Advancement in Safety Practice for the Lift and Escalator Industry in Hong Kong

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ABSTRACT

Hong Kong is a modern city with a high population density and a great demand for efficient vertical transportation. Lift and escalator safety has become increasingly important. The Hong Kong Government has imposed strict requirements on the design, construction and maintenance of lifts and escalators in order to safeguard installation and maintenance workers and passengers. The implementation of the new safety audit scheme and the performance monitoring system has contributed to the improvement of the overall safety performance at the work-places.

This paper will focus on the current safety practice, including the requirements of the auditing and monitoring systems and the local statutory practice of the lift and escalator industry. In addition to emphasizing the advances in safety practice, I will identify some of the potential hazards related to the lift and escalator safety and highlight effective preventive methods.

1. INTRODUCTION

Lifts and escalators, we take them for granted as safe and reliable. Because of the innovative design of modern skyscrapers and the advancement of technology, the need for faster and more comfortable lifts and escalators becomes obvious. It necessitates lift and escalator manufacturers and contractors to take due care and pay attention to the safety of design, installation and maintenance. However, the installation, major alteration, modernization and maintenance of lifts and escalators is a paradoxical mix of sophisticated high technology and manual commissioning. Development of predisposing condition may give rise to accident (McDonald Accident Model). Therefore, active hazard control is not the only solution and in fact passive hazard control is also crucial for preventing human error. To this end, improving the efficient operation of lifts, effective safety practices and management systems should be adopted to upgrade the standard of safety of the whole industry.

2. CURRENT SAFETY REGULATIONS AND REQUIREMENTS

In principal, safety aspects related to lifts and escalators include factors such as (1) system design and construction; (2) proper installation and maintenance; (3) work safety; (4) user conditions; and (5) environment of lift and escalator. To govern these aspects, there are comprehensive safety regulations and requirements established in Hong Kong. For example, Lifts and Escalators (Safety) Ordinance, Chapter 327, Code of Practice on the Design and Construction of Lifts and Escalators, Code of Practice on the Examination, Testing and

Maintenance of Lifts and Escalators and Code of Practice for Safety at Work (Lift and Escalator), etc..

The Government has also laid down the obligations of employers for the 'safety of employees' in the legislations, namely Factories and Industrial Undertaking Regulations, Cap. 59 and Occupational Safety and Health Ordinance, Cap. 509. The employers are required to ensure the health and safety at work of all persons employed in the factories or industrial undertakings. The obligatory duties mainly include:

- provide and maintain plant and work systems that are safe and without risk to health;
- make arrangements to ensure safety and health in connection with the use, handling, storage or transportation of plant and substances;
- provide all necessary information, instructions, training and supervision to ensure health and safety at work of all persons employed;
- maintain every part of the factory or industrial undertaking in a condition that is safe and without risk to health, and provide means of access to and egress from the work, that are also safe and without health risk; and
- provide and maintain a working environment for all persons employed that is safe and without risk to health.

Hong Kong has encountered a severe construction site accident when a passenger hoist loaded with workers collapsed at a Java Road construction site in 1993. The fatalities caused by this accident served to awaken the public's awareness of the importance of site safety management. Investigations revealed that the major contributing factor causing this accident was that the hoist had neither been properly maintained nor periodically inspected by competent person. As a result, the Government conducted an investigation and review of procedures on construction sites and the company involved in the accident was prosecuted. This accident at Java Road prompted the Government to take serious and direct measures in order to improve site safety practices. In July 1995, a White Paper on self-regulation was published explaining how the enforcement approach to safety management was fraught with drawbacks, due to the prescriptive nature of the legislation required and that a self-regulation initiative was required. "Hong Kong should transform an enforcement approach to a safety management approach in tackling workplace safety and health issues. The new system will be based on the Government encouraging employers and employee promotion of safety concepts and a better understanding of the cost of accidents." (The White Paper - Hong Kong Government 1995). This revealed that, for Hong Kong to achieve high standards of safety and health at work, enterprises must embrace self-regulation and safety management. Consequently, the Government introduced a safety management system consisting of 14 elements. In order to implement the system comprehensively, the "Factories and Industrial Undertakings (Safety Management) Regulation" was enacted on 24 November, 1999. This regulation will be enforced after 1-year grace period and also be imposed on the lift and escalator industry.

3. ACTIVITIES ON SAFETY MANAGEMENT AND QUALITY PERFORMANCE

In addition to the regulations, there have been different kinds of schemes introduced by various govenment departments to enhance the safety management and quality performance of the contractors.

3.1 SAFETY TRAINING FOR CONSTRUCTION WORKERS

In 1995, the general safety induction training course ("Green Card Course") for construction workers was first introduced by the Hong Kong Construction Association. On the recommendation of the Labour Department, an enhanced "Green Card Course" run by the Construction Industry Training Authority, was further developed. Workers have to pass a test before being awarded a "Green Card accredited by Labour Department" which certifies their successful completion of the Course. This recognised safety training will be made mandatory for all employees working at construction sites with effect from September 2000.

3.2 SAFETY AUDIT SCHEMES

Since 1996, two safety audit schemes namely, the Housing Authority Safety Audit Scheme and the Independent Safety Audit Scheme have been adopted by the Hong Kong Housing Authority and the Works Bureau respectively. Under these schemes, significant continuous improvement on the contractors' safety performance was observed.

3.2.1 Housing Authority Safety Audit Scheme ("HASAS")

The purpose of this safety audit scheme is to prove that the safety performance of the contractor is satisfactory before the contractor can be allowed to tender for public works. It is an audit scheme solely for the assessment on the safety aspects at construction sites, and the main concern is safety at the workplace. The audit is intended to reveal the strengths and weaknesses of the contractor's management of on-site safety, by encouraging self-regulation through a safety management system.

3.2.2 Independent Safety Audit Scheme ("ISAS")

ISAS has been devised and is monitored by the Occupational Safety and Health Council ("OSHC"). The system itself is based on the structure of Complete Health and Safety Evaluation ("CHASE") and OSHC has restructured the audit questions of CHASE to correspond with the 14 essential elements of Safety Management System. It has two parts, A and B consisting of 129 questions and 280 questions respectively. This audit system was adopted by the Works Bureau and was applied to tenders that were called on or after 19 April 1996. The procedure of this scheme is similar to that of the HASAS. If the contractor has been convicted of 5 or more site safety related offences within 6 months, or has incurred a serious accident on site, temporary suspension from tendering for contractor will be imposed. Then, an independent safety audit on the contractor's safety management system and its implementation on-site, is required to be carried out by an accredited safety auditor, who needs to submit a further audit report to the Works Bureau.

The contractor will only be allowed to tender for new works' contracts after he has proved to have satisfactory site safety performance. The suspension from tendering can only be reinstated after the expiry of the period of suspension determined, or until the Works Bureau is satisfied with the adequancy of the contractor's site safety management and its implementation on site.

3.3 PERFORMANCE MONITORING SYSTEMS

Apart from the safety audit schemes, the Hong Kong Housing Authority ("HKHA") adopted the Building Service Performance Assessment Scoring Scheme for their new works' contracts

and the Performance Monitoring Point System for all of their new and existing works' contracts. The Electrical and Mechanical Services Department ("EMSD") also adopted a point system to monitor the private works of lift and escalator installation.

3.3.1 Building Service Performance Assessment Scoring Scheme ("BSPASS")

The BSPASS was introduced for the new works' building contracts by the Housing Department in October 1993. It was proposed that a new BSPASS would soon be implemented for the BS nominated sub-contracts with a view to assessing the sub-contractors' performance and encouraging contractors to improve works quality through the implementation of new incentive schemes. The performance will be assessed in various aspects, for example, the safety assessment on precautionary measures, work related safety, safety planning and co-ordination with the main contractor etc..

3.3.2 Performance Monitoring Point System ("PMPS") of EMSD

This point system was officially implemented by EMSD on 1 July 1992. It aims to monitor and record the work performance of registered lift/escalator contractors and/or engineers, so as to maintain the quality of works and to ensure the safety of passengers.

The performance of registered lift/escalator contractors or engineers will be assessed based on the requirements stipulated in the Lifts and Escalators (Safety) Ordinance, and any regulation applicable to a lift or an escalator. Any non-compliance item found will be recorded in terms of the PM points and the points incurred will remain in the records of that registered contractor or registered engineer for 12 successive months. For a registered contractor or registered engineer who has accumulated the designated PM points, warning letter may be issued to them or the matter may be brought to a disciplinary board.

3.3.3 Performance Monitoring Point System ("PMPS") of HKHA

The Housing Authority introduced the PMPS on lift and escalator installations in 1998. The system was firstly implemented for new lift installation, and eventually applied to all new and existing lift and escalator installations. For this system, tailor-made forms cater for the PMPS assessment. Assessment is carried out at regular intervals, for example, once a year or once every five years. Points taken for each assessment will be passed to EMSD for merging with the contractors' or engineers' record, and disciplinary action against the contractors or engineers will be taken if necessary.

3.4 OCCUPATIONAL SAFETY CHARTER

The Hong Kong Government has decreed a policy statement in promoting safety that is the Occupational Safety Charter in September 1996. The mission to this implementation was to ensure the risks to people's health and safety at work were properly controlled. This can only be achieved by the active participation of both the employers and the employees.

In the work safety environment, there is inevitably a triangular relationship between the employer, the employee and the Government Departments. In the Safety Charter, the responsibilities and obligations of different parties are set out. It states that employers in partnership with their employees should plan, communicate, implement and evaluate their own version of system as self-regulation is encouraged. Advice and guidance are provided by the relevant Government Departments. It is recognised that active participation and involvement

of both employers and employees is fundamental in turning good policy and procedure into health and safety at work.

4. SAFETY MANAGEMENT SYSTEM

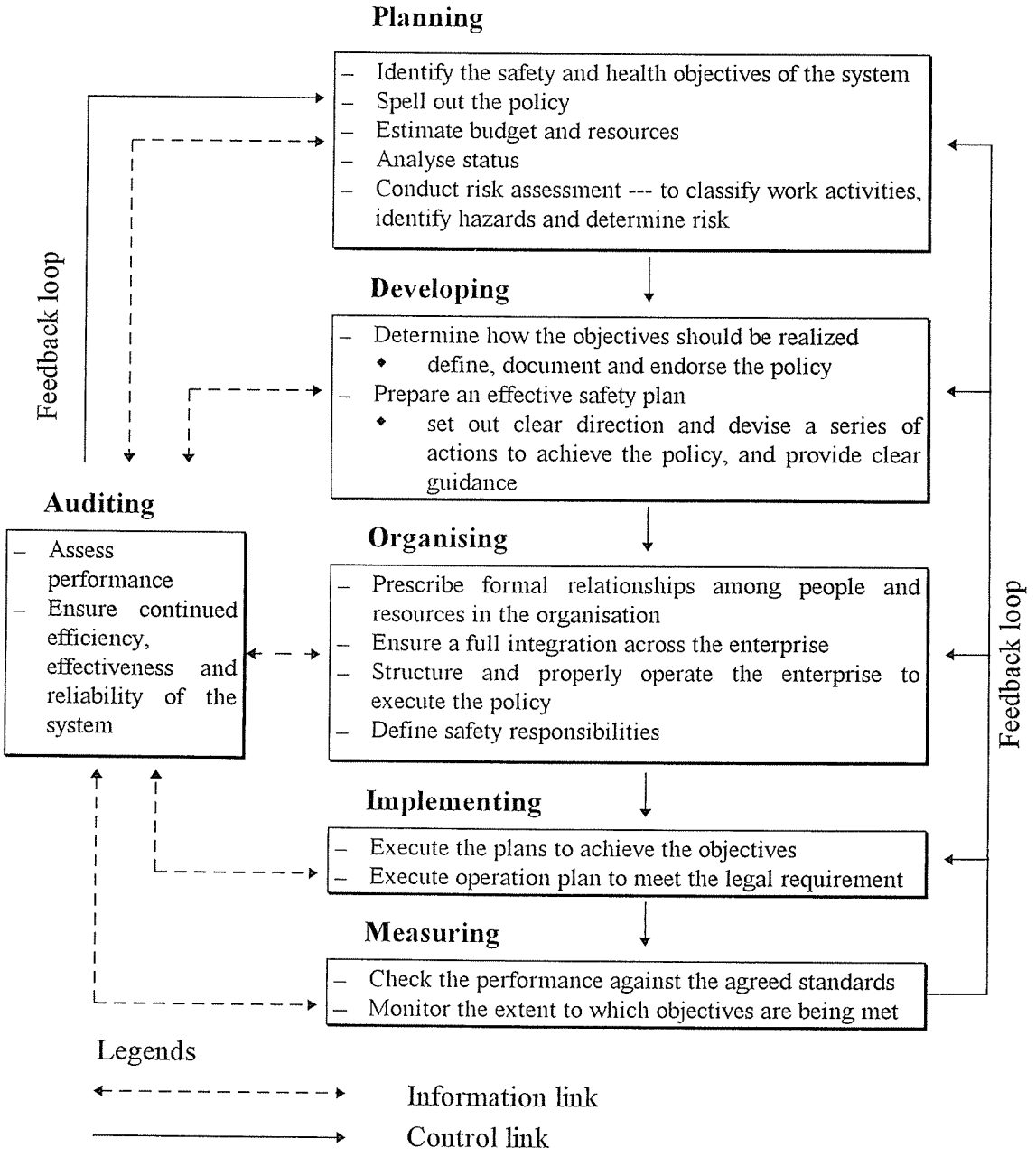

Figure 1. Management model

The above figure shows a model on how to set up a safety management system. As required by the newly introduced regulation, Factories and Industrial Undertakings (Safety Management) Regulation, contractors have to develop, implement and maintain a safety management system containing 14 specified safety elements. This model should be adopted not only in the development, implementation and maintenance of a safety management system, but also in the development, implementation and maintenance of each and every element constituting the system

The 14 process elements of the safety management system stipulated are as follows:

1. Safety policy
2. Safety organization
3. Safety training
4. In-house safety rules and regulations
5. Job hazards analysis
6. Personal protection program against hazards and risks
7. Accident or incident investigation
8. Emergency preparedness
9. Evaluation, selection and control of sub-contractors
10. Review measures by safety committee
11. Evaluation of potential hazards and development of safety procedures
12. Safety promotion
13. Accident control and elimination of hazards
14. Protection against occupational health hazards

5. RISK MANAGEMENT

Nowadays, occupational health and safety management systems have been widely adopted and implemented in various developed and advanced countries like England, Australia and New Zealand, through country standard and legislation. Among the various elements within the system, job hazard analysis and control, share a significant portion. The Australian / New Zealand Standard AS/NZS4360 Risk Management brings an integrated approach to risk management with common terminology and methodology which can be applied across different risk areas and at all levels within an organization.

The process of risk management defined in ASNZS4360 is illustrated in the following figure.

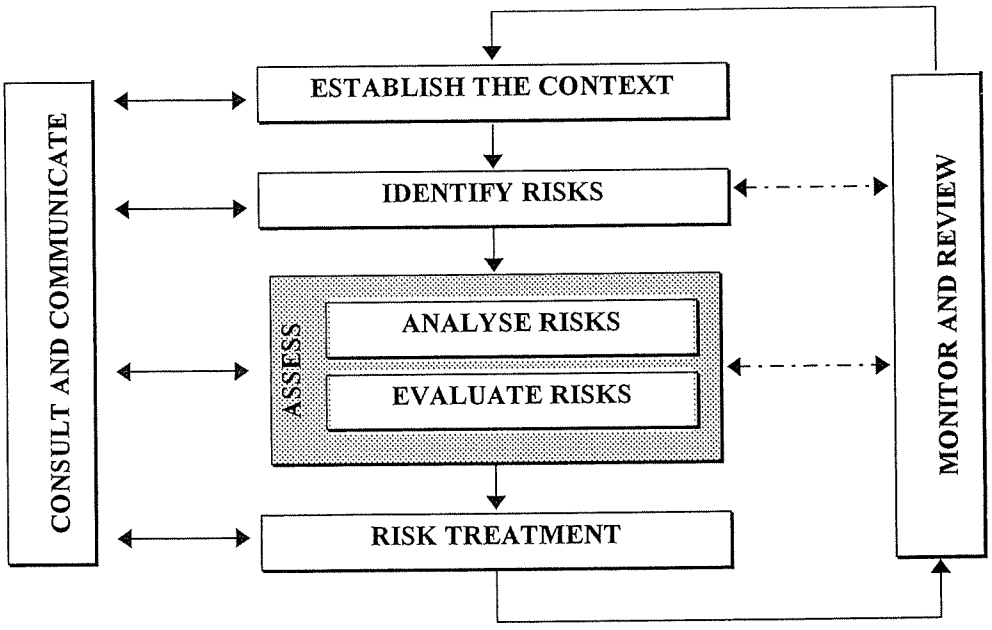

Figure 2. (Process of risk management)

The risk management system provides a systematic and effective means for the assessment of risks and hazards. Risk assessment of this system is divided into two stage processes involving

a factual analysis of how large a risk is and a more subjective evaluation of the acceptability of the risk level. So, risks can be prioritised for action or resource allocation using the following risk matrix.

Table 1. (Risk matrix)

Consequence / Likelihood		Insignificant	Minor	Moderate	Major	Catastrophic
		1	2	3	4	5
Almost Certain	A	S	S	H	E	E
Likely	B	M	S	S	H	E
Moderate	C	L	M	S	H	E
Unlikely	D	L	L	M	S	H
Rare	E	L	L	M	S	S

E	Extreme Risk	consider stopping work until dealt with
H	High Risk	must be dealt with as soon as possible
S	Significant Risk	a timetable and plan for action must be defined
M	Medium Risk	responsibility allocated
L	Low Risk	managed by routine procedures

As shown from the table, each risk identified can be ranked by its "Likelihood" and "Consequence". The risks are then categorized into different risk levels. Appropriate action or resource can be allocated in handling different risks systematically.

According to risk assessment, some processes in lift and escalator industry are regarded as high-risk activities e.g. where workers exposed to falling hazard or live work. Developing risk or hazard control is a necessity in bringing the workers to work in a safe place. The above illustrated concept offers new ideas for handling and managing different kinds of risk using an integral approach. Risk ranking as part of risk assessment helps to ensure that a limited budget is spent in the most cost effective way to reduce injury and disease.

6. PREVENTIVE MEASURES AGAINST ACCIDENTS

As mentioned before, identifying the potential hazard of work is an important step in the implementation of risk and safety management. It is necessary to recognise the work nature and the working environment so as to identify all the risk and potential hazards and to carry out site safety assessment. According to the Code of Practice for Safety at Work (Lift and Escalator), particular attention should be paid to potential dangers to prevent accidents from happening.

6.1 NATURE OF WORK AND WORKING ENVIRONMENT

In general, all lift and escalator workers engaged in heavy electrical and mechanical work and also fine manual testing and adjusting should be alerted to the potential hazards involved in different types of work, for example:

- Working at height
- Manual lifting work
- Mechanical lifting
- Fire prevention (general and in case of welding and cutting)

- Rope socketing
- Electrical work

To protect against the potential hazards for different work types and working environments e.g. "machine room", "car top" and "lift pit", sufficient and effective safety precautionary measures must be taken.

For lift work, the general precautionary measures include:

- Keep the working environment in a safe condition
- Provide adequate lighting and keep the place clean and tidy
- Turn the lift into inoperative mode before any inspection, cleaning or lubrication
- Provide a safe means of access to the lift well
- Keep a minimum number of persons working at the same time in a lift shaft
- Practise good house-keeping for manuals, drawings and equipment. Arrange these materials in proper place to facilitate workers easy reference

The specific working environment and the respective safety measures against the identified potential hazard can be briefly categorized into the following aspects.

Table 2. (Potential hazards of lift work environment)

LOCATION	HAZARD	SAFETY MEASURES
Car top	Falling due to loss of balance	• Ensure the car top stopping device operates normally • Provide a control station to interrupt normal operation and movement of lift car • Provide guard rails at car top • Assign only one man to control the station and give clear instruction • Keep car top clean and tidy • Turn to inspection operation upon entering car top
	Injury due to moving parts	• Stand clear from the moving parts, like moving rope or sheaves • Never hold any wire rope
	Injury due to colliding	• Provide enough headroom and give clear warning sign • Keep the body within the limits of the car top and stay in the safe region • Beware of the landing plate and counter weight in the lift well • Beware of the movement of the adjacent lift and never stand on the partition wall, in case of a common lift well
Lift pit	Injury due to movement of lift car	• Provide an effective stopping device in the lift well • Activate the pit-stop switch before entering the lift pit • Provide a counterweight screen to avoid colliding with the counterweight • Keep clear of the rotating parts in the lift pit
	Injury due to falling	• Provide safety means of access to the lift pit • Keep the lift pit clean and free from oil and water
	Falling of passengers	• Always keep doors closed • Provide fencing/barriers when the doors need to be kept open • Provide fencing/barriers with warning notice

Lift machine room / pulley room	Potential danager for unauthorized person	• Keep the doors locked and display permanent warning signs
	Injury due to rotating parts	• Guard all the dangerous parts of the lift machine such as the rotating parts and live parts • Provide a stopping device near the lift machine for emergency stopping • Keep the lift stationary when working on moving or rotating parts • Follow the work instruction strictly when leveling the lift car manually
	Electric shock	• Display electric shock treatment notices in prominent places • Provide an insulation rubber mat on the floor in front and at the rear of the controller and electrical switchboard • Never work on live equipment. If unavoidable, take adequate precautions. Be careful of the capacitors with large capacity even when the power is off • Give clear signals when resuming the power supply

With respect to escalator work, the safety precautionary measures are in general as follows:

- Provide fencing and warning notices at both landings prior to the work starting
- The escalator should be turned off, locked and tagged by the person-in-charge
- Ensure the effectiveness of the emergency stopping switches, overspeed and other protection devices
- Exercise extra care when working on the escalator truss.

6.2 SITE SAFETY ASSESSMENT

To operate a safety management system for lift and escalator work, a site safety assessment has to be carried out before the commencement of each work phase. Through the site assessment, a number of safety measures in respect of different working environments will be identified and recorded, including means of access, rescue procedures and evacuation, necessary safety guarding, essential safety control switches and safe working conditions of the site.

After the site safety assessment, a method statement should be provided. From the statement, the workers involved can clearly understand what to do and how to do. Subsequent periodic re-assessment of the site conditions should also be made in order to ensure a safe working environment throughout the whole work period.

7. CONCLUSION

In Hong Kong, major lift and escalator accidents involving injuries or fatalities generally result in lawsuits. The lengthy proceedings incur substantial loss to the involved parties in terms of money, time, manpower and even intangible damage e.g. reputation. A lot of resources need to be devoted to the investigation of the cause of accident and the determination of the liabilities concerned.

The effective means to prevent accidents rely upon not only the Safety Ordinance and Regulations, but also the Government's auditing / monitoring systems, and the contractors' "safety management system". It must follow the same principles applied to all systems that attention must be paid to key sub-systems such as structure, culture, commitment, motivation and leadership. None of these elements can exist in isolation and a change in any one will affect all the others to some extent. It should include integration perspective (Dunford 1992) in the democratic model as well (Spillane and Lansbury 1992). Besides, laying emphasis on training, the network of communication and the hazard control can also change the safety performance from 'metastable' to 'stable'. More importantly, both the employer and employee should work closely together to create a safe and healthy working environment. The public should also be aware of the proper usage of lifts and escalators. Ultimately, we must aim to achieve and maintain an extraordinary safety record in our lift and escalator industry.

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9. BIOGRAPHICAL DETAILS

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