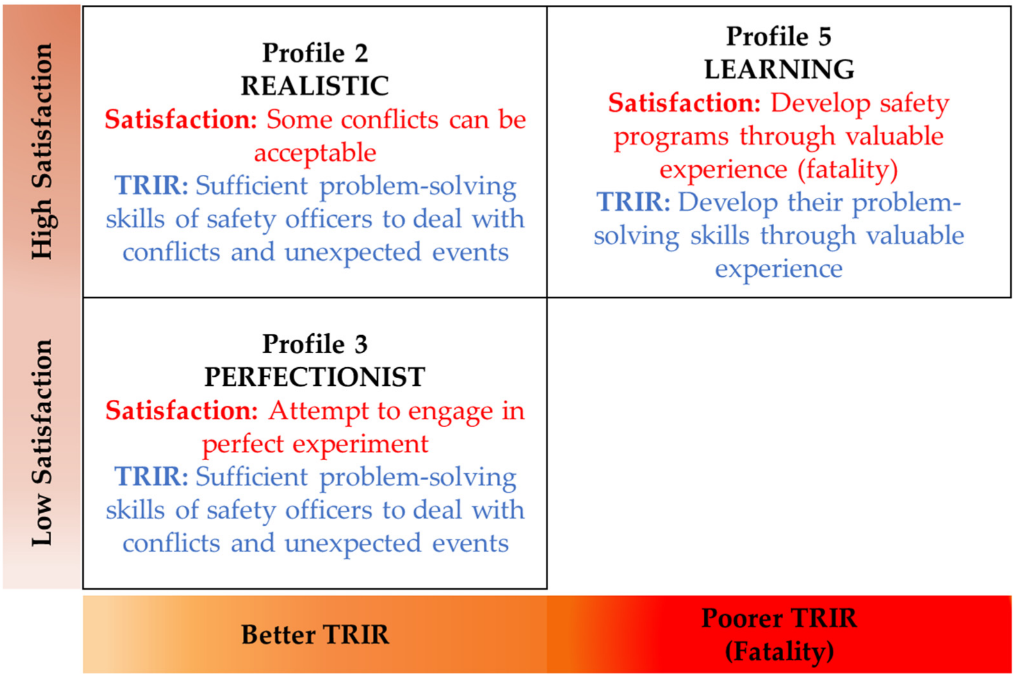

Figure 9. Characteristics of safety officers in large-scale projects (Profiles 2, 3, and 5).

In contrast, Profile 5 concerns learning safety officers who learn from valuable experiences (i.e., fatalities). They did not pay attention much at the early stage but instead developed the quality of their safety programs by undergoing unpleasant experiences (fatalities). This demonstrates the dynamic change in their safety programs, which resulted in poor accident records but high satisfaction.

By using in-depth interviews to compare these practices with engagement levels across six profiles, it became clear that Profiles 1 and 2 represent realistic safety officers, Profiles 3 and 4 discuss perfectionistic safety officers, Profile 5 encompasses undemanding safety officers, and Profile 6 contemplates learning safety officers. By knowing this, associated parties can initiate a fruitful strategy to retain valuable human resources in the construction industry.

It is crucial to acknowledge that accurately measuring safety performance presents some challenges in this area of research. For safety satisfaction, the subjectivity in evaluating safety programs remains challenging in this area of research. To ensure the systematic measure of satisfaction, the authors employed three features to gauge this indicator [3]. First, in this research, overall satisfaction considers two predominant aspects, namely satisfaction with the safety climate/culture and satisfaction with incident occurrence. Second, the measurement of satisfaction targeted the inner realities of three parties: safety officers, project managers, and owner representatives. Third, safety officers were identified as the key actors who must bridge gaps among all the parties in relation to safety initiatives, indicating that they may be able to provide sufficient data about satisfaction.

Although TRIR is an objective measurement that does not depend on a subjective evaluation, it is still difficult to gather accurate data on TRIR in the workplace for various reasons. Construction has been recognized as a hazardous industry, and this concept is normalized among individuals. Hence, the concept of accident occurrence is perceived as a normality, which may result in underreported cases. Occasionally, project managers may not report an accident to protect the company's reputation, which can affect the measurement error on the TRIR value. However, the authors employed various systematic methods to eliminate systematic and random errors and ensure the correctness of TRIR. Primarily, the authors used the following screening questions to ensure that the correct respondents were targeted: (1) Are you a safety officer at a professional level working for contractors in a construction project? (2) Do you have full-time safety officers in the company? Furthermore, this study captures the perspectives of safety officers, an area that has received limited attention in previous research. Notably, many respondents have expressed appreciation and support for this study, suggesting heightened positive expectations and a willingness to share accurate accident-related information.

Despite the immense efforts funneled into this research, there are certain limitations and areas for future exploration. First, two factors were primarily considered to compare the safety programs of large- and small-scale projects: (1) governmental attention and (2) individuals' basic perceptions of individuals on safety programs. Primarily, governmental inspections of safety programs are nearly absent in the context of the construction industry. Respondents discussing large-scale projects claimed that government attention was dedicated to the project only once per year on average. Furthermore, when inspections took place, they mainly focused on the project's documents rather than on the actual construction site. This issue has shaped the perceptions of stakeholders in the construction industry, causing them to believe that paying attention to a project only when a governmental inspection is conducted is sufficient. This issue is exacerbated in small-scale projects; the in-depth interviews revealed that the respondents never met any governmental representatives during the course of construction. There may be some probability of governmental inspection in large-scale projects, but there is no such probability for small projects. Therefore, increased governmental attention would contribute to the development of better safety programs in the construction industry. Furthermore, when compared to small-scale projects, large-scale projects tend to perceive safety programs as being of high importance. This may be caused by the perception that large-scale projects face higher risks of fatality or severe injury. In contrast, site supervisors and workers for safety programs in small-scale projects might believe that there is no possibility that fatalities or severe accidents would occur. This aspect is worth investigating in the future.

Second, this research only captures the perspective of safety officers in the construction industry. Therefore, more perspectives on safety programs can be incorporated to strengthen the research results, thereby helping to increase the practitioners' confidence in applying the results.

Third, although this research identified the hidden characteristics of safety officers in the construction industry, there remains the assumption that the subpopulation in each profile still exists. By further analyzing this, the additional characteristics from each profile can be discovered, such as the issue of whether some construction projects are affected by unfortunate conditions, even though their effort in managing safety programs is superior. From this analysis, more fruitful results can be added to the academic literature.

Lastly, the geographical aspect is assumed to have an impact on the analysis results, as this study predominantly captured the current status of safety programs in Thailand. Thus, different results could arise from the inclusion of related data from different nations due to the legislative frameworks about occupational safety in the construction industry. Ultimately, the practitioners can enjoy abundant alternatives to their decision-making process. Section 8 attempts to guide construction practitioners through findings from this study.

8. Practical Implications

The identified hidden characteristics of safety officers under conditions of low safety satisfaction but strong TRIR (Profiles 3 and 4) and conditions of high safety satisfaction but poor TRIR (Profiles 5 and 6) inform practitioners in the construction industry. For perfectionistic safety officers (Profiles 3 and 4), project managers can pay attention to help remove some safety-related conflicts, since the safety officers in this profile possess sufficient capability to manage the safety programs. Perfectionistic safety officers must better understand that in real-world practice, nothing is perfect; thus, some conflicts can occur during the implementation of safety programs. Managing safety programs at construction sites is challenging since it involves people from various backgrounds who have different expectations. Therefore, perfectionistic safety officers can learn that safety programs and construction productivity are vital. By realizing this concept, perfectionistic safety officers can reshape their ideal standards to match more realistic expectations of safety programs.

For undemanding safety officers (Profile 6), this is regarded as a dangerous characteristic of safety officers, since they perceive the high flexibility of safety programs, while there is room for improvement in problem-solving skills (management of conflicts and unexpected events). This requires project managers to pay close attention to and include safety programs as an important aspect of their organization. In addition, training to enhance the soft skills of safety officers is expected to contribute to the success of safety programs. Safety officers supporting this phenomenon can avoid employing harsh strategies for dealing with site supervisors and workers, such as escalating an argument or fighting with site supervisors. Instead, undemanding safety officers can choose to compromise with supervisors and workers whenever safety-related conflicts occur. To this point, it is assumed that undemanding safety officers can reform their expectations of safety programs and their capability in managing safety programs.

Underlying the learning safety officers (Profile 5), this characteristic requires early attention from project managers (listening to opinions, conveying confidence in safety officers, and including safety as an important element of a company) so that the project can prevent severe accidents, such as fatal cases. As in Profile 6, the training class for enhancing the soft skills of safety officers is assumed to contribute to successful safety outcomes. Soft skills can include, but are not limited to, adaptability, emotional intelligence, and negotiation. By supporting this aspect at the early stage, safety programs can secure high levels of cooperation from individuals involved in the construction project, and, thus, major accidents can be prevented.

9. Conclusions

This research pursued the following objectives: (1) to analyze the relationship between satisfaction with a safety program and TRIR, (2) to elucidate the process of safety satisfaction occurrence, and (3) to derive the associated process of TRIR occurrence. First, the relationship between safety satisfaction and TRIR was analyzed using correlation analysis, revealing that the correlation between these two indicators was relatively weak and not significant, which contrasts with the common-sense assumption that high satisfaction should be evident when the incident rate is low. To achieve objectives (2) and (3), the project samples were separated into two main groups, encompassing large- and small-scale projects, by conducting LPA and one-way ANOVA. The small-scale projects comprised three subpopulations, and, similarly, the large-scale projects comprised three subpopulations. The comparison between support, motivation, and engagement in each scale was conducted using one-way ANOVA. An in-depth interview was then conducted with representatives from each subpopulation. Subsequently, a comparison between the quantitative analysis and in-depth interview results was conducted.

As a result, three characteristics of safety officers in small-scale projects were identified in this research as follows:

- ➢ The first characteristic represented realistic safety officers, who can accept minor conflicts and unexpected events through sufficient problem-solving skills and by employing effective strategies to cope with conflicts and unexpected events (proactive strategies), resulting in high satisfaction and a strong accident record (TRIR).

➢ The second characteristic corresponded with perfectionistic safety officers, who attempt to engage in perfect experiments through their adequate problem-solving skills as they seek to eliminate conflicts and cope with unexpected events (proactive strategies), leading to low satisfaction but a strong TRIR record.
➢ The third characteristic involved undemanding safety officers, who often perceive high flexibility on safety programs in terms of attitudes toward conflicts and unexpected events (reactive strategy), resulting in high safety satisfaction but a poor accident record.

Similarly, three characteristics underlying large-scale projects were also derived as follows:

➢ The first two characteristics (pertaining to realistic safety officers and perfectionistic safety officers) are similar to those identified in small-scale projects.
➢ The third characteristic contemplates learning safety officers, who develop high-quality safety programs after the occurrence of fatalities in two stages: (1) the early stage in which safety programs do not receive substantial attention and (2) the developed stage after the occurrence of fatal cases; this involves close attention to safety programs, resulting in high safety satisfaction but a poor incident record (TRIR).

This third characteristic of small- and large-scale projects was discovered in this work and suggests that construction companies should pay close attention to safety initiatives to support safety officers, especially in the development of their capabilities. It is worth noting that this research refines the perception of stakeholders regarding safety performance at the construction sites. Although this research identified the different characteristics of safety officers, which is similar to one previous study [23], this research initially sheds light on the different perspectives regarding various dimensions of safety performance.

Despite substantial research efforts, this study has some limitations and areas for future exploration. First, this study examined two key factors when comparing safety programs in large- and small-scale projects: (1) governmental attention and (2) individuals' safety perceptions. Government inspections in the construction industry are minimal, with large-scale projects typically receiving visits only once per year, focusing mainly on paperwork rather than site conditions. This has led stakeholders to view safety as a priority only during inspections. For small-scale projects, respondents reported never encountering government inspectors. Increasing governmental oversight could improve safety programs across the industry. Therefore, future research can be conducted to assess the government's contribution to the successful implementation of safety programs. Second, this study focused solely on the views of safety officers. Including insights from other stakeholders could strengthen the findings and bolster practitioners' confidence in applying the results. Third, while this research identified distinct safety officer profiles, it assumes that subpopulations exist within those profiles. Further exploring these variations may reveal additional factors, such as the role of unexpected incidents despite strong safety management. Such insights could provide practitioners with more effective decision-making strategies. Last, the geographical context likely influences the analysis, as this study focuses on safety programs in Thailand. Including data from other countries could yield different results due to varying occupational safety laws. This diversity offers practitioners a wider range of options for decision-making.

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Appendix A.

Appendix A.1. In-Depth Interview Results from Representatives of Small-Scale Projects

Table A1. Conflicts and resolutions between safety officers and supervisors in small-scale projects.

No.	Cause of Conflict with Supervisors	Resolution by Safety Officers
Profile 1 #25	**Permission to work:** "Once a field engineer brought machinery, like a crane, to the site without requesting permission."	**Explain the rationale:** "We discussed it in detail since an accident could harm both the project and its reputation." **Negotiate with the owner:** "I addressed this by discussing with the project owner the possibility of submitting a later permit application."
	Exposure to hazards: "Sometimes, the field engineer works near the electrical system and mentions the urgency of the task."	**Facilitate by overseeing and monitoring the situation:** "I can only supervise the field engineer while he works."
Profile 1 #128	**No conflicts:** "I had minor issues with the foreman, but we usually resolved them through compromise."	NA
Profile 1 #154	**Reliance on the safety officer's expertise:** "The field engineer and the foreman have more experience than me. They are quite confident in their experience."	**Encourage learning while closely monitoring:** "I let the team try their method while monitoring. When it failed, they adopted mine, reinforcing their trust in me."
Profile 4 #41	**Engineering supervision:** "In construction, the field engineer should be on site while workers are active, but sometimes I notice he isn't present the entire time."	**Discuss and attempt to understand:** "I will first speak with the field engineer to understand the issue. If it continues, I'll involve the project manager to help resolve it."
	Permission to work: "Sometimes, the field engineer must rush the work to be on time, which causes the field engineer to bring in various machines, such as forklifts, to use in the project."	**Facilitating by negotiating with project owner:** "I try to help negotiate with the project owner whether we can send the permit application later or not."

Table A1. *Cont.*

No.	Cause of Conflict with Supervisors	Resolution by Safety Officers
Profile 4 #124	**Reliance on the safety officer's expertise:** "Most field engineers and foremen on site had more experience and years of experience than me, so they did not listen to me much at that time."	**Discuss and gently remind:** "The professional safety officers discussed and used techniques to remind them of the general reasons why we had to follow safety procedures." **Understand the nature of construction:** "Problems like this happen in our work, often due to the rush to meet deadlines in construction, but I can understand."
	Compromise of safety with productivity: "Problems like this do occur in our line of work."	
Profile 4 #222	**Reliance on the safety officer's expertise:** "I faced issues with the supervisor and foreman, as they saw me as a newbie and doubted my safety management skills."	**Discuss with reasons supported by the owner's statement:** "I use the requirements from the project manager and the reasons to discuss and agree with the foreman."
Profile 6 #38	**Engineering supervision:** "He lacked leadership, struggled with safety issues, and resisted my advice."	**Fight with supervisors and refer to the law:** "We argued at times. To resolve issues, I cited safety laws, warning of legal consequences for noncompliance."
	Gender discrimination: "Perhaps because I am a woman, the field engineer doubted my qualifications as a professional safety officer."	
Profile 6 #96	**No conflicts:** "I have a few issues with the field engineer and foreman."	NA
Profile 6 #98	**No conflicts:** "A past accident that killed a subordinate deeply affected the foreman, making safety his top priority."	NA

Table A2. Conflicts between safety officers and workers in small-scale projects.

No.	Cause of Conflict with Workers	Resolution by Safety Officers
Profile 1 #25	**Understanding safety issues:** "What I have with workers are minor issues where some workers may not understand why they need to wear safety equipment or PPE."	**Discuss with reasons:** "I have to explain the reasons and the possible consequences if they don't wear safety equipment."
Profile 1 #128	**Understanding safety issues:** "For me and my workers, there are times when we don't understand each other, but not often because I'm quite close to them."	**Warning by using humor:** "I warn them by inserting a joke, joking around, so that they don't feel too opposed to safety regulations."
Profile 1 #154	**Miscommunication:** "There were times when I and the workers did not understand or miscommunicate because sometimes these workers do not have a good understanding of safety work."	**Discuss by providing a reason:** "I have to try to teach them in addition to training. In the actual work, I have to warn them and explain the reasons for the importance of safety work."
Profile 4 #41	**PPE issue:** "There are a few, but not serious problems."	**Warning by using humor:** "I will use the method of warning them with jokes to make them feel comfortable."

Table A2. *Cont.*

No.	Cause of Conflict with Workers	Resolution by Safety Officers
Profile 4 #124	**PPE issue:** "Many workers are unfamiliar with the project's safety rules. They avoid safety shoes due to discomfort and skip gloves in hot conditions, despite the requirements."	**Warning and attempt to understand:** "Most of the time, we use warnings and attitude adjustments with those workers because we can understand that they have never done this type of work before."
Profile 4 #222	**PPE issue:** "Sometimes the workers do not wear gloves."	**Warning, informing supervisor, and being flexible:** "I typically give a warning and inform the supervisor to address issues. For minor problems with low risk, I let the workers continue." **Creating a good relationship:** "I ate lunch with the workers and asked about any issues they encountered."
Profile 6 #38	**No issue:** "I have never had any problems with the workers in the construction work. The workers tend to side with me, and often the workers come to inform me about the safety problems of the engineers that the construction work is not careful."	NA
Profile 6 #96	**PPE issue:** "There were some problems between me and the workers, which is normal in some construction projects. For example, if the workers did not wear safety equipment, especially the safety helmet."	**Letting site engineer/foreman deal with the conflict:** "I thought the workers already knew that wearing safety equipment was something they had to do. I was very picky, and they didn't want to talk to me, so I solved the problem by leaving it up to the on-site engineer and the foreman to deal with their own subordinates."
Profile 6 #98	**Improper working style:** "Workers modify construction equipment to be more suitable for the work because these workers think that they want to help the construction company reduce the cost of work. But in reality, this kind of action tends to be dangerous."	**Discuss with reason, try to be flexible, and retrain:** "We solve the problem by calling to talk if it is a small modification of the equipment. But if the foreman modifies the equipment a lot, we will have to train and talk to each other to create a mutual understanding."

Table A3. Unexpected events regarding the presence of untrained workers in small-scale projects.

No.	Presence of Untrained Workers	Measure	Type of Measure
Profile 1 #25	**No:** "For this project, this doesn't happen very often."	**Proactive measure:** "Our project has a measure that most employees who come to work in our project must receive a scan card to enter the project."	Proactive
Profile 1 #128	**No:** "In this area, we don't often have problems with workers not being trained before they start working."	**Proactive measure:** "Since our project is quite small, I can remember the faces of every worker."	Proactive
Profile 1 #154	**Yes:** "There were some during the rush period."	**Reactive measure:** "I tried to talk to the supervisors and field engineers to bring those workers back for training first, because these things could affect indicators, such as the company's reputation."	Reactive
Profile 4 #41	**No:** "In our project, there is no problem of detecting employees who have not been trained before."	**Proactive measure:** "We have measures to issue employee ID cards to all employees."	Proactive
Profile 4 #124	**No:** "In our project, there is no problem of encountering untrained workers coming to work, because we have employee cards in the project."	**Proactive measure:** "We have employee cards in the project."	Proactive
Profile 4 #222	**No:** "In our project, there is no problem with this issue at all, and I have never encountered a worker who has not been trained before coming to work."	**Proactive measure:** "In our project, every employee who comes to work is always trained beforehand, and we have measures to check this issue by giving cards to employees."	Proactive

Table A3. *Cont.*

No.	Presence of Untrained Workers	Measure	Type of Measure
Profile 6 #38	**Yes:** "At that time, there were some workers from the subcontractors who came to do specific work."	**Reactive measure:** "I couldn't do anything because they had been working for a certain period of time. I later found out that the workers had not been trained. In addition, at the time I was working on this project, I was not brave enough to give a warning."	Reactive
Profile 6 #96	**Yes:** "This issue often arises with subcontractors, who sometimes send a list of workers but bring others not listed on the actual workday."	**Reactive measure:** "I have warned those subcontractors and, in some cases, provided training at the company. Sometimes, I have to solve the problem by asking the field engineer or project manager first what to do and whether to conduct further training or discussion."	Reactive
Profile 6 #98	**Yes:** "During that time, there was a worker who came to work on the project with his face covered. But since I could remember the worker's appearance, I asked where the worker came from. The conclusion was that he was a worker who had never received any training before."	**Reactive measure:** "I called to report and stated my intention that this kind of action was inappropriate, and that this kind of incident should not have happened. In addition, I took the worker back to receive training before coming to work. These things are normal for construction sites."	Reactive

Table A4. Unexpected events regarding the COVID-19 pandemic in small-scale projects.

No.	Interview Script	Measure	Type of Measure
Profile 1 #25	**Effect of COVID-19:** "During that time, there was a COVID period."	**Provide quarantine area:** "If an employee showed symptoms or tested positive for COVID, we isolated them and their close contacts." **Conduct the ATK test:** "ATK tests were conducted daily before work each week." **Declare the timeline:** "Workers had to report any places they visited while traveling."	Reactive
Profile 1 #128	**No COVID-19:** "At that time, there was none yet. COVID-19 had not arrived yet."	NA	NA
Profile 1 #154	**No COVID-19:** "There was no issue with COVID at that time, since there was no outbreak."	NA	NA
Profile 4 #41	**Effect of COVID-19:** "During that time, there was also some COVID outbreak."	**Stop working:** "If a worker tested positive for COVID, we had to suspend work, causing significant delays." **Productivity management:** "The project also had to find replacements for workers with COVID." **Human management:** "We had measures to confirm with the hospital that the worker was COVID-free."	Reactive
Profile 4 #124	**No COVID-19:** "There was no COVID-19 during the project."	NA	NA
Profile 4 #222	**Effect of COVID-19:** "At that time, our project had COVID."	**Provide quarantine area:** "If someone tested positive for COVID, they were quarantined, treated, and retested. The measures were strict, as it was the start of the pandemic." **Checking temperature:** "We implemented measures like checking workers' temperatures, restricting their movement, and banning outside workers from entering."	Reactive

Table A4. *Cont.*

No.	Interview Script	Measure	Type of Measure
Profile 6 #38	**No effect of COVID-19:** "At the time this project was being done, there was no pandemic or COVID-19 yet."	NA	NA
Profile 6 #96	**No effect of COVID-19:** "During the time this project was in progress, there was no pandemic or COVID."	NA	NA
Profile 6 #98	**Effect of COVID-19:** "At that time, when our project started to survey."	**Unfamiliar with it at the beginning:** "COVID-19 spread quickly, and at the start of the project, we were unsure how to address it due to its newness." **Conflicting information:** "The conflicting information from the government and agencies left us unsure how to handle the situation." **Ineffective use of masks:** "Masks were ineffective, as workers had to work outdoors in the heat, making them an obstacle." **Impose social distancing measure:** "Our project attempted to separate the workers into groups."	Reactive

Table A5. Unexpected events regarding weather conditions in small-scale projects.

No.	Interview Script	Type of Measure
Profile 1 #25	**Yes:** "The safety department will check the weather conditions before every time to make sure that the workers can work without danger. If there is a forecast of storm or rain any day, we will inform you in advance."	Proactive
Profile 1 #128	**No:** "There aren't many problems. In this project, there will be some flooding problems, but that is not a big problem because the flooding happened in the area where we did not work."	NA

Table A5. *Cont.*

No.	Interview Script	Type of Measure
Profile 1 #154	**Yes:** "In terms of weather, we have planned from the beginning by checking the weather forecast to see if it will rain or not."	Proactive
Profile 4 #41	**No:** "No, it's very little. If the wind comes, it will run away on its own."	NA
Profile 4 #124	**Yes:** "To solve the problem of rain, we helped each other monitor until the rain stopped and then reassessed the situation. If the situation was good, we would go back to work."	Proactive
Profile 4 #222	**Yes:** "We planned for harsh weather, but during the rainy season, continuous rain softened the soil, causing scaffolding to fall. We stopped work and later implemented measures to compact the soil to withstand the weather for scaffolding installation."	Proactive
Profile 6 #38	**Yes:** "I remember it occurring once in that project, which happened to be the time when we were setting up scaffolding. So, I asked the workers to stop working so that I could come down and observe the storm situation."	Reactive
Profile 6 #96	**No:** "As I mentioned, since it was a small project, there were not many problems, even in terms of weather conditions."	NA
Profile 6 #98	**Yes:** "There was one time when it rained but we did not check the weather forecast. At that time, we had to manage the safety of the surrounding environment, which was quite difficult at that time."	Reactive

Table A6. Interview transcripts for support provided by project managers in small-scale projects.

No.	Autonomy Support		Competency Support		Relatedness Support	
Profile 1 #25	"When I have a suggestion, I and the project manager discuss it based on the reason."	Yes	"The company rewarded good safety performance with awards and a meal, including pizza."	Yes	"The project manager prioritized safety and recognized its importance in the job."	Yes
Profile 1 #128	"The project manager prioritizes safety and approves extra measures if my reasons are valid."	Yes	"The project manager rarely praised me directly but did so indirectly, such as when he commended me before a visiting committee."	Yes	"She is very determined. She is a person who is serious about everything and every task."	Yes
Profile 1 #154	"I presented the safety plan to my project manager, who questioned it until satisfied before approving it."	Yes	"Prizes are rare, but I occasionally receive compliments for good safety performance on the project."	Yes	"My project manager prioritized safety, work quality, and productivity."	Yes
Profile 4 #41	"When I noticed safety violations, I urged the project manager to reject the subcontractor's work. The contractor considered my perspective."	Yes	"There are no rewards for staff, but if the project earns the owner's praise, the project manager treats the team to dinner."	Yes	"The manager is supportive, with a positive attitude toward safety."	Yes
Profile 4 #124	"Overall, this manager listens, supports, and prioritizes safety on site."	Yes	"This person excels at these tasks and praises subordinates when they perform well."	Yes	"My project manager supports safety more than the others I've worked with."	Yes
Profile 4 #222	"The project manager was very open to suggestions and suggestions from the safety professionals."	Yes	"This project will award certificates to workers who make outstanding safety contributions."	Yes	"The project manager prioritizes safety, especially since the company values human resources highly."	Yes
Profile 6 #38	"He listens well to my work issues."	Yes	"He often treats the team to snacks and food. While my manager does not give many compliments, his actions show trust in me."	Yes	"My manager addresses safety issues, but at times, I feel a sense of consideration toward him."	Yes

Table A6. *Cont.*

No.	Autonomy Support		Competency Support		Relatedness Support	
Profile 6 #96	"The project manager listens to my suggestions, but sometimes it's not possible to implement them."	Yes	"Our company rarely gives positive feedback, as this project doesn't prioritize safety and lacks rewards or incentives."	No	"The project manager values safety, but not fully. Since the project is small, safety isn't a major focus."	No
Profile 6 #98	"The project manager supports safety equipment like signs and cones but views specialized training for workers as a waste of time."	Yes	"The project manager and I are close, having worked together for seven to eight years."	Yes	"He has not received training on tool or machinery safety and mostly relies on his understanding of the laws."	No

Note: "Yes" indicates that the respondents report support from project managers, while "No" means that the respondents report little support from project managers.

Appendix A.2. In-Depth Interview Results from Representatives of Large-Scale Projects

Table A7. Transcripts of conflicts between safety officers and supervisors in large-scale projects.

No.	Cause of Conflict with Supervisors	Resolution by Safety Officers
Profile 2 #48	**PPE issue:** "Most of the time, we can talk and understand each other. One time, it happened to a subcontractor. That day, he did not bring a safety helmet."	**Request to bring PPE, another member helps to mediate the situation:** "I didn't let him enter the site without a helmet. After some arguing, his friend got one, and another safety officer mediated the situation."
Profile 2 #79	**Engineering supervision:** "Issues mostly arise with the supervisor, who often works incorrectly and instructs subordinates to follow improper procedures."	**Request to stop and warn in a minor case:** "If this happens, we stop them from working. For minor issues, we issue a warning."
Profile 2 #97	**Safety budget:** "Some subcontractors said that safety equipment is expensive. Small companies complain that it is too expensive."	**Support some part and help to search for the good one:** "The project provides alternative choice for subcontractors, allowing them to select the most affordable and high-quality options."
Profile 3 #24	**Improper working styles:** "There are some because sometimes they take easy and convenient work, but sometimes it is not safe like this."	**Discuss and negotiate:** "We talked to the team that we asked for 80 percent in terms of safety. If it is not too dangerous, we will close our eyes and get something like that."
Profile 3 #54	**No conflict:** "Not very often. There aren't any at all because I'm the top in the safety department, and I work with a foreman who I'm close to."	NA

Table A7. *Cont.*

No.	Cause of Conflict with Supervisors	Resolution by Safety Officers
Profile 3 #199	**Working style:** "There have been some cases, for example, I can mention that it was a concrete pouring job with a basket using a crane to lift it. They said that the height was not that high."	**Discuss by providing reason:** "I had to make them understand. At first, they didn't really understand or were not happy, so I talked to them often and told them about the consequences that would follow."
Profile 5 #17	**Working condition:** "There is a matter of accident prevention. I recommend that the engineers on site always install a small railing, but the engineers on site said that they do not have time to do it for me that much. The civil engineering work is urgent."	**Recommended, but no cooperation obtained:** No action
Profile 5 #26	**Compensate safety with productivity:** "Sometimes they have to work according to the time and productivity."	**Taking picture and waiting for the meeting:** "We collect pictures and make reports to wait for the meeting that is called to update and collect work data."
	Improper working style: "At the early stage, some subcontractors let the construction workers perform the construction activity until the late night."	**Report to PM, and request for termination of contract:** "When I found that situation, I reported to the PM and requested for the termination of the contract."
Profile 5 #32	**Trusting in the ability of safety officer:** "Normally the foreman in the construction project will have quite a lot of work experience."	**Try to negotiate:** "I used to negotiate with the foreman, but we ended up fighting."
	Compensating safety with productivity: "The foreman often negotiates safety measures, believing work should be fast, convenient, and easy."	**Request to terminate contract:** "The most serious incident at that time was an accident that caused someone to die. After that, I asked the project manager to fire this foreman."

Table A8. Transcripts of conflicts between safety officers and workers in large-scale projects.

No.	Cause of Conflict with Workers	Resolution by Safety Officers
Profile 2 #48	**No issue:** "There is no problem with the workers. The workers are obedient and easy to teach."	NA
Profile 2 #79	**Understanding of safety issue:** "There were sometimes but not often. When we ask deeper why the workers don't follow the instructions, the workers will say that our boss ordered them (boss refers to supervisor)."	**Warning and reject if necessary:** "It is divided into two parts: Unacceptable actions, like climbing scaffolding over 6 m without a belt, are rejected immediately; acceptable behaviors, like not wearing gloves, receive a warning. After three warnings, the worker is asked to leave."

Table A8. *Cont.*

No.	Cause of Conflict with Workers	Resolution by Safety Officers
Profile 2 #97	**PPE issue:** "It's normal. Construction work is a rush job with a schedule and time, because the work site is pressed. So, when we find something that they did wrong or a violation."	**Discuss by providing reason:** "Most of the time we will go and advise them. Advise them immediately."
Profile 3 #24	**PPE issue:** "Sometimes most of the local workers don't like to wear welding masks and welding gloves while welding."	**Discuss by providing reason:** "We explain that wearing protection is necessary because welding dust and metal powder can harm the lungs, potentially causing issues like lung cancer years later."
Profile 3 #54	**PPE issue:** "There are some PPE issues."	**Understand the nature:** "We didn't talk to them directly, sometimes the urgent work we understand." **Help and facilitate workers:** "If working at night, the most important thing is the reflective vest. Our regular duty is to be on the roadside, helping and facilitating the workers."
Profile 3 #199	**PPE issue:** "The Thai workers are skilled craftsmen, but many experienced ones resist wearing PPE, especially during high-rise tasks like steel frame or roof horn installation, despite the necessity for safety."	**Claim the agreement and provide sufficient training:** "Before the project starts, we discuss and train everyone to agree on the work and safety measures."
Profile 5 #17	**PPE issue:** "The workers are very obedient because we have to train and have meetings. I have encountered this sometimes."	**Warn:** "I walked by, and we warned them beforehand."
Profile 5 #26	**Misconception on safety:** "Workers can't differentiate between what they did wrong and what they did as the supervisor told them to do."	**Express a good care:** "Our spirit is that we want employees to be safe because they have their own families."
Profile 5 #32	**Communication with foreign workers:** "I often argued with my foreign workers, and if we did not argue one day, my food did not taste good."	**Fight back:** "I got really angry."
	Addiction to drug: "In addition, my project also had some problems with drugs."	**No action:** Not mentioned

Table A9. Unexpected events regarding the presence of untrained workers in large-scale projects.

No.	Presence of Untrained Workers	Measure	Type of Measure
Profile 2 #48	**Yes:** "There was a worker who had been working for a while and I happened to walk by and saw that the card he was wearing was not the same card that we use on our site. It was another type of card."	**Proactive measure:** "The company has the system to provide employee cards for trained workers." **Reactive measure:** "We stood and trained him on site to let him know."	Proactive
Profile 2 #79	**No:** "My project did not experience that."	**Proactive measure:** "Our system uses a two-level scan: scan at the door, then again inside. Without training, workers won't have cards."	Proactive
Profile 2 #97	**Yes:** "There are some."	**Reactive measure:** "Mostly I will take the employees to talk and adjust their attitudes. Then, let them get proper training, prepare for the course. Then come back in, but first I will ask the workers to stop working first."	Reactive
Profile 3 #24	**Yes:** "Trained workers have a sign indicating completion. This issue mainly occurs with civil engineering subcontractors, who, in their rush, bring in workers without notifying us."	**Proactive plan:** "For trained workers, we use a sign to indicate completion. We randomly check names against the system and cards to verify training." **Reactive measure:** "If we find any, we stop work and ask them to leave. Subcontractors must follow our initial procedures to bring them in."	Proactive
Profile 3 #54	**Yes:** "There are some that are part of the subcontractors. During the additional work, the project has to bring in more people. We don't know because they didn't inform us."	**Reactive measure:** "When we find workers who haven't been trained, we will call them back to the office for training."	Reactive
Profile 3 #199	**Yes:** "Yes, there is."	**Proactive measure:** "We control this by issuing employee cards after training. Security guards check the cards on site, and only those who have completed safety training receive them." **Reactive measure:** "We call subcontractors to discuss issues, often involving our project manager or executives talking to their counterparts. It is usually a significant matter."	Proactive
Profile 5 #17	**No:** "My part does not have any."	**Proactive measure:** "I inform all on-site engineers and subcontractors that new employees must undergo training before starting work, with their names and details announced each time."	Proactive

Table A9. *Cont.*

No.	Presence of Untrained Workers	Measure	Type of Measure
Profile 5 #26	**No:** "My project did not experience that."	**Proactive measure:** "There are some measures in place. If the project finds out that workers have not been trained before, they will be asked to leave our worksite."	Proactive
Profile 5 #32	**Yes:** "Sometimes the foreman would secretly bring in untrained workers to work, and he would reason that he only brought workers in for a few days."	**Reactive measure:** "After that, I solved the problem by having the security guard help screen people before they came in to work. If the workers did not have a card, they would not be able to work."	Reactive

Table A10. Unexpected events regarding the COVID-19 pandemic in large-scale projects.

No.	Interview Script	Measure	Type of Measure
Profile 2 #48	**No COVID-19:** "At that time, COVID-19 had not yet happened."	NA	NA
Profile 2 #79	**Effect of COVID-19:** "Mine is full of COVID-19."	**Provide quarantine area:** "We prepare a camp as an isolation zone and take anyone found to the camp." **Provide COVID-19 testing:** "We attempt to provide the COVID-19 testing to all employees." **Ensure COVID-19 is not spreading:** "If we find the first case, we will have all the workers who are close stop working."	Reactive
Profile 2 #97	**No COVID-19:** "When I was on the project, there was no COVID-19."	NA	NA
Profile 3 #24	Effect of COVID-19: At that time, in the beginning of the project during COVID-19.	**Following provincial measures:** "We follow provincial measures. Udon Thani province required reporting to health volunteers and testing. The company prioritizes COVID-19 precautions and adheres to these measures." **Second plan to test COVID:** "Initially, we used hospital-provided COVID evidence when hospitals were full, then switched to self-testing as measures relaxed." **Require self-quarantine:** "Initially, after testing, you had to quarantine for 7–14 days." **Declare timeline:** "Everyone must write a timeline. **Conduct a COVID test:** "There is a check every week." **Provide the necessary kids:** "There is a spraying of alcohol." **Provide cleaning:** "If I remember correctly, every day after work, there will be a housekeeper to clean." **Ensure everyone does not have COVID:** "If one person is found, we will test by having everyone get tested for COVID." **Stricter measure is applied when necessary:** "If multiple cases are found, we will close the site for 7 days and clean everything."	Proactive

Table A10. *Cont.*

No.	Interview Script	Measure	Type of Measure
Profile 3 #54	**Effect during COVID-19**	**Provide the test:** "There were people infected with COVID-19 at the site. We started to plan to send them for testing and separate people at risk." **Provide quarantine area:** "Those who are in close contact will be separated. We will separate them into green, yellow, and red. We have a spare room for quarantine." **Provide necessary kids and food:** "The project also has a policy to serve workers, such as giving away free rice 2–3 times a day and various safety equipment such as masks and hand sanitizers."	Reactive
Profile 3 #199	**Effect of COVID-19:** "COVID-19 was not an uncertainty when the project started."	**Advanced measure:** "COVID-19 was already there, and we knew about it. Oh, so we have some measures to support it."	Proactive
Profile 5 #17	**Effect of COVID-19:** "There were a lot of COVID cases at the first project, all 2200 workers."	**Provide COVID-19 testing:** "We had a plan to deal with it. When workers entered the project, we checked them before they entered the project, everyone. We checked their body temperature." **Provide a random check:** "We checked randomly all the time, going to the victim's nose." **Provide the necessary kids:** "Face masks, hand sanitizers, etc.; the project provided these."	Reactive
Profile 5 #26	**No COVID-19:** "When I was working on that project, there was no pandemic or COVID-19."	NA	NA
Profile 5 #32	**Effect of COVID-19:** "During that time, there was an outbreak of COVID."	**Project manager support:** "During that time, the project manager appointed people to help support my work, and I was able to do my job very well." **Provide the necessary kits:** "Our project had measures in place. We provided safety equipment such as hand sanitizers for workers to wash their hands before starting work, and separated areas for eating, which were measured in terms of general health." **Provide a random check:** "After that, we randomly tested for COVID once a week."	Proactive

Table A11. Unexpected events regarding weather conditions in large-scale projects.

No.	Interview Script	Type of Measure
Profile 2 #48	**Yes:** "When it rains and storms, all work stops."	Reactive
Profile 2 #79	**Yes:** "We'll have a plan to prepare it and let it go in one place so it doesn't affect the work site we're working on."	Proactive
Profile 2 #97	**Yes:** "All lifting work must stop, no lifting allowed. Then, only the work that can be done will be done. Stop working until the scaffolding is completely dry."	Reactive
Profile 3 #24	**Yes:** "Yes, there is. But it's already a measure. We work with power plants. If it rains, everyone knows that they have to leave the workplace. Everyone knows that. Underground water, we predict that it already exists, because before doing the project, we will have a soil test."	Proactive
Profile 3 #54	**Yes:** "During the rainy season, it happens often because it rains and floods. We have to stop working. The workers and supervisors follow the instructions very well."	Reactive
Profile 3 #199	**Yes:** "They already have measures in advance, such as flooding. We already know which month the rainy season is in the area we are going to. So we will have a construction plan in place to make it consistent with the weather conditions."	Proactive
Profile 5 #17	**Yes:** "When it rains, the upper part cannot work, but the inside of the building can."	Reactive
Profile 5 #26	**Yes:** "Every time it rained, the project had to order workers to stop working and strictly forbade them from working at heights. Everyone strictly followed the instructions because they were informed of the consequences that would not be worth what would happen if an accident occurred."	Reactive
Profile 5 #32	**Yes:** ". . .After that, I tried to increase safety measures and tried to inform everyone involved about the weather conditions."	Reactive

Table A12. Interview transcripts of support provided by project managers of large-scale projects.

No.	Autonomy Support		Competency Support		Relatedness Support	
Profile 2 #48	"The project manager listens to opinions and transfers tough decisions to the project director."	Yes	"There is praise and there is consolation and there is, um, protection of the subordinates."	Yes	"He considered costs in every decision but always prioritized safety, discussing it in every meeting."	Yes
Profile 2 #79	"The project manager listened to me when there were critical safety concerns."	Yes	"In my company, if there is no lost-time work for three months, the project team receives a monetary reward."	Yes	"The requirements are strict, and the project manager works within the established framework."	Yes
Profile 2 #97	"I could tell him about project management, PPE equipment, or people management—everything was handled well."	Yes	"He provided great feedback. We have statistics in place, with a target set: If we reach the target without any accidents, the company rewards us."	Yes	"My project manager shows strong leadership, making decisions and taking responsibility for the organization—very effective."	Yes
Profile 3 #24	"If we have additional comments beyond the owner's requirements, my manager well cooperate with my suggestion more than 50 percent."	Yes	"The company conducts an annual performance evaluation, including feedback on major projects for each position."	Yes	"He prioritizes safety at the sufficient level more than 50 percent."	Yes
Profile 3 #54	"When I suggest choices to the project manager with a clear justification, my manager always approves my choices."	Yes	"I usually receive compliments when solving problems."	Yes	"For safety-related work, we receive a certain level of support under the reasonable budget."	Yes
Profile 3 #199	"The project manager cooperates well and responds positively to requests and suggestions."	Yes	"We emphasize understanding and ensuring everyone follows basic safety practices."	Yes	"He gives safety programs equal priority to the productivity in project."	Yes
Profile 5 #17	"The project manager paid good attention when we made suggestions about safety programs."	Yes	"The project manager praises us for prioritizing safety and preventing accidents, though compliments are rare due to few incidents."	Yes	"I have worked with this project manager for many years, and he prioritizes safety."	Yes
Profile 5 #26	"The project manager listens but considers the project timeline as the main factor."	Yes	"Feedback is minimal, but if there are no accidents in a quarter, the project rewards employees."	Yes	"Project managers primarily focus on performance and work quality."	No
Profile 5 #32	"He listens to my opinions on safety, but sometimes the project manager has to consider other factors, like the project budget."	Yes	"When inspecting the construction site, he buys snacks, milk, water, and other foods to treat his subordinates."	Yes	"My manager values safety, but productivity is also important."	Yes

Note: "Yes" indicates that the respondents report support from project managers, while "No" means that the respondents report little support from project managers.

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