

## **Industrial safety in Elevator Installation and Maintenance: Analysis of Industrial reports in Nigeria**

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### **ABSTRACT**

Elevators installation demands a high safety requirement and manpower training. Any noticeable fault in the elevator affects not only the operations in the industries but also trigger high fatality rate among workers. In order to maintain a hitch free operation in high rise building, an elevator must be frequently and appropriately maintained to sustain its operational efficiency. In this study, attempts were made to analyse the operational performance of elevators in Nigeria with focal point on existing data domiciled in major industrial players. Key of the results emanating from this research indicates that 49% of serious injury was as a result of accidental fall during installation of elevators with high mortality rate between 2001-2006. Further investigation revealed that practicable maintenance method particularly risk based inspection must be rejuvenated with strong political will from government to enforce basic tenet of industrial safety.

**Keywords:** Accident, elevators, hazards, risk, workers.

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### **INTRODUCTION**

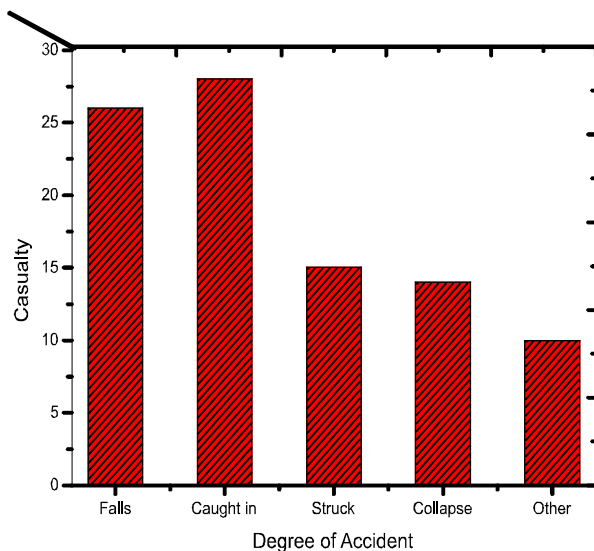
The introduction and development of high-rise industrial building in cities is accompanied with high-speed elevator systems for easy access within the buildings (Emmanuel et al. 2014). It is therefore expected that these elevators operate at jet speeds with modern accessories. To achieve this basic requirement, elevators are required to operate at the super high speed of 810 m/min, and with capacity to handle loads ranging from 10 kN to 20 kN (Venkatesh and Cho, 1998). Part of the mechanical structure embedded in the elevators is functioning in line with their rating speed and the maximum load capacity. In many published works, elevators are generally of three principal mechanical parts namely traction machine, cage, and counterweight. The traction machine is situated in a machine station located on the top of a high rise building housing station motor, main sheave, and breaker. The counterweight is used to provide weight balance with the cage and linked to the second sheave of the traction machine through a moving pulley. While the compensation rope and the sheave are used to reduce the weight difference noticeable in the side ropes in line with the cage position

(Park and Yang, 2010). In order to develop modern elevator techniques, it is important to imbibe day-to-day maintenance of the elevators. Part of the lapses culminating into high casualty incidence in the elevation industries is as a result of continuous usage of elevators which often time increases chances of fault-occurrence (Suarez and Singh, 2000). This is often accompanied with troubleshooting and detection of fault in the elevators (Thontteh and Olanrele, 2015). In order to maintain a hitch-free operation in the management of elevators, development of maintenance structure is an integral part of overall elevator system (Olabode et al. 2017). Safe and reliable operations must be sustained in line with operational capacity of the elevator while equipment life span is maintained within the time-frame specified in the maintenance structure (Erinle et al. 2017). The introduction of elevator was dated back in the early 1910s and the Nigerian industrial sectors have also incorporated reasonable numbers of elevators in their operation (Olabode et al. 2017). However, the number of workers who have suffered various degrees of accidents in the installation of elevators in Nigeria is of great

concerns in many published works (Olabode et al. 2017). The data obtained from key elevators installers in Nigeria shows that there were undocumented cases of elevators accidents and of the entire casualty recorded only 90 and 97 cases were reported in the years 2001 to 2006 respectively. The cases that were recorded is far from the reality in view of numerous cases cited in many published works. These accidents are reported to remain high in the year to come due to lack of maintenance structure inherent in many industries (Erinle et al. 2011). It is therefore necessary to develop new technical solutions that would encompass unreported cases elevators accident. This will go a long way to save equipment and workers from all forms of eventuality (Lauener, 2007). Key objective of this work is to x-ray the concept of risk-based inspection (RBI) as it relates to proper management of elevators.

### Brief History of Elevator Accidents in Nigeria

Up till date, the data available for evaluating the casualty in the maintenance and installations of elevators in Nigeria is depicted in Figure 1 as collated from 2001-2006. It can be seen that accidental fall and caught-in accounted for the highest mortality rate as shown. The data presented in this figure may not capture all the industrial activities in Nigeria in view of discrete nature of many players in the industries.

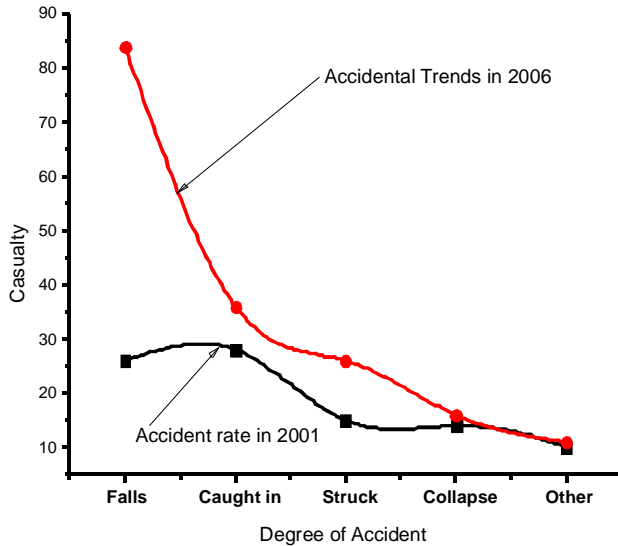


**Figure 1:** Elevator Accidents and their casualties (2001-2006)

In a comparative study, the total number of elevators installed in Korea is 359,098 with the rate of elevator accidents per ten thousand elevators accounted for 1.54. Their works also dwelt on serious incident cases, leading to high mortality rate of about 21.8% of the entire cases (Lauener 2007) It is also reported that poor management and maintenance culture in most developing countries may cause high proportion cases leading to as high as 23%. This data corroborated the facts that death resulting from caught in/between elevators and elevator shafts or other elevators and accidental falls is the most dangerous part of elevators activity in Nigeria. Although, the work of elevator installers and repairers are interwoven, this may have informed 80% increase in the number of casualty. Some authors (Holden and Sunindijo, 2018) have also corroborated this claim in their research findings but no concrete solutions were proffered for further works.

### Existing Methodology and its Risk index

The degree and potentials of elevator accidents are increasing every year with projection of severe injury as shown in Figure 2. But the trend at which the accidental falls increase between 2001 and 2006 is most worrisome as shown. Even though these accidents seemed to have occurred with few casualties as noticed in the data used in the analysis, the declining gap in the preventive measures is an indication that workers need to be informed and properly trained on the causes of accidental falls in the elevators installation. Although, potential causes of accidents are prevalent in the installation of elevators in Nigeria, this, however, point to the fact that sustainable and corrective measures must be devised by players in the industries to mitigate its negative repercussions. Part of the scope employed in this work is to x-ray the accidental collapse in the year 2001 and 2006 as depicted in the industrial masterplan. This may not be said for struck and caught in accidents in elevators installation, as these two cases of accident were rarely reported in Nigeria environment.

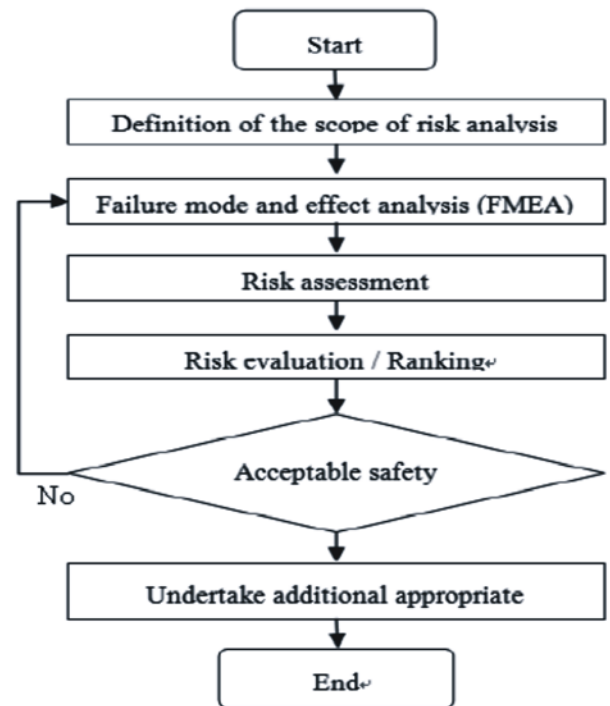


**Figure 2:** Accidental occurrence as depicted in the elevators activity (2001-2006).

**Projection of Risk-based inspection (RBI) in Elevator Maintenance.**

The projection of industrial growth in Nigeria is real so also the prospect of adopting elevators in work places is also expedient. Having discussed the existing challenges in the maintenance of elevators in Nigeria, it may be of necessity to adopt best international practices in order to maintain a hitch free operational elevation system. In much literature, the concept of Risk-based inspection has been discussed with many researchers proposing different novel idea in order to maintain a hitch free system. Risk-based inspection (RBI) is often used as a diagnostics approach combining systemic failure and aftermath failure. In another paper published by Levy et al. (1977), three types of RBI tests are generally recommended for thorough analysis of elevators failure. One of such approach is qualitative method employing descriptive data with the aid of engineering judgment, followed by quantitative approach which normally adopts probabilistic or statistical models. The third concept is semi quantitative approach, which normally employ elements emanating from both qualitative and quantitative tests. It is also very important to note that semi-quantitative RBI approach is more realistic in Nigeria environment because of its detailed prediction of data while the other methods may not be adapted in Nigeria in view of its complexity and variation in data interpretation

(Holden and Sunindijo, 2018). In order to enhance the working principle of elevators, it is encouraged to adopt logical steps that promote systematic identification of accidental occurrence with detailed background study of the hazards and their resulting causes and effects. With the aid of interactive process, each hazard and their level of occurrences are evaluated on the basis of safety measures designed to reduce the effect of failure as shown in Figure 3.



**Figure 3:** Risk analysis procedure (Suarez and Singh, 2000)

This may also include the formation of risk analysis team by selecting the capable members and choosing a team motivator among the elevators installer. This may also include the willingness of the team members to analyze the probability of occurrence and the severity of hazard under consideration. It is also of necessity to empower the lift technician to take appropriate measure to reduce the risk factors to acceptable level.

**CONCLUSION**

Elevators installation and safety management are highly interrelated and there is need to develop a sustainable roadmap for this sub-sector in Nigeria. While the installation of

elevators would continue unabated with possible impact on accidental occurrences, it is of necessity for industrial players to devise a robust approach to mitigate incidence of failure in elevators installation. The period of accidental occurrence must be enlarged to include pre-safety period and safety period while all efforts must be directed toward achieving negligible failure rate.

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