

Trends and Issues in Safety Management of Elevators in Korea

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Abstract : This study focuses on the trends and issues of improving safety management of elevators in Korea. Frequency and severity of accidents in relation to conditional pass in periodic inspection, maintenance, market surveillance are analyzed based on the statistical data and social cost due to a variety of related fields in managing elevator safety was estimated first. The results of statistical analysis performed in this study will provide logical basis and future direction for improving the safety management system. The role of certification and supervision is particularly addressed to reduce the related accidents and the social cost. The effectiveness of such procedures can be found from the results of simple statistical analysis.

Key words: elevator, safety management, certification, supervision, inspection

1. Introduction

Safety management of elevators in Korea is known to be non-systematic and inefficient, which result in 108 cases of death and 129 cases of severe injuries from the year 1993 to 2004. In 2004, 5,511 locked-in accidents have been reported and 12,078 individuals were rescued from these accidents. Compared to the current safety management system, more realistic and efficient safety management system is, therefore, required to prevent the elevator-related accidents.

This study focuses on the trends and issues of improving safety management of elevators. The role of certification and supervision is particularly addressed to reduce the related accidents. The effectiveness of such procedures can be found from the results of simple statistical analysis.

2. Trends in Safety of Elevators in Korea

Table 1 shows that Fatality Rate in Korea (number of death in elevator accidents divided by the total number of installation) is about 5 to 10 times that of most of the major European countries.

Number of the injured and the dead in elevator accidents in Korea are compared with the total number of elevators installed (accumulated or newly-installed) in

Table 1. Total number of injured/dead in elevator-related accident in major countries

	Total Number of Installation (Units)	Annual Number of Death (Persons)	Comparison Index
Korea	211,741	9	100 (Basis)
Germany	433,660	2	10.8
England	172,000	1	13.7
France	491,000	4	19.2

*The above statistics were taken from the year 1996 to 2003.

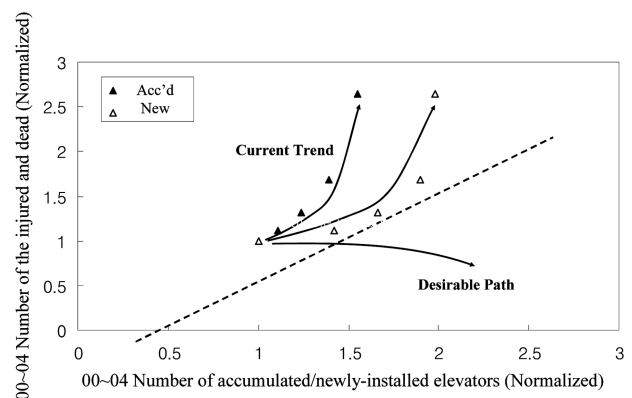


Fig. 1. The relationship between the number of the injured and dead in elevator accidents and the total number of elevators installed (accumulated)/ newly-installed.

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Figure 1. In the figure, all the data were normalized by the data in the reference year (the year 2000 in this case). It is desirable to have the decreasing trend of the number of injured and the dead even when the number of elevator in use increases. The data in Figure 1, however, indicates the increasing trend over the past five years. Furthermore, the rate of increment of the injured/dead surpasses that of the number of elevators installed so that slope of the injured and the dead becomes steeper. It is noticed from the figure that the current safety management system is not able to cope with the increasing number of new installations and is not also effective in terms of reducing the accidents and saving lives and properties of users and owners.

3. Issues in Safety of Elevators in Korea

3.1 Social Cost due to Poor Maintenance and Management of Elevators

Figure 2 show the relationship between the safety and the cost. As seen in the figure, the sensitivity of main-

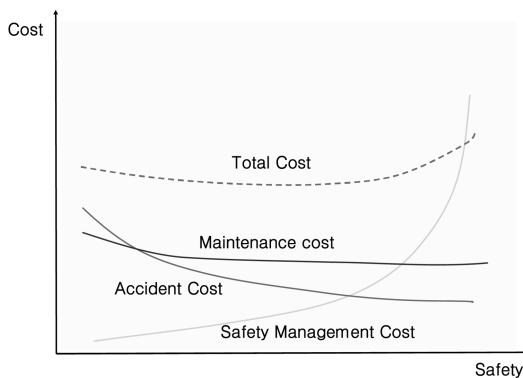


Fig. 2. The actual relationship between the level of safety and the cost.

tenance or management cost to the safety is low so that the optimum management cost-safety relationship can hardly be found.

Poor maintenance and management of elevators, however, reveals the sufficient sensitivity to the accidents and the overall social cost. Table 2, for example, shows the direct and indirect social costs due to poor maintenance, poor management and the related accidents. Estimate ranges from approximately 500 billion to 900 billion Korean won (approximately 0.5 billion to 1 billion US dollars) per year. Considering the fact that the size of new elevator market is in the neighborhood of 2 trillion won per year, such social cost is big enough not to be ignored. This suggests that improvement of maintenance and management of elevator is needed to reduce such social cost.

3.2 Problems in the Safety Management System

Figure 3 shows the relationship between the number of injured/dead and the conditional pass in regular

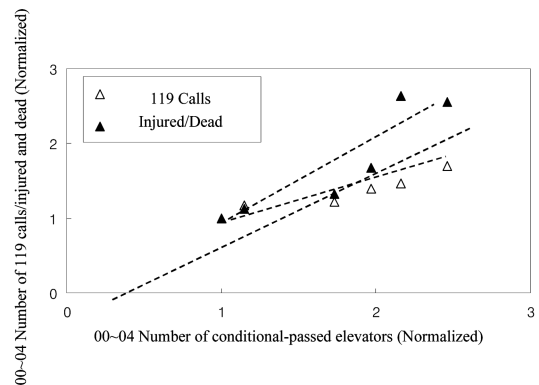


Fig. 3. The relationship between the number of injured/dead and the conditional pass in regular inspection.

Table 2. Direct and indirect social loss due to elevator-related accidents

	Market Size (Billion Wons)	Social Cost due to Poor Maintenance, Management and Inspection
New Installment	957	214.5
Maintenance	45	30
Components	340	227.8
Inspection	45	9
Direct Cost due to Accident	-	4(Year 04)
Indirect Cost due to Accident	-	16(Heinrich's Law)
Insurance Fee, etc	-	3(Estimated)
Other Indirect Cost	-	50(Estimated)
Total Social Cost		542.3 Billion Wons

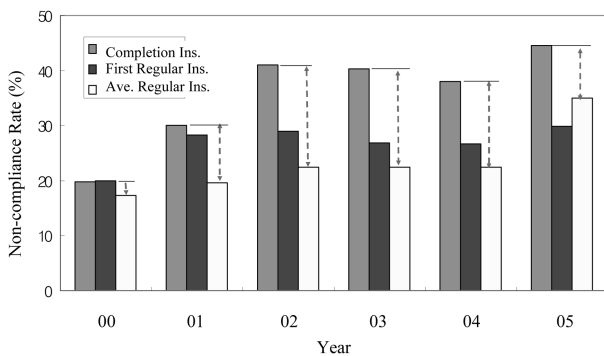


Fig. 4. The non-compliance rate in first year inspection (for the elevators used for one year) and the average non-compliance rate of all elevators in use.

inspection.

It is interesting to see that between the number of injured/dead and the rate of conditional pass a strong correlation is seen in the figure. A possible reason for this is that conditional pass in completion and regular inspection leads to a poor maintenance by the users, which may cause the accidents.

Furthermore, Figure 4 shows both the non-compliance rate in first year inspection (for the elevators used for one year) and the average non-compliance rate of all elevators in use. Non-compliance means both failure and conditional pass in inspection. The first year non-compliance rate appears to be excessively higher than that of average elevators. This leads to a conclusion that either assembly and installation must be performed at a higher level of integrity or any inspection in the early stage of use must be more strict.

Increasing rate of non-compliance over the period in use in Figure 5, results from the fact that the quality control and the supervision in assembly and installation are not enforced. Unusually high rate of non-compliance and inspection failure are the combined results of unreliable inspection in the early stages of use and insuffi-

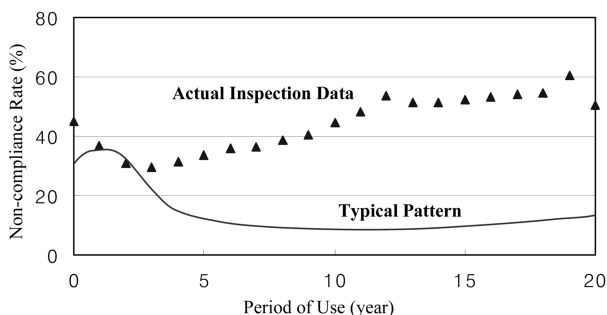


Fig. 5. Non-compliance rate over the period in use.

cient maintenance by the owner, which leads to the sharp deterioration of parts and system of elevators. Therefore, it is needed to certify the parts and the system in the manufacturing stages, to supervise the assembly and the installation, to supplement the completion inspection. Furthermore, the regular inspection must be performed based on the objective and quantitative inspection standards. This is particularly important since it eliminates the subject and qualitative judgement of the inspector on site.

4. Strategy to Promote the Safety of Elevators

In general, any product including elevators can cause safety problems for various reasons. The technical reasons are that: the average performance of the products falls short of the safety requirements and, therefore, resides outside the safety band or the average performance of the products satisfies the safety requirements but any performance of a particular product resides outside the safety band due to poor quality assurance in the manufacturing or the assembly and installation stage or the average performance of the product resides outside the safety band due to deterioration of composing parts and the products over the period of use.

In order to solve the above problems, one has to first of all increase the average performance of the products by certification in manufacturing stage so as to meet the safety requirements defined by the safety band and minimize irregularity of the quality of the product by quality assurance so that every product falls within the safety band and prevent the deterioration of the parts and products by the appropriate maintenance and the effective regular inspection.

The above three requirements are satisfied by the safety management system including the following functions:

- examination of the performance of the products and
- quality assurance of the either product or the production system in the manufacturing stage and
- supervision during assembly and installation and
- completion inspection before the elevator is put into service and
- regular inspection.

Assembly and installation of elevators require high level of technical and management skills to guarantee the quality of the finished products and the safety involved in using them. Supervision is the process of assuring the quality and the safety of the elevator

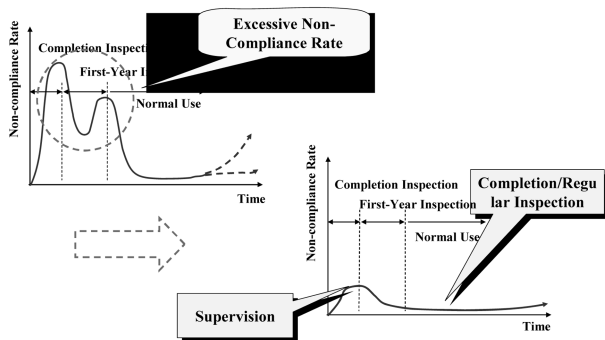


Fig. 6. Effect of supervision in assembly and installation stage.

before they are put into service. Supervisors in this case need to have sufficient knowledge and experiences. Inspection failure or non-compliance due to quality problem in the early stage is minimized, which results in the prevention of safety-related accidents by minimizing poor quality products. This will also minimize the unnecessary maintenance cost and other social cost. Figure 6 indicates the plan for introducing certification and supervision program in manufacturing and assembly/installation stages, respectively. Figure 13 explains the effect of supervision during assembly and installation of elevators in site. It is expected to minimize the non-compliance rate before use and reduce failure rate in the regular inspection and validation later on.

5. Conclusion

This study focuses on the trends and issues of

improving safety management of elevators in Korea. Frequency and severity of accidents in relation to conditional pass in periodic inspection, maintenance, market surveillance are analyzed based on the statistical data and social cost due to a variety of related fields in managing elevator safety was estimated first. The results of statistical analysis provide the logical basis and the future direction for improving the safety management system. Need of certification emphasizing the quality assurance in manufacturing, and validity and effectiveness of supervision in assembly and installation of elevators were discussed. These procedures may in turn promote the quality of production and, therefore the quality of product, and reduce the non-compliance rate and failure rate in the regular inspection and validation.

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