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Original Article

Surprising Incentive: An Instrument for Promoting Safety Performance of Construction Employees

Fakhradin Ghasemi [1], Iraj Mohammadfam [1,*], Ali Reza Soltanian [2], Shahram Mahmoudi [3], Esmaeil Zarei [1]

[1] Department of Occupational Hygiene Engineering, School of Public Health and Research Center for Health Sciences, Hamadan University of Medical Sciences, Hamadan, Iran
[2] Department of Biostatistics and Epidemiology, School of Public Health and Modeling of Noncommunicable Diseases Research Center, Hamadan University of Medical Sciences, Hamadan, Iran
[3] HSE Department of MAPNA Group, Tehran, Iran

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ABSTRACT

Background: In comparison with other industries, the construction industry still has a higher rate of fatal injuries, and thus, there is a need to apply new and innovative approaches for preventing accidents and promoting safe conditions at construction sites.
Methods: In this study, the effectiveness of a new incentive system—the surprising incentive system—was assessed. One year after the implementation of this new incentive system, behavioral changes of employees with respect to seven types of activities were observed.
Results: The results of this study showed that there is a significant relationship between the new incentive system and the safety performance of frontline employees. The new incentive system had a greater positive impact in the first 6 months since its implementation. In the long term, however, safety performance experienced a gradual reduction. Based on previous studies, all activities selected in this study are important indicators of the safety conditions at workplaces. However, there is a need for a comprehensive and simple-to-apply tool for assessing frontline employees' safety performance. Shortening the intervals between incentives is more effective in promoting safety performance.
Conclusion: The results of this study proved that the surprising incentive would improve the employees' safety performance just in the short term because the surprising value of the incentives dwindle over time. For this reason and to maintain the surprising value of the incentive system, the amount and types of incentives need to be evaluated and modified annually or biannually.

1. Introduction

In recent years, the construction industry has been improving significantly regarding safety issues; however, it is still one of the most risk-posing industries in the world. According to the statistics published by the Health and Safety Executive (HSE-UK), the rate of fatal injuries in construction sites was at least two times higher than in the manufacturing industry between 1980 and 2013 [1]. Based on the National Safety Council reports, in comparison with other industries, the highest number of deaths was reported in construction sites [2]. In the developing countries, such as Iran, the situation is even worse, which is a result of many factors such as lack of rules and regulations, inadequate and incomplete government inspection, employing unskilled workers who migrated from other areas or other countries, employed for just a short period, higher pressure in terms of time and economy, and absence of a comprehensive accident recording and reporting system [3]. Apart from these, accidents also have undeniable adverse economic and social outcomes. De Saram et al [4] investigated the nonmaterial costs of accidents, which include pain and suffering costs and loss of quality of life, and reported that these costs were approximately 30% of direct accident costs. As a result, safety has become a new

* Corresponding author. Department of Occupational Hygiene Engineering, School of Public Health, Hamadan Medical Science University, Hamadan 689, Iran.
E-mail address: Mohammadfam@umsha.ac.ir (I. Mohammadfam).

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index, besides the triangle of time, cost, and quality, to evaluate the construction project success, and there is a need to improve it [5,6].

Obviously, there are many inter-related factors affecting safety on construction sites. A number of studies were carried out to identify these factors and their relationships. For example, Aksorn and Hadikusumo [7] reported four determinant groups of factors, which influence safety performance at construction sites, including worker involvement, safety prevention and control measures, safety arrangement, and management commitment. Haslam et al [8] investigated 100 accidents and determined five categories of factors that have an impact on these accidents. These categories are as follows (in the order of importance): organizational influences, worker and work team, equipment, workplace, and materials. Based on these factors, several frameworks for assessing safety and health issues at construction companies have been proposed; for example, Mahmoudi et al [9] proposed a framework for continuous monitoring and improving safety at construction companies. This framework contains seven main factors and 120 related subfactors that can have an impact on the safety of a construction project. Ng et al [10] also proposed a framework for assessing safety performance of project contractors. In their study, 13 and 18 influencing factors were found at the organization and project levels, respectively. As shown in many studies, performances of frontline employees are always a critical factor in promoting safety at all types of workplaces. On the one hand, these employees are familiar with their workplaces, the equipment, and machinery that they utilize; they are also supposed to be the first persons who will recognize new hazards and potentially troublesome issues. Furthermore, they are the ones who are most likely to be harmed if something goes wrong. Therefore, they are usually keen to find out suitable ways to protect themselves against hazards. On the other hand, a high proportion of construction-related accidents occur despite the workers recognizing an unsafe condition, meaning that they knowingly work in an unsafe condition or take an unsafe action [11]. Choudhry and Fang [12] also found that one of the reasons that workers do not avoid an unsafe act is to prove themselves as “tough guys” for co-workers. The HSE-UK also pointed out that 80% of the accidents could be prevented by avoiding unsafe acts [13]. Accordingly, frontline employees’ performance can have two completely different results based on the actions that they adopt. The main issue here is to identify the best possible ways to enhance the safety-related performance of employees.

In fact, a large number of activities carried out by management and safety practitioners at workplaces (e.g., safety training, safety communication, safety rules and procedures, incentive) are intended to improve the safety performance of employees. According to Griffin and Neal [14], safety performance refers to the personal behavior of employees by which their own safety and their co-workers safety would be promoted. Safety performance has two aspects, namely, safety compliance [e.g., using personal protective equipment (PPE), following safety procedures and rules] and safety participation (e.g., voluntarily participating in safety-related activities such as safety meetings). A high volume of studies had proven the positive impact of motivation and employees’ knowledge on safety performance. Griffin and Neal [14] in the same study indicated that knowledge, skill, and motivation are parameters that can directly influence safety performance. In another study, Neal et al [15] found that safety knowledge and safety motivation partly mediated the effects of safety climate on safety performance. Vinodkumar and Bhasi [16] also demonstrated that safety knowledge and safety motivation are two main factors mediating the effects of management practices on safety performance. According to aforementioned studies, one of the most important preconditions for enhancing employees’ safety performance is motivating them with a granted and proper incentive.

Incentives are a proactive approach applied by management to enhance the safety-related performances of employees. The use of incentives, which include both financial and nonfinancial rewards, can be helpful for encouraging workers to be involved in safety programs. Examples of financial incentives are money or prizes, whereas nonfinancial reinforcement can be achieved by positive appraisal, recognition, or positive feedback [17]. Many studies have highlighted the positive impacts of both financial and nonfinancial rewards on employees’ safety performance. Hagenzieker et al [18] indicated that incentives improve the seat-belt usage by drivers. Sulzer-Azaroff et al [19] demonstrated that incentives improve safety performance at construction sites. Teo et al [20] stated that incentive, policy, process, and personnel (3P + I) were the key factors that must be considered while managing safety at construction sites. Vredenburgh [21] reported that incentive is one of the six management practices that can proactively reduce the injury rate in industries.

However, it must be considered that every incentive system does not determinately lead to improvement of safety performance. Swearington [22] reported that incentives could act as a double-edge sword. He explained that ambiguous criteria in an incentive system can lead to a higher number of unsafe behaviors by employees. The same result has also been reported by Halloran [23]. Hasan and Jha [24] concluded that the successfulness of an incentive and penalty system is dependent on six main factors, including incentive distribution method, proper labor training, special attention to risky situations, role of safety committee and subcontractors, specialized works and equipment safety, and the right form of incentive and penalty. Haines et al [25] also commented that the effectiveness of such programs depends on the kind of relationship that exists between supervisor and subordinate.

Therefore, we cannot blindly apply a new incentive system and expect an improvement in safety conditions or a reduction in accident rates. Accordingly, the aim of the present study was to evaluate and to compare the impacts of implementing two different incentive systems, ordinary and surprising incentive systems, on the degree of frontline employees’ safety performance.

2. Materials and methods

This was a case–control study conducted in two power-plant construction projects in Iran during 2012 and 2013. One project had 342 employees (case project) and the other (control project) had 402 employees. Two incentive systems were adopted: the surprising system for the case project and the ordinary system for the control project. It should be noted that the ordinary system was already in place in both projects for several years, and the incentive was paid to the employees at 3-month intervals. Incentives consisted of both financial and nonfinancial benefits.

The definition of the “surprising incentive system” in this study is the incentives paid to an employee within a week after complying with the predetermined performance. In all cases, except pilgrimage and introducing individuals to the community as a safe worker through the local newspapers, the incentive was given immediately at restaurants or the praying room. Introducing individuals to the community as a safe worker through the local newspapers was accomplished within 3 days (maximum), and sending them to a pilgrimage along with an accompanying person was achieved as soon as their received incentives totaled 100 USD. The amount of incentives was determined by the HSE department of the company, and varied for each case between 5 and 15 dollars in cash and its equivalent was considered for nonfinancial incentives. The same amounts of incentives were paid to employees in both incentive systems.

In this program, rewardable activities included parameters shown in Fig. 1. Based on the definition provided in the previous section, parameter A is categorized under the safety compliance group and

Parameter	Description
A	Proper use of PPEs
B	Record and report near misses
C	Record and report minor accidents
D	Record and report unsafe conditions (unsafe machineries, unsafe environments, etc.)
E	Proposing appropriate technical and managerial suggestions to correct the unsafe conditions and behaviors

Fig. 1. Parameters selected as representatives for assessing employees' safety performance. PPE, personal protective equipment.

the others are categorized under the safety participation group because of the voluntary nature of these activities in the project.

The rewardable activities were monitored by either of the two following methods:

- *Real-time observation of employee behaviors:* Three HSE officers and 12 supervisors who routinely supervise the activities of frontline employees collaborated to obtain the required data. Before starting the study, the officers and supervisors received appropriate training. Cohen and Jensen [26] also used real-time observation for assessing the effects of safety training on the performance of lift-truck drivers. This method was used only for parameter A, that is, "proper use PPEs."
- *The "green card" system:* According to this method, workers recorded and reported their points about unsafe work conditions, near misses, minor accidents, and also their proposed solutions on a single card and dropped it into the available boxes in their workplace. Using the "Green Card" system for reporting near misses, minor incidents, unsafe work conditions, and also providing probable solution was introduced in a previous study [27]. It must be mentioned that both these methods for monitoring and recording rewardable activities had been in use in the company for several years.

The incentives were selected based on the cultural characteristics of Iran's society. The offered incentives based on the reported cases were categorized into two general types:

- *Financial incentives:* Paid in the form of cash or gift cards.
- *Nonfinancial incentives:* This included flashes, home appliances, pilgrimage, and introducing them to the community as a safe worker through local newspapers.

In this study, the percentages of employees participating in the aforementioned activities were used for data analysis. The difference between the case and control groups was evaluated at regular intervals using the Chi-square test before and after implementing the new incentive system. A p value < 0.05 was considered statistically significant. The first comparison was made 3 months before the implementation of the new incentive system for each parameter. The purpose of this comparison was to answer the following question: "Is there any significant difference between these two projects with respect to safety performance?" The answer to this question was not only a motivation for designing a new incentive system, but also formed the basis for the following sets of comparison. Moreover, to find the effectiveness of the new incentive system over time, the safety performances of employees were followed for the next 12 months. Accordingly, we hypothesized the following:

Hypothesis 1: Ordinary and surprising incentive systems differ in terms of safety performance and
Hypothesis 2: A surprising incentive system has a permanent effect on safety performance.

Moreover, the changes in parameters were determined at 3-month intervals, and finally, to define the trend change in the case project, a curve regression analysis was applied and r^2 was used as the goodness-of-fit index. For this purpose, parameters' trend changes were verified by the inverse, quadratic, and cubic curves, and the curve with the best index value was selected for predicting each parameter's effectiveness. SPSS software version 20 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis.

3. Results

One year after the implementation and enforcement of the new incentive system, the results were analyzed. The overall results of this study are presented in Tables 1 and 2. The main goals of these sets of comparison were to find whether there are significant differences between the case and control projects both before and after implementing the new incentive system. Statistical analysis was performed using the Chi-square test. According to the information presented in Tables 1 and 2, before the intervention, the only index which differed significantly between the case and control projects was the "proper use of PPEs," meaning that the level of safety performance in both projects before intervention was very close. Nevertheless, after implementing the new incentive system, the differences in all parameters considered in various periods were significant between these two projects, suggesting significant relationship between the new incentive system and safety

Table 1
Impacts of incentive systems on safety performance parameters after various periods

Awardable actions	3 mo before intervention		3 mo after intervention		6 mo after intervention		9 mo after intervention		12 mo after intervention	
	Case	Control	Case	Control	Case	Control	Case	Control	Case	Control
A	6.43	8	21.93	12.87	31	16.1	26	12.87	21.93	12
(p)	(0.037)		(0.001)		(0.001)		(0.001)		(0.001)	
B	3.22	2.63	14.62	6.43	16.67	7.31	21.35	7.02	20.76	7.02
(p)	(0.058)		(0.001)		(0.001)		(0.001)		(0.001)	
C	0.88	1.17	9.06	3.51	8.77	4.1	7.9	3.22	8.2	2.63
(p)	(0.6)		(0.001)		(0.001)		(0.001)		(0.001)	
D	16.97	18.42	41.23	27.5	39.2	19.3	32.75	16.1	28.36	12.57
(p)	(0.09)		(0.001)		(0.001)		(0.001)		(0.001)	
E	3.22	2.92	6.43	16.1	5.26	18.71	6.14	21.35	4.1	19.6
(p)	(0.12)		(0.001)		(0.001)		(0.001)		(0.001)	

Table 2
Correlation coefficients between study variables for Groups A and B

Groups		Before 3 mo	After 3 mo	After 6 mo	After 9 mo	After 12 mo
A	Before 3 mo	1	0.967	0.873	0.817	0.755
			0.007*	0.053	0.091	0.132
	After 3 mo	0.967	1	0.951	0.913	0.884
		0.007		0.013	0.030	0.047
	After 6 mo	0.873	0.951	1	0.966	0.933
		0.053	0.013		0.007	0.021
	After 9 mo	0.817	0.913	0.966	1	0.990
		0.091	0.030	0.007		0.001
	After 12 mo	0.765	0.884	0.933	0.990	1
		0.132	0.047	0.021	0.001	
B	Before 3 mo	1	0.893	0.654	0.406	0.274
			0.041	0.232	0.497	0.655
	After 3 mo	0.893	1	0.882	0.756	0.647
		0.041		0.048	0.139	0.238
	After 6 mo	0.65	0.882	1	0.942	0.897
		0.232	0.048		0.017	0.039
	After 9 mo	0.406	0.756	0.942	1	0.987
		0.497	0.139	0.017		0.002
	After 12 mo	0.274	0.647	0.897	0.987	1
		0.655	0.238	0.039	0.002	

* The significance level of the analysis was less than 0.05.

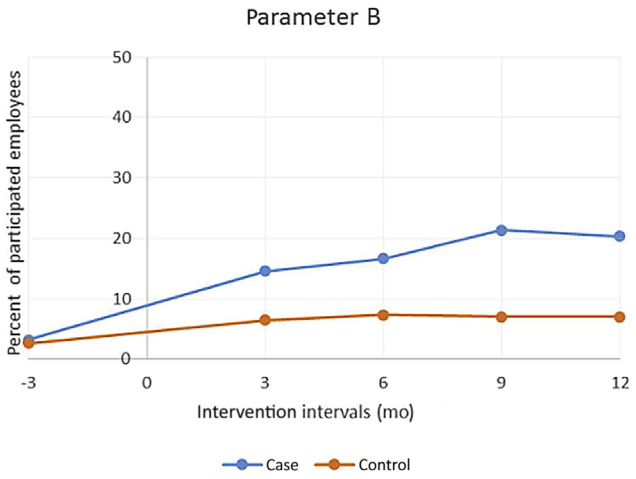

Fig. 3. Trend of changes in parameter B (record and report near misses) during the study in the case (blue line) and control (orange line) projects.

performance of frontline employees. The absence of significant difference between case and control projects before intervention was not surprising because these two projects are supported by the same company with identical methods for enforcing safety rules, monitoring activities, and rewarding employees.

The changes in the parameters during various periods are demonstrated in Figs. 2–6. It can be seen from these figures that each parameter in the control project is approximately steady over the period of intervention. Moreover, there is no obvious trend that can be used for illustrating the changes of all parameters in the case project. It can be seen from the related curves that "proper use of PPEs" (Parameter A) and "record and report unsafe conditions" (Parameter D) increased at first but several months after the intervention, they began to decrease gradually. Parameter A had an upward change during the first 6 months after the intervention and its maximum amount was at the 6th month; however, in the following months, it showed a downward trend gradually (Fig. 2). As shown in Fig. 5, Parameter D increased steadily, with its maximum amount noted at the 3rd month since the implementation of the new incentive system. Afterward, however, this parameter too began to decrease and after 12 months from the beginning, it had reached its minimum amount. As shown in Figs. 3 and 4, "record and report near misses" (Parameter B) and "record and report minor accidents" (Parameter C) had a steady state during the study period with no significant changes. Surprisingly, the results for "proposing appropriate technical and managerial suggestions to correct the unsafe conditions and behaviors" (Parameter E) were higher in the control project compared with the case project, as shown in Fig. 6.

Using regression analysis, a deeper analysis was also performed on the trend of changes for each parameter. The results of the curve regression analysis are presented in Table 3.

As shown in this table, "proper use of PPEs," "record and report minor accidents," and "proposing appropriate technical and managerial suggestions to correct the unsafe conditions and behaviors" had a quadratic trend. Having a quadratic trend indicates that these parameters have a short period of effectiveness, and after reaching a maximum point, their effectiveness begins to decrease. These results outline that the surprising incentive system has only a short-term effect on these parameters. Furthermore, according to this table, "record and report unsafe conditions" has a cubic trend that also indicates an increase at first but then a decrease, although a tendency to increase is observed at the end of 12 months for this

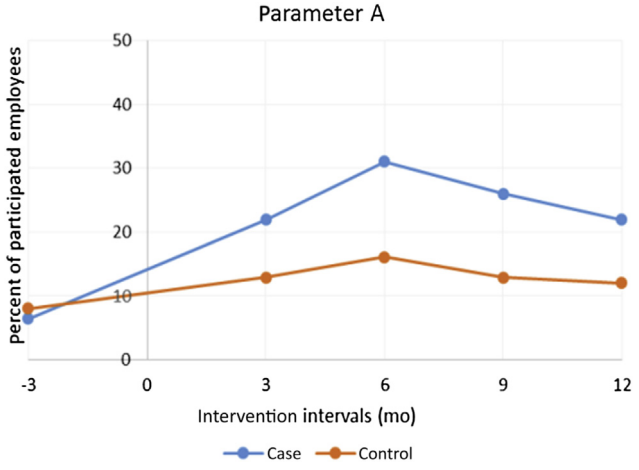

Fig. 2. Trend of changes in parameter A (proper use of PPEs) during the study in the case (blue line) and control (orange line) projects. PPE, personal protective equipment.

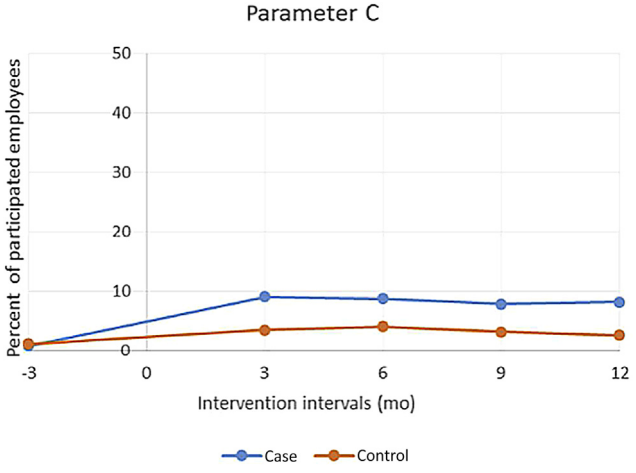

Fig. 4. Trend of changes in parameter C (record and report minor accidents) during the study in the case (blue line) and control (orange line) projects.

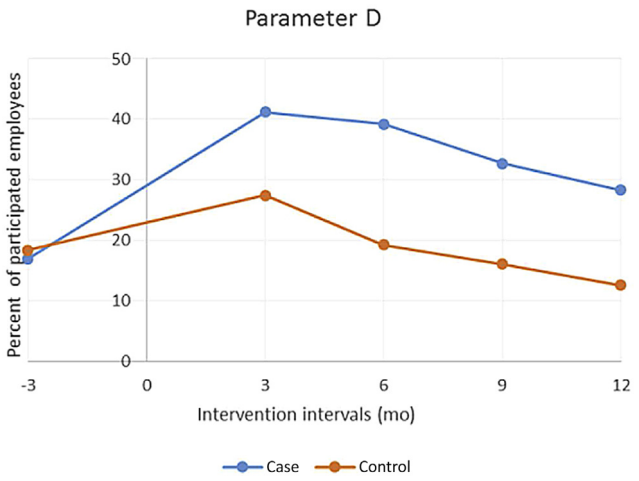

Fig. 5. Trend of changes in parameter D (record and report unsafe conditions) during the study in the case (blue line) and control (orange line) projects.

parameter. However, the inference for this parameter according to the trend curve equation in Table 3 and Fig. 5 is similar to that of parameters "proper use of PPEs," "record and report minor accidents," and "proposing appropriate technical and managerial suggestions to correct the unsafe conditions and behaviors" (i.e., Parameters A, C, and E, respectively). An inverse trend for "record and report near misses" shows that its effectiveness finally reaches a maximum and constant value.

4. Discussion

The importance of safety issues at construction sites cannot be overemphasized. Although adopting various strategies, occurrence of a high number of minor and major accidents at construction sites, in both developed and developing countries, indicate that we need to use new and innovative approaches to prevent such accidents.

Using incentives for improving safety performance has been employed for many years. The effectiveness of such incentives has always been a controversial debate between researchers. Hinze and Gambatese [28] stated that incentives do not necessarily lead to improved safety performance. Kressler [29] has demonstrated that there is a close relationship between incentives, motivation, and

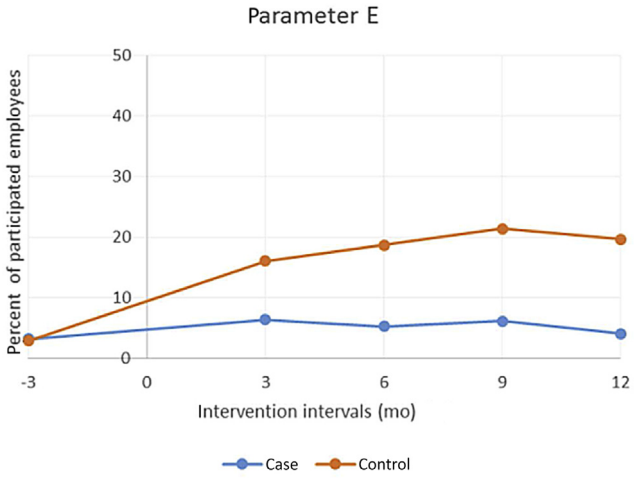

Fig. 6. Trend of changes in parameter E (proposing an appropriate solution) during the study in the case (blue line) and control (orange line) projects.

Table 3
Result of regression analysis of parameters A to F in the case project

Parameter	Model summary			Curve model
	Inverse	Quadratic	Cubic	
A	0.758	0.962	0.562	$Y = -15.67 + 26.31x - 3.8x^2$
B	0.981	0.966	0.782	$Y = 25.54 - 22.37\,(1/x)$
C	0.587	0.791	0.642	$Y = -1.53 + 3.4x - 3.8x^2$
D	0.601	0.676	0.911	$Y = -43.14 + 83.64x - 25.67x^2 + 2.36x^3$
E	0.452	0.985	0.968	$Y = 0.36 + 3.77x - 0.61x^2$

performance. Cadsby et al [30] proved the role of incentives in heightening performance and productivity. McAfee and Winn [31], by reviewing 24 studies that examined the effects of incentives on the safety condition of workplaces, inferred that incentives have a positive impact on safety. In the present study, we assessed the effectiveness of a new incentive system, known as the "surprising incentive system," in improving frontline employees' safety performance.

As the focus of the present study was on the frontline employees, lack of a comprehensive and universally accepted framework for measuring the safety-related performance of frontline employees was one of the most problematic issues of the study. Consequently, based on the authors' experiences and reviewing papers published in the field, five parameters were selected as representatives of safety performance. The first parameter was "proper use of PPEs." It has been seen for many years in construction projects in Iran that employees do not use PPE, despite the fact that most employers make it available for them. Therefore, it was selected as one of the indices of safety performance, as was the case in several other studies [32]. The second parameter was "near miss reporting and recording." Near misses are defined by Occupational Safety and Health Administration as follows: "near misses describe incidents where no property was damaged and no personal injury sustained, but where, given a slight shift in time or position, damage and/or injury easily could have occurred" [33]. Then, near misses can occur again, but unlike the previous occurrence, with irrecoverable consequences. Near misses can be categorized as both leading and lagging indicators, but Hinze et al [34] have illustrated that it is more favorable to consider near misses as the leading index, and therefore, by discovering their root causes, their recurrence can be prevented. The third parameter, "record and report minor accidents" (without lost days), was also treated as near misses in this present study. Desai et al [35] found a positive relationship between minor accidents and future safety climate. Hinze [36] pointed out that minor accidents must not be underestimated, as there is always a possibility that these minor accidents could finally become more severe accidents.

"Record and report unsafe conditions" and "proposing appropriate technical and managerial suggestions to correct the unsafe conditions and behaviors" are unique to frontline employees and can dramatically result in improvement of overall safety. However, these types of activities need special training and investment to meet predetermined objectives.

A high volume of studies also made a comparison between various sorts of incentives. For example, Stajkovic and Luthans [37] reported that financial incentives had greater impacts on performance than nonfinancial incentives. In this study, two different incentive systems, surprising and ordinary systems, were compared together. Our results show that in comparison with the ordinary system, the surprising incentive system improves employees' safety performance. The same result was also obtained by Hinze [38], who reported that more frequent and low-price incentives had a greater positive impact on safety performance.

The result of the study also showed that in the short period after adopting the new incentive system, the safety performance improved but after a few months, 3 or 6 months, the performance showed a declining trend. These changes were observed almost in all parameters. This could be due to attractiveness of the new incentive system at the first few months of its implementation.

The result is consistent with the results obtained by Kane et al [39]. The authors concluded that economic incentives had a short-period positive effect on preventive health behavior. By considering the short-term nature of many construction projects, it can be inferred that the new incentive system is more useful for construction industries rather than other industries.

Surprisingly, the result for Parameter E was higher in the control project compared with the case project. This could be due to the training that they had received in the past in that specific topic.

Unlike most studies performed on this subject, which mainly focused on management and organizational factors, the present study concentrated on frontline employees. The results of this study show that the surprising incentive would improve the employees' safety performance only in the short term as the surprising value of the incentives dwindle over time. For this reason and to maintain the surprising value of the surprising incentive system, the amount and types of incentives need to be evaluated and modified annually or biannually. These modifications can be made based on the needs and characteristics of the society at that particular point in time.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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