

ANALYSIS OF SAFETY MANAGEMENT SYSTEM TO MINIMIZE THE RISK OF WORKING AT HEIGHT

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HONG Kong construction industry has a very high accident record rate. Highest numbers of accidents have occurred due to falling from height. This paper presents a research that was carried out through case studies on 14 sites where personnel were working at a height. The study indicates that 65% of the respondents did not have a safety management system in force while the rest had a reasonably sound system and complied with it. Further, a detailed study was carried out on the circumstances that led to a major accident causing many fatalities. Results point to the fact that safety management systems implemented by most construction companies lack effectiveness. Poor motivation and lack of commitment to eliminate or reduce risks and achieve progressive improvement of safety standards for all risk areas was observed. Findings suggest that financial pressure may have made the companies objectives different from those that are safety related.

Keywords: Safety, Height, Construction, Contractors, Hong Kong

Introduction

Hong Kong construction industry has a bad reputation for its high accident rate that is about 5.8 times higher as compared to the other industries. Also its fatal accident rate is 10.5 times higher than the overall average for industrial workers (HK Education, 1995). Further the number of accidents in this industry due to fall from height have an average of 9000 per annum of which the number of fatal accidents average to 50 per annum. Being a territory that builds many high-rise structures, this must be a matter of great concern.

Until 1995, HK Government's strategy on industrial safety was entirely an "enforcement approach". Identifying the drawbacks of this system, the strategy was moved towards a "self regulation" approach where industries were motivated to implement safety management system (HK Education, 1995). Previous research by the authors (Ahmed, 1999) found that owners of Hong Kong construction projects consider site safety the most important risk that should be shared by the owner and the contractor. Another significant observation made during that survey was that the Hong Kong construction contractors also give a high importance to the risk of safety.

A previous survey conducted by the authors (Ahmed, 1997) concluded that although most contractors have their safety policy and management systems in place, their effectiveness appears to be reduced.

This paper presents results from an opinion survey and a case study conducted in Hong Kong. The opinion survey was by a series of 14 structured interviews. Respondents were selected from among the supervisors and operators at the 14 sites visited for this purpose. The case study was conducted

on an accident where 12 persons were killed due to a free fall of a passenger hoist. Data on the case was collected by interviewing the site personnel who was on duty at that time and by referring to the accident investigation report filed with the Labor Department.

Opinion Survey

A questionnaire was prepared to obtain facts about the comprehensiveness of the safety management systems from construction contractor companies. An outline of the 100 questions concerning safety management is listed in **appendix 1**. During structured interviews the respondents were asked to answer mentioned questionnaire. All positive answers were given one mark and negative answers were given zero marks. Subtotals of scores that fall into different classes are listed in **appendix 2**. Finally, the total marks scored by the safety management set-ups at the respondents' organizations were calculated. The results are summarized in Table 1 located at the end of this text.

Table 1: Level of safety management set-ups at Hong Kong construction companies

% of Respondents (approx.)	Number of Respondents	Marks
21%	(3)	Above 90%
14%	(2)	Between 75% - 80%
7%	(1)	14%
58%	(8)	Less than 10%

The results displayed in Table 1 indicate that there is a wide disparity in the safety management set-ups of each Hong Kong construction company. While 21% scored above 90% marks, an alarming number of respondents (57%) scored below 10% marks.

It was revealed by this survey that 65% of the organizations that scored 14% marks or less did not have a safety management system in place. In that situation, the staff and workmen of these companies did not receive any message from the top management requiring them to ensure safety at work sites.

In contrast, 35% of companies that scored above 75% marks had implemented safety policies committed to achieve full compliance with all safety legislation. In those companies:

- ✘ Managing Directors were leading the safety management system
 - ✘ There were written specifications for the control measures of each hazard
 - ✘ Safety elements were included into the method statements
 - ✘ Safety committees were established with the participation of the senior management and representatives at all levels, and would meet regularly
 - ✘ Workmen received training on safe working procedures
 - ✘ Personal protective equipment (PPE) was provided and adequate guidelines were provided at the sites.
 - ✘ Workmen knew the emergency plans and evacuation procedures
 - ✘ A job hazard analysis was carried out
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However, it was commonly observed that the safety policy was not displayed at a prominent place and no target was set in the policies for safety performance including a commitment for progressive improvement in standards for all risk areas. Arrangements to monitor the adequacy of compliance with hazard control measures were often absent. Even where job hazard analysis was carried out, no controls were recommended to prevent injury or loss. Hence the hazard could not be eliminated. When processes or functions were changed, the risk assessments were seldom reviewed or updated. Fewer than 14% of the respondents claimed that their companies considered safety performance during assessment for promotions, increments, et. al.

Case Study

A horrific industrial accident occurred in a construction site at North Point, Hong Kong in June 1993. A total of 12 workmen including a teenager were killed when a passenger hoist underwent a free fall from height. Summary of the study on the incident is as follows:

The company had a safety policy signed by the Managing Director. However, the message of the policy was not passed effectively to all the employees to make them aware of their safety responsibilities. This came about due to the organizational deficiency of poor communication at two levels:

- Ꞑ between the workmen and the site management
- Ꞑ between the site management and the top management of the company

Company goals being incompatible with the safety policy and the resulting lack of financial support encouraged the site management to undermine the safety arrangements.

Before the accident, the site management had not arranged the lift subcontractor to carryout regular examination and maintenance of the lift. The assistant engineer had also ignored the arrangement for weekly inspection. There were no full time safety personnel on site to take action and keep records of required certificates.

On the fateful day after tea break, some workers were seen horse-playing and safety consciousness was apparently low. They crowded into the lift ignoring the maximum loading capacity. There was no security guard in charge of the lift to prevent such overloading. Due to the inadequacy of the training provided or the sheer negligence and incompetence of the operator, the potentially dangerous consequences of the overloading were overlooked/ignored.

Overall, the site management and the workers violated the safety policy of the company. As a consequence, a bad safety organization prevailed. In the process control programme, the management was negligent of the fact that the hoist facility provided was insufficient. The company had employed a lift subcontractor who provided a hoist with an unknown manufacture date. Neither follow-up action was taken nor it was discussed at the safety committee meeting.

The lift contractor was also guilty of professional negligence because of inadequate design of the passenger hoist and its improper installation. Safety alarm for overloading was not installed.

Consequence of these failures in safety management systems was that 12 workers were trapped in a free falling hoist. All were killed in the incident. The Labor Department under the provisions "General Duties of the Proprietors" and "General Duties of the Persons Employed" prosecuted the main contractor and the lift subcontractor. More than 50 summons were issued to site personnel including the Project Manager, Site Agents, Assistant Engineer, General Foreman and the Site

Safety Officer. Most of them were convicted of manslaughter. The amount of money spent was also enormous and the company received a bad reputation.

Conclusions

The research findings point to the fact that 65% of construction contractors in Hong Kong are not actively implementing safety management systems. Even where safety management systems were in force, the opinion survey pointed to the fact that motivation to comply with the system left much to be desired. Commitments to eliminate or reduce the risks to progressively improve safety standards for all risk areas were lacking. Safety performance not being seriously considered during employee evaluation could be seen as a contributing factor.

The case study conducted at a site where a major accident took place revealed how lack of communication, incompatibility of company goals with the safety policy and the resulting lack of financial support contributed to poor implementation of mentioned safety policy. These factors coupled with professional negligence caused the terrible accident.

Results of this study reinforce earlier findings that safety policies and management systems implemented by most construction contractors in Hong Kong lack effectiveness. In this context, serious attention should be given to motivate the contractors to comply with their safety management systems and to comply with the safety legislation, by providing financial incentives such as paying for the safety management system elements.

Acknowledgement

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References

- HK Education and Manpower Branch, (1995). Consultation Paper on the Review of Industrial Safety in Hong Kong, Government Secretariat, Hong Kong, July.*
- Ahmed, Syed M, Ahmad, Riaz & De Saram, D. Darshi, (1999). "Risk Management Trends in Hong Kong Construction Industry: A Comparison of Contractors and Owners Perceptions", accepted for publication in a forthcoming issue of the Journal of Engineering, Construction and Architectural Management, UK.*
- Ahmed, Syed M and Chim, S P, (1997). "Application of Risk Management Techniques to Improve Safety Management in the Hong Kong Construction Industry", International Journal of Project and Business Risk Management, UK, Vol. 1, Issue 4, pp 359-371.*
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Appendix 1: Scores of the 100 Safety Questions

Legend: Y - Yes, N - No, N.A. - Not Applicable

Elements	Nos.	Question	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11	Case 12	Case 13	Case 14	Total % of "Y"	
Safety Policy	1	1.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	2	1.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	3	1.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	4	1.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	29	
	5	1.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	6	1.6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	0
	7	1.7	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	8	1.8	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	9	1.9	N	Y	N	N	N	N	Y	Y	N	N	N	N	Y	N	29	
	10	1.10	N	Y	N	N	N	N	Y	Y	N	N	N	N	Y	N	29	
Safety Organization	11	2.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	12	2.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	13	2.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	14	2.4	N	N	N	N	N	N	N	N	N	N	N	N	N	N	0	
	15	2.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	N	21	
	16	2.6	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	17	2.7	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	79	
Safety Training	18	3.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21	
	19	3.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	20	3.3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	93	
	21	3.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	22	3.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21	
	23	3.6	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21	
	24	3.7	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	14	
Safety Regulations and In-house Safety Rules	25	4.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21	
	26	4.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21	
	27	4.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21	
	28	4.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
	29	4.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	14	
	30	4.6	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
Safety Committee	31	5.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	43	
	32	5.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	43	
	33	5.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	43	
	34	5.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	43	
	35	5.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	43	
	36	5.6	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	43	
	37	5.7	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	43	

Scores of the 100 Safety Questions (Appendix 1: Contd...)

Legend: Y - Yes; N - No; N.A. - Not Applicable

Elements	Nos.	Question	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11	Case 12	Case 13	Case 14	Total % of "Y"
Programme for Inspection of Hazardous Condition	38	6.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	39	6.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	40	6.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	41	6.4	N	N	N	N.A.	N	N	N	N	N	N	N	N	N	N	0
	42	6.5	N.A.	Y	N.A.	N	N	N	N	N	N	N	N	N	Y	Y	21
	43	6.6	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	44	6.7	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
Job Hazard Analysis	45	7.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	46	7.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	47	7.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	48	7.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	49	7.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
Personal Protection Equipment	50	8.1	N	Y	N	N	N	Y	Y	N	N	Y	N	N	Y	Y	43
	51	8.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	52	8.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	53	8.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	54	8.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	55	8.6	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	56	8.7	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	N	21
Accident Prevention	57	9.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21
	58	9.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	59	9.3	Y	Y	N	N	N	Y	Y	N	N	Y	N	N	Y	Y	43
	60	9.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	61	9.5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
	62	9.6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
	63	9.7	N.A.	Y	N.A.	N	N	Y	Y	N.A.	N	N	N	N	Y	Y	36
	64	9.8	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
Accident Investigation	65	10.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	66	10.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	67	10.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21
	68	10.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	69	10.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
Emergency Preparedness	70	11.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	71	11.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	72	11.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	73	11.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	74	11.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	75	11.6	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36

Scores of the 100 Safety Questions (Appendix 1: Contd...)

Legend: Y - Yes, N - No, N.A. - Not Applicable

Elements	Nos.	Question	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11	Case 12	Case 13	Case 14	Total % of "Y"
Safety Promotion	76	12.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	77	12.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	78	12.3	N	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	21
	79	12.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	80	12.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	81	12.6	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	N
Evaluation, Selection and Control of Sub-contractor	82	12.7	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21
	83	13.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	84	13.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	85	13.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21
	86	13.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	87	13.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	21
	88	13.6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	93
	89	13.7	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
90	13.8	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36	
Process Control Programme	91	14.1	N.A.	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	92	14.2	Y	Y	N	N	N	Y	Y	N	N	N	N	N	N.A.	N.A.	29
	93	14.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	94	14.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	N.A.	N.A.	21
	95	14.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
Safety Information System	96	15.1	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	97	15.2	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	98	15.3	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
	99	15.4	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
Total Marks	100	15.5	N	Y	N	N	N	Y	Y	N	N	N	N	N	Y	Y	36
			7	96	5	5	4	95	94	5	2	14	4	5	79	76	

Appendix 2: Summary of the Scores of the 14 Cases and the Fatal Accident Case

Elements	Total marks	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11	Case 12	Case 13	Case 14	The Fatal Accident Case
Safety Policy	10	0	9	0	0	0	9	9	0	0	0	0	0	9	6	2
Safety Organization	7	1	6	1	1	0	6	6	1	0	1	0	1	5	5	1
Safety Training	7	1	6	1	1	1	7	7	1	0	1	1	1	3	3	1
Safety Regulations and in-house Safety Rules	6	0	6	0	0	0	6	5	0	0	0	0	0	2	2	0
Safety Committee	7	0	7	0	0	0	7	7	0	0	7	0	0	7	7	3
Programme for Inspection of Hazardous Conditions	7	0	6	0	0	0	5	5	0	0	0	0	0	6	6	2
Job Hazard Analysis	5	0	5	0	0	0	5	5	0	0	0	0	0	5	5	1
Personal Protection Equipment	7	0	7	0	0	0	7	7	0	0	1	0	0	6	6	2
Accident Prevention	8	3	8	2	2	2	8	8	2	2	3	2	2	7	7	1
Accident Investigation	5	0	5	0	0	0	5	5	0	0	0	0	0	4	4	1
Emergency Preparedness	6	0	6	0	0	0	6	6	0	0	0	0	0	6	6	1
Safety Promotion	7	0	7	0	0	0	6	6	0	0	0	0	0	5	5	1
Evaluation, Selection and Control of Sub-contractors	8	1	8	1	1	1	8	8	1	0	1	1	1	6	6	1
Process Control Programme	5	1	5	0	0	0	5	5	0	0	0	0	0	3	3	0
Safety Information System	5	0	5	0	0	0	5	5	0	0	0	0	0	5	5	0
Total Marks	100	7	96	5	5	4	95	94	5	2	14	4	5	79	76	17