

IS THERE A LINK BETWEEN SUPPLY CHAIN RISK MANAGEMENT PRACTICES AND POWER SUPPLY DISRUPTIONS CONTROL? EVIDENCE FROM KENYA

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Abstract

The study sought to explore the supply chain risk management practices adopted by the power sector firms in Kenya and their effectiveness in disruptions control within the value chain. In order to satisfy the objectives of the study, a survey was conducted in the three power sector firms in Kenya. Focus being on the key electric power sector value chain players from generation, transmission up to the distribution. The research instrument used was Excel and SAS, descriptive statistics was used by way of mean and the standard deviation to summarize the data and inferential statistics (regression analysis) used to derive the relationship between the practices and disruptions control. The findings revealed that the power sector firms have implemented the supply chain risk management practices albeit to a varying extent. In particular supply contingency planning by way of having in place a backup supply in the critical yet disruption prone categories, adoption of capacity reservation contracts and suppliers' disruption historical background checks had not been afforded due regard. In addition, it was established that the power sector firms have suffered supply chain disruptions, the major one being those associated with stock outages. On a moderate scale, catastrophic disruptions such as fire outbreak, IT systems breakdown and environmental disruptions have been experienced. Finally, the study affirmed that there exist a statistically significant relationship between loss of critical stock and supply chain risk management practices adopted by the organization. The study is presented in five chapters each with various sections through which the researcher has tried to discuss the above issues. The findings of this study should be appreciated and evaluated in light of the limitations of the study. The study is specifically of value to power sector firms but due to the growing vulnerability of the modern day supply chain, the study finds a place in all organizations that have the desire to instill resilience, robustness and responsiveness in their supply chain. The study therefore recommends that all the power sector firms should endeavour to appreciate their supplier chain risks, determine all the robust supply chain risk management practices that can be embedded into the day to day supply chain operations to ensure proactive control of disruptions or to minimize the effect of any incident disruption.

Key words: Supply Chain Risk Management Practices, Power Supply Disruptions Control & Kenya.

Introduction

Risk management practices are aimed at seeking to eliminate, reduce and generally control pure risk (Waring and Gledon, 1998, p.3). A typical risk management processes for enterprise risk involves: risk identification; risk analysis (risk assessment and classification); risk treatment, and risk monitoring (Damodaran, 2007; Waring and Glendon, 1998; Sheffi and Rice, 2005). With the supply chain risk management practices the firm tries to insulate the organization against the causes of supply chain disruptions by embedding practices that avoids, defer, reduce or transfer the risks. Other than the practices that proactively manage disruptions, the organization will put in place supply chain resilience measures. Supply chain resilience measures consists of all supply chain management practices that allows the organization to return to normal performance level in the event of a supply chain disruption (Sheffi 2005). Supply chain resilience can be achieved by building redundancy or through flexibility (Christopher and Peck, 2004).

Traditional supply chain strived to achieve the lowest initial purchase prices while assuring supply. Its typical characteristics are: multiple partners, partner evaluations based on purchase price, cost-based information bases, arms-length negotiations, formal short-term contracts and centralized purchasing (Spekman et al., 1998). All these features lead to forecast inaccuracies and slow response to the changing market scenarios. The traditional supply chain is defined as an integrated manufacturing process wherein raw materials are manufactured into final products and then delivered to customers (via distribution, retail, or both). Its design, modeling, and analysis had primarily focused on optimizing the procurement of raw materials from suppliers and the distribution of products to customers (Beamon, 1998, 1999).

Other sources of supply chain exposures are risk of sharing sensitive information (Rahman, 2004), dependence on outsourcing (Chandra and Kumar, 2000), pursuits to become agile and lean, exposures to market risks (Johnson, 2001) and environmental exposures such as fire outbreaks, earth quakes and floods. All these predictable and unpredictable risks have made organisations to rethink their risk management strategies in context of supply chains serving across nations and continents. Supply chain risk management has emerged purposefully to ensure that partners in a supply chain are able to deal effectively with risks and uncertainties impacting the supply chain (Norman and Jansson, 2004). Firms in their own accord have limited control over the events that disrupt a supply chain, but it is by adopting effective practices it can attempt to control how well a supply chain copes with those disruptions (Swaminathan, 2003).

Risk is a combination of probability or frequency of occurrence of a defined hazard and the magnitude of the occurrence (BS 4778, 1991). A Supply chain risk is an event that adversely affects supply chain operations and hence its desired performance measures such as cost, customer service level offering and responsiveness (Choi and Krause, 2006; Zsidisin et al., 2000, 2004). Supply chain risks causes disturbances and interruptions to the flows within the goods, information and finances as well as the social and institutional networks. Further the risks will negatively affect the objective accomplishment of the individual company, the wider supply chain, in regard to the end-user advantage such as costs, time or quality (Ziegenbein, 2007; Li and Hong, 2007; Kajuter, 2007). According to Fone and Young (2000) risk management is a general management function that seeks to assess and address risks in the context of the overall aims of the organization. Supply chain risk management (SCRM) as a derivative of risk management is the identification of potential sources of risk and implementation of appropriate strategies through a coordinated approach among supply chain members, to reduce supply chain vulnerability” (Manuj and Mentzer, 2008a). The focus of SCRM is to proactively and reactively manage supply chains in times of crisis and disastrous situations that are becoming increasingly prevalent through adopting desirable supply chain risk management practices (Manuj and Mentzer, 2008b; Rao and Goldsby, 2009).

Studies conducted by (Manuj and Mentzer, 2008) indicates that business activities are being increasingly integrated to take advantage of human, material, and capital resources that are often heterogeneously distributed across multiple businesses. Further research by Juttner (2005), identifies; globalization (reported by 52 per cent of managers), reducing stock levels (51 per cent), smaller supply base (38 per cent) and outsourcing (30 per cent), poor planning and execution and limited stock buffers as

the sources of supply chain vulnerability. Hendricks and Singhal (2003, 2005a, b) demonstrated the loss of shareholder wealth attributable to supply chain disruptions and the duration of those losses. The prevalence and cost implications of supply chain disruptions are the motivation for the choice of this study area.

Supply chain disruption is an event that might happen in any part of the chain and causes undesired impacts on the achievement of objectives. Thus, an event that has no adverse effect on the achievement of the objectives is not regarded as a disruption. The emphasis on the impact on the objectives is essential as it helps to better justify the investment of resources for managing disruptions (Berg et al., 2008). Previous research by Rice and Ciniato (2003) indicate that supply chain disruption cost averages at \$50-100 million per day. Event studies have gone ahead to show that as a result of supply chain disruption, operating performance can remain diminished for by as much as two years (Hendricks and Singal, 2005). Sheffi and Rice (2005) advocates for the building of resilience and flexibility in the supply chain. Redundancy has many dimensions including the holding of buffer inventory and multiple sourcing of strategic critical supplies.

The Power sector is a key pillar of the Kenya's vision 2030 and is key Kenya's economic growth. Moreover, it is the most sought after energy service by the society since access to electricity is associated with rising or high quality of life. The Kenya National Energy Policy document of 2012 acknowledges the significant reforms and restructuring that took place in the power sub-sector by Government between 1994 and 2000, through rationalization of the operations of sub-sector players by placing all power generation assets under KENGEN and transmission under KETRACO and distribution assets under KPLC, tariff adjustments to generate revenue for system operation and expansion, introduction of competition by liberalizing generation, thus broadening resource for generation system expansion and enactment of new electricity law in 1997 under which an independent power sub-sector regulator was established. KENGEN, a 100% state owned company is concerned with power generation. KETRACO undertake new transmission activities while KPLC has a virtual monopoly in power distribution. Furthermore, KPLC as the only licensed Public Electricity Supplier has energy purchase contracts with Independent Power Producers (IPPs) and KENGEN. KENGEN accounts for about 82.1% of the total installed capacity, the private sector for about 15.2%, imports for about 2.4% and the Government under the Rural Electrification Programme for less than 1%.

Problem of Research and Focus

Supply chain risk management (SCRM) practices are activities meant to enhance the implementation of strategies to manage both every day and exceptional risks along the supply chain based on continuous risk assessment with the objective of reducing vulnerability and ensuring continuity. Recent crises and catastrophes abruptly reminded companies how vulnerable their global supply chains are. The above definition is combination of separate definitions by Ju'ttner et al. (2003), who underline the reduction of vulnerability, Tang (2006a), who emphasizes continuity, and Manuj and Mentzer (2008), who highlight strategy implementation. Generally, structured SCRM approach involves the identification, assessment, controlling, and monitoring of possible risks within the supply chain (Hallikas et al., 2004; Kern et al., 2012). An organization that embeds robust supply chain risk management practices is likely to avert disruptions in its supply chain. The most common supply chain risk management practices include long term collaborative relationships, enhanced knowledge about risk, maintenance of buffer stocks, supplier capacity assessments and qualification screening, back-up supplier arrangement, contingency planning and risk transfer through insurance. These practices if embedded in the day to day supply chain operations will see a reduction in the incidences of supply chain disruptions.

Supply chain disruption is any event that might happen in any part of the chain and has the capability of causing undesired impacts on the achievements of the targets organizations performance objectives. According to Berg et al., (2008) events that have no adverse influence on the objectives are not regarded as disruptions.

Disruption control in supply chains will always take different forms and include different types of activities ranging from a “time perspective”; all control activities which can be viewed in two respects: “Pre-disruption” and “Post-disruption” also called “Prevention” vs. “Response” (Dinis, 2010; Thun and Hoenig, 2009). According to Dani and Deep (2010) essentially, an effective disruption can be achieved chiefly by practices that enhance supply chain visibility in the face of risks that are inherent and practices that enhance resilience.

A range of different supply chain strategies are proposed to mitigate disruption impact, including the use of advance warning of disruptions (Snyder and Tomlin, 2008), strategic inventory (Schmitt, 2011), contracting and supplier diversification (Babich et al., 2007), and dual sourcing and mix-flexibility (Tomlin and Wang, 2005; Tomlin, 2006). Stecke and Kumar (2009) confirm the speculation that both the number of supply disruptions and the size of economic losses are increasing at a faster rate. Based on a statistical study of a vast data set, they propose strategies that can be implemented to decrease the possibility of a disruption, provide advance warning, and cope after a disturbance. Further, at a macro level, Sheffi (2001, 2005), Rice and Caniato (2003), Lee (2004), and Tang (2006a) discuss strategies to design fundamentally resilient supply chains. Others propose different methodologies to show how supply chain resilience could be achieved, such as via multi-agent based modeling (Swaminathan et al., 1998; Thadakamalla et al., 2004), supply network modeling (Choi et al., 2001; Barabasi and Bonabeau, 2003; Barabasi, 2009), and case studies (Norrman and Jansson, 2004; Allen et al., 2006; Apte, 2011).

Recent empirical research on SCRM and supply disruptions is a study by Kern et al. (2012), which focuses on the process dimensions of upstream SCRM and shows that competent SCRM (including risk identification, assessment, and mitigation) in companies leads to superior performance. Papadakis (2006) investigates vulnerability of supply chains empirically by analyzing and comparing stock performance of firms with make-to-order (MTO) and make-to-forecast (MTF) models facing supply disruptions. While certain empirical results on supply disruptions and associated risk can be industry specific as in Sodhi and Lee (2007) and Kilian (2008), Wagner and Bode (2006) reveal in a comprehensive study of German companies that supply chain characteristics such as the reliance on specific customers, the degree of single sourcing, and dependence on global sourcing are all relevant for a company’s exposure to supply chain risk. Hendricks and Singhal (2005), in an extensive empirical study, report that supply chain disruptions can lead to a company’s long-term negative financial performance, especially in terms of shareholder wealth and stock returns when compared to an industry benchmark. Anecdotal business examples are abundant over the last 15 years to support their findings. As an example, Ericsson was slow to react to a supply disruption caused by its supplier’s semiconductor plant fire in 2000, losing € 400 million in sales (Hopkins, 2005). Similarly, during a supply shortage of computer components resulting from a major earthquake in Taiwan in 1999, Dell and Apple responded with different pricing strategies, which led to a setback for Apple while improving Dell’s earnings by more than 40 percent over the period of supply crisis (Martha and Subbakrishna, 2002).

A survey conducted by (Aberdeen Group, 2005) concluded that 80% of supply management executives had experienced disruptions in their supply chain within the past 24 months and that 75% predicted risks would increase over the next three years. The increased probability of disruption can be ascribed to several factors, including the rise of global supply chains (Juttner et al, 2003), lean operations and supply (Sheffi, 2005), supply base complexity (Choi and Krause, 2006) and an excessive focus on outsourcing, natural disasters, political and labour unrest, IT system failure and global economic recession. Ironically, some of these factors were originally championed for driving better supply chain practices. These events may have a low probability of occurring individually; however, collectively, the probability of occurrence and the long-term impact could be quite significant (Snyder and Shen, 2006).

Academicians have shown growing interest in the area of supply chain risk management and supply chain disruption. For instance studies by Raman and Schmidt (2012) focused on when supply chain disruption matters. The study examined more than 500 disruptions cases, and established that a higher rate of improvement in operating performance aggravates the impact of internal disruptions but not external

disruptions and that managers exhibit systematic bias in the disruptions they choose to announce. A further study on the related subject was done by Zsidisin and Wagner (2010); the study investigated the validity of risk perceptions with regard to supply chain disruption occurrence, as well as the moderating effects of supply chain resiliency practices on disruption occurrence. The study concluded that not all risks are the same, nor should supply chain disruptions be managed using the same tools. Further, the study established that understanding the source of risk is important for creating a tailored strategy for reducing the occurrence of supply chain disruptions.

In Kenya, a number of studies on supply chain risk management had been conducted. Ambato (2012), studied supply chain vulnerability and customer satisfaction on petroleum products in Kenya, the study revealed that there is a positive relationship between the causes of supply chain vulnerability and customer dissatisfaction. Murigi (2013) studied strategies of minimizing the effects of supply chain disruptions caused by natural disasters in Kenya, a case of Brookside Dairy Limited. The study established that strategies such as quick responses to disturbances, safe inventory, forming collaborative relationships, preparation of a robust supply chain continuity plans and procurement of insurance can effectively work to minimize the effects of supply chain disruptions. On the local scene the closest study on this subject was done by Nelson (2012) on supply chain risk management practices used among state corporations in Kenya. Similarly, studies by Ngugi (2013) on supply chain risk management practices in the mobile telecommunications sector industry in Kenya based on the top four mobile telecommunications. The study revealed that the mobile telecommunications players under study have adopted supply chain risk management practices to a large extent but the practices are embedded in their operations.

From the studies discussed above, not much has been done regarding supply chain risk management practices and disruption control in general and the power sector in Kenya. It is against this background that the study sought to fill the existing research gap. The study therefore sought to provide answers to the questions: What are the supply chain risk management practices adopted by the power sector firms in Kenya? Is there a relationship between the supply chain risk management practices and power supply disruptions control in the Kenyan energy sector? The objectives of the study were:

To establish the supply chain risk management practices used by the electric power sector firms in Kenya; and

To determine the relationship between the supply chain risk management practices and electric power supply disruptions control in Kenya.

Methodology of Research

General Background of Research

The study will adopted a descriptive survey design to investigate the effect of supply chain risk management practices in disruption control. The research designed was deemed appropriate for this study since it enabled the study to describe the situation and its usefulness in identifying relationship between variables (Aldridge and Levine, 2001; Bourque and Fielder 1995; sampling guide; statistical good practice guide; Fowler, 2001).

Sample of Research

The population of the study comprised all the 3 leading electric power sector firms involved in generation, transmission and distribution. In this regard, a census was conducted in this study to ensure representativeness. The researcher conducted a census of all the 3 participating firms, 40 respondents were drawn from procurement, storage function and operations in. The rationale for picking the respondents from the functions was therefore, their interaction with the supply chain processes and hence good amount of knowledge in the area being researched on.

Instrument and Procedures

Primary data was used in this study. The study used primary data which was collected through the use of a structured questionnaire; A five point likert scale questionnaire was be used. The likert was used to measure the extent to which the respondent agrees with the measures provided. The scale ranks to be used are: Very Great Extent (VGE), Great Extent (GE), Moderate Extent, Small Extent, and Very Small Extent (VSE). Questions in section A were used to provide general information about the respondents. Section B provided information to answer the first objective, to establish the supply chain risk management practices used by the electric power sector firms in Kenya. Section C addressed the objective to establish the extent of supply chain disruptions in the power sector while Sections C and D were used to determine the relationship between the supply chain risk management practices and disruptions control in the electric power sector in Kenya. The questionnaires were administered to the respondents through “drop and pick later method” and a few others through e-mail.

Data Analysis

The data collected from the questionnaire was edited, coded and tabulated. This involved converting qualitative (nominal and ordinal data) into numerical codes. The study was analyzed using descriptive statistics in order to depict a pattern on the respondent’s background information, to help determine the supply chain risk management practices adopted by the power sector players and the extent of supply chain disruption and the relationship between supply chain risk management practices and disruptions. The study adopted a multiple linear regression model to establish the relationship between the supply risk chain management practices adopted by the power sector players and the disruption control. Specifically, the model took the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

Where:

Y-Disruption Control,

β_0 .The Constant

$\beta_1, \beta_2, \beta_3, \dots, \beta_{10}$. Regression co-efficient (Change induced on Dependent variable by each of the independent variable)

X_i - Independent Variables (The supply chain management practices) for $i=1, 2, 3, \dots, 7$,

ε -The error term.

Results of Research

This chapter presents descriptive analysis using means, standard deviation, and factor analysis to determine the extent to which various variables and SC design practices are used in the various firms. Regression analysis was used to explain the relationship between the supply chain risk management practices and power supply disruptions control.

The primary data was successfully collected from 35 out of the sample size of 40 targeted respondents. This confirms that the study achieved a response rate of 87.5%. According to studies by Cooper and Schindler (2003), a response rate of between 30 and 80% of the total sample size is sufficient to represent the opinion of the entire population.

The study equally sought to establish the academic background of the respondents. This aspect was deemed to be important because the gloss between experience and a higher the level of education enhances increased understanding of an organization's operation. In addition, a higher level of education is necessary in stimulating the thoughts of a professional and increasing awareness about concerns such as process disruptions. The findings indicate 80 % of the respondents were bachelor degree and master degree holders put together a factor that provide a pointer to the fact that the majority of the respondents were professionals with have in-depth understanding of organization. Besides, these are professionals who are aware of business process disruptions. The remaining 20% are Diploma holders with long experience judging by their ages, this a valuable credential in this outcome of this study.

The number of years of experience of the respondents is an important indicator of the extent to which the respondents appreciates the company's processes and the changes within the organization over time. In this research the number of years of experience is critical in providing information on supply chain disruptions recorded in the last ten years. Further this variable was critical in providing a comparative feel, about how the organizations risk awareness has evolved from infancy to date given that the concept of "enterprise risk management" (ERM) is fairly new. In this study the respondents were asked to indicate the number of years that have elapsed in their current position and findings indicate that 71.4% of the respondents had worked in their current position for between 6 to 21 years. This fact credence to the fact that majority of the respondents have a good understanding of the organization's processes and participated in the organizations risks assessments and sensitization activities that took place in the wider public sector approximately 3-5 years ago. 28.57% of respondents in the bracket 0 to 5 years are attributable to KETRACO which is about 5 years old as an independent electrical power transmission company.

The study targeted professionals working in procurement, stores and operations. This manner of choice was deliberate because professional in the procurement and stores who formed 68.6% of the total study population are the supply chain process owners charged with the responsibility of implementing the process controls. The operational staffs forming 31.4% of total were useful in the study to provide feedback on the extent of operational disruption associated with the supply chain risk sources. The level of staff who participated in the survey was deemed knowledgeable on matters of supply chain risk management practices and supply chain disruptions.

Supply Chain Risk Management Practices

Seven supply chain risk management practices were considered in this study, these are long-term collaborative relationships, knowledge about risk and risk analysis, redundant stock arrangement, supplier capacity assessment and qualification screening, back up supplier arrangement, supply chain contingency planning and transfer of risks through insurance. The study aimed at determining the supply chain risk management practices adopted by the selected firms in the power industry. To this end indicators of these practices were developed to allow determination the practices that are put into use by power sector firms. On a likert scale where 5= Very great Extent; 4=Great Extent; 3=Moderate Extent; 2=Small Extent and 1=Very Small Extent, the respondents were asked to state which of these practices are applicable in their organization. The result is as shown in table 1.

Table 1: Supply Chain risk management practices adopted by power firms

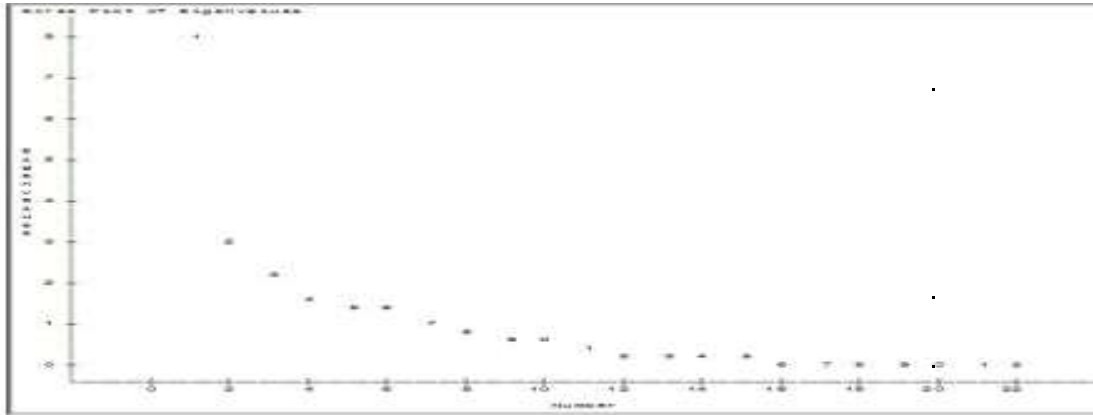
Supply Chain Risk Management Practices Indicators	N	Mean	Std. Dev.
The company treasures a long term collaborative relationship with its key suppliers.	35	3.18	1.14
The firm and its key suppliers collaborate in the areas of sharing risks.	35	2.54	1.09
There exist a high degree of trust between the firm and its key suppliers.	35	2.77	1.09
The existing level of trust & collaboration supports responsiveness and leanness in the supply chain.	35	2.75	1.08
The key supply chain risks are known and documented	35	3.50	1.14
The process of risk management all inclusive	35	3.41	1.05
The risks in the supply chain are profiled as high, medium & low	35	3.53	1.02
Risk awareness culture has been natured in the organization	35	3.49	1.04
The organization maintains buffer stocks	35	3.66	0.84
Inventory is only maintained for long-lead time, single sourced & critical items	35	2.83	0.86
The buffer stocks are maintained within the confines of minimizing stock holding cost	35	2.46	0.82
The company identifies the potential supplier disruption reports during vendor appraisals	35	2.66	1.06
The company undertakes continuous supply chain performance audits(quality, cost, delivery)	35	2.77	0.97
The company demands to see a proof of business continuity plans before award of business	35	2.74	1.02
The company maintains a backup supplier	35	2.79	0.96
The company has in place a capacity reservation contract (a secondary supplier guarantees amounts delivered up to the reserve capacity)	35	1.82	0.90
The backup supplier is picked in such a way as to avoid “share of similar disruption risk.”	35	1.91	1.15
The supply chain contingency planning is a critical element of the Business contingency planning.	35	2.80	1.26
The plan contributes to loss minimization, safeguarding assets and risk mitigation.	35	2.97	1.04
The company considers insurance as a key means of mitigating supply chain risks.	35	4.09	0.70
The unforeseen insurable risks are constantly reviewed and insured.	35	3.43	0.85
Recent cases of disruptions arising from insurable risks were adequately compensated.	35	3.51	0.82

Source: Research Data (2014)

From the result the practices listed above are practiced by the firms under study to a varying extent. None of these practices have been adopted to a very great extent. However, documentation of the key supply chain risks, profiling of supply chain risks as high, medium & low, nurturing of a risk awareness culture, maintenance of buffer stocks, adoption of insurance as a key means of mitigating supply chain risks and adequate insurance compensation in the past cases of losses have been practiced to a great extent ($3.5 \leq \text{Mean} \leq 4.4$) with a fairly low standard deviation showing a low degree of variance within the responses except for indicator about knowledge and documentation of the key supply chain risks. The indicators on having long term collaborative relationship, collaboration in areas of risk sharing, existence of a high degree of trust, inclusiveness of the risk management process, maintenance of inventory of critical, long lead time and single sourced items, maintenance of buffer within the confines of minimal stock holding, supply chain performance measures, determination of past disruption cases during appraisals, assessments of the business continuity plans during appraisals, back up supplier arrangements and continuous review of the insurable risks have been adopted to a moderate extent ($2.5 \leq \text{Mean} \leq 3.4$). In addition the degree of variance between the responses to a large extent shows the existence of a significant level of variance in perception among the respondents. Indicators to measure whether or not the company has in place a capacity reservation contracts and if back up suppliers are picked in such a way as to avoid disruptions within a locality were seen to have been adopted to a very small extent.

The factors in table 1 above were too many and therefore a factor analysis was necessitated to reduce them to a manageable number. The supply chain risk management practices rotational component matrix was used and the results are in figure 1 and table 2.

Figure 1:Scree Plot



Source: Research Data (2014)

Factor analysis conducted on 22 different indicators of the supply chain risk management practices. The scree plot shows that 11 of those factors explain most of the variability because the line starts to straighten after the 12th and 16th factors. The remaining factors explain a very small proportion of the variability and are likely unimportant. The plot picks out four categories of factors.

Table 2: Supply Chain Risk Management Practices Coded

The company treasures a long term collaborative relationship with its key suppliers.	R1
The firm and its key suppliers collaborate in the areas of sharing risks.	R2
There exist a high degree of trust between the firm and its key suppliers.	R3
The existing level of trust & collaboration supports responsiveness and leanness in the supply chain.	R4
The key supply chain risks are known and documented	K1
The process of risk management all inclusive	K2
The risks in the supply chain are profiled as high, medium & low	K3
Risk awareness culture has been natured in the organization	K4
The organization maintains buffer stocks	RS1
Inventory is only maintained for long-lead time, single sourced & critical items	RS2
The buffer stocks are maintained within the confines of minimizing stock holding cost	RS3
The company identifies the potential supplier disruption reports during vendor appraisals	SCA1
The company undertakes continuous supply chain performance audits(quality, cost, delivery)	SCA2
The company demands to see a proof of business continuity plans before award of business	SCA3
The company maintains a backup supplier	B1
The company has in place a capacity reservation contract (a secondary supplier guarantees amounts delivered up to the reserve capacity)	B2
The backup supplier is picked in such a way as to avoid “share of similar disruption risk.”	B3
The supply chain contingency planning is a critical element of the Business contingency planning.	SCC1

The company considers insurance as a key means of mitigating supply chain risks.	SCR1
The unforeseen insurable risks are constantly reviewed and insured.	SCR2
Recent cases of disruptions arising from insurable risks were adequately compensated.	SCR3

Source: Research Data (2014)

Table 3: Supply chain risk management practices Rotated Component Matrix

Rotated Factor Pattern	Factor1	Factor2	Factor3	Factor4	Factor Name
B3	0.9081	0.0481	0.1597	-0.0067	<i>Supply Chain Risk Management Practice No. 1</i> Backup Supplier Arrangements, Risk Awareness & Long-term Collaborative Relationships
B1	0.8457	0.2770	0.0322	0.2355	
K2	0.8385	-0.0312	-0.0743	-0.0468	
K4	0.7322	0.2039	0.4380	0.0849	
R3	0.6957	-0.1063	0.2622	0.2257	
B2	0.6956	0.2070	0.1370	-0.0187	
R4	0.6751	-0.2313	0.2825	0.3952	
K3	0.6679	0.1901	0.2312	0.0138	
K1	0.5691	0.4159	0.1581	0.0670	
SCA3	0.5573	0.0163	0.1499	0.5280	
SCC1	0.5550	-0.3551	0.5238	-0.0083	
SCA1	0.3398	-0.0091	-0.1983	0.3279	
SCR3	0.0615	0.9228	0.2265	-0.1128	
SCR2	0.2985	0.7014	0.2056	0.0721	
RS2	-0.0859	0.5283	0.3379	0.3158	
RS1	0.0403	0.4124	-0.0843	-0.0515	<i>Supply Chain Risk Management Practice No. 3:</i> Supply Chain Contingency Planning And Buffer Stock Regime
RS3	0.1518	0.3890	0.8040	0.1877	
SCC2	0.2885	-0.1874	0.7578	-0.2095	<i>Supply Chain Risk Management Practice No. 4:</i> Supplier Performance Audits
SCR1	0.0794	0.2065	0.5883	0.0281	
R2	0.4532	0.1712	0.5047	-0.2337	
SCA2	0.1389	0.4688	0.0104	0.8687	
R1	-0.0148	-0.2200	-0.0521	0.3917	

Source: Research Data (2014)

Supply Chain Risk Management Practice No. 1: Backup supplier arrangement & Risk awareness. Maintenance of back-up supplier and the practice of picking the supplier in such a way to avoid supply chain disruption is strongly correlated to disruptions control in the power sector firms this is because contracts with back-up suppliers help insure the company against disruptions in the flow of raw materials in situations of delayed or non-supply from the primary supply source. While selecting the back-up suppliers, the necessary condition is that the supplier must not be exposed to the same share of disruptions sources as the primary supplier, this study result is in agreement with Wilson (2007) who indicated that the backup approach works best if the selection of the extra supplier is made in such a way as to avoid the “share of common risks among the two sets of suppliers”. Further, the analysis points out the critical position of risk awareness as a key contributor to supply chain disruptions control. In order to mitigate supply chain disruption it is important to profile the supply chain risks and to assess them with regard to their likelihood and impact, the study agrees with the position of Hallikas et al.(2004) that improved understanding of risks in the supply chain helps in making better mitigating decision not only within the organization but also within its network. The implementation of back up supplier arrangement requires the organization profile its purchases on the basis of spends and exposures in terms of supply

source, complexity of the item being purchased, its availability within the market & lead times. Critical items would be those that are associated with high spends & a great propensity to stop the core organization's operational activities. A policy on source identification should be developed to mitigate against the possibility of supplier failure from both sources. As for risk awareness, sensitization training and inculcation of a risk conscious culture of wider supply chain staff is recommended.

Supply Chain Risk Management Practice No.2: Transfer of supply Chain Risk through Insurance. While many risk management practices are premised on either tolerating or treating risks, insurance focuses on transferring risks to a third party provider. The study provides a pointer to the fact that insurance is a key safeguard to supply chain disruptions control. Insurance therefore provides an approach of spreading the risks through insurance covers. Power sector firms are vulnerable to disruptions sources such as thefts of critical and high cost installations, fire, or in transit supplies. As shown in the study outcome it is important the insurable risk profiles are regularly reviewed and updated. Insurance compensations have judged as common for incidences like vandalism, theft, fire outbreak and cases of accidents and death of employee within the value chains. Such compensations have greatly reduced the would be financial losses, reputational exposures and a large extent ensured business continuity.

Supply Chain Risk Management Practice No. 3: Buffer Stock Arrangement and Supply Chain Contingency Planning. Power sector firms use a wide range of equipment, parts, component parts and consumables. The day to day operations of the firms in this industry would be network expansion and infrastructure maintenance. To a large extent the maintenance comes up as an emergency which can be very disruptive. The study points out that buffer stock arrangement has a strong correlation with supply chain disruptions control, this position is supported by Krause and Hanfield (1999) that maintaining redundant stocks is an effective and economical strategy for reducing supply side risks since stocks give slack in supply chain. The buffer stock arrangement is however, advised for items that have a low holding cost, long lead times, single-sourced and stocks that are not prone to being outdate as pointed to by (Wilson, 2007). Supply chain contingency planning is another practice that is seen to contribute strongly to disruptions control from the outcome of the analysis. The aim of the supply chain contingency planning is to minimize potential loss by identifying, prioritizing and having in place measures to reduce the organizations exposure in the event of a disruption or a disaster. This study is in support of the views of Rice and Caniato (2003) that supply chain contingency planning is about developing a plan to be resilient to unexpected disruption. A properly prepared contingency plan should thus detail a timely and complete response to a specific risk or a cluster of risks.

Supply Chain Risk Management Practice No. 4: Supplier Performance Audits. Continuous supply chain performance audits has been identified was also identified as a key supply chain disruptions control. A well-established quality control process should decrease the exposure to the supply chain risks by allowing better and faster ways of identifying the possible causes of disruptions, reducing the frequency of exposures and avoiding the propagation of problems within the supply network. It is also expected that regular performance audits give suppliers an opportunity to work on their weak points before disruptions occur. The practice of the future will be to have a proof that a business is prepared for trouble before any major contract is effected. The practice of supplier performance audit or vendor rating should therefore be carefully thought through, properly structured and the correct methodology applied. In the public sector generally and specific to the firms under study the practice has not been fully integrated, besides, the outcome of this important process has not been used to inform future sourcing. This explains why cases of delayed delivery, non-supply and quality failures are considered normal occurrences. Successful implementation of the practice is key to the future of a fool proofed supply chain within the public sector power firms and generally to other organizations.

Extent of Supply Chain Disruptions

Supply chain disruption is a combination of an unintended, anomalous triggering event that materializes somewhere in the supply chain or its environment, and a consequential situation which significantly threatens normal business operations of the firms in the supply chain. The study sought to establish the extent to which the firms studied had experienced any of the seven common forms of supply chain glitches in the last 10 years, consideration was given to the fact that one of the participating firms had been autonomous for less than 10 years but their experience in the last 6 years was deemed relevant to the study objective of determining the extent of disruptions in the power sector firms' supply chain. Respondents were asked to indicate the extent to which their firms have experienced supply chain disruptions. Five-point Likert-type items were used to operationalize all constructs. All items were scored so that higher numbers reflect increases in the underlying constructs. The results are as shown in in table 4.8 below.

Table 4: Extent of the supply chain disruptions

Forms of disruptions	N	Mean	Std. Dev.
Critical stock outage	35	4.00	0.84
Fire outbreak	35	3.26	0.86
IT system breakdown	35	3.17	0.86
Loss of key supply chain personnel	35	2.57	0.88
Loss of critical stocks	35	3.60	0.74
Reputational damage	35	1.94	0.67
Environmental disruption	35	2.62	0.92

Source: Research Data (2014)

According to the research results provided above, all the firms studied had experienced supply chain disruptions but to a varying extent. While none of these disruptions forms have been experienced to a very great extent ($4.5 \leq \text{Mean} \leq 5.0$) and to Very Small Extent ($1.0 \leq \text{Mean} \leq 1.4$). The most incidences of disruption are stock out of critical stocks and loss of critical stocks whose occurrence have been to a great extent ($3.5 \leq \text{Mean} \leq 4.4$) and the magnitude of the standard deviation indicate that variance in the respondents perception on the two aspects of disruptions are very small.

The result further indicate that to a moderate extent ($2.5 \leq \text{mean} \leq 3.4$) the firms have experience fire outbreak, IT system outbreak, loss of key supply chain personnel and environmental disruptions. Finally, it is evident that the firms have experience reputational damage to a small extent. The implication of the research findings are that power sector firms are exposed supply chain disruptions, the key disruption being those associated with materials availability. As a consequence attention and resources should be allocated to mitigate these risks. Other risks such IT system breakdown, fire outbreak and environmental disruptions are moderately common but catastrophic and so a proactive control regime should be implemented.

Relationship between Supply Chain Risk Management Practices and Power Supply Disruption Control

The study sought to investigate the relationship between Supply chain risk management practices (independent variables) and disruptions control (outcome variable) in the electric power. Disruptions had 8 dimensions: Critical stock outage; Fire outbreak; IT system breakdown; Loss of key supply chain personnel; Loss of critical stocks; Reputational damage and Environmental disruption. The supply chain risk management practices are the determinants of the disruption control.

Table 4.8 shows the p-values for each model above. In all the models, all 8 independent variables were included and therefore the result below does not consider a parsimonious model. Using a significance

level of 5%, co-efficients having p-values less 5% are considered significant. The only variable that has shown significance in the 8 models considered is ‘Redundant Stock arrangement’ (p-value = 0.038) for *Loss of critical stock disruption*. In this model that the percent variability (adjusted R-square) explained by the regression model is 63.8%. The unexplained variation is 36.2%, which implies that there are some factors not covered in the study that are responsible for the remaining variation in the model. The other determinant that was approaching significance is the ‘Transfer of supply chain risks through insurance’ with a p-value of 0.0716 and a variability explanation for model of 27.7%.

Table 5: P-values of disruptions models

SC Risk Management Practices	p-values for the disruption models						
	Critical Stock Outage	Fire Outbreak	IT System Breakdown	Loss of Key SC Personnel	Loss of Critical Stock	Reputational Damage	Environmental Disruptions
Intercept	0.131	0.289	0.0278	0.051	<0.0001	0.093	0.195
Relationships	0.760	0.191	0.701	0.278	0.103	0.241	0.796
Knowledge	0.807	0.145	0.534	0.545	0.926	0.728	0.357
Redundant Stock	0.943	0.993	0.315	0.950	0.038	0.914	0.335
Supplier Capacity Assessment	0.734	0.811	0.359	0.599	0.201	0.774	0.694
Supplier Backup	0.411	0.870	0.906	0.873	0.309	0.570	0.767
Contingency	0.736	0.880	0.141	0.152	0.586	0.116	0.380
SC Risks	0.938	0.755	0.072	0.097	0.272	0.203	0.799

Source: Research Data (2014)

The ANOVA results (Table 6) of the model for ‘Loss of critical stock disruption’ has a p-value of 0.0063 which is an indication a highly statistically significant full model. This model is suitable model for explaining the relationship between the 8 supply chain risk management practices and Loss of critical stock as a dimension of disruption control.

Table 6: The ANOVA model/ Analysis of Variance

Source	DF	Sum of Squares	Mean square	F Value	Pr > F
Model	7	14.59294	2.08471	5.53	0.0063**
Error	11	4.1439	0.37672		
Corrected Total	18	18.73684			

Source: Research Data (2014)

The multiple regression models for this study on relationship between supply chain risk management practices and power supply disruption control had a general form of:

$$\text{Supply Disruption Control} = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 +$$

Where:

Disruption was specified and measured using any of the following: Critical stock outage; Fire outbreak; IT system breakdown; Loss of key supply chain personnel; Loss of critical stocks; Reputational damage and Environmental disruption

From the results, the fitted regression models on the relationship between supply chain risk management practices and power supply disruption control are:

Critical Stock Outage = 3.73+ 0.19 Long Term Collaborative Relationships +0. 11 Knowledge About Risk+ 0.33 Redundant Stock Arrangement + 0.13 Supplier Capacity Assessment And Qualification Screening- 0.40 Back Up Supplier Arrangement - 0.11 Supply Chain Contingency Planning + 0.03 Transfer Of Supply Chain Risks Through Insurance

Fire Outbreak = 2.46 - 0.83 Long Term Collaborative Relationships +0. 69 Knowledge About Risk - 0.004 Redundant Stock Arrangement + 0.09 Supplier Capacity Assessment And Qualification Screening- 0.08 Back Up Supplier Arrangement - 0.05 Supply Chain Contingency Planning + 0.16 Transfer Of Supply Chain Risks Through Insurance

IT System Breakdown = 3.80 - 0.16 Long Term Collaborative Relationships +0.19 Knowledge about Risk - 0.31redundant Stock Arrangement + 0.24supplier Capacity Assessment and Qualification Screening+ 0.04back Up Supplier Arrangement + 0.34supply Chain Contingency Planning - 0.69 Transfer Of Supply Chain Risks through Insurance

Loss Of Key Personnel = 4.41 + 0.62 Long Term Collaborative Relationships +0.25 Knowledge About Risk - 0.02redundant Stock Arrangement - 0.18supplier Capacity Assessment And Qualification Screening+ 0.06back Up Supplier Arrangement - 0.44supply Chain Contingency Planning - 0.85 Transfer Of Supply Chain Risks Through Insurance

Loss Of Critical Stock = 9.09 – 0.61 Long Term Collaborative Relationships - 0.02 Knowledge About Risk - 0.59redundant Stock Arrangement + 0.29supplier Capacity Assessment And Qualification Screening- 0.28back Up Supplier Arrangement - 0.10supply Chain Contingency Planning - 0.34 Transfer Of Supply Chain Risks Through Insurance

Reputational Damage = 3.23 – 0.58 Long Term Collaborative Relationships + 0.12 Knowledge About Risk - 0.03redundant Stock Arrangement + 0.09supplier Capacity Assessment And Qualification Screening+ 0.21back Up Supplier Arrangement + 0.42supply Chain Contingency Planning + 0.56 Transfer Of Supply Chain Risks Through Insurance

Environmental Disruption = 2.41 – 0.12 Long Term Collaborative Relationships + 0.33 Knowledge about Risk - 0.34redundant Stock Arrangement + 0.11supplier Capacity Assessment and Qualification Screening- 0.11back Up Supplier Arrangement - 0.22supply Chain Contingency Planning - 0.11 Transfer Of Supply Chain Risks through Insurance

In particular documentation of the key supply chain risks, profiling of supply chain risks as high, medium & low, nurturing of a risk awareness culture, maintenance of buffer stocks, adoption of insurance as a key means of mitigating supply chain risks and adequate insurance compensation in the past cases of losses have been practiced to a great extent. Long term collaborative relationship, collaboration in areas of risk sharing, existence of a high degree of trust, inclusiveness of the risk management process, maintenance of inventory of critical, long lead time and single sourced items, maintenance of buffer within the confines of minimal stock holding, supply chain performance measures, determination of past disruption cases

during appraisals, assessments of the business continuity plans during appraisals, back up supplier arrangements and continuous review of the insurable risks have been adopted to a moderate extent. While capacity reservation contracts and if back up suppliers are picked in such a way as to avoid disruptions within a locality were seen to have been adopted to a very small extent. As for the extent of supply chain disruption measured over the period covering the last ten years, the study established that all the firms studied had experienced supply chain disruptions but to a varying extent. While none of these disruptions forms have been experienced to a very great extent, incidences of disruption are stock out of critical stocks and loss of critical stocks has been experienced to a great extent. To a moderate extent the firms have experience fire outbreak, IT system outbreak, loss of key supply chain personnel and environmental disruptions while the firms have experience reputational damage to a small extent. The implication of the research findings are that power sector firms are exposed to supply chain disruptions, the key disruption being those associated with materials availability. As a consequence attention and resources should be allocated to mitigate these risks.

Other risks such IT system breakdown, fire outbreak and environmental disruptions are moderately common but catastrophic and so a proactive control regime should be implemented. As for whether there is a relationship between supply risk management practices and disruptions control. The study points out that only redundant Stock arrangement has shown significance to loss of critical stock disruption. The other practice that was approaching significance is the transfer of supply chain risks through insurance. The rest of the practices are more certainly adopted but not with the view of risk management but as supply chain practices. This fact clearly points out the fact that supply risk awareness in the power sector firms in the public sector is just taking off. It is equally noteworthy the practices listed in this study as supply chain risk management practices are initially supply chain practices, what takes them to the level of risk management is the inculcated risk awareness culture.

Conclusions

The aim of research study was to establish the extent to which various supply chain risk management practices adopted by the power sector firms in Kenya contributes to disruptions control. The study indeed established that all the supply chain risk management practices examined in the study were all adopted by the power sector firms but in varying extent. The study concludes that respondents are aware of the supply chain risk management practices adopted by the power sector firms in Kenya. Further, the study indicates that the common forms of supply chain disruption in the power sector firms are those that affect availability of stocks. Other aspects of disruptions such as fire outbreak, IT system breakdown, loss of key staff and reputational damages have been adequately mitigated by the organizations. Finally, the study indicates that not all the practices studied here are adopted with the view of managing supply chain risks but rather as supply management practices. Only redundant stock arrangement and transfer of supply chain risks through insurance are viewed in terms of supply chain risk management approaches, other practices are viewed in terms of general routine supply chain management practices.

Limitations and Suggestions for Further Study

From the finding, it is clear that power sector firms should invest more on the aspects of supply risks that affect stock availability since this is the most prevalent source of supply chain disruptions. It is also recommended that power sector players should embed a risk management culture in their day today supply chain management practices. Finally, the power sector firms should recognize environmental disruption sources as the invisible but potent source of catastrophic disruption that must be mitigated proactively. A set of limitations were significantly important in the result that were obtained in this study:-The study targeted the 5 electric power firms located within Nairobi County. However 2 of the firms indicated their unwillingness to participate. The study conclusions were based on those that participated; this could have been a limitation to more conclusive results if all the 5 firms would have participated. Time was not enough to conduct a survey of all electric sector firms in Kenya. This explains why the researcher settled on the

survey of the firms within Nairobi County. These findings were based on the research data generated by three state corporations who are the leading firms in electric power generation, transmission and distribution. Thus findings are limited to the public sector firms and can only be applied to a limited scale in a private sector environment.

In actual sense, no research is exhaustive to an end. This research gives an opportunity for future scholars to carry out further findings for improvement. There is need to undertake a similar research but using secondary data or oral interview technique to be able to establish if indeed the other practices ruled as significant by this study are indeed not factors to enhance disruption controls. The supply chain risk management practices provided here have been qualitative in nature; future research should focus on quantifying the costs and benefits of the practices to business. Further, the research has basically given an outline of practices, extent of disruptions and the relationship between disruption and adoption of the risk management practices, future researchers should explore the how best the practices can implementation to ensure that supply chain disruption is managed.

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