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A multiple regression analysis on safety performance in university laboratories

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ABSTRACT: In this article, the authors explore the predictors of safety performance in college and university laboratories. A total of 465 faculty and staff from laboratories of four universities in Central Taiwan completed the self-administered questionnaire in 2004, yielding a response rate of 61.67%. The researchers conducted stepwise regression analysis, which showed that managers' commitment and action to safety was the best predictor of performance. As such, if excellent safety performance is to be sought in university laboratories, then management should focus on safety commitment and action. The research results support those obtained by Wang, Wu and Kang, but did not support those found by Wu and Su. Obviously, safety performance in different industries resulted from different predictor variables.

INTRODUCTION

University laboratories should provide protective conditions, be assessed for occupational hazards and have their safety quality evaluated in relation to governmental regulations, and employer and labour requirements [1]. However, if the laboratory lacks spontaneous safety management, the above-mentioned roles have to be questioned. On the other hand, in terms of total quality management, occupational safety should be maintained and enhanced in advance instead of improved after accidents happen [2][3]. If this is carried out, then laboratories can provide excellent safety performance. However, identifying what factors will predict the safety performance is a cause for concern.

Wang's research on telecommunications, as well as Wu and Kang's research on the manufacturing industry, have shown that the manager's safety commitment and action were the best predictors of safety performance [4][5]. However, Wu and Su's research on the construction of Taiwan High Speed Rail Contract indicated that emergency response was the best predictor of safety performance. Further exploration regarding predictors of safety performance in university laboratories is required in order to provide a reference framework for safety control measures at universities. In light of this, this research article is focused on exploring factors that affect safety performance in university laboratories.

METHOD

Research Framework

Questionnaires were used in order to collect the needed information and a multiple regression analysis was conducted for a statistical analysis of the collected data. The research framework is shown in Figure 1.

Participants

Participants comprised 465 faculty and staff travelling into and out of laboratories in four universities, two public and two private, in Central Taiwan. Of these, 174 were from public universities (37.42%) while the other 291 were from private ones (62.58%). There were 273 males (58.71%), 188 females (40.43%) and four missing values (0.86%). The average age for the participants was 37, with the oldest being 64 years old and the youngest 18 years old.

Instruments

The questionnaire incorporated four parts, as follows:

- General information;
- Safety leadership scale;
- Safety climate scale;
- Safety performance scale.

General information consisted of organisational factors (size, ownership, safety manager, safety committee and location) and individual factors (gender, age, job tenure, title, accident experience, safety training and work site), a total of 12 items. The safety leadership scale, developed by Wu, included three sub-scales, such as safety coaching, safety caring and safety controlling, with a total of 35 items [6]. The safety climate scale, developed by Wu and Lee, identified a CEO's level of commitment and action to safety, managers' commitment and action to safety, employee's commitment to safety, plus perceived risk and emergency response sub-scales, giving a total of 46 items [7]. The safety performance scale, developed by Wu and Chung, comprised six sub-scales like safety organisation and management, safety equipment and measures, safety training practice, safety training evaluation, accident investigations and accident statistics, a total of 40 items [8].

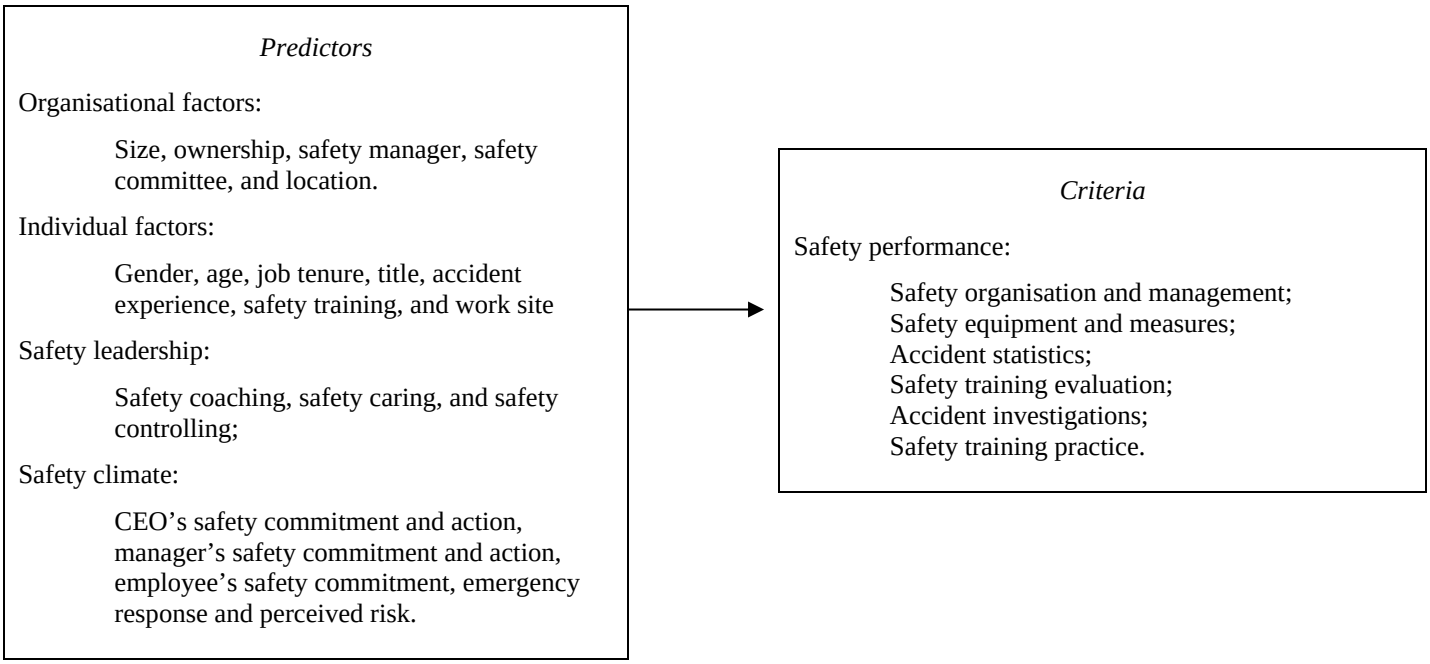

Figure 1: The research framework.

All four parts incorporated a 5-point Likert-type scale and went through item analysis, exploratory factor analysis and internal consistency analysis so that they possessed good validity and reliability.

Procedure

During the timeframe of this research (October 2004), the population size was 920 faculty and staff. The researchers utilised a simple random sampling method to select a sample size of 754, and they mailed out a total of 754 questionnaires, souvenirs and postage prepaid envelopes. In all, 492 copies were collected; 27 invalid responses removed, yielding a total of 465 copies of valid questionnaires. The response rate was 61.67%.

Data Analysis

The researchers used *SPSS* for Windows 8.0 and conducted a multiple regression analysis to predict safety performance. In the analysis, organisational factors, individual factors, all dimensions of safety leadership and safety climate were predictors, and all the dimensions of safety performance and overall safety performance were the criteria. The categorical variables of organisational and individual factors were transformed into dummy variables. The significance level (alpha) was 0.05.

RESULTS

First, the researchers examined multicollinearity. When Variance Inflation Factor (VIF) was found to be greater than 10, then this indicated the existence of multicollinearity [9]. Also, if the Condition Index (CI) was above 30, then it meant that serious issues of collinearity existed [10]. The results are listed in Table 1. All variance inflation factors are less than 3 and all condition indexes are less than 25. Therefore, no serious collinearity issue was detected.

It can be seen from Table 1 that three models have been selected, respectively, in multiple regression analysis on safety organisation and management, safety equipment and measures, safety training practice, safety training evaluation, accident statistics, accident investigations and overall safety performance. The table also shows that, except for accident statistics, the best predictor of other dimensions in safety performance and overall safety performance is the managers' commitment and action to safety. The best predictor of accident statistics is the employee's perception of risk.

DISCUSSION

Managers (level 1 or level 2) play the role of communicators and coordinators in the vertical, horizontal and depth relationships in a safety management system. As such, managers can usually express in definite terms that they are willing to provide adequate safety facilities and safety training. They also often state in clear terms that safety is as important as lectures and frequently implement positive safety actions to show that they care about staff welfare, praise staff safety behaviours and communicate safety issues. This contributes to the enhancement of safety performance, such as safe organisation and structure, safe working environment, safety training and accident investigations.

Furthermore, the potential hazards in a working, environment such as physical, chemical, infectious, ergonomic and social, if properly contained or eliminated, will help reduce the number of exposed risks and minimise injuries, disability or death in a working environment. In terms of overall safety performance, the most explanatory factor is the manager's level of commitment and safety actions.

Predictions were made about safety performance in the past that resulted in different research results. The research results of Wong, Wu and Kang showed that the best predictor of safety performance was managers' commitment and action to safety [4][5]. Generally speaking, the results of this research support their results. However, the research conducted by Wu and Su showed that the best predictor of safety performance was emergency response [11]. A possible reason for differences in the results could reflect the fact that the construction industry is more dynamic and complex than the tele-communications, manufacturing and education industries.

Construction involves mainly infrastructure construction or building construction. Especially in the construction of the tunnel or bridge for the high-speed railway, fall, trip, collapse, poisoning, oxygen deficiency, fires, explosions or electric shocks may occur to labourers and therefore employees' emergency responses are required for to prevent such injuries.

Due to the fact that factors influencing safety performance are complex, besides the organisational factors, individual factors, safety leadership and safety climate, other influential aspects that impact on safety performance may also include organisational culture and climate, safety culture or organisational leadership. Also, the different processes or hazards in different industries will also result in different influential factors on safety performance. Therefore, future researches, apart from further exploring the above-mentioned predictors, can be focused on studying other different industries.

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Table 1: Multiple regression of safety performance on organisational factors, individual factors, safety leadership and safety climate.

Criteria	Model	Predictors	R	R^2	R_a^2	F	β'	t	VIF	CI
Safety Organisation and Management	1	Manager's commitment to safety	0.779	0.607	0.606	524.497***	0.608	18.025***	1.302	1.882
	2	Emergency response	0.820	0.673	0.671	348.919***	0.294	8.942***	1.236	14.594
	3	Location	0.840	0.705	0.702	269.198***	-0.184	-6.046***	1.060	15.936
Safety Equipment and Measures	1	Manager's commitment to safety	0.710	0.504	0.503	344.748***	0.527	13.700***	1.308	1.886
	2	Emergency response	0.779	0.607	0.605	261.474***	0.362	9.685***	1.232	14.521
	3	Location	0.786	0.618	0.615	181.750***	-0.106	-3.060**	1.068	15.908
Safety Training Practice	1	Manager's commitment to safety	0.640	0.410	0.408	236.878***	0.450	10.562***	1.306	1.886
	2	Emergency response	0.707	0.500	0.497	170.122***	0.342	8.269***	1.231	14.521
	3	Location	0.727	0.528	0.524	126.341***	-0.172	-4.459***	1.068	15.925
Safety Training Evaluation	1	Manager's commitment to safety	0.440	0.194	0.191	81.716***	0.273	3.948***	2.147	3.697
	2	Safety coaching	0.470	0.221	0.216	48.018***	0.243	3.510***	2.145	15.986
	3	Work site	0.497	0.247	0.241	37.055***	0.164	3.465***	1.004	23.320
Accident Statistics	1	Perceived risk	.480	.231	0.228	102.483***	0.346	6.657***	1.309	4.576
	2	Employee's commitment to safety	0.538	0.289	0.285	69.468***	0.265	5.078***	1.325	16.190
	3	Safety training experience	0.546	0.299	0.292	48.258***	0.096	2.106*	1.015	24.836
Accident Investigations	1	Manager's commitment to safety	0.729	0.531	0.530	386.276***	0.536	9.673***	2.438	14.106
	2	Emergency response	0.751	0.564	0.562	220.032***	0.184	4.642***	1.255	17.699
	3	Safety caring	0.757	0.574	0.570	151.984***	0.151	2.737**	2.405	24.171
Safety Performance	1	Manager's commitment to safety	0.766	0.587	0.586	476.156***	0.574	17.098***	1.300	1.880
	2	Emergency response	0.831	0.691	0.690	374.081***	0.366	11.192***	1.234	14.527
	3	Location	0.844	0.712	0.709	273.886***	-0.146	-4.835***	1.059	15.868

Notes: $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; *R*: Multiple correlation coefficient; R^2: Coefficient of multiple determination; R_a^2: Adjusted R^2; β': Standardised regression coefficient; VIF: Variance Inflation Factor; CI: Condition Index.

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