CASE STUDIES OF RETURN ON INVESTMENT IN CONTRUCTION SAFETY MANAGEMENT

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Expressing the benefits of investing in construction safety management in monetary terms will allow project stakeholders to have a better understanding of the significance and effectiveness of the investment. This paper presents the results of case studies of six building construction projects in relation to the return on investment in construction safety management. The paper is built on the research work that the authors have previously published on the development of the return on investment models. It is found that investing in construction safety management will yield positive outcomes and for the six cases studied, the returns on investment were in the range of 46% to 364% with an average of 214%.

Keywords: return on investment, construction safety, risk management, cost of accident, investment in safety.

INTRODUCTION

The building construction industry has a high rate of occupational accidents in most countries (Torner, 2009). Construction is always risky because of outdoor operations, work-at heights, complicated on-site plants and equipment operation coupled with workers' attitudes and behaviours towards safety (Choudhry, 2008). In addition, the nature of the work, working environment, and job site conditions are often changing, making the field less safe (Broadbent, 2006). Not only does risky behaviour potentially affect the workers' safety, but there can be high costs to the construction companies, such as workers' compensation insurance, increased chance of liability units, and criminal prosecutions of managers who allow work in unsafe conditions (Gambataese, 1999). Effort has been made to mitigate safety risks through technical solutions, rules, and regulation (Torner, 2009). A construction safety management system (SMS) is formal, business-like approach to managing safety which includes the necessary organizational structures, accountabilities, policies and procedures. An effective SMS can be used as a company strategy by construction firms to earn a competitive position of optimum advantage (Rechenthin, 2004).

To achieve high level of construction safety performance, it is necessary to invest human resources and money to the development and implementation of SMS systems. However such investment is not where a company generates revenue but it is a place that generate profit by minimizing and mitigating safety risk and thus lower or eliminate the potential for loss. Furthermore, decision makers' motives for introduction of a SMS may stem from various concerns such as humanitarian, legal,

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company image and cost. Since intense competition has made construction market dominated by clients groups (Egemen and Mohamed, 2006), contractors may ignore the importance of safety as their extra expenses on safety management may place them in a less competitive position during the tendering stage. In addition, compared with the large amount of inputs at the beginning, it may take years to identify the benefits of safety management, especially when many benefits are intangible and hard to convert into monetary terms (Muñiz *et al.*, 2009). These barriers lead to a misunderstanding that safety investment is a non-returnable investment that is not of benefit to anyone (Occupational Health and Safety Research Institute, 2007).

This research was built on the previous work undertaken by the authors (Zou *et al.*, 2010; Sun and Zou, 2010) where a ROI model was developed, and presents the results of the studies of six real project cases. In simple term, the ROI may be defined as Equation 1.

$$ROI = \frac{TPO - TPI}{TPI} \times 100\% \qquad (1)$$

Where: ROI – Return on Investment; TPO – Total Project Outcomes; TPI – Total Project Investments.

While the readers may find full details in the papers by Zou *et al.* (2010) and Sun and Zou (2010), the calculation steps in the ROI model may be presented by Figure 1.

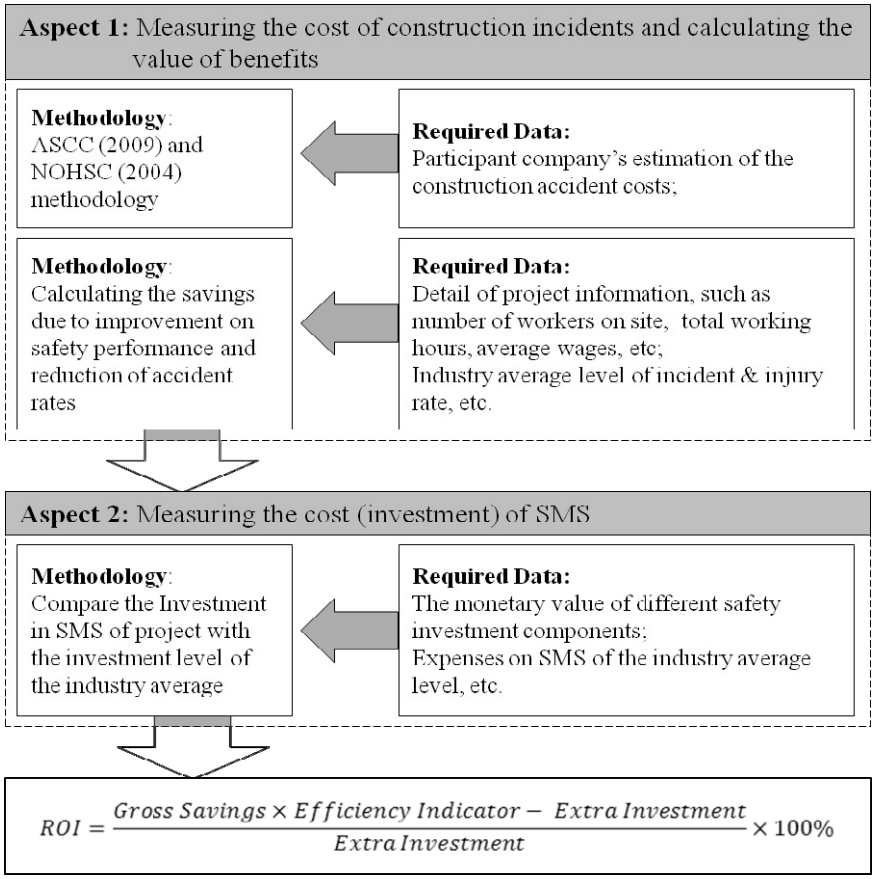

Figure 1 ROI Model (adapted from Zou et al. *2010)*

CASE STUDIES

Case studies of six real construction projects were undertaken and the results are presented. The data of safety performance and safety investment were collected from real projects undertaken by General Construction Company (GCC); the name was fictional for confidential reasons, but the company and projects were real), which was one of the largest construction companies in Australia and has global operations. The basic information of the six projects was listed in Table 1.

Table 1 Basic information of the six projects under study

Project ID	Construction Period	Project Budget ($millions)	Safety Investment Ratio (SIR) (%)	Total Hours Worked
Project 1	2007-2010	100	3.02	711,192
Project 2	2007-2010	480	2.24	3,001,762
Project 3	2007-2009	215	2.59	2,555,917
Project 4	2007-2009	70	2.90	1,348,629
Project 5	2006-2008	140	2.59	1,087,423
Project 6	2007-2009	100	2.70	972,156

Table 2 Statistics of incidents, injuries and fatalities of construction industry in Australia (2007-2009)

		2006-2007	2007-2008	2008-2009	06-09 Average
Short absence1	Number of claims	6122	5454	5520	5699
	Frequency rate2	16.4	13.0	13.1	14.1
Long absence	Number of claims	10915	11560	11709	11395
	Frequency rate	8.3	8.6	7.9	8.26
Partial incapacity	Number of claims	2130	1730	1838	1899
	Frequency rate	1.6	1.3	1.2	1.37
Full incapacity	Number of claims	970	1115	1133	1073
	Frequency rate	0.7	0.8	0.7	0.73
Fatality	Number of claims	53	37	42	44
	Frequency rate	4.1	2.8	2.7	3.2

1 The data for short absence injuries is based on the statistics of NSW rather than the national scope, because in Australia, Jurisdictions have different excess period where the costs of injury/disease are paid during the excess period before compensation from insurers incurred. Since the projects under study were located in NSW, the statistics of NSW were selected for data analysing.

2 Frequency rata of occupational injuries and diseases is the number of cases expressed as a rate per 1 million hours worked by employees. Such rates are calculated using the following formula.

$$Frequency\ rate = \frac{number\ of\ occupational\ injury\ and\ disease\ cases\ \times 1{,}000{,}000}{number\ of\ hours\ worked}$$

Frequency rate for fatal incident is based on per 100 million hours worked by employees.

(Source: The Safe Work Australia Online Statistics Interactive)

To compare the safety performance of GCC project with the industry average, statistics of incidents, injuries and fatalities of Australia construction industry of the reference year were collected from the National Online Statistics Interactive (NOSI), which were summarized in Table 2.

Table 3 Results of the comparison study of safety performance

	Difference of number of incidents				
Project ID	**Short absence**	**Long absence**	**Partial incapacity**	**Long incapacity**	**Fatality**
Project 1	7.28	4.87	0.89	0.53	0.02
Project 2	24.17	12.76	3.75	2.25	0.08
Project 3	-10.92	-8.91	3.19	1.92	0.07
Project 4	11.60	11.13	1.69	1.01	0.04
Project 5	13.41	-1.01	1.49	0.80	0.03
Project 6	8.78	3.04	-0.67	0.71	0.03

Using the model developed by Zou *et al.* (2010), the safety performance of the six GCC projects and industry average could be compared, for which the results were summarized in Table 3.

Once the differences in numbers of incidents and the cost of relevant incidents are determined, the savings from the reduced number of accidents could be therefore calculated. In terms of safety investment, data of the relevant components were collected from GCC. Table 4 summarizes the results of savings and ROIs of all six projects under study. As can be seen from Table 4, an average saving of AUD$2.9 million and average ROI of 214.19% were achieved by these projects, which has verified the ROI model proposed and proved the positive economic impact of SMS on project performance.

Table 4 Results of savings and ROI calculation

	Savings from safety improvement (AUD$)	**Extra safety investment (AUD$)**	**ROI (%)**
Project 1	1,491,654	1,021,126	46.08
Project 2	5,980,676	1,141,132	424.10
Project 3	4,211,207	1,271,660	231.16
Project 4	2,908,417	627,018	363.85
Project 5	1,937,445	824,897	134.87
Project 6	1,304,521	704,742	85.11
Average	2,972,320	931,763	214.19%

DISCUSSION

As can be seen from the ROI calculations, although the safety investment ratios for the six projects were higher than the industry average (2%), all projects have achieved better safety performance. With a higher safety investment, approx AUD$2.9 million could be saved from the reduced number of construction accidents, which could generate an average ROI of more than 200%. It shows that the increasing expenses on safety management will be covered by the savings from reduced number of accidents. It should be noted that these savings were actually not ‘cash profit’ which can be paid back to project stakeholders. But the economic benefits from improved safety performance cannot be ignored.

It should be pointed out that a 2% industry average has been used as safety investment in the calculation for comparison purpose. This figure was estimated based on the current literature. However, this figure may change from time to time and from project to project. With lower or higher industry average values, the ROI results would be lower or higher accordingly.

Another important issue was the intangible benefits. This research only focused on the tangible benefits, which was relatively easier to convert into monetary value. One cannot underestimate the effect of intangible benefit. In terms of construction sector, intangible benefits of safety investment may include, but not limited to, worker's motivation and satisfaction, client's satisfaction, company's market share, corporate image and reputation, etc. So far there are few systematic methodologies that are able to measure the intangible benefits objectively, which was also a limitation faced by this study. In general, the value of intangible benefit was often considered to be much more than the tangible benefits; hence the overall benefits will be much more significant if the value of intangibles was calculated. Investigating into the intangible benefits of SMS investment would be a future endeavour in this research area.

Another limitation of this research was that only six projects were studied. The small number of projects may not reflect the true effectiveness ROI of the construction SMS. Consequently, it also limited the ability of this research in investigating or comparing how different characteristics of projects could influence the safety performance and the ROI of SMS. Future study can be carried out to replicate this research to a larger scale. For example, future studies can involve more projects from the same company.

CONCLUSIONS

The focus of this research was on undertaking case studies on the return on investment (ROI) of safety management system of construction projects. Using the methodology of the ROI model developed by Zou *et al.* (2010), all six projects under study have achieved a positive ROI and generated large amount of savings from the reduced number of construction accidents. The average savings and ROI for the six projects were approx AUD$2.9 million or 214.19%, which proved that increasing investment in SMS could bring economic benefits to construction projects.

The significance of this research was that it provided a good example of measuring the benefits of safety investment using quantitative approaches. The data analysing of this study was based on the actual statistics collected from relevant database rather than traditional qualitative methods such as questionnaire survey and interview, and this guaranteed the objectiveness and accuracy of data analysing and research findings.

Replication of this research on a larger scale will allow researchers and practitioners to assess the generalisability of the findings across the construction industry to have a better understand of safety investment. Future research in this topic would include replicating the ROI model developed with more real case projects to achieve a statistically meaningful conclusion and understanding the role of intangible benefits derived from investment into construction safety management system.

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