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Electric Power Outage Dynamics and Non-Financial Performance of Manufacturing Firms in Kenya

By: Njiraini, Winfred Wanjiku[1] Mwangi, M. (PhD)[2], Kaijage, E.S. (PhD)[3] , Pokhariyal, G. (PhD)[4].

Abstract

Manufacturing firms are heavily reliant on electric power supply to power their operations. Electric power outages are therefore a major disruption to any manufacturing activities that are operated by powering by electric energy. This study aimed at establishing the influence of electric power outage dynamics on non-financial performance of manufacturing firms in Kenya. The study utilized positivism philosophical point of view and descriptive survey research design. The null hypothesis which stated that the relationship between electric power outage dynamics and financial performance of manufacturing firms in Kenya is not significant was tested at 95% confidence level whereby multiple regression models were incorporated for data analysis. A population of 447 firms whose main area of focus is manufacturing in Kenya and are members of Kenya Manufacturers Association was considered for the study out of which a sample size of 138 firms was drawn using stratified random sampling. Structured questionnaires were utilized to collect data which involved drop and pick approach. The research results indicate that electric power outage dynamics did not have a statistically significant influence on non-financial performance. Statistical analysis indicated that power outage frequency did not have statistically significant influence on non-financial performance, while power outage duration had an indirect link on non-financial performance of manufacturing firms which was not statistically significant. For power outage notification, a negative association with non-financial performance of Kenyan manufacturing firms was established, this relationship was not statistically significant. Time of power outage had an adverse relationship with non-financial performance which was not statistically significant. This study outcome provides a contribution to existing knowledge by providing evidence that electric power outage dynamics did not have statistically significant influence on non-financial performance of manufacturing firms. This implies that presence or absence of electric power does not significantly affect firm operations in relation to customer focus, operations efficiency, employee productivity, green performance and social responsibility. The effective performance of these indices may therefore be affected by other factors than power outage dynamics. The study has also made an input to the academic literature in relation to the assimilation of transformation theory as a production process theory by considering electric power as a major input factor to the manufacturing production process.

Keywords: *Electric Power Outage Dynamics, Non-Financial Performance, Manufacturing Firms*

[1] ***PhD Candidate, University of Nairobi, Department of Finance and Accounting (wndubai@gmail.com)***
[2] ***Professor, University of Nairobi, Department of Finance and Accounting***
[3] ***Professor, University of Nairobi, Department of Finance and Accounting***
[4] ***Professor, University of Nairobi, Department of Applied mathematics***

Introduction

Electric energy is an essential input factor for many production processes and is also the dominant source of energy for manufacturing firms (Karen, Erin & Qiong, 2015). The central role of electricity in manufacturing processes renders any deficiencies negative to the firm production efficiencies and further results into a decline in output (Abotsi, 2015). Low supply of electricity is depicted by power reliability problems characterized by power outages and/or power quality fluctuations (Eto, Koomey, Lehman, Martin, Mills, Webber &Worrell, 2001). Power outages are a major challenge for industrial firms and have negative effect on productivity and performance of firms (Allcott, Allan & Stephen, 2014). An electric power outage is a supply interruption of electric power (Fouzul, Dhananjay, Neelotpal & Deepak, 2012). Power outage effects manifest in various ways within the firm including; effect on firm efficiency, additional costs to the firm's production processes through investment in alternative sources of energy or costs incurred in replacement or repairs of affected equipment due to power outages and, impact on quality of goods or services as a result of power outage (Cissokho & Seck, 2013). Therefore, these dynamics adversely impact firm performance in a variety of ways (Steinbuks & Foster, 2010). Electric power outages are characterized by dynamics which may include aspects such as time of occurrence of the outage, length/duration of outage, frequency of outage, source of outage, perceived reliability level of power supply and notification of outage, or lack of it among others (Nooij, Koopmans & Bijvoet, 2007).

Power outage can be defined as a short or long-term loss (supply interruption) of electric power (Eto *et al.* 2001). This irregularity may arise due to circumstances that are either planned/foreseen or unplanned/unforeseen by the power utility. A planned power outage is an electricity shortage scheduled by the electricity suppliers and may be as a result of scheduled maintenance or due to a need to address an emergency (Moyo, 2012). A planned outage may also be necessitated by lack of sufficient power generation to meet the full demand of the end users (Scott, Darko, Lemma, and Juan-Pablo, 2014). This kind of power dynamics occur at designated time spans and are usually scheduled in advance and are sometimes accompanied by notifications from the power providers. On the other hand, unplanned outage is shortage of

electric power that is not scheduled by the providers. The causes of such scenarios could be uncontrollable activities such as cable theft, bad weather, illegal power connections that affect the system, aged power infrastructure that may malfunction and other human activities such as excavation or physical developments in affected areas (Simonoff, Zimmerman, Restrepo, Dooskin, Hartwell, Miller, Remington, Lave & Schuler, 2005). Unplanned power outages are not anticipated and randomly affect electricity end users resulting in numerous damages of equipment, hence resulting in further consequential losses such as loss of business opportunities, lost production time and loss of expensive raw materials (Bawuah & Anaman, 2018). As a result of power outage, both domestic and commercial customers are adversely affected (Singh & Mangat, 2012). Power outage occurrences are characterized by specific aspects which define characteristics of the outage such as power outage frequency, power outage duration, power outage notification and time of power outage (Alam, 2014; Singh & Mangat, 2012).

Power outage frequency or number of occurrences refers to the number of power blackouts over a specific time period, either per day, week or on monthly basis. Power outages may also be defined based on fluctuations of electricity supply in a certain locality (Schoeman & Saunders, 2018). Power outage frequency is how often service is interrupted. Any frequency of power outage is undesirable; however, higher frequency of the outages increases the unreliability of power and may result in significant effect on business operations.

Power outage duration is the amount of time spent without electricity power. Outage duration measures the amount of time that curtailed supply of electricity is experienced by individual or commercial customers (Fisher-Vanden, Mansur & Wang, 2015). The duration of the power outage is known to determine the costs of the interruption to firms (Nooij, Koopmans and Bijvoet, 2007). Power outage frequencies and the duration are characteristics that are known to trigger strains for some industries, mainly those that rely on electricity as a major input resource (Frederick and Selase, 2014).

Large power consumers or those whose operations are sensitive in nature and that are heavily dependent on electricity may require advance communication of power outage within a reasonable period before the outage occurs. A notification before an interruption lowers the

consequences of that interruption (Nooij, Koopmans & Bijvoet, 2007). Outage notification alleviates negative effect of power outage by businesses as they are provided the opportunity to shift to alternative power sources such as generators, or safely discontinue operations, thus reducing or eliminating damage to semi-finished goods and reducing wasted manufacturing time. On the other hand, unmitigated loss due to lack of notification may cause various damages that may affect product quality and cause significant increase in costs of operations (Lai, Yik & Jones, 2008).

The time of occurrence of a power outage is also a component of electric power outage dynamics. This perspective refers to the timing of blackout occurrence whether planned or unplanned (Frederick & Selase, 2014). The timing of the occurrence can be either during the day, evening or and night. Further, it can occur during the working days from Monday to Friday or it can occur over the weekend, Saturday or Sunday. The time power blackouts occur has diverse implications such as the number of users affected and the costs thereof. For instance, it is expected that if power outage occurs during the day, commercial enterprises will be more adversely influenced as compared to domestic users of electric power due to heightened operations at that time of the day. In the study of Schoeman and Saunders, (2018) for example, it was revealed that in Ireland, firms engaged in industrial activities lost more of their value load in the middle of the week between eight am and six pm in the evening as compared to domestic users of electric power.

The interface between electric power outage dynamics and non-financial performance is underpinned by the transformation theory of Shepherd, 1970's. The theory is based on Input, Process and Output (IPO). The theory provides for breakdown of each process into distinct activities implemented by specialized persons. All actions are systematically ordered and coordinated. The theory seeks to optimize the whole production system by optimizing singular tasks towards optimal firm performance and consequently, higher customer value. Since production comprises the conversion of inputs into output of goods or services. Managers are focused on attainment of efficiency throughout the process of production for both technical and economic use of inputs. The efficiency goal provides the firm with adequate guidelines on how

to optimize inputs to obtain the desired level of outputs for goods and services, this will be signified by high levels of both financial and non-financial performance by the firm.

Firm performance is the firm's effectiveness and efficiency in which it conducts its affairs (Chakravathy, 1986). The evolution of performance measurement led Kaplan and Norton, in the early 1990's to develop the model of the Balanced Scorecard (BSC). This was a new method of performance assessment as a result of difficulties of short-range focus and past attention in Management Accounting (Kaplan & Norton, 1992). The main focus of BSC is to overcome the sole reliance on financial performance (Horngren, Forster, Rajan, Ittner & Datar, 2010). The BSC provides a set of non-financial parameters that characterize distinct requirements and competencies (Moller & Schaltegger, 2004). Sustainability Balanced Scorecard (SBSC) concept was recently developed to incorporate social and environmental considerations to the BSC for measurement of firm performance. Although most studies are in agreement that performance cannot be fully explained by a single measure due to various organizational objectives as well as contextual factors, this study considered the non-financial based proxies to measure performance of firms in the manufacturing sector in Kenya, which are also members of Kenya Association of Manufacturers (KAM). The choice of this class of firms is backed by the following reasons: First, electricity is a major input of the firms' production processes, therefore a disruption in electricity supply has significant impact on the operations of the firms and second, manufacturing firms in Kenya comprise of firms in varying categories of industries that provide a heterogeneous analysis of impact of electric power outage dynamics on the performance of firms.

Literature Review

The aspect of power outage dynamics has become a matter of great concern to most of the users of electricity. Efforts to determine the impacts by scholars resulted to diverse research findings. For instance, Alam (2014) conducted a study in India to evaluate the effect of power outage on firm size, productivity levels and profitability. The analysis adopted a model to generate comparative static predictions about input choices, output and changes in profits while increasing the occurrence of power outages. The conclusion of the study indicated that the effect of power outage differs across industries. In some power-intensive industries, increased frequency of outages was found to lower production and profits, while some industries were less affected due

to availability of greater adaptation mechanisms. For instance, a rise in the occurrence of power outages lowered the yield and returns of only some electricity-intensive industries. In addition, the study found that short-run changes in power outages do not induce firms to install back up power generators. This study was bivariate as it was in many past studies, only considering the link between power outage and profitability, firm size and productivity. The study portrayed a methodological gap for measurement of power outage was based on power outage frequency dynamics.

Fisher-Vanden, Mansur and Wang (2015) examined the response level of China based organizations on the power scarcity they experienced from 1999 to 2004. The study considered a panel data of twenty-three thousand (23,000) intensive energy user- Chinese firms. The rationale of undertaking such a study was that the Chinese firms once faced by blackouts caused by fast-growing demand coupled with regulated electricity decided to purchase intermediate goods that they previously produced directly and also to improve their efficiencies in technical undertakings. Factor-neutral and factor-biased properties of electricity scarcity was utilized by the study to establish the magnitude of productivity losses incurred. The research findings revealed that firms developed optimization strategies among factors in response to scarcity of electricity by shifting from energy into materials. While outsourcing was expensive, Chinese firms avoided extensive losses in production by adopting the new strategy. Unit production costs increased by 8% as a result of rise in power shortage. Hence, the affected firms preferred to purchase intermediate goods than engage in primary manufacture of raw materials. However, the study did not establish any evidence of those firms increasing their self- generation. Those observations were found to be common with textiles, timber, chemicals, and metals firms.

Braimah and Amponsah (2012) carried out a study to assess the origins and impacts of regular and unexpected power outages on operations of small industrial firms in Ghana. The study sampled 320 firms obtained from three industry clusters. Secondary and primary data was utilized for the study to evaluate the impacts of power outages that occurred frequently and without notification on the operations of the firms. Structured questionnaires were managed at interviews to collect the primary data for selected institutions. On the other hand, secondary information was obtained on efforts made by successive governments in Ghana for supply of

sufficient and dependable electricity for industrialization. For analysis purpose, the two categories of data, namely; primary and secondary was synchronized through the process of triangulation. The study revealed that in an average month, firms experienced blackouts for about 10.3 hours. Out of the 320 SMEs surveyed, 44% of the firms experienced stoppage in operations in the duration of the power outage, while 56% of the firms continued operations since they owned alternative sources of electricity (generators). The paper concluded that electricity reliability is a critical component of efficient industrial operations and that numerous repeated blackouts increased the production costs of the firms in the study and therefore affected the effectiveness of meeting contract deadlines.

In the study of Frederick and Selase, (2014), the aim was to analyze the influence of electric power variation on small and medium enterprises (SMEs) profitability and competitiveness in Ghana. The country had achieved middle-income status and needed to sustain this condition. The research paper utilized a case study approach with a main target group for the case study being SMEs with operations located within the Accra business district in Ghana. The study utilized cross-sectional survey and systematic sampling technique was considered most appropriate to select a sample size of 70 Ghanaian SMEs. The criteria that was used to select an SME firm was the location and dependence on the level of electricity as a major input for business processes. Structured questionnaires were utilized to collect data related to power fluctuations, firm profitability and firm competitiveness. The study outcome was that unreliable power supply resulted in firm's inability to increase the quantity and quality of their products that further led to poor sales and profitability. Hence both Return on Investment (ROI) and Return on Assets (ROA) for the SMEs were adversely influenced by the low profitability levels experienced by the aforementioned firms.

Abotsi (2016) carried out a study to evaluate the effect of power outages on production efficiency of businesses in Africa that included manufacturing, services and retail sectors. The study was based on secondary data obtained from the data bank of the World Business Environment Survey directed by the World Bank. A two-tail Tobit and stochastic production frontier models were used to carry out the data analysis. The outcome of the study indicated that

frequent electric outages impacted the production proficiency of African based firms in a negative manner.

Cole, Elliott, Occhiali and Strobl (2018) assessed the scope to which power outages impact the turnover for organizations in the African continent. Using World Bank Enterprise Surveys data for 14 countries, it was evident that firms that did not own a generator were more negatively affected in sales due to unreliable power supply. It was established that a downsizing of the expected outage levels to those achieved by the South Africa economy during the study time span would result to the organization's overall turnover up rise by 85.1%. This would lead to 117.4 per cent for the persons without generator facility.

Quarshie, Agyeman, and Bonn, (2017) conducted a study on manufacturing firms listed on the Ghana stock exchange. The study sought to establish whether diverse outcomes were realized in relation to power outage impacts on firm performance. The population used was all the manufacturing companies listed at the Ghana Stock Exchange (GSE) for the period 2007-2013. Quantitative data analysis was utilized through descriptive statistics, averages and variances to make conclusions. It was discovered that the difference in Return on Equity (ROE) for power outage and non-power outage years, were not significant and that power outage does not affect ROE of manufacturing firms. On the other hand, power outage had effect on asset management ratio or asset turnover ratio of manufacturing firms. Return on Asset ratio (ROA) of manufacturing firms was higher in non-power outage periods than during power outage periods. The paper concluded that power outages in the short run, do not explain much of the gap in productivity and that manufacturing firms in the long run maybe affected by power outages.

Amadi, Ephraim, Okafor and Izuegbunam, (2016) investigated the impact of power outages in Nigeria's industries for the year 2014 through the simulation of statistical data collected from two hundred and fifty (250) electricity intensive industries drawn from the nation's three major industrial cities. The sample was determined using the technique of stratified random sampling. The research outcomes concluded that in 2014, Nigerian industries spent a significant amount of money as a consequence of power outages. The results further showed that Nigerian industries suffered low-capacity utilization, significant reduction in productivity, low marginal profit and

lack of competitiveness in the international market due to perennial shortages in energy supply resulting from high distribution losses.

Siddiqui, et al. (2012) explored the cost of energy not served in Pakistan that occurred due to power outages. The study utilized survey technique and was carried out for four major industrial cities with an aim to; determine the extent to which energy not served influenced production output of firms in India; assess the impact of energy not served on employment level; examine the impact of energy not served on cost of production and establish the impact of energy not served on supply of orders. To estimate the impact thereof, output loss was measured using two-dimensional methodologies, one, checking for changes in the duration of outages and in the hours of shifts. To select the sample size, random sampling technique was utilized. Hence 339 firms which constituted almost 8 percent of the total population was considered. The survey data revealed that workers did not lose their jobs as the management sought alternative energy arrangements which ensured continuous production However, the additional source of energy apart from the mainstream one resulted to increased production cost of the firms. Further, energy shortages translated into delayed execution of orders placed for delivery. The study opined that the total industrial production loss fluctuated between 12 percent and 37 percent and that the most affected province was Punjab.

Research Problem

The linkage between electric power outage dynamics and non-financial performance of manufacturing firms has resulted to mixed debate amongst scholars over the years. The conceptual implications and the methodology used to assess the extent to which these dynamics influence firm productivity is yet to be resolved. Electric power outage dynamics have been measured using various indicators in past literature; Cissokho and Seck (2013) utilized frequency, duration and their severity to measure outage characteristics, Alam (2014) used frequency, while Allcott, Allan and Stephen (2014) and Karen, Erin and Qiong (2015), utilized notification of outage. This paper sought to expand the operationalization of electric power outage dynamics by adopting four indicators in order to have a wider scope of evaluation of power outage effects, these are; power outage frequency, power outage duration, power outage notification and time of power outage.

Studies on the extent to which electric power outages affects performance of firms have been carried out in well-developed economies including Germany, China, India and Pakistan. Whereas little attention has focused on few developing countries in Africa with the exception of Nigeria, to which a considerable number of studies have focused. In Kenya, similar studies on electric power outage are scarce, with the country only being included in generalized studies based on panel data sets by Oseni & Pollitt (2013) and Steinbuks & Foster (2010). The outcomes of these studies provide generalized data that may not be fully relied on for Kenyan firms, a gap that this paper seeks to fill. In addition, reviewed literature had varying indicators for representation of electric power outage impact on performance. Siddiqui et al. (2012) used outage damage costs, Oseni and Pollitt (2013) used the cost of operating back up generation facilities and Cissokho and Seck (2013) adopted firm productivity to represent performance indicators. This paper measures performance using non-financial indicators comprising of customer focus, employee productivity, operations efficiency, social responsibility and green performance dimensions. The focus of this study is on firms in the manufacturing sector in Kenya, whose reliance on electricity as an input factor of production is significant.

Research Methodology

This current study made use of positivism philosophical paradigm and descriptive survey research design respectively. A population of 447 firms whose main area of focus is manufacturing in Kenya and were also members of Kenya Manufacturers Association was considered out of which a sample size of 138 of such firms was selected. Structured questionnaires were utilized to collect data which involved drop and pick methodology for five years from 2014 to 2018. Questionnaire return rate was used to present the percentage of the successfully returned questionnaires. Data analysis was undertaken using SPSS computer software version 21which focused on two perspectives, one; descriptive data analysis, whereby results were presented using two aspects of statistics, one; frequency, percentage, average and standard deviation and two, best of fit tests. Electric power outage dynamics was the predictor variable and was operationalized using power outage frequency, power outage duration, power outage notification and time of power outage. Whereas, non-financial performance was the

response whereby it was gauged using customer focus, operations efficiency, employee productivity, green performance and social responsibility.

Response Rate

To determine the questionnaire return rate, the number of questionnaires received from the respondents as compared to those issued was analyzed and the results indicated in Table 1

Table 1: Questionnaire Return Rate

Particulars	Returned	Not Returned	Distributed Questionnaires
Frequencies	73	65	138
Percentages	53%	47%	100%

Out of 138 questionnaires which were distributed, 73 were returned inclusive of six which were totally spoiled (returned with no useful information). Therefore, 67 were properly filled and returned. This translates to a 51% (73-6)/132) questionnaire return rate. This response rate is acceptable as per Richardson (2005) who regards a questionnaire return rate of at least 50% as being acceptable in social research survey.

Electric Power Outage Dynamics

Electrical Power Outage Dynamics (EPOD) was represented by four indicators; power outage frequency, power outage duration, power outage notification, and time of outage. The study investigated each component of EPOD to establish the general trend within the period given.

Power Outage Frequency

The issue of the rate at which power supply is on and off is paramount to manufacturing firms. This is because the more frequent the power outage, the more unreliable it is. Therefore, each firm's officials were requested to give their opinion pertaining the extent to which power outage occurred (frequency) in a month and responses were obtained as represented in Table 2.

Power outage frequency was not high for the majority of the firms (88%) reported up to 10 cases of blackout occurrences in a month. Whereas, 12% of the manufacturing firms experienced over 10 outages in a month.

Table 2: Power Outage Frequency

	Frequency	Percent (%)
X<5 Time duration	25	37
5-10 Time duration	34	51
11-15 Time duration	4	6
16-20 Time duration	1	1
Over 20 duration	3	5
Total	67	100

Power Outage Duration

The time span within which the firm experiences power outage is of great concern to most of the players in the manufacturing industry. Responses obtained from firms on the average outage duration in a month is shown in Table 3

Table 3: Power Outage Duration

	Frequency	Percent (%)
X<5 minute	4	6
5-20 minute	20	30
20-60 minute	32	48
1-5 hours	9	14
Over 5 hours	2	2
Total	67	100

84% of the firms in the study experienced power outage for less than one hour. 14% of the firms experienced power outage for between 1 and 5 hours, while 2% of the firms had outage for over 5 hours for each outage in an average month.

Power Outage Notification

Making users of electric power aware of power outage is valuable. This is because early alerts enable the users to make alternative arrangements to avoid production stoppages. This study

endeavored to establish the extent to which manufacturers were notified of an envisaged power outage before it occurred. Using a likert scale of three, the respondents were requested to portray the number of times firms they were working in were notified of power outages in advance. The responses were as per Table 4

Table 4: Incidence of Outage Notification

Notification	Frequency	Percent (%)
No	11	16
Some times	28	42
Yes	28	42
Total	67	100

From Table 4, 42% of respondents were always notified of foreseeable power outages before they occurred. Notification of outage for 42% of the firms was not consistent, with outage only being communicated some of the time. The result of timely communication of outage provided firms opportunity to put in place coping mechanisms in order to mitigate negative impact of power outages on operations. The remaining 16% of the electric power users did not receive any communication of outages before they occurred.

Average Notification Duration

A further clarification was necessary to know on average the timing of the notifications made by the power suppliers for firms that gave a positive response on notification of outage. Therefore, the current study sought the average time within which the manufacturing firms were notified that there was to be power interruption. The outcomes were presented in Table 5

Table 5: Power outage Notification

Average Notification	Frequency	Percent (%)
5-60 min	3	6
1-12 hours	11	21
Over 24 hours	38	73
Total	52	100

From Table 5 it was depicted that 73% of firms are informed of an outage over 24 hours prior to the outage, while 21% are informed between 1 hour and 12 hours to the outage. 6% of the firms depicted that they got notification of power outage between 5-60 minutes before the outage. This implies that most manufacturing firms were notified of power outages in fairly good time, hence were in a position to make alternative power arrangements or discontinue operations in a timely manner to prevent damage of equipment and spoilage of raw materials among other negative effects. This action would assist in ensuring that there were minimal operations interruptions that would adversely affect performance.

Time of Power Outage

The time of outage was also a focus of the current study. The aim was to establish the implications power outage had on performance depending on when the outage occurred. Manufacturing firms in Kenya have varying operating times. Some firms operate over 24 hours a day, 7 days a week, others have operations between 8 and 12 hours or more. This study sought to capture the time of occurrence of outages in order to capture the various operation schedules of the various firms. The response pertaining to time of outage is presented in Table 6

Table 6: Time of Power Outage

Rate of occurrence	Daytime		Evening		Night		Total	
	Freq.	(%)	Freq.	(%)	Freq.	(%)	Freq.	%
	27	20.3	57.0	43.0	87.0	66.7	171	43.07
1-5 times	103	77.4	74.0	56.0	44.0	33.3	121	55.66
5-10 times	2	1.5	1.0	1.0	1.0	0.0	4	0.010
10-15 times	1	0.8	0.0	0.0	0.0	0.0	1	0.0025
Total	133	100	132	100	132	100	397	

The outcome as per Table 6 depicted power outage less than 5 times in a month was experienced by 98.73% of the respondent firms, majority of which was experienced in the day and night time. For all categories of time, that is day, evening and night, there were very low incidents of power

outage depicted by the fact that power outage hardly exceeded 5 times in a month. This provided sufficient opportunity for firms to carry on production shifts in the day, night or both.

Non-Financial Perspective

The study further interrogated the non-financial performance trend for the manufacturing firms in Kenya for five years from 2014 to 2018. To determine the trend in non-financial performance, views on customer focus, operations efficiency, employee productivity, green performance and social responsibility were collected by asking the respondents to indicate the perceived performance of their institutions on the various perspectives. Descriptive data analysis from the data provided by the respondents was as shown in Table 7.

Table 7: Non-Financial performance indicators

Variable	N	Mean	SD	CV	Min	Max	Skew	Kurto
Customer Focus	67	70.500	15.749	0.223	0	90	-1.986	8.448
Operations Efficiency	67	67.604	15.922	0.236	25	90	-0.906	2.979
Employee Productivity	67	81.738	14.699	0.180	0	100	-3.066	16.726
Green Performance	67	62.006	20.239	0.326	0	100	-0.952	4.044
Social Responsibility	67	61.741	27.723	0.450	0	100	-1.144	3.404

It was established that on average, firms rate performance on the customer perspective at 70%. This attainment was based on indicators of customer satisfaction and level of resolution of customer complaints and was considered critical for attainment of good performance for all organizations. Operations efficiency had an average attainment of 67% measured against rate of automation of processes in the firm and capacity utilization of existing infrastructure. Employee productivity rate had an average score of 81% for 67 firms. This measure was based on employee satisfaction, employee retention and competency and development budget in relation

to firm's total budget. Green performance attained an average of 62% for implementation of environmental protection policy in the firm's operations and level of adoption of green technologies in the operations. Finally, the social responsibility score was 61% for rate of implementation of social responsibility policy and the budgetary allocation for social responsibility programmes in relation to firm's total budget of firms attribute their non-financial performance to customer focus as shown in Table 7. This is because customer focus aids the management in many strategic perspectives such as the adoption of customer satisfaction programs could foster customer royalty and increase of competitive edge which will in the long run be reflected in the financial performance perspective.

On variability perspective, social responsibility had the highest value of coefficient of variation (45%). This indicates that priority of executing social responsibility policies varies within firms with some firms paying significant attention on this aspect while others did not give the matter a valuable consideration. Employee productivity had the least variation (17.9%), indicating that firms are cautious about satisfaction and retention of employees across board. Variation in customer focus was also low (22.3%), meaning that firms pay close attention to their customers in their operations to avoid loss of market share to their competitors. All variables are negatively skewed implying lack of asymmetry. Both skewness and kurtosis values indicate that operations efficiency, green performance and social responsibility are normally distributed. Their skewness values are close to zero while their kurtosis values are approximately three.

The linear regression function established for this study was as follows:

$$NFIN = \beta_{10} + \beta_{11}OF + \beta_{12}OD + \beta_{13}ON + \beta_{14}TO + \varepsilon_{it},$$

Where;

NFIN is non-financial performance of firm i in time t
Power Outage Frequency of firm i in time t
Power Outage Duration of firm i in time t
Power Outage Notification of firm i in time t
Time of Power outage of firm i in time t
β_{10} *is the regression constant or y intercept*
$\beta_{11\text{-}14}$ *are regression coefficients of OF, OD, ON, and TO respectively.*
$\mathcal{E}_i$ *is the random error term*
Data analysis was performed to establish the association between electric power outage dynamics and non-financial performance using multiple regression models

Results and Discussion

Table 8: Regression Analysis Results of OF, OD, ON, TO and Non-Financial Performance

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.120[a]	.014	-.049	.15466

a. Predictors: (Constant), TO, OD, ON, OF

ANOVA

Model		Sum of Squares	df.	Mean Square	F	Sig.
1	Regression	.022	4	.005	.226	.923[b]
	Residual	1.483	62	.024		
	Total	1.505	66			

a. Dependent Variable: NFIN

b. Predictors: (Constant), TO, OD, ON, OF

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.756	.130		5.814	.000
	OF	.000	.022	-.002	-.012	.991
	OD	-.005	.025	-.029	-.211	.834
	ON	-.016	.027	-.080	-.597	.553
	TO	-.036	.058	-.084	-.634	.528

a. Dependent Variable: NFIN

The F statistic in Table 8 showed a value of .226 (p=.923). Therefore, the regression model was not significant at 95% confidence level for the (p>.05) hence it did not fit in estimating performance of non-financial firms undertaking manufacturing activities in Kenya. Goodness of fit test was also performed which entailed coefficient of determination and test of the slope (β), whereby the outcome was as follows;

The Adjusted R^2 was -.049 as per Table 8. This was the coefficient of determination for model in question and it depicted that outage frequency, outage duration, outage notification and time of outage taken together failed to explain the variations in performance of firms engaged in manufacturing undertakings in Kenya, especially in the non-financial performance perspective. This is because the Adjusted R^2 assumed a -4.9% value. That means that variations of performance (non-financial) were explained by other variables that were not captured in this model. For the test of the slope, a unit variation in power outage frequency resulted to .002 unit transformation in the same non-financial performance of Kenyan based manufacturing firms

aforementioned which was inverse and not statistically significant with (p=.991). Further, a unit variation in power outage duration translated to .029 unit variation in performance (non-financial) which was inverse and not statistically significant with (p=.834). For power outage notification, a unit alteration in this variable resulted to .080 unit adjustment in manufacturing firm performance in Kenya which was inverse and had no statistical significance with (p=.553) and lastly, a unit alteration in time of power outage led to .084 unit alteration in performance of firms undertaking manufacturing activity which was indirect and had no statistical significance with (p=.811). Therefore, the model developed from this analysis was presented as follows;

NFIN= .756 -.002OF-.029OD- .080ON-.084TO

Where;

NFIN is Non-Financial Performance of organization i in time t

OF is power outage frequency of organization i in time t

OD is power outage duration of organization i in time t

ON is power outage notification of organization i in time t

TO is time of power outage of organization i in time t

Conclusions

The multiple regression outcomes portrayed that the four components of electric power outage dynamics had similar inverse implication on non-financial performance of manufacturing firms in Kenya but in varied magnitudes. Power outage frequency had a negative influence on non-financial performance which was not statistically significant with (p=0.991), while power outage duration had a negative link on non-financial performance of firms in Kenya undertaking manufacturing activities which was not statistically significant with (p=0.834). Power outage notification also had an inverse association with non-financial performance of Kenyan based manufacturing firms although not statistically significant with (p=.553). Lastly, the time of power outage had a negative relationship with non-financial performance which was not statistically significant with (p=.528). In general, it was concluded that the association between electric power outage dynamics and non-financial performance of manufacturing firms in Kenya

was not statistically significant. Nevertheless, the directional variations were directed by the specific electric power outage dynamics components estimating firm performance.

This study outcome provides a contribution to existing knowledge by providing evidence that electric power outage dynamics did not have statistically significant influence on non-financial performance of manufacturing firms. This implies that whether electric power is present or absent (power outage) in a manufacturing set up, does not significantly affect firm operations in relation to non-financial performance measures such as customer focus, operations efficiency, employee productivity, green performance and social responsibility. The effective performance of these indices may therefore be affected by other factors than power outage dynamics. The current study has also made an input to the academic literature in relation to the assimilation of transformation theory as a production process theory by considering electric power as a major input factor to the manufacturing production process and therefore assessing whether the presence or absence of electric power had any effect on non-financial performance of manufacturing firms in Kenya.

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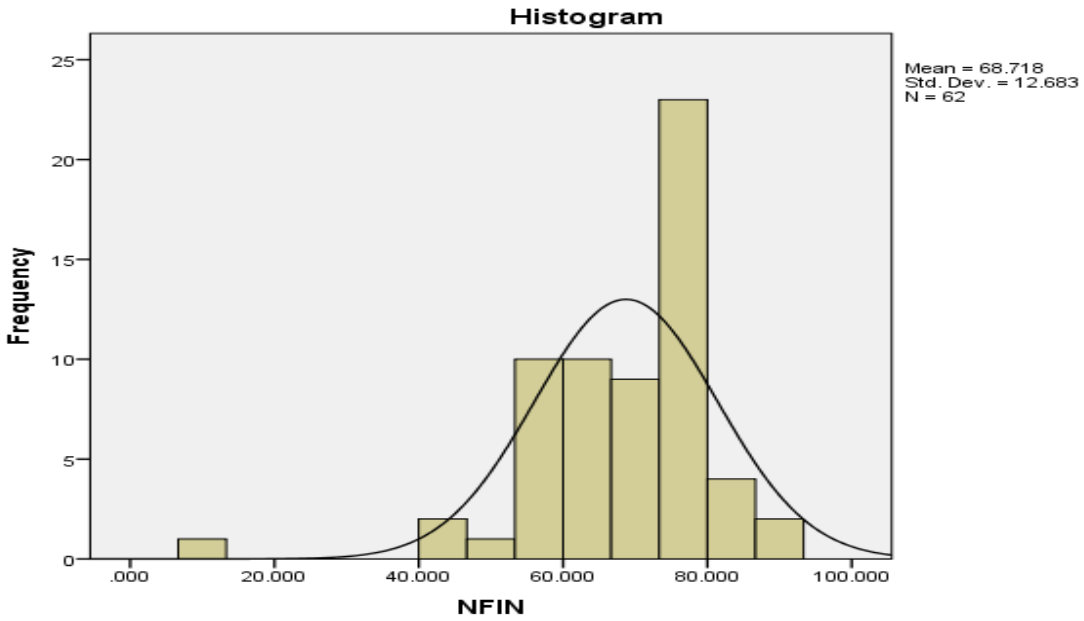
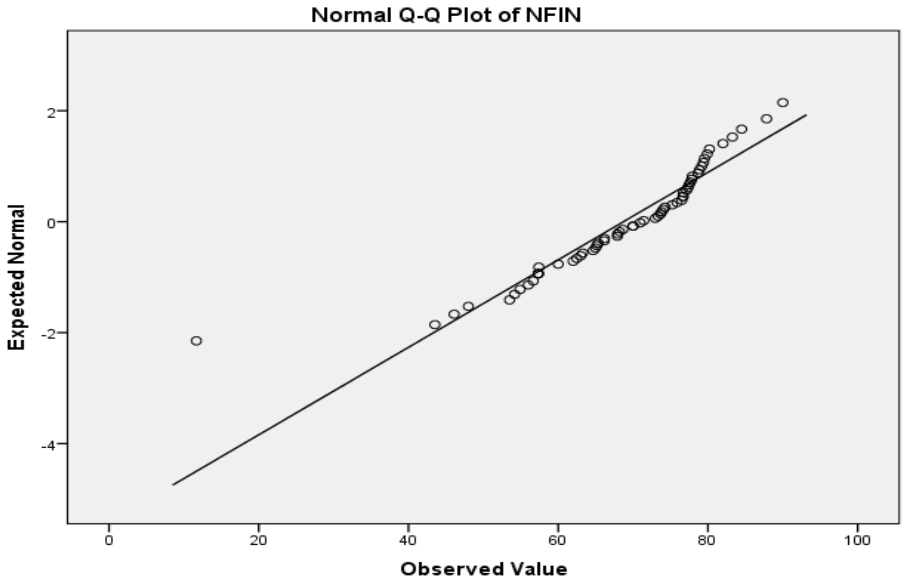
Appendices

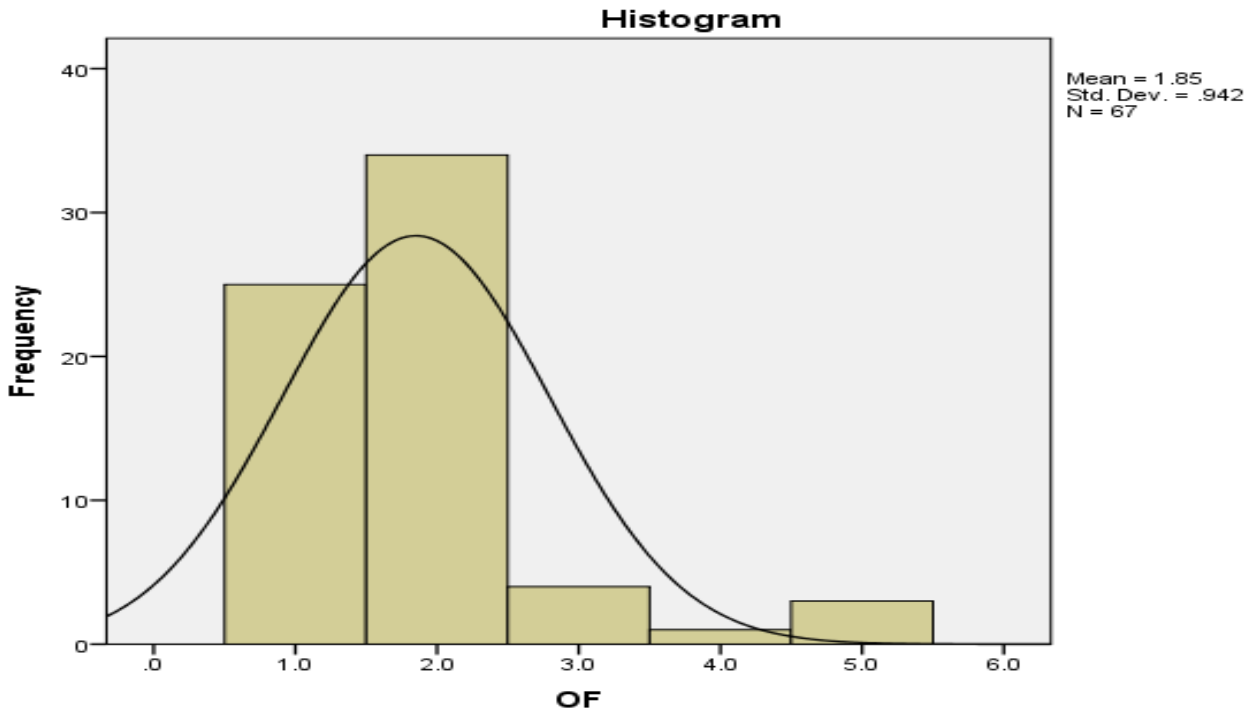
Appendix I: Normality Test Summary for Individual Study Variables

Non-Financial Performance





Power Outage Frequency



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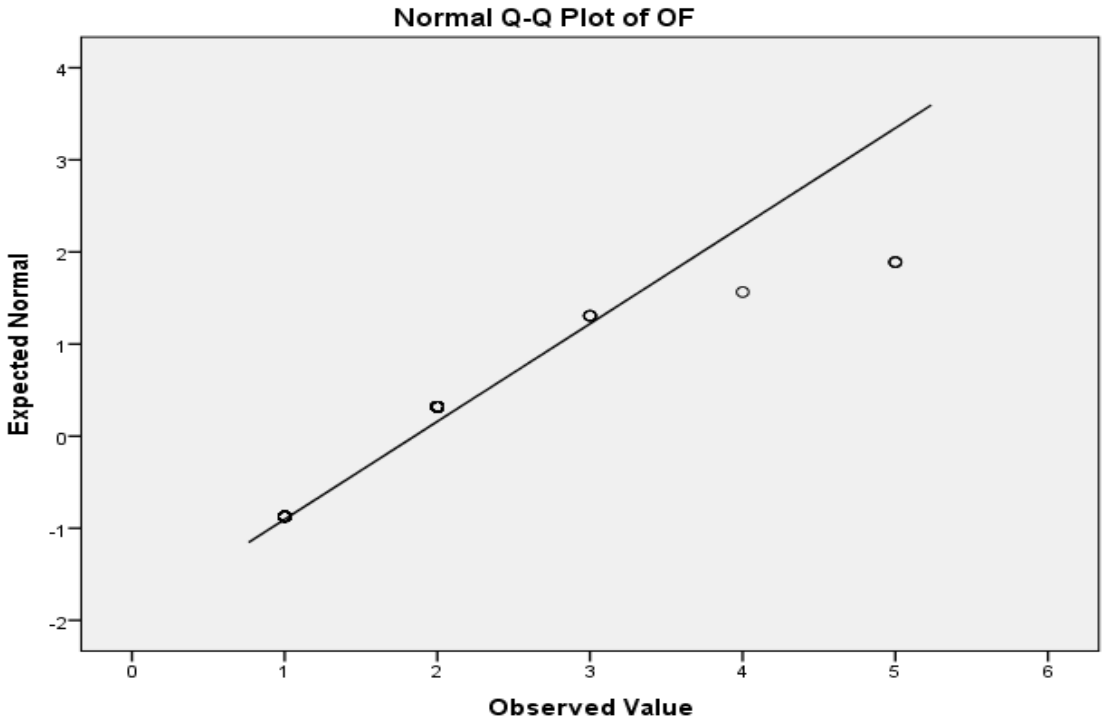
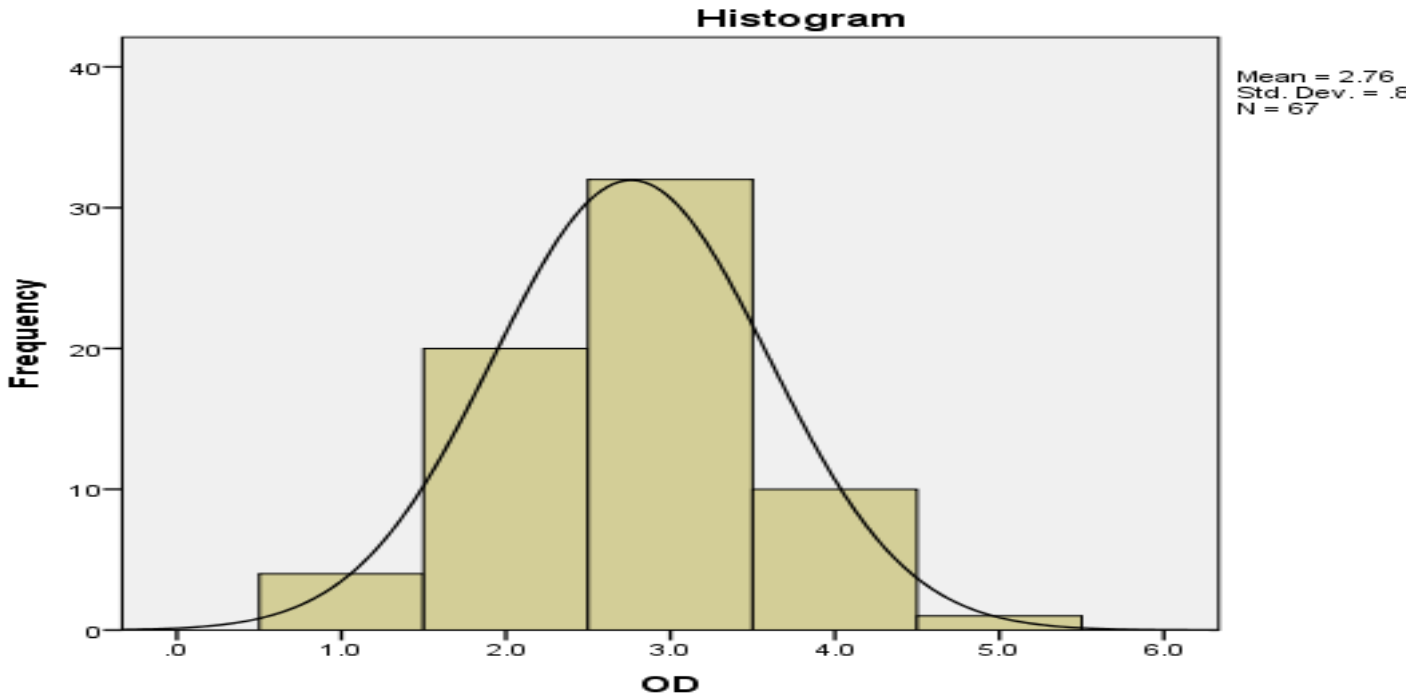


Power Outage Duration



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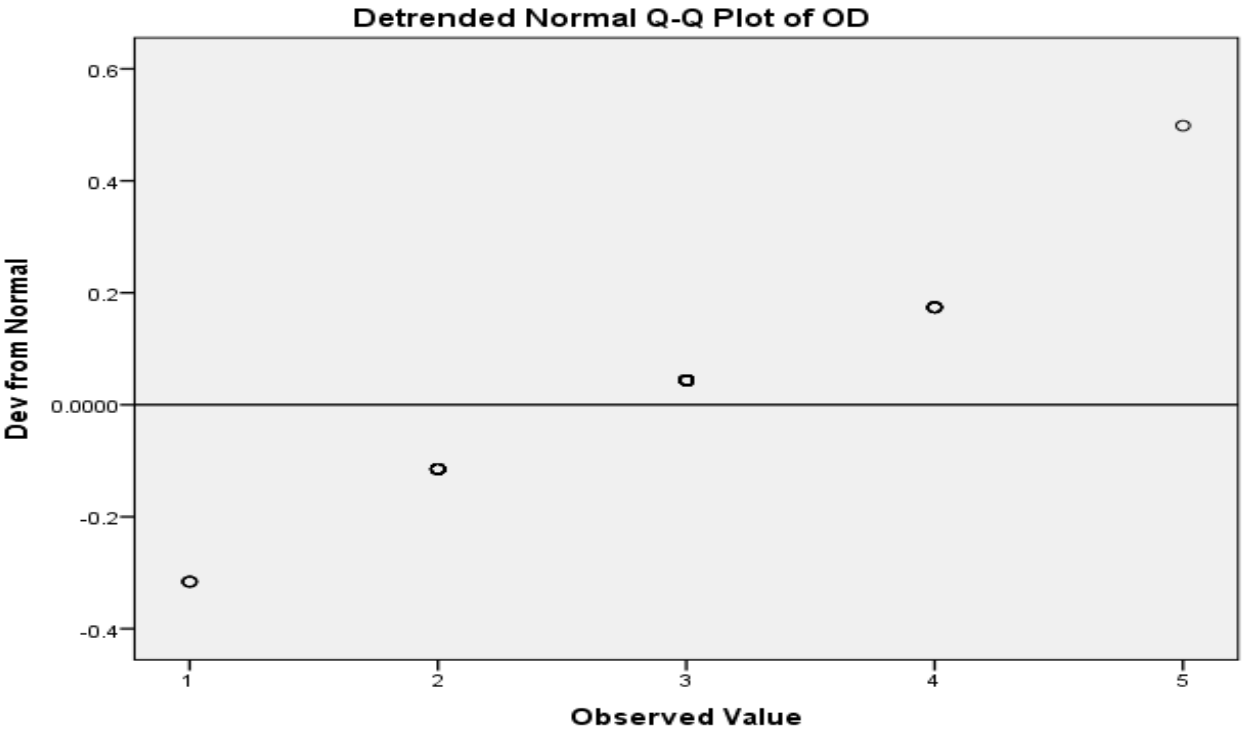
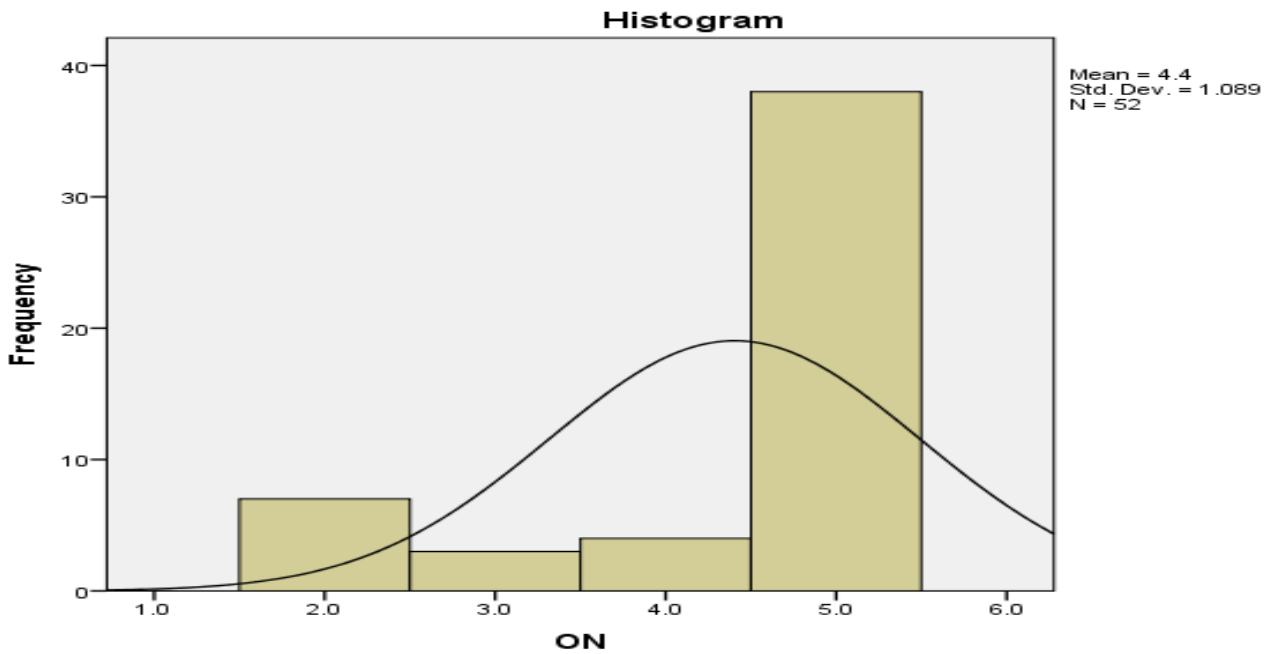


Power Outage Notification



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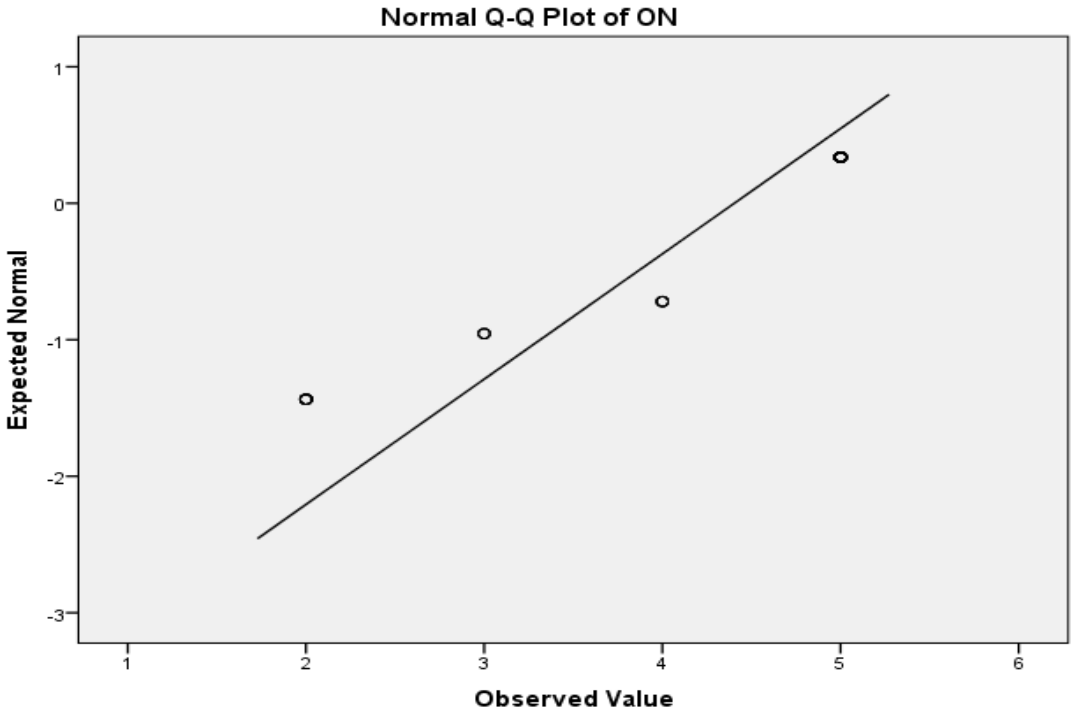
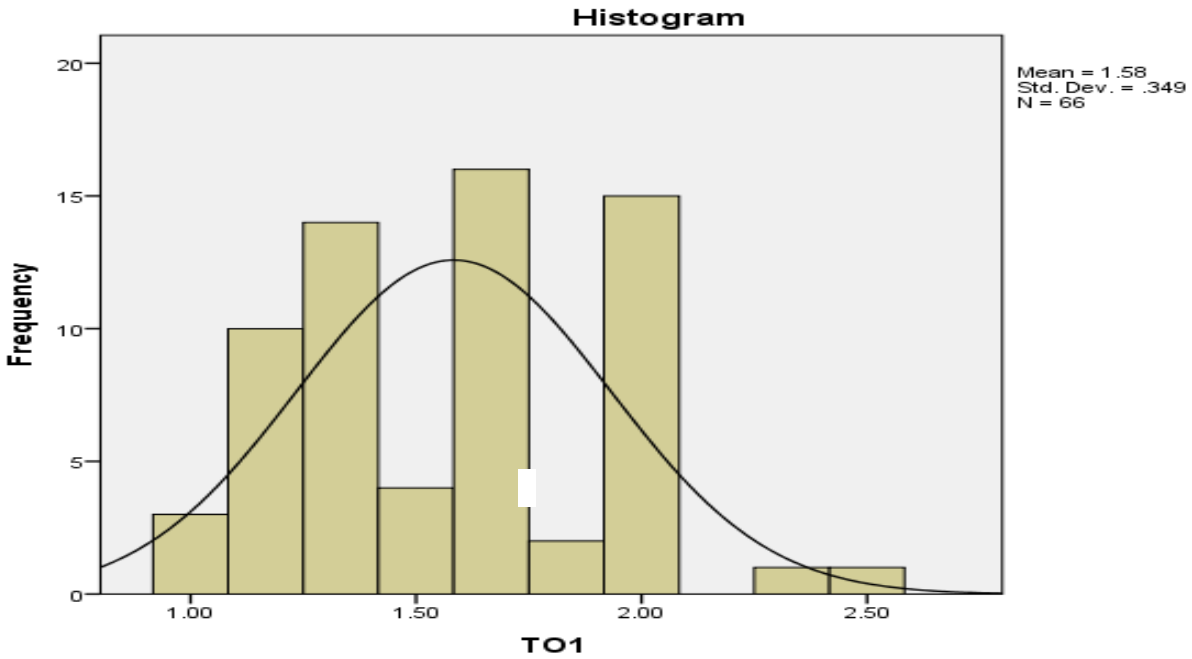


Time of Power Outage



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