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**“INFLUENCE OF AUTOMATED SYSTEM ON PERFORMANCE OF  
THE NAIROBI SECURITIES EXCHANGE”**



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## **Abstract**

Technological advancement has played a key role in creating change within the securities trading. This study sought to examine the influence of automated system on performance of the NSE. Specifically this study examined the influence of electronic clearing and settlement, electronic ordering and electronic security transfer on performance of the NSE. The study was informed by Socio-Technical Systems Theory of Acceptance. It adopted a survey research design. The target population consisted of top executive and middle management staff/supervisors of 18 licensed brokerage firms and stratified random sampling techniques was used to select 96 respondents. Primary data was collected using questionnaire and it was analysed using descriptive and inferential analysis. The results revealed that of electronic clearing and settlement, electronic ordering and electronic security transfer had significant positive effect on the performance. Further, electronic clearing and settlement significantly accounted for 67.1%, electronic ordering, 27.1% and electronic security transfer, 71.2% of variance in performance of NSE. It was therefore recommended that investors and traders should be allowed to access any information from the automation system that is deemed crucial and critical to their decision making process, thus efficiency on the market and improve in share volume traded.

**Key Words: Automated System, Electronic Clearing and Settlement, Electronic Ordering, Electronic Security Transfer, NSE performance**

## **1. Introduction**

Securities market is important as key players in an economic institution that enhances the efficiency and effectiveness of capital formation and allocation. It enables a country to raise future capital which helps them in financing new projects and overall expansion plans. Securities market performance is driven mainly by expectations (Sandte, 2012). Advocates of automation suggested that execution of trade is faster and less costly under computerized trading systems. However, critics of automation argue that electronic trading could not have an Influence on performance since judgmental aspects of trade execution are lost with automation, which could be particularly important in times of fast market movements.

Automation is the use of self-regulating machinery, electronic equipment to make an exchange system or process operates at greater speed and with little or no human intervention. Automating system enables traders have access to broader information including bid and ask prices, trades sizes and volume, at lower costs, due to the existence of a

limit order book than under manual systems that restrict access to information about standing orders above and below the market. This would attract more investors and improve performance and generate better price discovery.

According to (Jian, 2005), rapid technological advancements in telecommunications and the internet has been transforming the business model of the stock exchanges. Globally the security exchange technology has evolved from the open outcry system to the on-line screen based system thus bringing about unprecedented importance in changing the market practices. Millin (2010) asserted that computer technology being a main factor influencing electronic trading has seen great development over the years and as a result it has seen the elimination of human labour in the order marching process of trading. Before the introduction of the on-line screen based electronic trading, in 1878, phone lines from brokers to the New York Security exchange floor was installed and used for trading purposes (Clemons, 1990).

The African Capital market has seen a number of developments in the early 1990s (Yartey & Adjias, 2007). Preceding 1989, we had only five exchange markets existing in the sub-Saharan Africa and three in North Africa. Currently we have 19 security exchanges in these regions. Excluding South Africa, Other African security markets have increased market capitalization between the years 1992 and 2002. Total market capitalization for these markets rose from US\$113,423 million to US\$ 244,672 million between 1992 and 2002. This quick progress of the Exchange markets was as a result of automation of the Exchange markets around the African Continent. The biggest challenge so far is that most of these exchange markets, trade in few Securities that account for a significant part of the total market capitalization (Yartey & Adjias, 2007).

Automated System is defined by three core elements, electronic ordering, electronic security transfer and electronic clearing and settlement. Electronic ordering is a more efficient way of placing orders contrary to the passed where phones are faxes were used to place orders with electronic ordering, you can buy or sell shares via the Internet or by using a more structured order system such as electronic data interchange (EDI) (Laudon & Laudon, 2006). Electronic security transfer is a method of electronically transferring new shares or paper share certificates from the depository trust company (DTC), which acts as a clearinghouse for settling trades in corporate and municipal securities (Alec, 2012).The deposit/withdrawal at custodian (DWAC) is one of two ways of transferring between broker/dealers and the DTC,

the other being the direct registry system (DRS) method (Alec, 2012). Both enable investors to hold securities in registered form on the books of the transfer agent, rather than in physical form.

Securities clearing and settlement mean the comparison of information from buyer and seller and the transaction of exchanging security ownership against payment or in some cases free of payment (Norman, 2008). Securities can be both traded on exchange or off exchange in the over-the-counter market (McInish, 2003). Electronic clearing and settlement incorporates a sophisticated electronic book-entry system, in which trading instruments such as stocks are represented in computer records rather than by traditional engraved paper certificates (Kohn, 2004). Electronic clearing and settlement of securities is centralized through the central depository and settlement corporation (CDSC). Before trading in a stock exchange, an investor must place all the securities (fully dematerialized) into an account opened with the CDSC. The capital market in Kenya has had a long history of paper based transactions and physical certificates until the CDSC commenced operations in 2004.

The modernization and automation of Kenya's securities market commenced in 1999, when CDSC was incorporated as a company with the intention of introducing book entry or electronic securities in the market, to do away with the inefficiencies of a paper based trading environment, and enhance the safety and security of dealing with shares listed on the securities exchange. The paper based system has had a variety of challenges like duplication of shares, loss and mutilation of certificates, signature mismatches and a time consuming transfer process (CDSC, 2013)

Dematerialization also refers to the process of converting paper certificates into electronic form, the main difference being that on the dematerialization date, all securities will be held in electronic form and the underlying physical certificate will cease to be evidence of ownership of securities of any company quoted at the Nairobi Securities Exchange (NSE). Evidence of ownership will be in the electronic holdings maintained in the central depository system (CDS) operated by CDSC.

This had become a major contributor to rising arbitration cases and investor disputes. The setting up of the CDSC revolutionized the industry by substantially reducing the inefficiencies risks associated with the paper certificates through immobilization of securities, allowing for the electronic settlement of transactions concluded on the securities exchange

(CMA, 2013). Therefore, it is important to examine the influence of automation on performance of the NSE with specific reference on the electronic clearing and settlement, electronic ordering and electronic security transfer in order to provide recommendation that may be used to attain a sustainable security market performance.

### **1.2 Statement of the Problem**

The shortening of the period between a trade being initiated and complete, and the reduction of latency as it is known, is the ultimate aim of any stock exchange (McDowall, 2006). Automation has improved the efficiency of markets especially in the developed countries like London Exchange markets and the wall street in the USA by reducing transaction cost, expediting and execution of orders to buy and sell securities, and by accommodating a greater number of participants than is possible in a manual trading scenario (Poser, 1992).

Recent researches have highlighted the factors leading to the performance of exchange markets basing on elements of computerisation that include volume and speed. These are but minor components in the gigantic technological matrix that makes up the automated exchange systems. Studies on electronic ordering, electronic clearing and settlement and electronic securities transfers which are the building blocks of an automated exchange system and their effect on performance of the NSE are wanting.

Looking at the recent trends especially in the Kenyan economy there has been significant focus on the capital market with the development of the central depository system and the introduction of Automated Trading Systems in the recent years (Ngugi, 2003). Efforts into automation have been for the mobilization of adequate resources and allocation of these resources efficiently with the aim of achieving the Vision 2030 development plan growth objectives. In light of these developments the sole purpose of this study was to highlight the influence of automated system on performance of the NSE with focus on electronic ordering, electronic security transfer and electronic clearing and settlement as the main components in automated system so as to gain knowledge and understanding of those factors responsive to performance of security markets and result to its implementations within the developing economies.

### **1.3 Objectives of the study**

The study was guided by the following specific objectives

- i. To investigate the influence of electronic ordering on the performance of the NSE.

- ii. To assess the influence of electronic clearing and settlement on the performance of the NSE.
- iii. To examine the influence of electronic securities transfer on the performance of the NSE.

## 2. Literature

### 2.1. Theoretical Review

The socio-technical systems perspective has become influential in the analysis of the organizational impact of technology. Originating in work carried out by the Tavistock Institute in London (Trist et al., 1993) on the introduction of mining technology in Britain, socio-technical systems theory views any organization as an open system of interdependent sub-units, transforming inputs to desired outputs. As the theory has moved on from its original psychodynamic model of human behaviour, the term "socio-technical" has become synonymous with almost any analysis of a configuration of technology and users (Cherns, 1976). Socio-technical theorists such as Eason (1988) conceptualize acceptance in terms of two competing forces: control and enhanced performance. Control factors are those that impose rules or structures upon the users, thereby removing autonomy (control over their own actions) from them. A technology that is designed to support such factors is likely to increase user acceptance in an organization and as a result improve in the performance of the organization.

Primary intention of Innovation Diffusion Theory is to provide an account of the manner in which any technological innovation moves from the stage of invention to widespread use (or not). Though not concerned with information technology exclusively, diffusion theory offers a conceptual framework for discussing acceptance at a global level. Diffusion theory posits five characteristics of innovations that affect their diffusion: relative advantage, compatibility, complexity, trial ability and observability (Rogers, 1962). While diffusion theory provides a context in which one may examine the uptake and impact of information technology on aspects of businesses example the exchange markets, it provides little explicit treatment of user acceptance.

A number of MIS specific models have been derived from TRA and one of them is Technology Acceptance Model (TAM). According to Davis (1989), the goal of TAM is to predict information system acceptance and diagnose design problems before users have

experience with a system. TAM predicts user acceptance of any technology is determined by two factors: perceived usefulness and perceived ease of use. Within TAM, perceived usefulness is defined as the degree to which a user believes that using the system will enhance his or her performance. Perceived ease of use (EOU) is defined as the degree to which the user believes that using the system will be free from effort. Both U and EOU are specific perceptions and are anchored to specific beliefs users hold about the system. According to TAM, U and EOU have a significant impact on a user's attitude toward using the system (A), defined as feelings of favourableness or unfavourableness toward the system.

## 2.2. Conceptual Framework

The conceptual framework shows both the independent and the dependent variables. In this case the dependent variable was “performance” which includes other variables like NSE 20 share index, Volume traded and share turnover. The independent variables were electronic ordering, electronic clearing and settlement and electronic security transfer. Electronic clearing and settlement was defined by intermediary, CDSC and Risk Factor, electronic ordering was defined by functional integration, EDI and Volume processed, electronic security transfer was defined by dematerialization, localization and security transfer while NSE performance was conceptualize in form of NSE 20 share index, volume trades and share turnover.

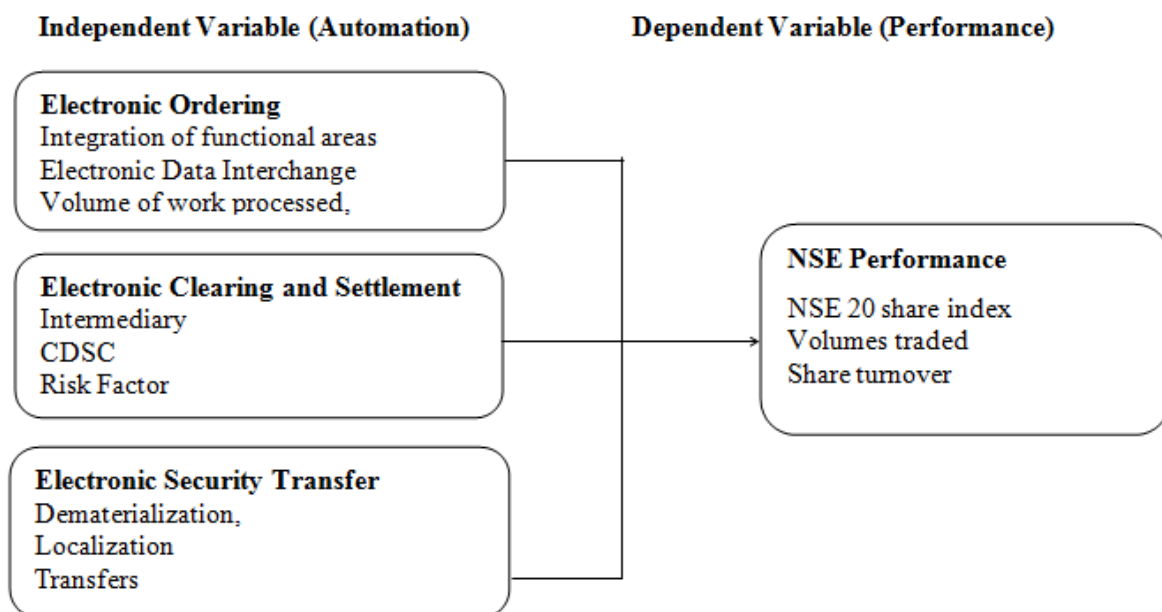


Figure 1: Conceptual Framework

Source: Researcher (2016)

### **2.3 Electronic Ordering**

Electronic ordering is a more efficient way of placing orders contrary to the passed where phones or faxes were used to place orders with electronic ordering, you can buy or sell shares via the Internet or by using a more structured order system such as electronic data interchange (EDI).. An EDI system enables businesses to exchange business documents such as share purchase orders, invoices and order status updates automatically and electronically, eliminating the need for manual processes. Benefits of EDI include; Reduced Cycle Time - With EDI, data can be sent and received 24 hours a day (Laudon and Laudon, 2006). Because EDI allows business to continue outside the normal business day the turnaround time for a business transaction can be significantly reduced. Increased efficiency More than 70 percent of manual data entry tasks originate from computer-generated documents. When trading partners develop compatible electronic documents, data is never copied, rekeyed, or manually filed – freeing employees for value-added activities.

### **2.4 Electronic Clearing and Settlement**

The securities trade completion process has two stages; clearing and settlement (Kohn, 2004), and both of these consist of different phases including matching, comparison (clearing) and settlement generally by payment against the delivery of securities. Nolan & Amos (2001) Clearing is defined as "the process of transmitting, reconciling and, in some cases confirming payment orders or security transfer instructions prior to settlement" (BIS, 2003). Whereas settlement is described as "the completion of a transaction, wherein the seller transfers securities or financial instruments to the buyer and the buyer transfers money to the seller" (BIS, 2003). The objective for clearing and settlement process is that the system is prompt and reliable as well as cost-effective and convenient to use (Guadamillas & Keppler, 2001).

Electronic clearing and settlement incorporates a sophisticated electronic book-entry system, in which trading instruments such as stocks are represented in computer records rather than by traditional engraved paper certificates (Kohn, 2004). Under this system investors can enjoy the convenience and speed of electronic securities registration, transfer, and trade settlement, and can obtain up-to-date account information on their shareholdings.

### **2.5 Electronic Security Transfer**

This is a method of electronically transferring new shares or paper share certificates from the depository trust company (DTC), which acts as a clearinghouse for settling trades in



corporate and municipal securities. The deposit/withdrawal at custodian (DWAC) is one of two ways of transferring between broker/dealers and the DTC, the other being the direct registry system (DRS) method (Alec, 2012). Both enable investors to hold securities in registered form on the books of the transfer agent, rather than in physical form. DRS is different from DWAC in that shares in DRS have already been issued and are held electronically on the books of the transfer agent. The DWAC and DRS processes offer a number of benefits to investors. Being electronic systems, they greatly reduce the amount of time required to transfer and deliver securities, thereby significantly accelerating the settlement process for investors. They also eliminate the risk of losing physical certificates, as well as the higher transportation and handling costs associated with such certificates (Alec, 2012).

### **2.6 Performance; NSE 20 share index**

The NSE 20 Share Index is a price weight index. The members are selected based on a weighted market performance for a 12 month period as follows: Market Capitalization 40%, Shares Traded 30%, Number of deals 20%, and Turnover 10%. Index is updated at the end of the day (My Stocks, 2014). It represents the geometric mean of share prices of the NSE's 20 top stocks. It has recently been joined by the more broad - based NSE All Share Index (NASI), aimed at capturing the market capitalization of all the NSE's listed equities traded in a day.

The Stock market performance is an assessment of an efficient market. A main feature of an efficient Exchange market is constant liquidity, an easy mechanism for entry and exit by investors. This call for sufficient volume and size of trades in the market (Yartey & Adjasi, 2007). Stock exchange markets can attract foreign portfolio capital and increase domestic resource mobilization, increasing the resources disposable for investment in developing countries.

### **3. Methodology**

This study adopted a Survey research design to assess the influence of automated system on performance of the Nairobi Securities Exchange. The target population was top executive and Middle Management Staff / supervisors of 18 firms licensed as brokerage firms due to their Decision making and strategic planning and contact persons with the technology deployed for

the purpose of improving performance respectively. Stratified random sampling was used to select a sample of 27 top executive and 69 Middle Management Staff / supervisors.

Primary data was collected using structured questionnaires using statements that were in five point Likert scale format where 5-Strongly Agree, 4-Agree, 3- Undecided, 2-Disagree and 1-Strongly Agree. Electronic Clearing and settlement had an alpha of 0.834 while performance had an alpha of 0.789. According to Santos (1999), Alpha of more than 0.7 is considered satisfactorily for the study therefore the instrument was reliable. Data was analysed descriptively using percentage and frequency while inferential analysis consisted of Pearson correlation and regression analysis with a significance level of 0.05

In order to determine the specific factors on the dependent variable multiple regression analysis was done using SPSS version 21. The test of significance, P- Value will be determined at the 5% level of significance and 1% level.

The multiple regression equation estimated from the data take the following form.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \alpha$$

Where,

$Y_i$  = Performance.

$\beta_1, \beta_2, \beta_3$  = the intercept

$X_1$  = Electronic Ordering

$X_2$  = Electronic Clearing and settlement

$X_3$  = Electronic Securities Transfer

$\alpha$  = are the error terms.

$i$  = the number of firms.

## 4. Findings

### 4.1 Descriptive Statistics

Descriptive statistic consisted of the frequency and percentage of statements in the questionnaire for each of the independent variables used in this study. Further, the mean and standard error of each items was also revealed. Mean is a measure of central tendency used to describe the most typical value in a set of values. Standard error of mean is a measure of reliability of the study results.

#### 4.1.1 Electronic Clearing and Settlement

Table 1: Respondents' Scores on Electronic Clearing and Settlement

Electronic Clearing and settlement	SD	D	U	A	SA	Mean	S.E
Market participants are able to settle amongst themselves without the use of an intermediary with these system	2.9% 2	11.59% 8	14.49% 10	53.62% 37	17.39% 12	3.71	0.12
The process of clearance and settlement is fast and on real-time using the automated system	2.9% 2	5.8% 4	8.7% 6	30.43% 21	52.17% 36	4.23	0.12
The level of paperwork required is minimal and cost saving.	2.9% 2	7.25% 5	23.19% 16	44.93% 31	21.74% 15	3.75	0.12
The method of Pay and Collect System is able to be done directly with the Settlement Bank	8.7% 6	11.59% 8	20.29% 14	44.93% 31	14.49% 10	3.45	0.14
The level of risk associated in trading is minimal with the automated system	2.9% 2	14.49% 10	27.54% 19	43.48% 30	11.59% 8	3.46	0.12
The automated system can provide for netting for both cash and securities	1.45% 1	11.59% 8	18.84% 13	50.72% 35	17.39% 12	3.71	0.11
The Settlement of non-broker institution transactions is possible directly with the Clearing Company using this automated system	2.9% 2	7.25% 5	17.39% 12	49.28% 34	23.19% 16	3.83	0.12
The process of Registration provides for Unique Identification Number (UIN) of all clients with codes provided by the system making the market highly transparent	1.45% 1	5.8% 4	14.49% 10	52.17% 36	26.09% 18	3.96	0.11
<b>Average Score</b>						<b>4.07</b>	<b>0.12</b>

Note: SD=Strongly Agree, D=Disagree, N=Neutral, A=agree, SA=Strongly Agree, SE= Standard Error

Source: Researcher (2016)

From Table 1, the mean score for the eight statements used to assess electronic clearing and settlement was 4.0 (Agree). The overall mean score shows that the respondents from stock brokerage firms in this study were in agreement of the electronic clearing and settlement in relation to the performance of NSE. All electronic ordering dimensions had a mean of between 3.5 and 4.3 except for the method of Pay and Collect System is able to be done directly with the Settlement Bank with a mean score of 3.0 (Undecided) and S.E of 0.14 of which 41(59.42%) of the respondents who confirmed that the method of Pay and Collect System was able to be done directly with the Settlement Bank. Also, the level of risk associated in trading is minimal with the automated system had a mean score of 3.0 (Undecided) and S.E of 0.12 of which 38(55.07%) of respondents who indicated that the level of risk associated in trading was minimal with the automated system.

More than half of the respondents (53.62%) agreed and 17.39% strongly agreed that market participants were able to settle amongst themselves without the use of an intermediary with these systems with a mean score of 4 (agree) and S.E of 0.12. Further, 36 (52.17%) of the respondents strongly agree that the process of clearance and settlement was fast and on real-time using the automated system and 21 (30.43%) agreed with a mean score of 4 (agree) and S.E of 0.12. The automated system provided for netting for both cash and securities as shown by 47 (68.11%) with a mean score of 4 (agree) and S.E of 0.11.

The Settlement of non-broker institution transactions was possible directly with the Clearing Company using this automated system as shown by 60 (72.47%) with a mean score of 4 (agree) and S.E of 0.12. However, only 7 (10.15%) of the respondents did not confirm this. Lastly, with a mean score of 4 (agree) and S.E of 0.11, 36 (52.17%) and 18 (26.09%) of the respondents strongly agree and agree respectively that the process of registration provided for Unique Identification Number (UIN) of all clients with codes provided by the system making the market highly transparent.

From the findings, electronic clearing and settlement had Influence on the performance of NSE. Specifically, the process of clearance and settlement is fast and on real-time using the automated system and the process of Registration provides for Unique Identification Number (UIN) of all clients with codes provided by the system making the market highly transparent. The high costs of cross-border securities clearing and settlement have to be acknowledged for the reason that the trading process is more economic and efficient and it is the clearing and

settlement part which usually increases the costs of the whole transaction (Serifsoy and Weiß, 2007).

From a Chinese perspective, the policies and projects in the field of clearing and settlement are an important and integral part of the development of the payment system, which is understood as not only including traditional banking payment and settlement, but also registration, custody, clearing and settlement of such financial market products as bonds and stocks (Ouyang, 2008) However, the industry itself has been making significant efforts in order to achieve cost reductions as well as reduce operational risk in post-trade processing. It has been acknowledged that progress on achieving both of these goals can be made with automated processing with minimum manual intervention i.e. by implementing so-called straight through processing (STP) from trade to settlement

#### 4.2 Electronic Ordering

Table 1: Respondents' Scores on Electronic Ordering

Electronic Ordering	SD	D	U	A	SA	Mean	S.E
Automated system integrate all the functional areas of trading	7.25% 5	10.14% 7	18.84% 13	56.52% 39	7.25% 5	3.46	0.12
Cost of automation is manageable to the users in terms of cost minimization	5.8% 4	10.14% 7	36.23% 25	39.13% 27	8.7% 6	3.35	0.12
The Automated system is able to process large volumes of work within a limited period of time after automation	1.45% 1	2.9% 2	20.29% 14	36.23% 25	39.13% 27	4.09	0.11
The Automated system is able to link buyers and sellers of the products on a real time basis	17.39% 12	1.45% 1	26.09% 18	39.13% 27	15.94% 11	3.35	0.15
Clients are able to place order from any location geographically using the automated system	4.35% 3	7.25% 5	26.09% 18	43.48% 30	18.84% 13	3.65	0.12
The automated system is able to provide live streaming prices on the various products in the market	1.45% 1	15.94% 11	23.19% 16	36.23% 25	23.19% 16	3.64	0.13

The automated system is able to provide for functional customization according to user preference	2.9%	11.59%	15.94%	36.23%	33.33%	3.86
	2	8	11	25	23	0.13
The automated system is able to detect real-time market manipulation and cub to avoid distortions in information using the automated system	4.35%	13.04%	21.74%	47.83%	13.04%	3.52
	3	9	15	33	9	0.12
<b>Average Score</b>						<b>3.6</b>
						<b>0.13</b>

Note: SD=Strongly Agree, D=Disagree, N=Neutral, A=agree, SA=Strongly Agree, S.E=Standard Error  
Source: Researcher (2016)

From Table 2, the mean score for the eight statements used to examine electronic ordering was 3.6 (undecided). The overall mean score shows that the respondents from stock brokerage firms in this study were undecided on the electronic ordering in relation to the performance of NSE. All electronic ordering dimensions had a mean of between 3.0 and 3.9 except for the Automated system is able to process large volumes of work within a limited period of time after automation which had a mean score of 4.09 and Standard error of 0.11 of which 52 (75.36%) of the respondents confirming that automated system is able to process large volumes of work within a limited period of time after automation.

Automated system integrate all the functional areas of trading had a mean of 3.46 (undecided) and S.E of 0.12. However, 44 (63.77%) of the respondent confirmed that there has been integration of all functional areas of trading. Also, cost of automation is manageable had a mean score of 3.35 (undecided) and S.E of 0.12 with only 33 (47.83%) of the respondent indicating that cost of automation was manageable. Automated system is able to link buyer and seller on real time basis as shown by over half of the respondents 38 (55.07%) with a mean score of 3.35 (undecided) and S.E of 0.15.

The findings also revealed that 43 (62.32%) of the respondents indicated clients are able to place order from any location geographically using the automated system with a mean score of 3.65 (undecided) and S.E of 0.12. Over half of the respondents 41 (59.42%) confirmed that the automated system is able to provide live streaming prices on the various products in the market with a mean score of 3.64 (undecided) and S.E of 0.13. Similarly, with a mean score

of 3.86 (undecided) and S.E of 0.13, 48 (69.53%) of the respondents indicated that the automated system is able to provide for functional customization according to user preference. Lastly, automated system is able to detect real-time market manipulation and curb to avoid distortions in information using the automated system as shown by 42 (60.87%) of the respondents with a mean score of 3.52 (undecided) and S.E of 0.12.

The finding indicated electronic ordering had significant effect on the performance of NSE. This because automated system has integrated all the functional areas of trading leading processing of large volume of work within limited period of time. Also, clients are able to place order from any location geographically using the automated system. According to Hendershotta & Moulton, (2011), the NYSE's introduction of its automated Market increases automation and speeds up electronic trading by an order of magnitude: The execution time for market orders drops from 10 seconds to less than one second. This showed that the automated Market raises the cost of immediacy (the effective spread) by about 10% relative to its pre-automation level and that this increase is attributable to higher adverse selection.

Boehmer & Kelley (2009) asserted that market and marketable limit orders are now automatically executed by default, rather than requiring a special code. As a result of these changes, more electronic orders enjoy the enhanced speed and anonymity of automatic execution in automated system. Further, automated system may enable informed traders to get better execution using Electronic orders, so they use floor brokers less

### 4.3. Electronic Securities Transfer

Table 3: Respondents' Scores on Electronic Securities Transfer

Electronic Securities Transfer	SD	D	U	A	SA	Mean S.E
The automated system provides for a dematerialized form of holding assets by the clients	4.35% 3	14.49% 10	23.19% 16	46.38% 32	11.59% 8	3.46 0.12
It is easy to transfer security from one holder to another in any geographical location using this system	4.35% 3	7.25% 5	11.59% 8	37.68% 26	39.13% 27	4.00 0.13
The assets are considered secure in the form which they are held in the automated system	4.35% 3	13.04% 9	24.64% 17	37.68% 26	20.29% 14	3.57 0.13

The daily securities transfer has increased compared to the passed periods	5.8% 4	10.14% 7	18.84% 13	43.48% 30	21.74% 15	3.65 0.13
The level of customer satisfaction on the effectiveness of operating has increased after automation	4.35% 3	11.59% 8	15.94% 11	50.72% 35	17.39% 12	3.65 0.13
The system is able to operate with limited man power and a reduced work load	2.9% 2	8.7% 6	17.39% 12	52.17% 36	18.84% 13	3.75 0.12
The clients are able to get their bonuses and IPOs instantly as they are issued in this automated system	2.9% 2	7.25% 5	20.29% 14	49.28% 34	20.29% 14	3.77 0.12
The system is user friendly and workable without constant support	1.45% 1	5.8% 4	14.49% 10	52.17% 36	26.09% 18	3.96 0.11
<b>Average Score</b>						<b>4.04</b> <b>0.12</b>

Note: SD=Strongly Agree, D=Disagree, N=Neutral, A=agree, SA=Strongly Agree, S.E=Standard Error

Source: Researcher (2016)

From Table 3, the mean score for the eight statements used to assess electronic securities transfer was 4.0 (Agree) with standard error of 0.12. The overall mean score shows that the respondents from stock brokerage firms in this study were in agreement of the electronic securities transfer sub constructs in relation to the performance of NSE. This was further shown by all electronic ordering dimensions having a mean of between 3.5 and 4.0 except the automated system provides for a dematerialized form of holding assets by the clients with a mean score of 3.0 (Undecided) and S.E of 0.12 of which 40 (57.97%) of the respondents who confirmed that the automated system provided for a dematerialized form of holding assets by the clients.

Specifically, it was easy to transfer security from one holder to another in any geographical location using this system as shown by 53 (76.82%) of the respondents with a mean of score of 4.0 (agree) and S.E of 0.13. Similarly, 40 (57.97%) of the respondent confirmed that the assets were considered secure in the form which they are held in the automated system with additional 17 (24.64%) been undecided. The mean of score of 4.0 (agree) and S.E of 0.13. Further, the daily securities transfer had increased compared to the passed periods as shown



30 (43.48%) of the respondents who agreed and further 15 (21.74%) who strongly agree. The mean of score of 4.0 (agree) and S.E of 0.13.

More than half of the respondents (50.72%) agreed that the level of customer satisfaction on the effectiveness of operating had increased after automation and further 12 (17.39%) strongly agreed with a mean of score of 4.0 (agree) and S.E of 0.13. similarly, More than half of the respondents (52.17%) agreed that the system was able to operate with limited man power and a reduced work load and further 13 (18.84%) strongly agreed with a mean of score of 4.0 (agree) and S.E of 0.12. Clients were able to get their bonuses and IPOs instantly as they are issued in the automated system as shown by 48 (69.57%) with a mean of score of 4.0 (agree) and S.E of 0.12. Lastly, the system was user friendly and workable without constant support as revealed by 36 (52.17%) and further 18 (26.09%) of the respondents were agree and strongly agree respectively with a mean of score of 4.0 (agree) and S.E of 0.11.

Lastly, electronic security transfer had a significant strong effect on the performance of NSE and a unit increase in electronic security transfer resulted to significant increase in performance. It was that, it is easy to transfer security from one holder to another in any geographical location using this system. This was further exemplified by Long (2000) who focused on the central feature of electronic trading systems, automation of trade execution. Electronic trading both removes geographical restraints and allows continuous multilateral interaction (whereas telephone trading allows only the former and floor trading only the latter). It allows much higher volumes of trades to be handled, and in customised ways that until recently would have been technically impossible or prohibitively expensive.

#### 4.4 Performance; NSE 20 Share Index

Table 4: Respondents' Scores on Performance of NSE

Performance of NSE	SD	D	U	A	SA	Mean S.E
There has been a significant increase in the NSE 20 share index after automation	4.35% 3	11.59% 8	14.49% 10	42.03% 29	27.54% 19	3.77 0.13
Volumes traded have increased after automation	2.9% 2	5.8% 4	11.59% 8	24.64% 17	55.07% 38	4.23 0.13
Most companies have recorded high turnover in shares annually after automation	2.9% 2	10.14% 7	26.09% 18	40.58% 28	20.29% 14	3.65 0.12

There has been a major change in the 20 listed companies on the index after automation	4.35%	11.59%	18.84%	40.58%	24.64%	3.7
	3	8	13	28	17	0.13
Pricing as a result of the index movement has become more volatile after automation	4.35%	10.14%	31.88%	39.13%	14.49%	3.42
	3	7	22	27	10	0.12
The value of shares for the 20 listed companies has increased after automation	1.45%	8.7%	44.93%	33.33%	11.59%	3.45
	1	6	31	23	8	0.1
The calculation and determination of the index price has become easier after automation	1.45%	5.8%	11.59%	52.17%	28.99%	4.01
	1	4	8	36	20	0.11
The number of new investors has increased after automation	1.45%	5.8%	14.49%	52.17%	26.09%	3.96
	1	4	10	36	18	0.11
<b>Average Score</b>						<b>3.7736</b>
						<b>0.1192</b>

Performance of NSE was operationalize in form NSE 20 share index, Volumes traded, share turnover, share pricing, index pricing and number of investors. Eight statements were formulated to investigate the NSE performance and respondents were asked to indicate the extent to which they agreed to the statements.

The mean score for the eight statements used to investigate performance of NSE was 4.0 (Agree) with standard error of 0.12. The overall mean score shows that the respondents from stock brokerage firms in this study were in agreement that performance has increased due to automation of NSE. This was further shown by all performance dimensions having a mean of between 3.5 and 4.3 except the pricing as a result of the index movement had become more volatile after automation with a mean score of 3.0 (Undecided) and S.E of 0.12. However, 40 (53.62%) of the respondents confirmed that the pricing as a result of the index movement had become more volatile after automation with 31.88% remaining undecided. Similarly, 31 (44.93%) of the respondents were undecided whether the value of shares for the 20 listed companies had increased after automation with a mean score of 3.0 (Undecided) and S.E of 0.1. Only, 31(44.92%) confirmed that the value of shares for the 20 listed companies has increased after automation

Specifically, there had been a significant increase in the NSE 20 share index after automation as shown by 48 (69.57%) of the respondents with a mean score of 4.0 (agree) and S.E of 0.13. Further, 38 (55.07%) of the respondents strongly agreed that volumes traded had increased after automation with additional 17 (24.64%) agreeing with a mean score of 4.0 (agree) and S.E of 0.13. It was also revealed that 42 (60.87%) of the respondents agreed that most companies have recorded high turnover in shares annually after automation with a mean score of 4.0 (agree) and S.E of 0.12 although 26.09% were undecided. The calculation and determination of the index price had become easier after automation as shown by 36 (52.17%) of the respondents who agreed and further 20 (28.99%) who strongly agreed with a mean score of 4.0 (agree) and S.E of 0.11. Lastly, the number of new investors had increased after automation as shown by 36 (52.17%) of the respondents who agreed and further 18 (26.09%) who strongly agreed with a mean score of 4.0 (agree) and S.E of 0.11.

#### 4.5 Inferential Analysis

The study also used both Pearson Correlational analysis ( $r$ ) and regression analysis ( $R^2$ ) to find to significant relationship between independent variables and NSE performance as well as coefficient of determination of each independent variable on the NSE performance. The findings are as shown in Table 5.

Table 5: Inferential statistic results

Model	R	R <sup>2</sup>	Adj. R <sup>2</sup>	Df	F	Sig.
(Constant)						
Electronic Clearing and Settlement	.819 <sup>a</sup>	.671	.666	(1,67)	136.726	.000
Electronic Ordering	.521 <sup>a</sup>	.271	.260	(1,67)	24.906	.000
Electronic Security Transfer	.844 <sup>a</sup>	.712	.708	(1,67)	165.563	.000

Source: Researcher (2016)

##### 4.5.1 Correlation Analysis Between Independent Variables and NSE Performance

The Pearson correlation analysis was used to investigate the relationship between Electronic Clearing and Settlement and NSE performance. The study established a coefficient of correlation ( $r= 0.819^{**}$ ,  $P>0.01$ ) between Electronic Clearing and Settlement and NSE performance which is positive significant and strong. This implies that the performance of the NSE increased strongly with increase in automation through Electronic Clearing and Settlement.

The study established a coefficient of correlation ( $r=0.521^{**}$ ,  $P>0.01$ ) between Electronic ordering and NSE performance which is positively significant. The objective answered what is the Influence of electronic ordering on the performance of the NSE as per the first research question of the study. This implies that the performance of the NSE increased moderately with increase in electronic ordering.

The study established a coefficient of correlation ( $r = 0.844^{**}$ ,  $P>0.01$ ) between Electronic securities transfer and NSE performance which is positive significant and strong. The objective answered what is the Influence of Electronic securities transfer on the performance of the NSE as per the third research question of the study. This implies that the performance of the NSE increased strongly with increase in electronic securities transfer.

#### **4.5.2. Regression Results of Independent Variables and NSE Performance**

Regression analysis was conducted to find the proportion in the dependent variable (NSE performance) which can be predicted from the independent variable (Electronic Clearing and Settlement, ordering and security transfer). The results in Table 5 indicated a coefficient of determination ( $r^2$  0.671). Meaning electronic clearing and settlement can explain 67.1 % of the variance in NSE performance. The F test gave a value of  $(1, 67) = 136.726$ ,  $P<0.01$ , which was large enough to support the goodness of fit of the model in explaining the variation in the dependent variable hence electronic Clearing and Settlement is a useful predictor of NSE performance.

The coefficient of determination ( $r^2$ ) for electronic ordering is 0.271. Electronic ordering can explain 27.1% of the variance in NSE performance. The F test gave a value of  $(1, 67) = 24.906$ ,  $P<0.01$ , which was large enough to support the goodness of fit of the model in explaining the variation in the dependent variable thus electronic ordering is a useful predictor of NSE performance. The coefficient of determination ( $r^2$ ) for electronic security transfer is 0.712. Electronic securities transfer can explain 71.2 % of the variance in NSE performance. The F test gave a value of  $(1, 67) = 165.563$ ,  $P<0.01$ , which was large enough to support the goodness of fit of the model in explaining the variation in the dependent variable hence Electronic securities transfer is a useful predictor of NSE performance.

#### **4.5.3 Coefficients of the Independent Variables and NSE Performance**

Table 6: Coefficients of the Independent Variables and NSE performance

	Un-standardized Coefficients		Standardized Coefficients		Sig.
	B	Std. Error	Beta	t	
(Constant)	.252	.270		.932	.355
<b>EO</b>	.044	.075	.047	.586	.560
<b>ECS</b>	.323	.144	.315	2.248	.028
<b>EST</b>	.582	.140	.544	4.169	.000

a. Dependent Variable: Performance

Source: Researcher (2016)

From the ANOVA results the F test gave a value of  $F(3, 65) = 62.051$ ,  $p < .01$ , which was large enough to support the goodness of fit of the model in explaining the variation in the dependent variables. It also means NSE automated system is a useful predictor of NSE performance. From Table 6, electronic ordering carried positive insignificant predictive power while the other variable i.e. Electronic Clearing and Settlement and Electronic Securities Transfer had significant predictive power as their significance level was less than 0.05. If NSE automated system is held at zero or it is absent, the NSE performance will be 0.252,  $p > 0.05$ . When Electronic Clearing and Settlement and Electronic Securities Transfer are controlled, electronic ordering with a beta of 0.044 is at statistically insignificant level and is not a good predictor of NSE performance implying that an increase in electronic ordering by one percent will result to insignificant increase in performance by 0.044. When Electronic Ordering and Electronic Securities Transfer are controlled, Electronic Clearing and Settlement with a beta of 0.323 is at statistically significant level implying that an increase in Electronic Clearing and Settlement by one percent will result to significant increase in performance by 0.323. Lastly, Electronic Ordering and Electronic Clearing and Settlement are controlled; Electronic Securities Transfer with a beta of 0.582 is at statistically significant level implying that an increase in Electronic Securities Transfer by one percent will result to significant increase in performance by 0.582.

A regression of the three predictor variables against NSE performance established the multiple linear regression model as below

$$\text{NSE Performance} = 0.252 + 0.044\text{EO} + 0.323\text{ECS} + 0.582\text{EST}$$

## 5. Discussion

This study established that automated system has significant effect on performance of the Nairobi securities exchange. This was depicted by the fact that the linear relationship between automated system and NSE performance was strongest as compared to individual independent variables that defined automation. This revealed that automated system has resulted to increase in performance of NSE through increase in share volume traded and increase in share turnover. According to Boehmer & Kelley (2009) if automation and speed reduce transaction costs, they enable more efficient allocation of securities among heterogeneous investors, improve risk-sharing and consumption smoothing, and can raise asset prices. Automation and speed may also enhance price discovery, or how efficiently new information is incorporated into prices. More efficient price discovery contributes to better informed financing and investment decisions, benefiting shareholders by facilitating better corporate decisions.

Debysingh and Watson (2007) using both parametric and non-parametric approaches to the degree of informational efficiency before and after the automation of the Jamaica (JSE) and Trinidad and Tobago (TTSE) stock exchanges finds mixed results. Findings reveal that exchanges are highly inefficient in both the pre and post automation periods, albeit an improvement in efficiency. Further, (Benouda & Mezzez, 2003) finds that automation of the Tunisian Stock Exchange (TSE) results in the improvement in the liquidity of shares, decreased returns but did not have significant effect on volatility or efficiency.

However, some studies have found that automation of securities exchange did result to market efficiency. Using nonparametric statistical analysis, Freund & Pagano (2000) measured the degree of market efficiency before and after automation at the New York and Toronto Stock Exchanges. Their findings indicate that the level of informational efficiency in these exchanges remains effectively unchanged during the automation period. Their findings further reveal that automation in these exchanges coincides with an improvement in market efficiency at the Toronto Stock Exchange relative to the New York Stock Exchange. Similar results were posted by Mensah, Poma-Berko & Ko Adom (2012) their study assessed the effect of technology on stock market efficiency in Ghana. The result showed that, the stock market even after the automation did not exhibit weak-form efficiency. This suggests that the automation of the exchange has not improved the efficiency levels of the exchange.

## 6. Conclusion and Recommendation

The study concluded that electronic clearing and settlement had significant strong Influence on the performance of NSE and a unit increase in electronic clearing and settlement resulted to significant increase in performance of NSE. Electronic ordering had a moderate effect on the performance of NSE and a unit increase in electronic ordering insignificantly increases the performance of NSE. Lastly, Electronic security transfer had significant strong effect on the performance of NSE and a unit increase in Electronic security transfer resulted to significant increase in performance of NSE. Overall conclusion was that automated system resulted to increase in performance of NSE through electronic security transfer and electronic clearing and settlement as shown by multiple regression coefficients. However, electronic ordering moderately affected the performance of NSE but any unit increase did not increase performance of NSE significantly. There was increase in investors, high share turnover and volume of share traded increased after automation.

The study recommended that investors and traders should be allowed to access any information from the system that is deemed crucial and critical to their decision making process, thus enhancing the efficiency on the market as well as improve share volume traded in the market. The study suggests that future research may be carried to confirm and assess the determinants of efficiency in the market after introduction of the automated trading system. Further research could also be conducted into the post-automation efficiency level of the NSE by adopting different estimation techniques as well as extending the sample size and scope.

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