

**OPERATIONS MANAGEMENT PRACTICES AND SYSTEMS DESIGN IN KENYA'S  
ELEVATOR INDUSTRY**

**BY**

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## DECLARATION

I hereby declare that this research project is my original work and has not been submitted for a degree in any other university or college for examination/academic purpose.

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This research proposal has been submitted with my approval for examination as the university supervisor

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## **DEDICATION**

I dedicate this research project to the Almighty God without whom I would not have had the grace and strength to complete this journey. To my family, mother and father, who have encouraged me throughout this academic journey.

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## **ABSTRACT**

The purpose of this study was to explore advances in elevator technology in Kenya and examine their impact on quality, safety and performance. The study explored the elevator system design and operation in order to reduce the probability of unwelcome events on building structural failures. Significantly, the study examined the future trends of building technology in harnessing smart and efficient elevator systems that not only advertises risk but provides energy saving consumption mechanism to deal with the ever-growing demand for power. Further, the study addressed quality management practices and performance of elevators in Kenya building architecture industry and their input in these new global technological advancements in elevator design. A descriptive research design was used targeting a population of 18 major players in the market. Primary data was then collected by means of structured questionnaires. The variables involved included Customer Relationship Management, Employee Empowerment and Involvement, Creativity and Innovation, Supply Chain Management, Capacity Planning and Business Process Improvement for the independent variables and Organizational Performance as the dependent variable. Data collected was analyzed with the aid of Statistical software and presented in the form of tables, pie charts and graphs. Descriptive statistics such as mean scores, standard deviation, regression and correlation were used to analyze data.



## **CHAPTER ONE: INTRODUCTION**

### **1.1 Background of the study**

With the rising number of competitors in the market, companies have been forced to come up with strategies that will position them differently in the minds of customers. Customers play a critical role in the economy, accounting for 70% of gross domestic product in the USA and 18% worldwide (Adams,2014). The need of customer expectations to be met has thus become a key performance indicator of every profitable organization. Customers are no longer just concerned with advertisements, packaging and branding but also prices, quality of both products and services as well as speed at which their demand can be met. These new expectations can be met through adoption of operations management practices and systems design.

Operations management has been touted as that part of an organization that is concerned with transformation of inputs into outputs (products and services) of additional value that meet a certain level of quality (Kumar&Suresh,2006). Operation management practices and philosophies such as lean production, waste reduction, Just-In-Time production, capacity planning, total quality management, technological inputs and continuous improvement are commonly practiced to enhance efficiencies that result into competitive pricing of goods and services.

Systems design can be used to synthesize operational strategies with technology to enhance customer satisfaction. Systems design just like operations has three main components; inputs, processing and output. Companies that are keen on maintaining a competitive edge focus on ensuring inputs are processed to release outputs of additional value. Systems design has been defined as that process that defines elements of a system like modules, architecture, components and their interfaces and data for a system based on specified requirements. It is also the process of defining, developing and designing systems which satisfies specific needs and requirements of an organization (Bentley, Lonnie, Dittman,Whitten,2004).

One area where operations management matters but has been neglected by scholars is in elevators which we use every day. In the last decade, elevators have become an integral part of buildings architecture. Main objective being moving people and equipment in and between buildings in a safe, convenient and reliable manner. This has resulted in elevators becoming an

important investment decision for developers in the construction industry. Just like other industries, Kenya elevator industry continues to face rising competition from international companies who have vast financial advantage enabling them to adopt operations management practices and policies that gives them a competitive edge. As competition continues to heat up, players in the industry have been forced to redesign their systems with improved quality and safety programs such as ISO 9001-2000 and EN81-20. In addition to this requirements, developers are keen on getting solutions that are energy efficient. In Kenya there are about 18 elevator firms up from 2 in 1980, a clear indication of the growth of this industry. The goal of this study is to identify the different operations management practices and systems design currently in use in the elevator industry in Kenya. What influence do they have on the performance of the industry and also in what areas do the players need to enhance adoption of the practices and designs. Efficiency in the elevator industry has to start from the point of sale, installation, use and it's upkeep.

### **1.1.1 Operations Management Practices**

Operations management has been defined as the business function responsible for planning, coordinating and controlling resources needed to produce products and services for an organization. It is also the set of policies and practices implemented to transform inputs into outputs of a higher value. Researchers noted that operations are more than planning and controlling; operations involves activities. This can be superior quality, speed to market, flexibility, low costs or excellence in operations (Russet,2007).

Operations management has different practices that are incorporated to enhance levels of efficiency and effectiveness in an organization. These practices include product and service design, process design, facility layout, inventory control, planning and control, job and people design, facility improvements, organization for quality among others. Each of these practices has different influences in enhancing excellent operations of an organization. In order to get into business, the product or service needs to be designed. Location of where it will be offered needs to be decided as well as the kind of people who will be offering the service. Inventory control systems need to be decided as well as quality measures. All of these are decisions that have to be made for smooth operations.

Operations management practices in general, seeks to offer solution to some of the current issues in the market. Some of the issues Operations Management practices seeks to address are, speed of getting new products into production, flexibility in the production system to enable mass customization of products and services, management of global production networks, revamping existing production systems by developing and integrating new production technologies, achieving and maintain high quality especially in the face of restructuring and managing a diverse workforce. These practices can be useful in ensuring companies remain competitive in the market in Kenya as well as enabling the country gain a competitive edge in the region.

### **1.1.2 Systems Design**

System has been defined as a collection of components working together to realize the same objectives. There are three main components of a system; input, processing and output. Objective of every system is a certain output is produced as a result of processing an input. Design, is the development, expression, documentation and communication of the realization of the architecture of the system, through a complete set of design characteristics described in a form suitable for implementation (Bentley, Lonnie, Dittman,Whitten,2006).

Systems are usually designed based on user requirements. These are sometimes influenced by external factors such as globalization of markets as well as legislation bodies. There are several tools and techniques used for describing systems design. These are; flowchart, data flow diagram, data dictionary, structured English, decision table and decision tree. Systems design are usually multi-disciplinary in nature requiring study of different practices as well as technological synthesis. This is so as to enhance efficient ways of problem solving within the organization. It is characterized by philosophy, methods and approaches to solving problems. Systems are designed to meet customer needs as well as that of the user and of the society. The idea of having systems design , is to ensure certain standards are met. This can be quality, safety or whatever the end user requires as an output. Systems designs can therefore simply be defined as the designing of systems (Dubberly,2006)

In the elevator industry, some people argue that elevator design began with a simple rope and a platform that was either pulled or pushed up by mechanical means( Bernard,2014). Elevators were powered by steam and water hydraulics piston or by hand. With recent innovation, players

in the industry moved from hydraulic elevators to traction elevators especially in high rise buildings. This posed as a more efficient solutions for tall buildings. Recent innovations in the industry are machine room-less elevators, elevator with regenerative drive, double deck elevators, compass destinations entry as well as ultra-ropes that are lighter and convenient during installations and maintenance of elevators in high rise buildings. In recent times we have seen an introduction of horizontal elevators which will also be rope-less

### **1.1.3 Elevator Industry in Kenya**

In the last 25 years, Elevator industry in Kenya has witnessed increase in number of players; from the initial 2 dominant players; Otis and Schindler, to the current 18 players in the market. There has been an increase in skyscrapers especially in big cities. This is to cater for rapid growth in the cities where space is limited, as well as to accommodate the ever growing population. With land being a resource that does not grow, the only way to increase living space is by going up.

Since the invention of elevators by Elisha Otis in 1852, it became almost mandatory for people operating in tall buildings to use elevators. It also became a requirement due to the increased awareness and developments of Disability Act. Developers became more conscience of decisions that help facilitate safe, convenient and reliable movement for persons living with disability. The total number of elevators installed in Kenya today, is more than one thousand five hundred with different players responsible for installation and maintenance of the elevators. This means, elevator industry in Kenya is rapidly growing. The industry is highly dependent on the construction industry; when new offices, hospitals, hotels, schools and even residential buildings are coming up, there is a very high probability that elevators will be required in the buildings. The Elevator business is parasitic to construction activity. Where construction business is booming, elevator business is also thriving.

Just like any other industry, there are regulatory bodies that govern operations and development of elevator industry in Kenya. This is to ensure certain standards are met that will protect the customer/end user, the environment as well as the parties involved especially during installation process. These bodies are, National Construction Authority(NCA), Energy Regulatory Commission (ERC), National Environment Management Authority(NEMA) among others.

There are different players who work together to assist in sourcing of customers in this business. These are, Electrical and Mechanical engineers, Architects, developers, lift consultants and government inspectors. These players must work in close collaborations to ensure customer's needs are met.

The elevator industry in Kenya only deals with supply, installation and maintenance. All the players have their products manufactured out of the country mostly in the middle east. Since elevators are unique to the building architecture; they are designed based on the number of floors the elevator is meant to serve, market segment (offices, residential, hospitals, hotels or schools), capacity the lift is meant to carry as well as desired speed of lift, majority of the elevator manufacturers practice Just-In-Time production. Key operational issues arise when players in the market are forced to practice good project management in order to beat production, transportation and installation lead times. This requires proper inventory management systems especially when it comes to spare parts needed in the event of damaged, faulty or missing parts. In Kenya, various regions experience frequent power outages which affect elevator operations both in installation processes and during normal operations. Players have thus been forced to come up with smart solutions that can mitigate the risks of power fluctuations and outages.

There are no records indicating the worth of elevator industry in Kenya. However, projections by markets and markets(2009-2017) indicates, elevators and escalators global market size will grow from USD 88.78 Billion in 2015 to USD 125.22 Billion in 2021. Clear indication that elevator industry is a rapidly growing industry.

## **1.2 Research Problem**

Every organization utilizes its operations and procedures to ensure inputs are transformed into outputs that fulfil customers. Kenyan elevator firms work in an environment that has been quickly changing. Increase in players in the market has resulted to increased competition and the need for companies to create a niche for themselves has become heightened. Research has been done to understand the contributions of Operations Management Practices in enhancing competitive advantage of an organization( Clark,1995). Alymkulova & Suipulnik (2005) stated, sustainability and the ability to achieve competitive advantage is one of the challenges facing multinational manufacturing firms in Central Asia. They found proper integration of operations

management practices was key to sustainability and survival. This kind of research is missing in Kenya.

Some of the common elevator problems in this industry are; Long project completion time from procurement stage to installation stage and finally to commissioning and handover stage, systems downtime which could either be due to worn out or damaged elevator parts and slow operations. Some uncommon ones are; high energy usage as well as downtimes with power outages and electrical noise generation while using the elevator. Understanding the nature, source and solution to common elevator problems can help in finding the most cost effective way to keeping elevators performing well. (Larson and Haldorsson, 2004) Where these are common problems challenging performance of elevators in Kenya, the same may not be encountered in developed countries. This means there, is a need for operational strategies to be put in place if local players are to compete with the international players in the market.

Research has been carried out in Operations Management by different people. For instance, Byengon (2013) researched on operations management practices and perceived service quality on Kenya Sugar industry and found that there was a lack of general understanding of operations management practices. This could either have been caused by poor communication to employees of the benefits of the practices or poor implementations to current systems. Mohammed (2016) looked at effects of total quality management practices (a key area in operations) on competitive advantage of transport and logistics firms in Mombasa County. He found that total quality management practices had a positive impact on competitive advantage on transport and logistic firms but at varying degrees. Maingi(2013) did a research on Operations Competitive priorities and performance of multi-nationals in Kenya. He found, operations competitive priorities which are; quality, innovation, delivery, cost and flexibility enhances better organization performance which in the long run impacts on their survival. It is evident that few researchers have focused on operations management practices and systems design of elevator industry in Kenya, though they use them every day! There is therefore need to bridge this gap by carrying out a study on the elevator firms in Kenya to assess the different operational practices and systems design. The study was guided by the following research questions;

- i. What are the operations management practices and systems design currently in use in the elevator industry in Kenya?
- ii. How does operations management practices affect the performance of the elevator industry in Kenya?
- iii. How does systems design affect the performance of the elevator industry in Kenya?

### **1.3 Research Objectives**

Below were the key objectives of this research;

- i. To determine operations management practices and systems design in the elevator industry in Kenya.
- ii. To determine the effect of operation management on the performance of elevator industry in Kenya
- iii. To determine the effect of systems design on the performance of elevator industry in Kenya

### **1.4 Value of the study**

The understanding of operations and its practices as well as systems design as adopted in elevator firms in Kenya, will help key stakeholders and policy makers to design policies and programs that can enhance growth and stability of the players in Kenyan market. The findings of this study can help improve the framework of the different governing bodies in the industry especially in energy regulation and health and safety ministry.

Management and staff of these firms can also gain insight on how other organizations effectively manage their operations. This study aimed at offering an understanding on the importance of operations management practices as well as developing proper systems designs that can enhance excellent operations and thus offer competitive advantage to the different firms. Research and development programs can also be employed to come up with smart solutions for these firms so as to have an edge over each other.

To the academician this study will provide useful basis where further studies in the industry could be carried out. Findings from this research can also be used to guide studies and research in other firms that deal with mechanical and electrical assembly of machines used in our era.



## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

In this chapter, different publications related to the problem statement were analyzed. Operations being the core business of an organization, the chapter examined what various scholars and authors have uncovered about Operations Management practices. The chapter presented Operations Management theories

### **2.2 Operations Management Practices**

In an organization, operations is responsible for the transformation of inputs into outputs of a higher value (Leonard and Parasurama, 2013). Operations management practices include: product and process design, supply network design, inventory planning and control, supply chain planning and control, capacity planning and control, enterprise resource planning (ERP), lean synchronization, project planning and control, quality management, layout, operations improvement, and risk management.

Process and capacity design is the process of shaping the physical form and purpose of products. It then determines the output levels in short and long term (Bowersox and Daugherty, 2009). Process and capacity design aims at meeting customers' needs by achieving required quality levels as well as ensuring levels of speed of delivery, flexibility and costs are achieved.

Supply chain management is a broad concept that covers management of supply chain from the raw material supplier to the customer (Dawe, 2014). Its activities include purchasing, logistics, materials management, distribution management and customer relationship management (CRM). Supply network design helps any operation to understand how it can effectively compete within the network (Slack et al., 2010). This is done by providing links within the network which help identify long-term strategic changes that may affect the business operations. The effectiveness of the supply chain has a bearing on the effectiveness of the inventory management policies that should be adopted by an organization. Location of the operation can be strategically selected while taking into consideration the supply side influences (labor, land, utility cost) and demand side influences such as positioning (image and convenience for customers).

Forecasting is a tool that uses quantitative and qualitative techniques to determine future performance. Its aim is to help managers plan and makes decisions about resources within the organization (Hines, 2014). Forecasting is very beneficial in deciding which operations management practices to adopt and helps in projecting performance outcomes based on these practices. The physical location where transformation process takes place is mainly analyzed in Operation layout (Slack et al., 2010), while capacity planning and control is concerned with how the operation unit seeks to organize allocated resources to achieve desired levels of value-addition while working under normal operating conditions over a period of time (Stevenson, 2014).

Since almost all operations keep some inventory, inventory management is a very important area that companies need to invest in (Hines, 2014). Inventory can be represented in the form of information, materials and even customers waiting on queues. Inventory may occur in operations because supply and demand do not always match. Enterprise Resource Planning (ERP) is a business management system that integrates information from various functions and automates some of these functions enabling the organization to plan and control operations activities more efficiently. The integration helps to ensure there is improved coordination between the different functions as well as transparency.

Lean synchronization was originally called just-in-time (JIT), Japan (Slack et. al., 2010). It aims at delivering what the customer wants, when they need it, in the quantity it is needed, at the place required and all this at the lowest cost. Quality management is increasingly becoming an area where most organizations are investing in with some having a separate function completely devoted in quality management of their products and services. When quality is managed properly, organizations get to save on reworks costs, waste, complaints and returns and, most importantly, good quality generates satisfied customers. No matter how well operations are managed, there is always room for improvement (Lassiter, 2007). Continuous improvement is key in enabling organizations achieve and maintain competitiveness in a continuously changing environment.

According to Kyengo (2012), risk management is a major concern of operations managers as it is difficult to ascertain the source and consequence of risks. Events such as bankruptcy, terrorist

attacks, sudden change in demand, or even heated political climates may greatly affect the normal running of operations. There may be other risks that tend to come up with changes in technology. All these events pose a serious risk to the organization and require quick actions to mitigate losses that may come as a result. When faced by risks, companies may end up taking measures such as increasing levels of capacity utilization, implementing sharp cost-cutting mechanism, paying more attention to media, lowering levels of inventories and increasingly effective regulation practices. This may end up making the cost of operational failure even greater. For these reasons, managing risks is a key factor for every operations manager.

In modern times operations management has been known to revolve around four theories; business process redesign (BPR), reconfigurable manufacturing systems, six sigma and lean manufacturing (Frohlich, 2015). Ensuring efficient business operations is a key responsibility that Operations management is involved with. This can be achieved by implementing systems that will allow the organization to use the least amount of resources to meet customers' expectations at the highest economical standard viable (Brudvig, 2008). Process management is involved in Operations management as it helps to monitor performance of the organization. In simple terms, process managements monitors the transformation of raw materials, labor and energy into goods and services. In order to enhance successful operations management, some fundamental factors need to be assessed; skill set of personnel, job creativity, rational analysis and technological knowledge (Leonard & Parasuraman, 2013). Division of labor and advancements in technology have proven to be beneficial to company productivity especially in business and manufacturing operations. An organization's performance is analyzed using different scientific formulas. This phenomena of measuring and calculating performance using formulas was unexplored before Fredrick Taylor's early work in the field. In his publication, principles of scientific operations management, in 1911 he discussed four unique categories; developing the true science of management, scientific selection of an effective and efficient worker, education and development of workers, and an intimate cooperation between management and staff (Meredith, 1998). His works gave a rise in the calculation of performance and theories such as six sigma were developed.

Six Sigma focuses on quality (Schroeder, 2008). It was developed primarily from 1985 to 1987 at Motorola. The theory has control limits placed at six standard deviations from the normal

distribution mean. According to Jack Welch, the initiative by General Electric to adopt the six sigma method in 1995, greatly contributed to the popularity of the approach. There has to be a step sequence and financial target set for every project within an organization that adopts Six Sigma approach (Wacker, 2008). The outcome could translate to increased profits or reduced costs indication six sigma is a can be a very beneficial operational strategy tool. Ratios, potential defect calculation and trending charts are some of the tools used within the six sigma process.

Lean manufacturing is a waste elimination method highly used within the manufacturing process (Čiarnienė and Vienažindienė, 2012). The lean theory monitors waste created due to uneven workload or overburdening of resource. This philosophy was borrowed from Toyota Production System and focuses on reduction of seven wastes that can improve overall customer satisfaction. These wastes are; waste of over processing, waste of unnecessary motion, waste of inventory, production of defects, waste of waiting, waste of transportation and waste of over production. The theory argues, resource allocation for reasons other than value creation is wasteful and should therefore be eliminated.

### **2.3 Technological Advancements**

A big percentage of “green” agenda, focuses on energy saving solution (AGN Yu, 2012). It has been pointed out that buildings consume about 40% of the world’s energy with elevators responsible for 2%–10% of a building’s energy consumption. Elevators may fully account for the 40% of building energy during its peak hours. On a daily basis, there are more than 7 billion elevator journeys happening all over the world (Glen Pederick, 2014). With this in mind, use of energy-saving elevators can significantly reduce energy consumption. Fortunately, researchers have come up with new technologies and best practices that can help to reduce energy consumption. Some of them are; regenerative drives, use of ultra-ropes instead of steel ropes, control software, optimization of counterweights, double-decker lifts and cabin lighting that can amount in significant savings. Researcher Patrick Bass pointed out that ThyssenKrupp has come up with technologies that provide about 27% savings in energy and 30% savings in space. In a research done by De Almeida and his colleagues on energy efficiency they indicated that there is more that 60% technical areas that elevators efficiency can be improved on in order to enhance energy efficiency (YIN Qin, XIAO, 2010). They argued, elevators and escalators can contribute

to current energy and climate targets by improving energy efficiency in existing and new equipment. Studies on energy consumption of newer and older elevator technologies are now being carried out to assess the value of the new technologies where ISO 25745-2:2015 standards are being used to help estimate energy consumption. Measured values and calculations are derived from these standards on an annual basis for the different types of elevators and data is then presented according to different energy classification systems for new, existing, and modernized elevators.

Full implementation of energy saving technology has been affected by general lack of awareness of these technologies (De Almeida , 2014). This research will try to respond to this gap and provide information to architects and developers on how to harness the power of these new technologies. In this study new technology was discussed within two categories: energy-efficient hardware (This is double deck elevators, regenerative drives, AC power, machine-room-less technology, elevator ropes, TWIN systems and LED lighting); and energy-efficient software (this is destination control systems, standby solutions, and people flow solutions). We also discussed other technologies related to elevators. The study started by mentioning energy efficient solution that were used in earlier times then moved to the most recent innovation.

## **2.4 Systems Design**

System design is the process of defining the architecture, modules, interfaces, and data for a system to satisfy specified requirements. Since systems design is multi-disciplinary in nature integrating different functions in order to ensure the system achieves certain goals, it may factor some principles in systems analysis, architecture and engineering to meet specific user requirements(Bentley, Lonnie, Dittman,Whitten,2006). System design relies heavily on market research as the findings are crucial in developing a system that will meet customer needs(Levin, Mark, 2015). It takes into consideration the design, manufacturing and marketing in order to enhance product development. The idea is to design a product that customers desire and have it manufactured. Systems design is therefore the process of establishing and creating systems that satisfy specific user requirements (Yun, et al. 2009). With its main components being; input, processing and output, the design of a system is represented in how data flows through the system to ensure output is as per the user requirements.

Systems design, can be divided into; user interface design, data design and process design. The user interface design is mainly concerned in ensuring user friendly features are in place. This is, users can easily input data and the can also consume feedback relayed by the system. Data design focuses on how data is stored in the system and how it is presented. Process design on the other hand is concerned with how data flows through the system, how and at what point data is validated as well as how it is transformed as it flows through the systems. Up until 1990s, systems design was greatly respected and used in the data processing industry(Bentley, Lonnie, Dittman,Whitten,2006).

## **2.5 Operations performance**

Since operations is an organization's core business, operations performance is a measure of the organization's performance. This is measured against defined standards of efficiency, effectiveness and environmental responsibility (Webb, 2012). In order to achieve world class operational performance there are key factors that should be considered. These are; tracking of productivity, setting of operational standards, continuous improvement in operations and to some extent, performance incentive programs. Operational performance management (OPM) is the practice of aligning all business units centered around operations to ensure that they are working together to achieve core business goals that while drive higher efficiencies within the organization. Performance objectives seeks to answer questions on "what and " how". They mainly relate to how the company seeks to handle its customers, suppliers, shareholders, employees, and society in general (Zhu and Sarkis, 2004). Operations management seeks to influence the quality of its product (goods and services). To the customer, quality is measured by their satisfaction or dissatisfaction. However, for the organization, quality is increased dependability at reduced cost. Speed of delivery is also a factor that operations management can use in enhancing competitiveness. While it is important for the customers to receive their goods and services at the speed they desire, for the organization, speed of delivery helps to reduce inventory by reducing internal throughput time and reducing risks caused by delaying the commitment of resources. Operations seeks to ensure things are done on time and therefore there is an increase in dependability of both goods and services. This dependability for customers, is an important aspect of customer service while for the organization, dependability enables them

save time and money thereby enhancing reliability and stability in their operation (Kyengo, 2012).

Different organizations have different influences on the flexibility with which the goods and services are produced. For the customer, flexibility means: product flexibility where organization introduces new products and services to fit their needs; mix flexibility where there is a wide range or mix of products and services (mix flexibility); volume flexibility where organization produces products and services with different quantities or volumes in order to reach a wide market; delivery flexibility where production can happen at different times to suit customer wants. For the organization, flexibility can be very useful in maintaining dependability, increasing response times and saving on time wasted during changeovers. Operations managements seek to influence the cost of the company's goods and services by actively looking at cost effective ways of operations. Low costs of operations can allow the organizations to reduce the price in order to attract higher volumes of demand. This may in the long term, increase profitability on existing volume levels. Cost management is clear indicator of good performance and is fundamental in an organization's performance objectives.

## **2.6 Elevator Industry In Kenya And Beyond**

Wood (2014) explains that with the increase in demand of buildings that require elevator use as well as increased competition, organizations within the industry have been forced to come up with strategies and operations systems in order to remain competitive. There are a number of bodies that are crucial in providing regulations for Kenya elevator industry and they work to ensure safety and energy guidelines are met as per standard. These are; The National Construction Authority, the Energy Regulatory Commission and Directorate of safety and health (Macharia, 2013).

The Kenyan elevator industry in itself is a parasitic industry that heavily relies on construction activities. For this reason, players in the industry work closely with several stakeholders to enhance customer satisfaction. They are involved at different stages and they include; the developers, Electrical and Mechanical Consulting Engineers, Architects, Builders, Lift Consultants, Inspectors and Governments Authorities. In the elevator industry, competitive strategies that may be employed are wide range of products, differentiated prices, fast delivery and installation of elevators, good quality of installations, comprehensive warranty and excellent

maintenance services (Wilk, 2014). The implementation of effective supply chain practices as well as their adoption by organizations has been argued to be beneficial in enhancing competitiveness within an organization. The practices may vary from just-in-time capabilities, integration of effective supply chain systems, customer relationship management, geographical proximity as well as information sharing

## **2.7 Systems Design and operations in the elevator industry**

Elevators are common in many high rise buildings (PAN Bin, 2008). They help to control the flow of traffic between various floors of buildings and they allow persons living with disability to access upper-level floors. Elevators also facilitate the movement of large or heavy loads between various levels of the building with ease. Factors that govern elevator type and design include cost, speed, capacity requirements, safety, reliability as well as traffic analysis within the building. There are a number of risks involved in elevator use. These include; downtimes where people get stuck in the lifts for long periods, elevator doors not making contact causing the elevator to plummet from highest floor to the lowest floor and in the event of fire, elevator use is discouraged due to the safety implications. The engineers designing the system, as well as the construction company assigned to build the building and installing the elevator system are responsible for the safety and smooth operation of the elevator system (YIN Qin, XIAO, 2010).

It is the responsibility of the building architects to provide space and structural support for the elevator (Jian, 2015). The elevator engineers design elevators to ensure they meet specified safety and quality standards. These are usually outlined in the safety requirements and compliance standards as specified for different regions. The engineers are also responsible for product reliability. Oldfield, et.al. (2009) observed that, the elevator users are responsible for operating the elevator according to the safety specifications laid out. Usually user manuals and trainings are carried out to ensure elevators are used in a safe and convenient manner. Users should ensure maximum capacity is not exceeded. This is however catered for in some elevators where the announcer will notify users in the event capacity is exceeded. The building owners are however responsible for maintenance of the elevator and for ensuring the elevator is compliant before use. In Kenya, government certificates are issued to certify compliance. In the elevator



design, elevator engineers are expected to communicate elevator specifications as well as space and support needed for the elevator to function as per standard. (Ali, 2008).

In the design, installation, and use of an elevator system Jian (2015) pointed out, that there should be constant communication between the design engineers, Construction Company, building architects, building owner, and users. It is important to communicate the rules and regulations created by government with the help of various other public organizations. Building codes, fire regulations and Disabilities Act are a few examples of rules that the engineers and architects must submit. As far as the specific rules governing the design of elevators, EN81-20 or EN81-50 give detailed documentation of what criteria must be met. In Kenya however, these standards to be met are not clearly outline thus players in the market are forced to comply with international standards in order to attract international developer. It is therefore important for the engineers that design the elevator to communicate to the architects to ensure them that these standards are met. In the documents issued to developers and architects, sections conveying the features and functions of the elevator system can be used to help them choose the elevator that best fits their needs (Foley, 2013). Gifford (2010) argues that the engineers must ensure construction companies fully comply to elevator needs while constructing a building.

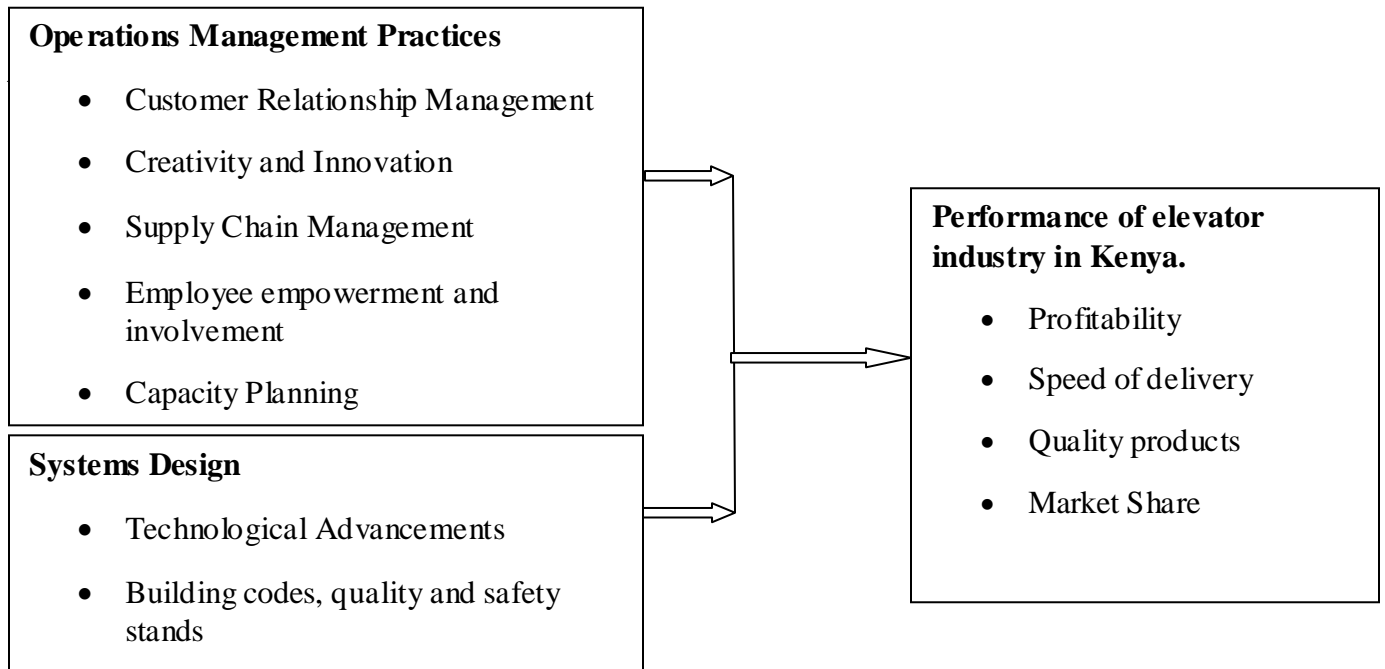
## **2.8 Conceptual Framework**

Based on the preceding literature review, the conceptual framework in figure 2.1, shows the relationship between the research variables.

Figure 2.1 Conceptual framework

**Independent Variables**

**Dependent Variable**



## **CHAPTER THREE: RESEARCH METHODOLOGY**

### **3.1 Introduction**

This chapter seeks to describe the research methodology that was used to conduct the survey, reasons behind the selection of research design, selection of target population, sampling method used, method of data collection and how data was analyzed, interpreted and presented.

### **3.2 Research Design**

A cross sectional research design was used to identify the different operations management practices and systems design currently in use in the elevator market in Kenya. It described some features in the population. This design allowed for the research to be done in a natural setting. Researcher could thereafter make statistical inference to broader population permitting them to generalize their findings to real life situations, thereby increasing the external validity of the study.

### **3.3 Population**

The target population was all the elevator firms in Kenya which are 18 in number (Appendix II). Census method was conducted due to the small number of players in the market

### **3.4 Data Collection**

Semi structured questionnaires were used to collect primary data. A “drop and pick later” method was used to administer questionnaires to the project managers, supervisors and site managers. This was to ensure respondents had enough time to fill in the required information. The questionnaire had four parts; Part A: data on the background information of the responded and part B: operations management practices Part C: systems design and Part D: operations performance. To allow for uniformity of responses, closed ended questions were used; while unstructured (close ended) questions were used to give the respondent freedom to respond in an open manner. This enabled the researcher to enhance credibility of data collected.

### 3.5 Data Analysis

Data analysis procedure is the process where data collected is packaged, arranged and structured to enable findings be easily and effectively communicated to stakeholders (Delno, 2006). In this study the data was analyzed using qualitative and quantitative techniques. Qualitative method involved evaluation of text material as well as content analysis while quantitative method involved the use of regression analysis.

Each objective was analyzed as below;

**a) To determine the operations management practices and systems design in the elevator industry in Kenya.** Descriptive analysis was used to identify different operations practices and systems design in use in the elevator industry in Kenya. Tools of analysis were mean score, standard deviation and percentile scores. Data was thereafter be presented in graphs and charts.

**b) To determine the effect of operation management practices on the performance of elevator industry in Kenya.** Regression analysis was used to ascertain the impact of different operations management practices on the performance of the elevator industry in Kenya.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i + \epsilon$$

Where:

Y = operations performance of elevator firms

$\beta_i$ 's = Coefficients

$X_i$ 's = operation management practices (Customer Relationship Management, Employee Empowerment and Involvement, Creativity and Innovation, Supply Chain Management, Capacity Planning and Business Process Improvement).

$\epsilon$  = error term

**c) To determine the effect of systems design on the performance of elevator industry in Kenya.** Regression analysis was used.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i + \epsilon$$

Where:

Y = performance of elevator firms

$\beta$ 's = Co-efficients

Xi's = Systems design (machine-room-less elevators, scaffold-less installation process, lifts with regenerative drives, lifts with energy efficient lighting)

$\varepsilon$ = error term

Two methods of data analysis was applied in this study; to measure the degree of association between different variables under consideration especially in the last two objectives Pearson correlation was used and to estimate the causal relationships between performance of elevator industry and other chosen variables regression analysis was used. In order to see the relationship between variables such as operation management practices, technology advancements and smart solutions, Pearson correlation analysis was used for data analysis.

## **4. CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATIONS**

### **4.1 Introduction**

This chapter entails analysis and findings of the study as set out in the research objectives and methodology. The findings of the study have been presented to assess different operational practices and systems design in Kenya's elevator industry.

### **4.2 Response rate**

The questionnaires were sent to 54 members of staff in the sampled Elevator industry firms in Kenya. Out of the 54 questionnaires sent, only 43 questionnaires were sent back completed and this made a response rate of 79.6 % (Table 1).

**Table 1: Response rate**

Item No.	Item Description	Research questionnaires –appendix I
<b>1</b>	No. of Questionnaires Issued	54
<b>2</b>	Percentage Response	79.6 %

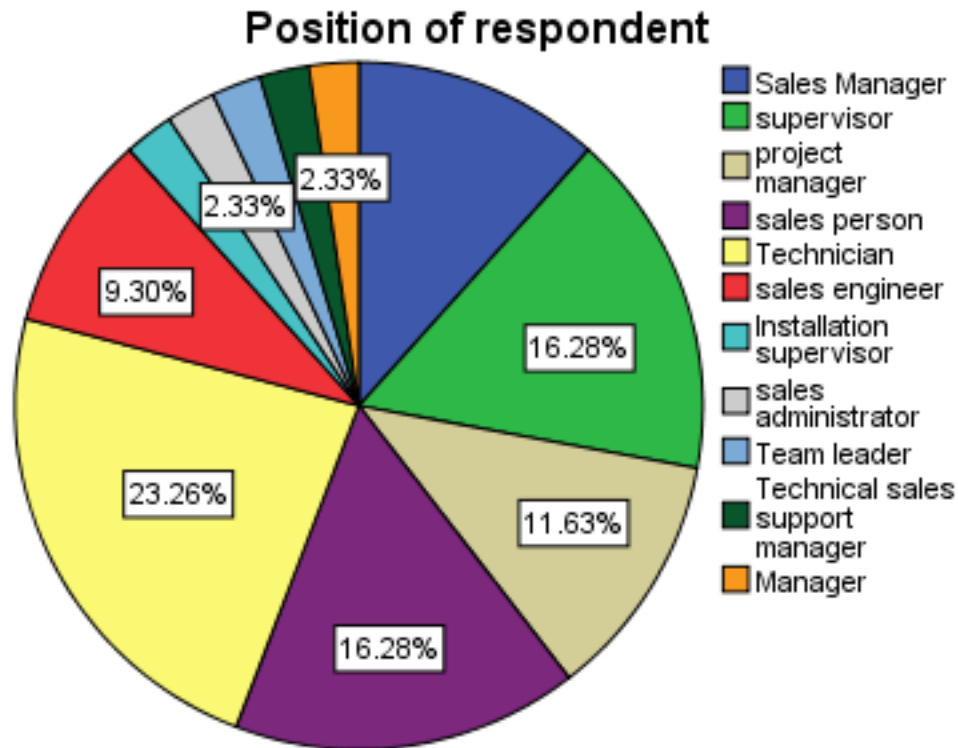
The response rate of 79.6 % is a good one since it is at least 50 % satisfactory. A good response improves the representation in the results to target population and hence the accuracy of the enquiry. According to Mugenda and Mugenda (2003), the response rate of at least 50 % is good enough to conduct a study.

### **4.3 Demographic Information**

The study sought out to ascertain the background information of the respondents that are involved in the study. Background information is essential so as to check out the extent of suitability of the respondents in answering the questions.

## Position of respondent

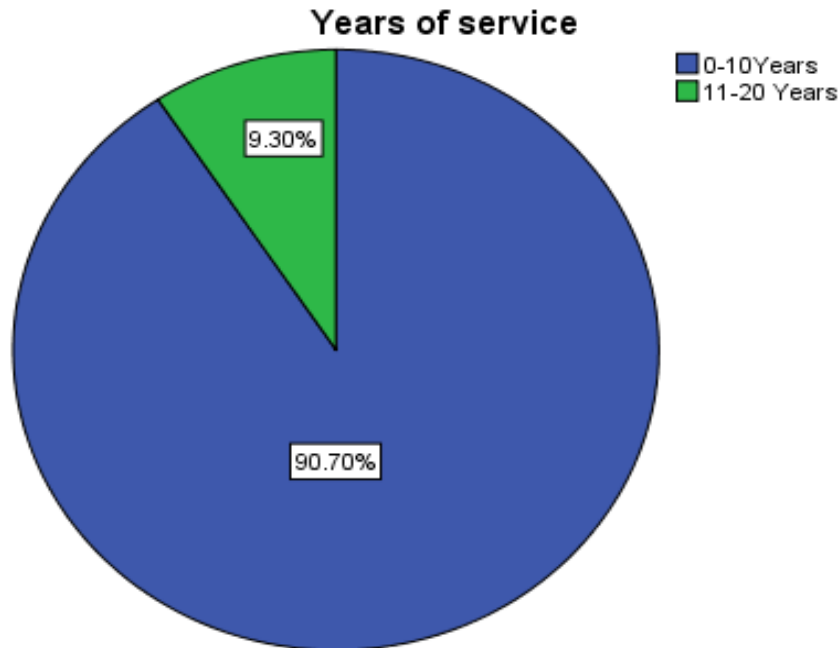
Figure 1: Position of respondent



This question was used to establish the position of the respondent in the organization. The findings showed that 5 respondents were sales managers that represented 11.6 %; 7 respondents were supervisors that represented 16.3%; project managers were 5 which represented 11.6 %; the sales persons were 7 which represented 16.3 %; the technicians were 10 which represented 23.3%; sales engineer were 4 which represented 9.3%; installation supervisors, sales administrator, team leader, technical sales support manager and manager were 1 for each category which represented 2.3 % for each. Since operations managements is a practiced daily in every organization, all the respondents have a good understanding and knowledge to be able to respond to questions regarding the operations management practices and systems design in their elevator firms and hence well suited for this study (Kinyua, 2014).

## Years of service

Figure 2: Years of service



This enquiry was intended to establish the years of service of the respondents in regard to operations management and systems design in the organization. The findings showed that 39 respondents had worked in the organization for 0-10 years which represented 90.7 % while 4 respondents had worked in the organization for a period of 11-20 years which represented 9.30%. The findings indicate that majority of the respondents had at least worked in the organization for a considerable period of time to understand the operations management practices and systems design. According to Kinyua (2014), where 66% of respondents have worked for an organization for a period of more than 3 years then, those respondents have adequate knowledge on the practices employed in their respective organizations. In this, we have 90.70% who have worked in the range of 0-10years. In conclusion, the respondents had knowledge and experience in the area of study..



#### 4.4 Operations Management Practices

An enquiry was made on the customer relations management practices in the organizations under study. Below is a summary of findings

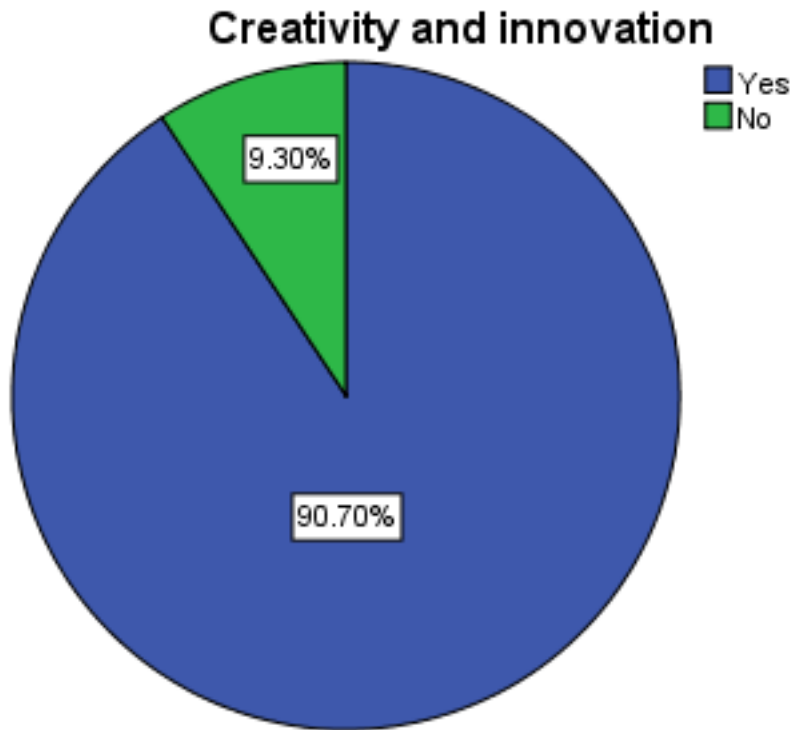
**Table 2: Customer relations Management practices**

This firm has had better customer service due to the implementation of CRM	Strongly disagree	Column N %	0.0%
	Disagree	Column N %	0.0%
	Undecided	Column N %	0.0%
	Agree	Column N %	39.5%
	Strongly agree	Column N %	60.5%
	Total	Mean	(4.6)
Due to introduction of CRM this firm has realized more new customers	Strongly disagree	Column N %	0.0%
	Disagree	Column N %	0.0%
	Undecided	Column N %	23.3%
	Agree	Column N %	46.5%
	Strongly agree	Column N %	30.2%
	Total	Mean	(4.1)
CRM has Enhanced effective cross and up selling of industry services	Strongly disagree	Column N %	0.0%
	Disagree	Column N %	0.0%
	Undecided	Column N %	0.0%
	Agree	Column N %	67.4%
	Strongly agree	Column N %	32.6%
	Total	Mean	(4.3)
The customer relationship management systems in this firm has Simplified the sales and marketing processes	Strongly disagree	Column N %	0.0%
	Disagree	Column N %	14.0%
	Undecided	Column N %	18.6%
	Agree	Column N %	41.9%
	Strongly agree	Column N %	25.6%
	Total	Mean	(3.8)
This firm knows the customers' expectations and requirements and d offer services, accordingly	Strongly disagree	Column N %	0.0%
	Disagree	Column N %	0.0%
	Undecided	Column N %	2.3%
	Agree	Column N %	39.5%
	Strongly agree	Column N %	58.1%
	Total	Mean	(4.6)
Elevator designs are arranged	Strongly disagree	Column N %	0.0%

with respect to the customers' needs, expectations, and complaints	Disagree	Column N %	0.0%
	Undecided	Column N %	0.0%
	Agree	Column N %	48.8%
	Strongly agree	Column N %	51.2%
	Total	Mean	(4.5)

An enquiry was made on the level of agreement of the respondents to the customer relationship management in their firm. The findings showed that this firm has had better customer service due to the implementation of CRM had a mean of 4.6; Due to introduction of CRM this firm has realized more new customers had a mean of 4.1; CRM has Enhanced effective cross and up selling of industry services had a mean of 4.3; The customer relationship management systems in this firm has Simplified the sales and marketing processes had a mean of 3.8; This firm knows the customers' expectations and requirements and offer services, accordingly had a mean of 4.6 and Elevator designs are arranged with respect to the customers' needs, expectations, and complaints had a mean of 4.5. It is clear that all these statements had a mean score of above 3.0 (population mean score) and hence are essential customer relationship management practices in the Elevator industry. This means majority of the respondent agreed with the findings on the impact of CRM on the performance of their organizations. These findings are in accordance with the research by Kagumba and Gongera (2013) that operating a customer-focused business helps firms build a loyal customer base.

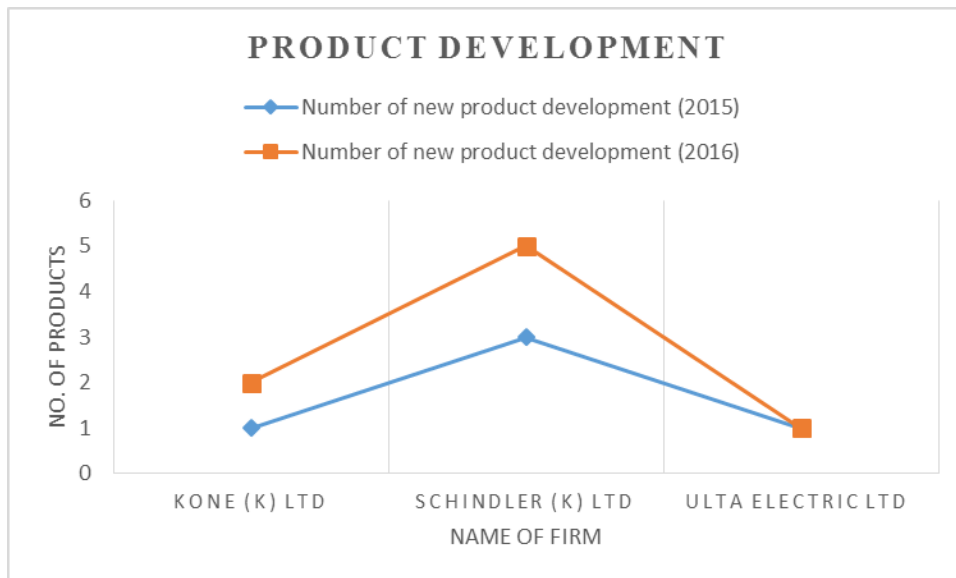
Figure 3: Creativity and innovation



This question was meant to understand whether the firms in the Elevator Industry practice creativity and innovation. The findings showed that 39 firms practice creativity and innovation that represented 90.70% while 4 firms did not practice creativity and innovation which represented 9.30 %. This research agrees with the findings done by Misiko (2014) that over 80% of the respondents attest to the fact that their companies practice creativity and innovation. Creativity and innovation is an essential concept in operations management practices and systems design to ensure quality and improved performance in an industry.

Further, to understand how creativity and innovation has helped progress of these firms, it was revealed that in terms of product development, Kone K Ltd, managed to develop 1 product in 2015 and 2 in 2016; Schindler K Ltd, 3 (2015) and 5 (2016) and Ulta Electric Ltd 1 (2015) and 1 (2016) (Figure 5). The respondents from the other organizations did not respond to the questions on the product development.

**Figure 4: Product Development**



Manufacturing companies in Kenya have been seen to be producing an average of 5 products per year according to a study done by Ndiho (2016) therefore the companies that participated in this question are slightly below the average required for manufacture. However, since only 3 out of 18 companies answered this question, this may not necessarily speak for the entire industry in Kenya.

**Table 3 : Supply Chain Management**

		Column N %	Mean
Supply chain management enhances improved relationships between our customers and us	Strongly disagree	0.00%	(4.26)
	Disagree	0.00%	
	Undecided	9.30%	
	Agree	55.81%	
	Strongly agree	34.88%	
	Total		
Supply chain management enables us to provide quality services to our customers	Strongly disagree	0.00%	(4.49)
	Disagree	0.00%	
	Undecided	2.33%	
	Agree	46.51%	
	Strongly agree	51.16%	
	Total		
developing strategic alliances with suppliers and working with suppliers help to ensure that expectations are met	Strongly disagree	0.00%	(4.26)
	Disagree	2.33%	
	Undecided	11.63%	
	Agree	44.19%	
	Strongly agree	41.86%	
	Total		
involving suppliers early in the product development process help in taking advantage of their capabilities and expertise	Strongly disagree	0.00%	(4.47)
	Disagree	0.00%	
	Undecided	2.33%	
	Agree	48.84%	
	Strongly agree	48.84%	
	Total		

An enquiry was made pertaining supply chain management in the organizations under study. The findings showed that Supply chain management enhances improved relationships between our customers and us had a mean of 4.26; Supply chain management enables us to provide quality services to our customers had a mean of 4.49; developing strategic alliances with suppliers and working with suppliers help to ensure that expectations are met had a mean of 4.26 and involving suppliers early in the product development process help in taking advantage of their capabilities and expertise had a mean of 4.47. The findings imply that supply chain management plays a crucial role in improving the operational performance by developing strategic alliances with the suppliers, taking advantage of capabilities and expertise in the supply chain, offering quality

services to the customers as well as enhancing improved relationship between the suppliers and the organizations. These are important in improving operational management practices for the firms in the Elevator industry. These findings are in line with the research by Tomasini and Wassenhove (2009) that strategic supplier relationship management is a very important move in improving performance across the supply chain, enabling the business to develop and generating greater cost efficiency.

**Table 4: Employee empowerment and involvement**

		Column N %	Mean
When employees are empowered with responsibility, managers become freed to concentrate on strategy and the bigger picture: daily stress declines	Strongly disagree	0.00%	(4.56)
	Disagree	0.00%	
	Undecided	0.00%	
	Agree	44.19%	
	Strongly agree	55.81%	
	Total		
Employee involvement and empowerment lead to enhanced morale,	Strongly disagree	0.00%	(4.60)
	Disagree	0.00%	
	Undecided	0.00%	
	Agree	39.53%	
	Strongly agree	60.47%	
	Total		
Employee involvement and empowerment lead to more productivity	Strongly disagree	0.00%	(4.63)
	Disagree	0.00%	
	Undecided	0.00%	
	Agree	37.21%	
	Strongly agree	62.79%	
	Total		
Employee involvement and empowerment helps to cultivate innovation	Strongly disagree	0.00%	(4.49)
	Disagree	0.00%	
	Undecided	0.00%	
	Agree	51.16%	
	Strongly agree	48.84%	
	Total		

The respondents were requested to indicate their level of agreement in relation to employee empowerment and involvement. The findings showed that When employees are empowered with

responsibility, managers become freed to concentrate on strategy and the bigger picture: daily stress declines had a mean of 4.56; Employee involvement and empowerment lead to enhanced morale had a mean of 4.60; Employee involvement and empowerment lead to more productivity had a mean of 4.63 and Employee involvement and empowerment helps to cultivate innovation had a mean of 4.49. It is clear that the statements had a mean score of above 3.0 (population mean score) and hence the statements are considered important in regard to employee empowerment and involvement. Clearly, employee empowerment and involvement cultivates a culture of innovation in the Elevator industry; it results to improved productivity; enhances the employee morale and strategize for the growth of the organizations. These are good operations management practices in the Elevator industry to enhance competitiveness. According to Kimolo (2013), an interpretation of a mean of  $1.5 \leq 2.4$  implies disagree,  $2.5 \leq 3.4$  implies neutral,  $3.5 \leq 4.4$  implies agree,  $\geq 4.5$  implies strongly agree.

**Table 5: Importance of Capacity Planning**

		Column N %	Mean
Capacity planning affects operational performance of this firm	Strongly disagree	0.00%	(4.56)
	Disagree	0.00%	
	Undecided	0.00%	
	Agree	44.19%	
	Strongly agree	55.81%	
Total			
Capacity planning includes vision, mission, and values of these firm	Strongly disagree	0.00%	(4.30)
	Disagree	0.00%	
	Undecided	16.28%	
	Agree	37.21%	
	Strongly agree	46.51%	
Total			
With effective strategic capacity planning efforts employees are taken as an input in developing the vision, mission, strategies, and objectives.	Strongly disagree	0.00%	(4.56)
	Disagree	2.33%	
	Undecided	0.00%	
	Agree	39.53%	
	Strongly agree	55.81%	
Total			
Capacity planning efforts also	Strongly disagree	0.00%	

take into account the possible side effects of the plan to the environment prior to the production.	Disagree	0.00%	
	Undecided	18.60%	
	Agree	37.21%	
	Strongly agree	44.19%	
	Total		(4.26)

An enquiry was made on the importance of capacity planning in Elevator industry. The findings showed that Capacity planning affects operational performance of this firm had a mean of 4.56; Capacity planning includes vision, mission, and values of these firm had a mean of 4.30; With effective strategic capacity planning efforts employees are taken as an input in developing the vision, mission, strategies, and objectives had a mean of 4.56 and Capacity planning efforts also take into account the possible side effects of the plan to the environment prior to the production had a mean of 4.26. It is through capacity planning that the Elevator industry firms are able to influence the quality of their products by strategizing in terms of the vision, mission and objectives and taking into account the likely side effects of the plan to the environment in production. These results agree with the findings of Ong'ondo (2013) that capacity planning influences the level of satisfaction of the customers and so enhancing competitiveness.

**Table 6 : Importance of process improvement**

		Column N %	Mean
Deployment of BPM lead to Improved Business Agility	Strongly disagree	0.00%	(4.40)
	Disagree	0.00%	
	Undecided	2.33%	
	Agree	55.81%	
	Strongly agree	41.86%	
	Total		
Deployment of BPM lead to Reduced Costs and Higher Revenues	Strongly disagree	0.00%	(4.51)
	Disagree	0.00%	
	Undecided	0.00%	
	Agree	48.84%	
	Strongly agree	51.16%	
	Total		
Deployment of BPM Enhanced	Strongly disagree	0.00%	



transparency that allows management gain a better understanding of their processes.	Disagree	0.00%	(4.51)
	Undecided	0.00%	
	Agree	48.84%	
	Strongly agree	51.16%	
	Total		
Deployment of BPM allows the management to modify structures and processes efficiently while keeping track of outcomes.	Strongly disagree	0.00%	(4.51)
	Disagree	2.33%	
	Undecided	0.00%	
	Agree	41.86%	
	Strongly agree	55.81%	
Total			
Deployment of BPM lead to Compliance, Safety and Security	Strongly disagree	0.00%	(4.47)
	Disagree	0.00%	
	Undecided	2.33%	
	Agree	48.84%	
	Strongly agree	48.84%	
Total			

An enquiry was made into the importance associated with process improvement in Elevator industry. The findings showed that Deployment of BPM lead to Improved Business Agility had a mean of 4.40; Deployment of BPM lead to Reduced Costs and Higher Revenues had a mean of 4.51; Enhanced transparency that allows management gain a better understanding of their processes had a mean of 4.51 and Deployment of BPM lead to compliance, Safety and Security had a mean of 4.47. The findings of this study further stated that the firms need to learn from the past such as proper sourcing of personnel, improvement of processes and early planning to avoid reactive actions and also Capacity planning needs to be emphasized in order to meet customer's expectations especially on project timelines. This is a demonstration that the business process improvement is essential for the firms in the Elevator industry to understand their processes and transparency which reduces costs and increases revenues. The process and capacity shape the physical form and purpose of the products. This has an influence on the output level both in the short and long term aiming to meet the customer needs through achieving required quality levels and also making sure that speed delivery, flexibility and costs have been achieved. In a study done by Kibwage (2012) on business process improvement practices adopted by Savings and credit societies with front office service activity in Nairobi county, he recommended that

organizations need to use high technology to emphasize on the Business Process Improvement practices. In Gitagama's (2008) case study of East African Breweries revealed the relationship between Business Process Reengineering and organization performance is symmetrical.

## 4.5 System design

**Table 7: Systems design in Elevator industry**

		Column N %	Mean
Before designing an elevator for the customer the engineers must submit Building codes, fire regulations, ISO standards compliance.	Strongly disagree	0.0%	(4.70)
	Disagree	0.0%	
	Undecided	0.0%	
	Agree	30.2%	
	Strongly agree	69.8%	
This firm ensures that local safety standards are met in the designing and construction of an elevator	Strongly disagree	0.0%	(4.51)
	Disagree	0.0%	
	Undecided	0.0%	
	Agree	48.8%	
	Strongly agree	51.2%	
The engineers are responsible for designing elevators that can be assembled and maintained easily and feasibly	Strongly disagree	0.0%	(4.53)
	Disagree	0.0%	
	Undecided	0.0%	
	Agree	46.5%	
	Strongly agree	53.5%	
The engineers are responsible for designing "fool-proof" systems that will work reliably and safely in the event that they are misused.	Strongly disagree	0.0%	(4.44)
	Disagree	0.0%	
	Undecided	0.0%	
	Agree	55.8%	
	Strongly agree	44.2%	
The engineers that design the elevator communicate to the architects to ensure them that these standards are met.	Strongly disagree	0.0%	(4.42)
	Disagree	0.0%	
	Undecided	0.0%	
	Agree	58.1%	
	Strongly agree	41.9%	
Total			(4.42)

An enquiry was made in order to understand the systems design in the Elevator industry. The findings showed that before designing an elevator for the customer the engineers must submit Building codes, fire regulations, ISO standards compliance had a mean of 4.70; This firm ensures that local safety standards are met in the designing and construction of an elevator had a mean of 4.51; The engineers are responsible for designing elevators that can be assembled and maintained easily and feasibly had a mean of 4.53; The engineers are responsible for designing "fool-proof" systems that will work reliably and safely in the event that they are misused had a mean of 4.44 and The engineers that design the elevator communicate to the architects to ensure them that these standards are met had a mean of 4.42. This shows that it is the responsibility of the building Architects to offer space and structural support for the elevator. Therefore, the design of elevators is meant to ensure specified safety and quality standards. They are often outlines in the safety requirements and compliance standards across regions. According to Kimolo (2013), an interpretation of a mean of  $1.5 \leq 2.4$  implies disagree,  $2.5 \leq 3.4$  implies neutral,  $3.5 \leq 4.4$  implies agree,  $\geq 4.5$  implies strongly agree. With a mean of 4.42, it is evident that all the respondent agreed that both local and international standards were observed and communicated to the engineers and architects to ensure fool proof systems in the operation of elevators. Majority of the scores indicated strongly agreed and on engineers responsibilities and communicated we had agreed with means of 4.44 and 4.42 respectively. It is clear that this can be improved on to ensure the entire industry understands it's responsivity during the design stage in order to communicate what is required.

**Table 8: Technological Advancement**

		Column N %	Mean
Machine room-less elevators	5.00	100.0%	(5.00)
	Total		
elevator with regenerative drive	1.00	20.9%	
	2.00	44.2%	
	3.00	20.9%	
	4.00	7.0%	
	5.00	7.0%	
	Total		(2.35)
double deck elevators	1.00	53.5%	

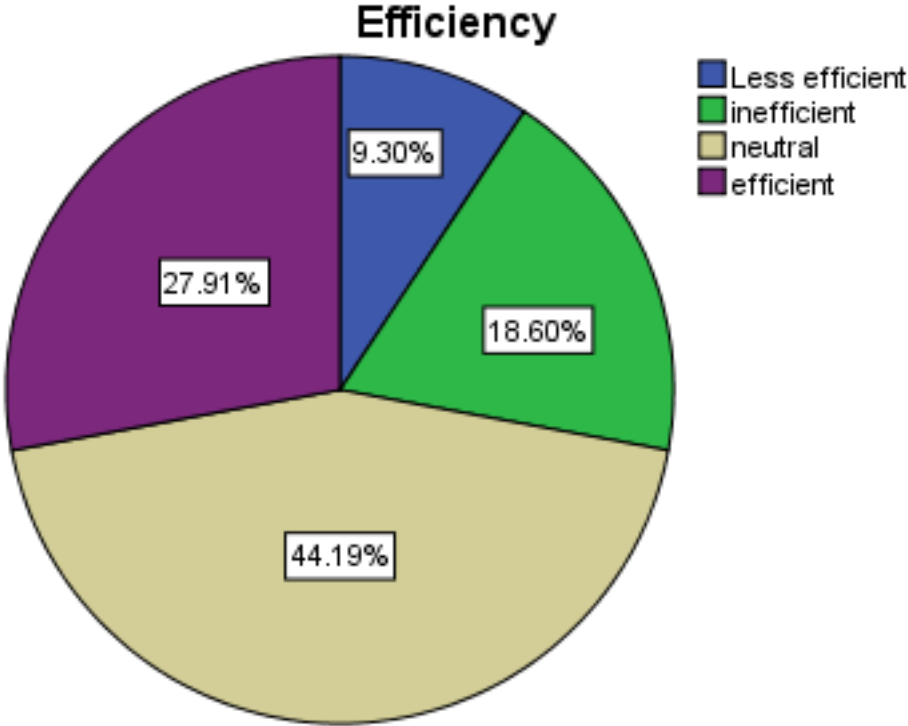
	2.00	25.6%	
	3.00	16.3%	
	4.00	2.3%	
	5.00	2.3%	
	Total		(1.74)
ultra-ropes that are lighter and convenient during installations and maintenance of elevators	1.00	2.4%	
	2.00	28.6%	
	3.00	45.2%	
	4.00	23.8%	
	Total		(2.90)
AC Power	1.00	41.9%	
	2.00	53.5%	
	5.00	4.7%	
	Total		(1.72)
Twin systems	2.00	2.3%	
	3.00	34.9%	
	4.00	34.9%	
	5.00	27.9%	
	Total		(3.88)
LED lighting	1.00	93.0%	
	3.00	4.7%	
	5.00	2.3%	
	Total		(1.19)
destination dispatching systems	5.00	100.0%	
	Total		(5.00)
people flow solutions	2.00	20.9%	
	3.00	46.5%	
	4.00	18.6%	
	5.00	14.0%	
	Total		(3.26)

This study wanted to understand the different technological advancements that have been made in the Elevator industry to address the issue of energy consumption to ensure that they provide best practices in the industry. The findings showed that the firms in the industry make use of machine room less devices, elevator with generative device, double deck elevators, ultra-ropes that are lighter and convenient during installations and maintenance of elevators, destination dispatching systems and people flow solutions. These have been considered to fully account for about 40 % of building energy during their peak hours. The use of these elements with energy

saving elevators can significantly reduce the energy consumption and are considered as best operational management practices in the industry. Elevators and escalators need to offer current energy and climate target through improved efficiency in the existing and new equipment. In addition, within the corporate level, the firms showed that it is important to embrace lighter materials, e.g. ultra-ropes while within the local level, the firms stated that there was need to be pro-active and aggressive in our offers, e.g. destination control, meeting local customer requirements, and generally being positive (having it-is-possible attitude). It is clear that there are some new technology that are not fully utilized with all the 18 companies under study. Machine room-less elevators and destination dispatching systems are being used in all the organizations, twin systems and people flow solutions are also fairly common, regenerative drives, double deck lifts, ultra-ropes, AC power and LED lighting are not so commonly used in the industry. Clear indication that full implementation of energy saving technology has been affected by general lack of awareness of these technologies (De Almeida , 2014).

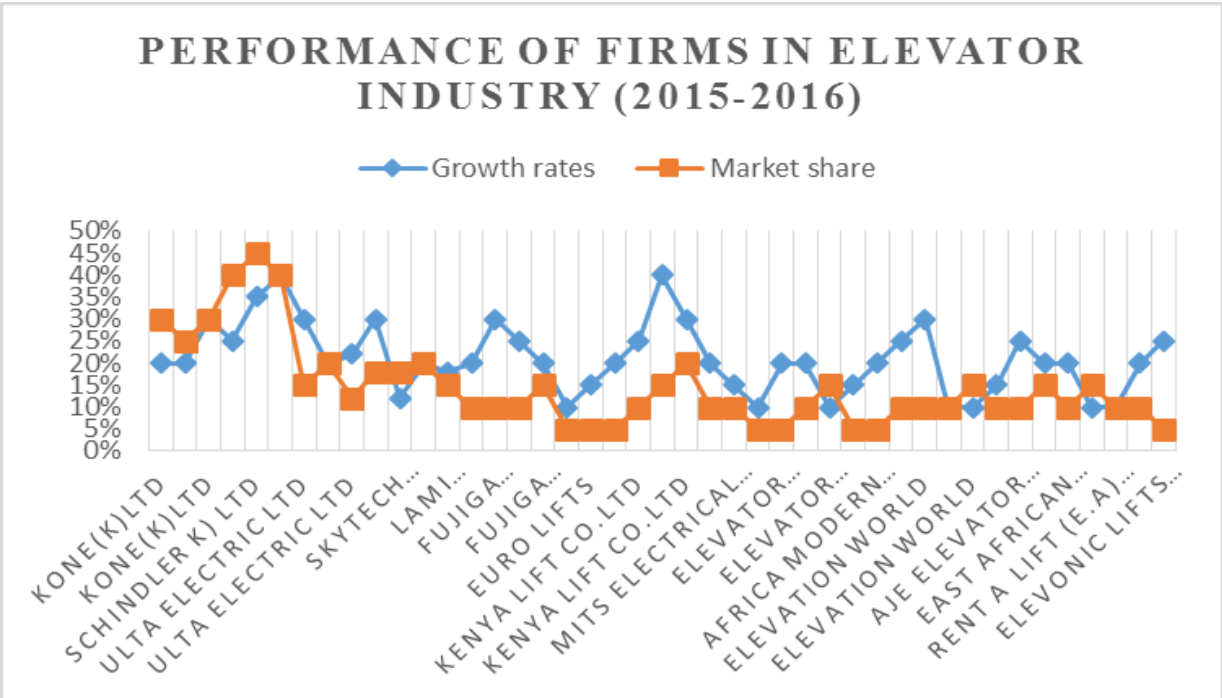
#### 4.6 Operations Performance

Figure 5: Efficiency of firms



An enquiry was made to understand the efficiency of the firms over a period of two years. The findings showed that most of the respondents considered their firms to be neutral in terms of efficiency. Efficiency is an essential measure of operational performance in organizations in the Elevator industry. Firms in the industry should place emphasis on operations management practices and systems design so as to improve their level of efficiency.

**Figure 6: Performance of firms in Elevator Industry (2015-2016)**



An enquiry was made on performance of firms in the Elevator industry over a period of 2015-2016. The findings showed that the growth rates and the market share for the firms in the Elevator industry fall below the average. This means that the firms in the industry still face challenges in terms of operational performance. Organizations in this industry are yet to realize higher profits and market share growth through operations management practices. Clearly, better waste management should be practiced in order to ensure reduced costs, adoption of operations management practices as well as system designs can enhance flexibility within an organization, creativity and innovation has resulted into increased productivity of the organization and

operations management practices as well as systems design can enhance better quality of products and services. These are essential since operations management influence the quality of the products (goods and services). Schinder (K) LTD, has the highest market share with a fairly high growth rate. Kenya Lift Co. LTD has a high growth rate although its market share is not so high. Schindler and Kenya Lift Co. have been in operation in Kenya from 1992 and 1980s respectively. Both have marked their existence in the Kenyan elevator industry for more than a decade. It is important to note, KONE has a high market share although it has not been in operation in Kenya for as long as some of the other players.

#### 4.7 Regression analysis

This study conducted a regression analysis in order to establish in order to establish the relationship between the independent and the dependent variables. The models are as below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i + \epsilon$$

Where:

Y = operations performance of elevator firms

$\beta_i$ 's = Coefficients

$X_i$ 's = operation management practices (Customer Relationship Management, Employee Empowerment and Involvement, Creativity and Innovation, Supply Chain Management, Capacity Planning and Business Process Improvement).

$\epsilon$  = error term

And

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i + \epsilon$$

Where:

Y = performance of elevator firms

$\beta_i$ 's = Co-efficients

$X_i$ 's = Systems design (machine-room-less elevators, scaffold-less installation process, lifts with regenerative drives, lifts with energy efficient lighting)

$\varepsilon$ = error term

#### 4.7.1 Strength of the models

The analysis of the models done in table 11 indicates that the coefficient of determination (percentage change of dependent variable explained by a change on independent variable). R<sup>2</sup> has two values of 0.743 ( customer relationship management, employee empowerment and involvement, creativity and innovation, supply chain management, creativity planning and business process improvement explain 74.3 % of the operations performance of elevator firms) and 0.651 (machine-room-less elevators, scaffold-less installation process, lifts with regenerative drives, lifts with energy efficient lighting explain 65.1 % of operations performance of elevator firms). The p values of 0.000 (less than 0.05 significance level) indicates that the models are significant at 5 % level of significance.

**Table 9: Summary of models**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.597 <sup>a</sup>	.743	.075	.55801	2.080
2	.601 <sup>a</sup>	.651	.067	.43234	1.09



## 4.7.2 Coefficients of Regression

**Table 10: Final Models**

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	sig
1	(Constant)	5.680	.856		2.521	0.000
	Customer relationship management	.044	.089	.610	3.271	.622
	Employee empowerment and Involvement	.173	.093	.640	1.043	.072
	Creativity and Innovation	.068	.102	.680	1.067	.316
	Supply chain management	.090	.088	.660	1.321	.828
2	Capacity planning	.025	.113	.649	1.211	.191
	Business process improvement	.151	.113	.610	1.352	.739
	(Constant)	3.21	.111	.780	1.035	.283
	Machine room-less elevators	.094	.086	.510	1.092	.136
	scaffold-less installation process	.193	.126	.650	1.123	.067
	Lifts with regenerative drives	.066	.072	.610	1.435	.109
	lifts with energy efficient lighting	.117	.086	.530	1.801	.126

- a. Dependent Variable: operations performance of elevator firms
- b. Dependent Variable: operations performance of elevator firms

By use of the B coefficients that are related to the 10 critical factors that explain about operations performance of elevator firms (Table 12), it is possible to develop multiple regression function that can predict the operations performance of elevator firms in Kenya when the values of the critical factors or the variables are known. Therefore, by using the coefficients, the prediction equations for operations performance of elevator firms are shown below:

Constant = 5.680, indicates that customer relationship management, employee empowerment and involvement, creativity and innovation, supply chain management, creativity planning and business process improvement being held constant (0), operations performance of elevator firms in Kenya would be 5.680.

$X_1 = 0.44$ , indicates that a unit change in customer relationship management results in 0.44 unit's growth in operations performance of elevator firms in Kenya.

$X_2 = 0.173$ , indicates that a unit change in employee empowerment and Involvement results in 0.173 unit's growth in operations performance of elevator firms in Kenya.

$X_3 = 0.68$ , indicates that a unit change in creativity and innovation results in 0.68 unit's growth in operations performance of elevator firms in Kenya.

$X_4 = 0.90$ , indicates that a unit change in supply chain management results in 0.90 unit's growth in operations performance of elevator firms in Kenya.

$X_5 = 0.25$ , indicates that a unit change in creativity and planning results in 0.25 unit's growth in operations performance of elevator firms in Kenya.

$X_6 = 0.151$ , indicates that a unit change in business process improvement results in 0.151 unit's growth in operations performance of elevator firms in Kenya.

And for model 2 where;

Constant = 3.21, indicates that machine-room-less elevators, scaffold-less installation process, lifts with regenerative drives, lifts with energy efficient lighting being held constant (0), operations performance of elevator firms in Kenya would be 3.21.

$X_1 = 0.094$ , indicates that a unit change in machine-room less results in 0.094 unit's growth in operations performance of elevator firms in Kenya.

$X_2 = 0.193$ , indicates that a unit change in scaffold-less installation process results in 0.193 unit's growth in operations performance of elevator firms in Kenya.

$X_3 = 0.066$ , indicates that a unit change in lifts with regenerative drives results in 0.066 unit's growth in operations performance of elevator firms in Kenya.

$X_4 = 0.117$ , indicates that a unit change in lifts with energy efficient lighting results in 0.117 unit's growth in operations performance of elevator firms in Kenya.

This analysis was done at 5% significance level where if the probability was less than  $\alpha$ , then predictor variable is significant .

## **CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 Introduction**

This chapter provides a summary of the findings of this study. The study aimed at evaluating operations management practices and systems design in the Elevator industry in Kenya. The focus was put on the Elevator firms in Kenya in which the regulatory bodies govern the operations and development of the elevator industry in Kenya. This is meant to ensure certain standards have been met in order to protect the customers or the end users, the environment and also the parties that are involved on more so in the installation process.

### **5.2 Summary of the findings**

#### **5.2.1 Operations Management practices**

Base on this study, it has been shown that from the sample of Elevator industry firms used in the study all the firms employ operations management practices and systems design in their daily operations. However, the industry has been less efficient and still faces challenges in terms of operational performance measured using the market share and the growth efficiency. The organizations in this industry are yet to realize higher profits and market share growth through the operations management practices. Operations management practices had a significant positive relationship with operations performance. This is supported by customer relationship statistics  $\beta = 0.44$ ; employee empowerment and involvement statistics  $\beta = 0.173$ ; creativity and innovation statistics  $\beta = 0.68$ ; supply chain management statistics  $\beta = 0.90$ ; creativity and planning statistics  $\beta = 0.25$  and business process improvement statistics  $\beta = 0.151$ .

#### **5.2.2 Systems Design**

The findings of this study has put emphasis on the significance of systems design in the Elevator industry. The findings indicated that before designing an elevator for the customer, the engineers must submit Building codes, fire regulations, ISO standards compliance (mean of 4.70); firm ensures that local safety standards are met in the designing and construction of an elevator (mean of 4.51); the engineers are responsible for designing elevators that can be assembled and maintained easily and feasibly (mean of 4.53); The engineers are responsible for designing "fool-proof" systems that will work reliably and safely in the event that they are misused (mean of

4.44) and the engineers that design the elevator to communicate to the architects to ensure that these standards are met (mean of 4.42). The findings indicate that it is the responsibility of the building Architects to offer space and structural support for the elevator. Therefore, the design of elevators is meant to ensure specified safety and quality standards. They are often outlines in the safety requirements and compliance standards across regions. Further, this study has out emphasis on technological advancement made in the Elevator industry so as to address the issues on energy consumption to offer best practices in the industry. Clearly, the firms in the industry make use of machine room less devices, elevator with generative device, double deck elevators, ultra-ropes that are lighter and convenient during installations and maintenance of elevators, destination dispatching systems and people flow solutions. These have been considered to fully account for about 40 % of building energy during their peak hours. The use of these elements with energy saving elevators can significantly reduce the energy consumption and are considered as best operational management practices in the industry. The findings of this study are supported by the statistics on machine-room less,  $\beta = 0.094$ ; scaffold-less installation process,  $\beta = 0.193$  and lifts with energy efficient lighting  $\beta = 0.117$ .

### **5.2.3 Operations performance**

Operations management in the Elevator industry is affected by the operations management practices such as customer relationship management, employee empowerment and involvement, creativity and innovation, supply chain management, capacity planning and business process improvement. In addition, the systems design have an effect on the operations performance of the Elevator firms and they include machine-room-less elevators, scaffold-less installation process, lifts with regenerative drives, lifts with energy efficient lighting. All these variables were considered to have a significant and positive relationship with operations performance.

### **5.3 Conclusion**

Based on the research findings, this study concludes, majority of the players in the elevator industry in Kenya have adapted operations management practices and systems design in their operations. They have been able to realize efficiency, profitability, speed of delivery, quality products and increase their market share and growth. This has significantly contributed to

customer satisfaction and has enhanced competitiveness of these firms through improved operational performance.

The study concludes that there is a significant relationship between operations management practices and performance of the elevator firms in Kenya's elevator industry. Customer relationship management, employee empowerment and involvement, creativity and innovation, supply chain management, capacity planning as well as business process improvement all have a positive impact on the performance of elevator firms. This is in relation to their market share as well as growth rates and efficiency.

The study concludes that there is a significant relationship between systems design and performance of the elevator firms in Kenya's elevator industry. This designs are aimed at ensuring energy efficient systems are in use as well as safety measures are encouraged. This is in relation to their market share as well as growth rates and efficiency. Technological advancements are employed to come up with systems aimed at enhancing customer/end user satisfaction. It is essential for the management of the Elevator industry firms to ensure that operations management practices and systems design have been emphasized in their firms as they result to improved operational performance.

#### **5.4 Recommendations**

Elevator firms can make use of operations management practices and systems design not only to meet customer expectations and requirements as well as enhance customer relationship management through quality, accuracy and performance but also improve profitability, speed of delivery, quality of products and market share that define operations performance. This can be done by considering the growing importance of ensuring safety is met and adhering to standards of good practice that protect customer /end user, the environment and the parties involved more so on installation process in the Elevator industry. More emphasis needs to be put in to the use of the operations managements practices as this can enhance operational performance in the organization.

Operations management practices and systems design are important concepts that can improve the level of efficiency in the Elevator industry. Therefore, firms can ensure that by fully

implementing the operations management practices and systems design in their organizations there is great improvement on its performance. This can be seen in its efficiency rates as well as profitability.

### **5.6 Limitations of the Study**

This study was carried out within limited time and therefore got responses from only 43 Elevator firms in Kenya but the industry has 54 firms across the country. This is a representation of about 80 % of the total firms in the industry.. Therefore, the study assumes a homogenous role among all the Elevator firms in Kenya irrespective of their standards of good practice on safety, which might not always be the case.

The operations performance of Elevator firms has been assumed to solely depend on the good practices of safety and standards set in the industry. Contrary to these, the changes in the business environment such as the performance of the economy would have an impact on the operations performance of these firms. Therefore, the measure of operations performance of these firms through market growth share and profitability would depend on other external factors not necessarily on the operations management practices. For the purpose of this study, market share and growth rate have been used to measure the contributions of good operations management practices and systems design as the main contribution for improved market share for the Elevator firms across the country. Future studies can ensure control of the external factors which would have an effect on the operations performance of these firms as well.

### **5.7 Suggestions for Further Research**

Future studies should cover all the Elevator firms as a way of getting a clear picture for comparison of the operations management practices for these firms across the country rather than to generalize the findings of the study. Future studies should also ensure control of the external factors which would have an effect on the operations performance of these firms as well. This will ensure the study comprehensively covers the operations management practices and systems design in the Kenya's elevator industry.

Also researcher should look at how good performance in the elevator industry can contribute to the GDP. Since Kenya is a growing economy it would be interesting to see what role the elevator industry plays in the realization of vision 2030.



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## APPENDIX I: INTRODUCTION LETTER



### UNIVERSITY OF NAIROBI SCHOOL OF BUSINESS

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Telegrams: "Varsity" Nairobi  
Telec: 22051 Varsity

P.O. Box 20197  
Nairobi, Kenya

DATE: 3<sup>rd</sup> November, 2017

#### TO WHOM IT MAY CONCERN

The bearer of this letter JACK ANYANG'O ALUOCH

Registration No. BE181992/2015

is a bona fide continuing student in the Master of Business Administration (MBA) degree program in this University.

He/she is required to submit as part of his/her coursework assessment a research project report on a management problem. We would like the students to do their projects on real problems affecting firms in Kenya. We would, therefore, appreciate your assistance to enable him/her collect data in your organization.

The results of the report will be used solely for academic purposes and a copy of the same will be availed to the interviewed organizations on request.

Thank you.



**PATRICK NYABUTO**  
SENIOR ADMINISTRATIVE ASSISTANT  
SCHOOL OF BUSINESS

## APPENDIX II: RESEARCH QUESTIONNAIRE

### PART ONE: BACKGROUND INFORMATION

1. Position of respondent .....
2. Years of service in the organization  
 0 – 10 yrs [ ]                                      11-20 yrs [ ]  
 21 – 30 yrs [ ]                                      30 yrs and above [ ]
3. Name of firm \_\_\_\_\_
4. Year established \_\_\_\_\_
5. Number of employees \_\_\_\_\_

### PART TWO: OPERATION MANAGEMENT PRACTICES

6. Is Customer Relationship Management practiced in your organization? Yes [ ] No [ ]

If yes please respond to each of the items below by ticking in the column that clearly represents your opinion as pertains to Customer Relationship Management in your firm. Where **1- Strongly Disagree; 2- Disagree 3-Undecided; 4-Agree; 5- Strongly Agree**

<b>Customer Relationship Management</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
• This firm has had better customer service due to the implementation of CRM					
• Due to introduction of CRM this firm has realized more new customers					
• CRM has Enhanced effective cross and up selling of industry services					
• The customer relationship management systems in this firm has Simplified the sales and marketing processes					
• This firm knows the customers' expectations and requirements and offer services, accordingly					
• Elevator designs are arranged with respect to the customers' needs, expectations, and complaints					

7. Is creativity and innovation encouraged in your organization? Yes  No

If yes please respond to each of the items below;

Kindly indicate in the table below the number of new products the organization has introduced into the market in the last two years.

	Previous year 2015	Last year 2016
No. of new products		
No. of patents		

8. Please respond to each of the items below by ticking in the column that clearly represent your opinion as pertains to Supply Chain Management in your firm. Where **1- Strongly Disagree; 2- Disagree 3-Uncecided; 4-Agree; 5- Strongly Agree**

<b>Supply Chain Management</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
• Supply chain management enhances improved relationships between our customers and us					
• Supply chain management enables us to provide quality services to our customers					
• developing strategic alliances with suppliers and working with suppliers help to ensure that expectations are met					
• involving suppliers early in the product development process help in taking advantage of their capabilities and expertise					

9. Please respond to each of the items below by ticking in the column that clearly represent your opinion as pertains to Employee Empowerment and Involvement in your firm. Where **1- Strongly Disagree; 2- Disagree 3-Uncecided; 4-Agree; 5- Strongly Agree**

<b>Employee Empowerment and Involvement</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
• When employees are empowered with responsibility, managers become freed to concentrate on strategy and the bigger picture: daily stress declines					
• Employee involvement and empowerment lead to enhanced morale,					
• Employee involvement and empowerment lead to more productivity					
• Employee involvement and empowerment helps to cultivate innovation					

10. Please respond to each of the items below by ticking in the column that clearly represent your opinion as pertains to Capacity Planning in your firm. Where **1- Strongly Disagree; 2- Disagree 3-Uncecided; 4-Agree; 5- Strongly Agree**



<b>Capacity Planning</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
• Capacity planning affects operational performance of this firm					
• Capacity planning includes vision, mission, and values of these firm					
• With effective strategic capacity planning efforts employees are taken as an input in developing the vision, mission, strategies, and objectives.					
• Capacity planning efforts also take into account the possible side effects of the plan to the environment prior to the production.					

11. Please respond to each of the items below by ticking in the column that clearly represent your opinion as pertains to Business Process Improvement in your firm. Where **1- Strongly Disagree; 2- Disagree 3-Undecided; 4-Agree; 5- Strongly Agree**

<b>Business Process Improvement</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
• Deployment of BPM lead to Improved Business Agility					
• Deployment of BPM lead to Reduced Costs and Higher Revenues					
• Deployment of BPM Enhanced transparency that allows management gain a better understanding of their processes.					
• Deployment of BPM allows the management to modify structures and processes efficiently while keeping track of outcomes.					
• Deployment of BPM lead to Compliance, Safety and Security					

**What else can you add on operations management in your firm**

?.....

**PART THREE: SYSTEM DESIGN**

12. Please respond to each of the items below by ticking in the column that clearly represent your opinion as pertains to system design in your firm. Where **1- Strongly Disagree; 2- Disagree 3-Undecided; 4-Agree; 5- Strongly Agree**

<b>Statements</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
• Before designing an elevator for the customer the engineers must submit Building codes, fire regulations, ISO standards compliance etc					
• This firm ensures that local safety standards are met in the designing and construction of an elevator					
• The engineers are responsible for designing elevators that can be assembled and maintained easily and feasibly					
• The engineers are responsible for designing "fool-proof" systems that will work reliably and safely in the event that they are misused.					

<ul style="list-style-type: none"> <li>The engineers that design the elevator communicate to the architects to ensure them that these standards are met.</li> </ul>					
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13. Please respond to each of the items below by ticking in the column that clearly represent your opinion as pertains to Technological Advancement in your firm. Where **1- Strongly Disagree; 2- Disagree 3-Undecided; 4-Agree; 5- Strongly Agree**

This firm utilizes

Statements	1	2	3	4	5
<ul style="list-style-type: none"> <li>Machine room-less elevators</li> </ul>					
<ul style="list-style-type: none"> <li>elevator with regenerative drive,</li> </ul>					
<ul style="list-style-type: none"> <li>double deck elevators,</li> </ul>					
<ul style="list-style-type: none"> <li>compass destinations</li> </ul>					
<ul style="list-style-type: none"> <li>ultra-ropes that are lighter and convenient during installations and maintenance of elevators</li> </ul>					
<ul style="list-style-type: none"> <li>AC power,</li> </ul>					
<ul style="list-style-type: none"> <li>TWIN systems</li> </ul>					
<ul style="list-style-type: none"> <li>LED lighting</li> </ul>					
<ul style="list-style-type: none"> <li>destination dispatching systems,</li> </ul>					
<ul style="list-style-type: none"> <li>people flow solutions,</li> </ul>					

**What else about your systems do you want to share with us ?**

.....

**PART FOUR: OPERATIONS PERFORMANCE**

14. Kindly indicate in the table below the profits and sales figures the organization attained in the last two consecutive financial years.

15. What is the approximate growth rate in profits from previous year(give latest data)\_\_\_\_\_

Rate your efficiency with 5= very efficient, 1=least efficient

Measure of performance	Previous year (2015)	Last Year (2016)
Profit in Millions of KSH		
Sales Revenue in Millions of KSh		

What is your approximate market share \_\_\_\_\_Percentage

### **APPENDIX III: ELEVATOR INDUSTRY**

1. Africa Modern Elevators
2. AJE Elevator Engineering Co Ltd
3. East African Elevator Co Ltd
4. Eleski Tech
5. Elevation World
6. Elevator Technics Limited
7. Elevonic Lifts Services
8. Euro Lifts
9. Fujiga Elevators Co. Ltd
10. Kenya Lift Co Ltd (Hauslift)
11. Kone Kenya Ltd
12. Lami Investment Ltd
13. Mako Lift Company Ltd
14. Mits Electrical Company Ltd
15. Rent A Lift (E.A) Ltd
16. Schindler Ltd – Head Office Branch
17. Skytech Elevators
18. Ultra Electric Ltd