CAPACITY PLANNING PRACTICES AND OPERATIONAL PERFORMANCE OF MAJOR HYDROPOWER STATIONS IN KENYA

BY

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DECLARATION

This research project is my original work and has not been submitted for the award of any degree in any other University.

Signed …… Date.....

Isaac MwangiNdegwa

D61/79312/2015

This research project has been submitted with my approval as a University Supervisor

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DEDICATION

This study is dedicated to my family and the Kenya Electricity Generating Company and affiliated hydropower generating stations.

ACKNOWLEDGEMENT

I wish to acknowledge my supervisor ZiporahKiruthu for her guidance throughout the process of writing the project.

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LIST OF ABBREVIATIONS

ACP	Aggregate Capacity Planning
ERP	Enterprise requirement plan
JICA	Japanese International Cooperation Agency
JIT	Just in time
KENGEN	Kenya Electricity Generating Company
KENTRACO	Kenya Electricity Transmission Company
KPC	Kenya Power Company
KV	Kilo Volts
MPS	Master Production Schedule
MRP1	Material Requirement Plan
RCCP	Rough Cut Capacity Planning
TOC	Theory of constraints
MW	Mega Watt

ABSTRACT

Capacity is key in any decision about product or services offered by any organization. No activity in business can occur without resources, since the quality of output largely depends on the management of resources engaged in operations. Capacity planning is concerned with the capacity of an entity with the demand. The study sought to establish the relationship between capacity planning practices and the operational performance of the major hydropower generating stations in Kenya. To facilitate generalization of the research findings, all the hydropower generating plants a descriptive survey was conducted. The study was a census that involved all the 10 major hydropower stations in Kenya. One chief engineer and one operations manager per hydro station were interviewed. Data collected from the respondents was to determine the capacity planning practices used in the hydropower stations and their influence on operational performance. The study findings revealed that majority of the respondents reported that strategic planning through evaluation of the overall capacity level for capital intensive resources that best supports the organization long range competitive strategy (personnel skills mix, plants, equipment or facilities and space) is adopted at a very high extent in their respective organizations with a mean of (M = 4.75; SD = 0.444). Also, other respondents reported that Aggregate Capacity Planning through determining capacity adjustment strategies in response to demand fluctuations and capacity forecasting through estimation of expected market demand are adopted at a very high extent with a mean (M = 4.60; SD = 0.883) and (M = 4.55; SD = 0.510) respectively.

CHAPTER ONE

INTRODUCTION

1.1 Background ofthe Study

In business a firm's competitiveness depends on its capability to change and adopt new strategic orientations and this has been attributed to successful firms that changedin order to survive(de Azevedo,Meinz,& Luis 2014).Ability to change is fundamental in the acquisition of competitive advantageand survival in the face of fierce global competition. Darlan (2012), identified labor, assets, reliability, quality management systems, lean practices, innovation, capacity management, production techniques, customer relations, communications technology, flexibility, delivery speed, and social responsibility asthe factors defining competitiveness both for manufacturing and service industries.

The Capacity of a production system influences the competitive power of a businessbecause it determines a the market response rate of an organization,the nature of itscosts, human resource mix, technological level,managementand its inventory levels. Capacity management is therefore the key planning role of every operations manager because the rest of the operations planning activities are based on decisions about capacity(David,Alexander,&Amedeo,2017).Managing capacity is therefore concerned with ensuring a balance between the capacity of a system and the output demanded of the system(Bloeman& Meass,2016)

Ottavio,Verdatt,and Morty(2017) define capacity as the total resources at the disposal of a firm to support its production. On the other hand they aver that capacity planning is concerned with defining the capacity level that will meet the market demand cost efficiently.Achieving competitiveness is an integrated approach involving all operations management practices that aim at improving speed of operations, managing costs, enhancing flexibility to respond to different market demands, embracing the quality culture and cultivating goodwill by being dependable. All that aims at delivering value to customers to achieve differentiation in the market(John& Keith,2010).

1.1.1 CapacityPlanning Practices

Capacity is the capability of a manufacturing or service entity's resources such as a facility, process, workstation, equipment or manpower to serve its purpose at a given time.(Mennezes, 2011).However,Christopher (2013) defines capacity from both the output and input perspective as the maximum output rate of a facility or the amount of input resources available to produce a relative output over a period of time.Location, layout, systems and processes impact on an organization's capacity

Capacity planning is concerned with determining the amount ofthose resources needed by a firm to meet the changing demand patterns (Younis, 2014). Any variation positive or negative between an organizations capacity and customers demand results to idle resources or unmet customersorders; this is what is meant

by inefficiency. Capacity planning therefore is meant to address this deviation.(Kalim, 2013).In operations management there are various capacity planning practices adapted by firms, be they in manufacturing or service. They include strategic or rough cut capacity planning, aggregate capacity planning, finite capacity planning also known as production scheduling and capacity forecasting (Dekkers&Kannagi, 2012).

1.1.2 Operational Performance

Operational performance means organizational aspectsthat can be evaluated against some predefined indicators of performance (Gregory, 2015).It is an indicator of the extent to which an organization efficiently and effectively produces its output; and the extent to which the output meets customers' needs. Cost, speed, quality, reliability, innovation,flexibility and customer relations are the commonly used metrics in measurement of operational performance(Benard, 2016). In operations management, these metrics are also viewedas the drivers of operational competitiveness (Younnis, 2014).Measuring Operational performance is an important task in operations management because according toBennadette(2015) performance measurement results allow organizations to realign their systems and processes to the operations strategy once deviations from the desired performance are exposed. It acts as the basis of organization improvement.

1.1.3 Capacity Planning Practices and Operational Performance

Capacity is at the centre of any decision managementmakes. According to Meredith and Scott (2002) planning capacity ensures that operating costs are maintained at as low as possible without compromising quality. This occurs when right inventory policies are guided by demand forecasts, minimizing carrying costs coupled with deploying adequate and right technology and manpower to minimize waste from errors and idle time. Planning capacity helps organizations remain competitive and achieves their growth plans due to the capability to control costs, achieving flexible capacity that matches demand such that no profit making opportunities are lost or overproduction costs incurred. This further leads to shortened lead times and speedy customer delivery (Vollman, Williams, &Whyback, 2005).

1.1.4 The Major HydropowerStations in Kenya

Hydropower is among one of the earliest recognized national resources and dates back to early 1920s. Early systems were all small hydropower firm comprising micro hydros and mini hydros. The Tana's seven forks falls was identified in 1914 as a potential area for power development. However, the scale and size of the plant waited for over fifty years to be developed with Kindaruma being developed in 1968, Kamburu in 1973, Gitaru in 1978, Kiambere in 1988,Turkwel and Sondu Miriu in 1990 (energy.go.ke./hydropower). Upon it's formation in 1997,Kengen a public limited company assumed the role of power generation in Kenya which accounts for 75% of the installed ellectricity capacity in Kenya. All

the 14major hydropower stations are therefore operated by Kengen. Hydropower is the leading source of electricity accounting for 41% of Kengen installed capacity or 881 MW,(http://www.kengen.co.ke/?q=content/hydro-power-stations).

1.2 ResearchProblem

The issues concerning capacity in the major hydropower generating stations in Kenya is an agenda for the policy makers in the energy ministry. Considering the massive government investments in the energy sector there is need to evaluate how effectively these resources are being utilizedby examining the reliability and efficiency of the hydropower stations in Kenya.

Astudy by Dekkers and Kannagi(2012) evaluated the practices for strategic capacity management in Malaysian manufacturing firms where they sought to investigate whether thestrategic capacity management concept involves an alignment of production capacity with the strategic direction. The study found that development of adequate manufacturing capacities that match the strategic objectives is at the heart of competitive advantage for firms. In Nigeria Garba,Ogbadu and Ademola(2012) studied capacity planning and it's implication on infrastructural development needs of institutions of higher learning in Nigeria. The study found out that absence of capacity planning both by the government and institutions concerned resulted to shortages of infrastructure needs in the institution.

In Kenya various studies have been done on capacity management.X.NIraki(2014)did a study onCapacity Utilization: The Forgotten Secret to Trading out Poverty. Theresearcher found that the role of capacity utilization driven by capacity planning as an ingredient to sustainedlong-term economic growth has been forgotten or ignored. Nations and firms can achieve more growth by using what they already have if they focused more on capacity planning and utilization but this is an area in the capacity management that is usually under emphasized by scholars and writers in spite of the significance of the two concepts in organizational performance (Moenga, 2017).Though these studies they offereda lot of insights on capacity,there was no evidence of any study on capacity planning practices focusingon the hydropower generating plants. This study intended to link capacity planning practices to the efficiency in operationsof the Kenya hydropower generating stations by seeking answers to the following questions; which capacity planning practices are adapted by the major hydropower generation stations in Kenya and what is the relationship between the capacity planning practices andoperational performance of these entities.

1.3 Research Objectives

The study was guided by the following objectives;

i. To establish the capacity planning practices adapted by firms in the major hydropower generation stations in Kenya.

ii. To determine the relationship between capacity planning practices and the operational performance of the majorhydropower generation stations in Kenya.

1.4 Value of the Study

The study is valuable to the power stake holders in Kenya like KENGEN, Rural electrification authority (REA),Kenya Power Company,and the Energy Regulatory Commission (ERC), who are collectively the implementing agents of the power policy in Kenya. The study will helpthem appreciate the benefits that result from managing the resources at their disposal that include equipment, manpower and space. The implementing authorities will also have some insights into the various ways of achieving a balance between capacity available and power demand.This will ensure reliable and affordablepower generation and distribution to support the country's drive towards the vision 2030. The study is of significance also to government of Kenya through the energy ministry that is mandated to ensure increased power connectivity nationally. The findings are of value to Kenya development partners including the World Bank and JICA. They will be able to prioritize their funding by financing those projects that have the greatest impact towards Kenya's development agenda

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews both theoretical and empirical literature relevant to the study. The relationship of the study main variables will thenbe summarized by a conceptual framework.

2.2 Theoretical review

2.2.1 Theory of Constraints

The theoryis ideal for improvement of the processes that are resource constrained. Conceived by Goldart andCox(1992) the theory seeks to identify the factors that negatively affectthe performance of a system and eliminates them to improve performance(Stefafaud, 2017).The logic of the theory is that in every system there is /are constraint(s) that negatively affects performance. Management must seek to identify the constraint and to systematically improve it until it is no longer a constraint, (Stefaud, 2017).

Within the context of global competition TOC views organizations as systems comprising of links in a chain. As a management philosophy TOC focuses on the weak links in the chain with the goal of improving the system performance.TOC views those links in the chain as interdependent rather than autonomous, seeks to identify the bottleneck links in the chain, establish their relationships, and turns them round in order to improve company performance (Aguilar, 2014). The

theory will guide the researcher in determining how capacity planningcan be used in the deployment of resources to unsure a match between the capacity of a system and its demand to ensure efficient operations.

2.2.2 Resource Based Theory

Developed in mid 1980s by Wernerfelt, Rumelk, and Burney the theory holdsthat resources are the basis upon which firms compete (Bridout, 2010). The resources however must be deployed if they are to confer competitive advantage (Mweru,&Muya, 2016).In general, the theory explains how resources internal to the firm drive competitive advantage for the firms.These resources tangible and intangible should be difficult to imitate to lead to distinctive competitive advantage.Tangible resources include premises,equipment,inventory and financial resources while intangibles are personnel, patents, technology goodwill and corporate culture. Resource based view appreciates he need for planning the deployment of the available capacity to avoid over or under resource allocation and drive competitiveness. The theory will aid the researcher in appreciating how capacity can be used to drive distinctive performance by firms.

2.3Capacity Planning Practices

Capacity planning practices occur in a hierarchical manner within the organization structure; at the top management, departmental and shop floor levels.

2.3.1 Strategic Capacity Planning

Strategic capacity planning is concerned with determination of long-term capability of a production system in terms of size and scope ranging between 3-10 years. It is concerned with resources that are capital intensive,those that take long to deploy and are critical to business operations like equipment,technology,plants, warehouses size and location, supplynetworks outsourcing decisions. Owing to the sensitive nature of the plan it occurs at the top management level involving all departmental heads(Dekkers&Kannagi, 2016).Otavio and Morty(2017) state that strategic capacity planning is concerned with managing that total capacity of resources of an organization with the goals of balancing total available capacity and overall forecasted demand in a cost effective manner, in the long term. De Azevedo et al., (2014) state that the strategic capacity plan links operations with corporate strategy since it seeks to operationalize the operations strategy through ensuring availability of resources necessary for implementation of the strategy.

According to MainaandMuya (2011), Strategic capacity plan is a quick way of evaluating if the master production schedule is achievable. It aids the master schedulers in evaluating the feasibility of any changes to the plan by comparing the work load and system bottlenecks. Lawson (2011) avers that rough cut capacity planning reveals resources shortages, any constrains on lead time, and any other capacity issues that can contribute to the development of a production plan and a master productions schedule which can be implemented successfully. Strategic capacity planning therefore facilitates testing the validity of both the

production plans and the MPS prior to any capacity planning exercise. The scholar avers that in addition strategic capacity planning guides any decision on mid and long range adjustments to capacity.

2.3.2Aggregate Capacity Planning

Aggregate capacity planning also known as sales and operation plan is 3-18 months is a medium term planning occurring at the corporate level. It focuses on an individual product by product, business unit or a product family. Thomson (2012) avers that aggregate capacity plans are about how much and when to produce in order to match sales to demand forecasts.Darlan(2012) looks at it differently; that it is a management decision concerning production rates, levels of work force,inventory investments taking into account customers' needs and capacity limitations. It is meant to determine the quantity and timing of production for the shortterm.By itsnature it is crossfunctional integrated with the general management, sales, operations and finance; Moreso with finance the relationship is stronger since budgets are based on aggregate output, human resource levels, procurement projections and inventory levels (Dekkers&Kannagi, 2012).

According to Jaafaru et al., (2012), aggregate planning aims to develop a production plan that will ensure effective utilization of the resources of an organization to meet the forecasted product by product demand with the objective of linking the company strategic plans to the operations processes. Aggregate

planning determines the overall organizations output levels, product by product planned, through the master production schedule and the overall resources requirement using the material requirements plan guided by the sales projections. It provides a link between facilities planning and scheduling. Facilities planning involves determining of the physical capacity that aggregate planning should not exceed. On the other hand scheduling is concerned with the allocation of available resources to jobs and orders or work stations.

As a medium term measure aggregate planning seeks to influence both demand and supply(Wairimu, 2014). Demand can be influenced through pricing, promotions, backlogging or reservations and the development of complementary products. On the other hand supply can be influenced through layoffs, using overtime and under time, part time workers, casuals, holding inventory, sub constructing and capacity sharing (Certan&Koren, 2014).In an effort to achieve capacity balance, aggregate capacity planners have a range of level workforces strategies whereby any variations in demand are met by either sub-contracting, holding inventories, part time workers, overtime and backordering (Kauda&Ebo, 2015). Neely(2012) holds the view that when a fixed output rate is maintained, any demand variations are met by holding inventories as buffer, sub-contracting or back ordering. On the other hand matching capacity to demand involves introducing exactly what has been ordered. This is similar to the JIT concept. A blend of these twostrategies would conveniently be the option.

2.3.3 CapacityScheduling

Capacity scheduling is short range, shop floor day to day capacity planning activity concerned with understanding how much work can be produced by a facility in a given time and allocating resources in the light of prevailing resource constraints, with the objective of ensuring that operations run at a uniform and efficient manner throughout an organization (Otavioet. al., 2017).Hallgram (2013) state that scheduling is an important in operations as itinvolves short-term planning as a part of the overall production planning. Operation schedules are therefore short-term plans designed to implement the sales and operations plans.

Johnson (2014) avers that there is need for careful and well thought out scheduling because if schedules are not carefully planned bottlenecks and waiting queues of customers waiting to be served in a service center, unmet orders or increased work in progress inventory , are the result. Well thought out production schedules act as sources of competitive advantage resulting from improvedeficiency of operations management and greater customer satisfaction (Wairimu, 2014).This according to the scholars result to the ability to supply orders on agreed due date (delivery reliability) and the capability to deliver faster than competitors (delivery speed).To compete his way firms need flexible manufacturing processes that can quickly respond to the customer requirements.

Dewa, Mhlanga, Masiyazi&Museka(2013) state that manufacturers face various constraints like resource shortages and unpredictable events, materials unavailability and a instances of machines break downs. This delays the production of orders expected by customers and compromises service level**.** Job orders should therefore be scheduled so that available capacity is utilized in an optimal manner. This calls for the use of finite capacity scheduling system. This system is referred as finite because it is based on capacity that is available and exhaustible from the beginning of the planning process.

Various methods can be used to generate schedules. These include Gantt charts, computer models like linear programming and most popular, the priority sequencing rules. These include the first come first served, where the jobs arriving at the work station is given highest priority, the earliest due date rule ,which gives highest priority to the job with the earliest assigned due date ,critical ratio and the Johnson's rule (Rossi et al., 2017).Jacobs et al., (2013) urges that in an effort to match capacity to changing demand patterns, especially for firms dealing with perishable products that are not inventorable like services, scheduling is done through various ways including flexible working hours, scheduled working shifts, offering overtime in peak periods and none in off-peak and part time workers(Neely, 2012).

2.3.4Capacity Forecasting

Capacity forecasting involves adaption of various techniques of projecting meant to offer operations managers' predictions about the future capacity and demand situations. Capacity forecasting aims at aligning capacity levels to demand patterns.Otieno(2016) avers that Capacity forecasting is normally evaluated from two perspectives-short-terms and long-term capacity needs. Inshort-term forecasting managers use products demand to estimate the short-term workload that a facility should handle. By projecting over 12 month duration managers predict the level of output required of different products. The requirements are then compared with the capacity available to determine thecapacity adjustments required.According to Baazet al., (2013) long-term capacity forecasts from five to ten years. This renders them more difficult due to demand uncertainties which are difficult to estimate. This therefore means that capacity forecasting should involve both product and technology forecasting.

2.4Operational Performance

Operational performance means aspects of an organization that can be evaluated against some predefined parameters (Gregory, 2015).It is an indicator of the efficiency and effectiveness withwhich firms produceoutput. Cost, speed, quality and flexibility are commonly used measures of operational performance. These metrics are also viewed as the drivers of operational competitiveness(Youniss,2014).Operational performance measurement is an

important role in operations management because according to Benadette (2015) performance measurement results allow organizations to realign their systems and processes to the operations strategy once deviations from the desired performance are exposed. It acts as the basis of organization improvement.Ndubi(2011) states that operational performance is the strategic dimension a firm chooses to compete onwhose Measurement is continuous unlike the traditional end of year financial analysis done using common metrics including the following

Speed is the time lapse between the customer's order placement and delivery of the goods (Maina&Muya, 2014). Lawson (2011) argues that the speed of response which is very closely related to flexibility is a dominant performance metric in time based competitive environment. Organizations obtain various benefits as a result of their speedy operations. However David et al., 2016) identified the major two benefits namely, increased customer loyalty resulting from quick response to customers' orders and an opportunity to charge premium prices against speedy delivery. Consequently speed results to reduced inventories and increased response time. In the service operations the length of the queue is an important indicator of the speed of the processes e.g. customers in a supermarket or a fast food outlet would avoid those with long queues. This impact on their loyalty to outlets (Kotler, 2011).

Dependability is carrying out activities in a timely manner to ensure that customers receive goods or services when needed or exactly as per the due dates

promised. It therefore means being right on time (Certan&Koren, 2014). Dependability can only be determined after a customer has consumed organizations products/services and the perception formed about organization has a strongly influence on his/her decision of repurchase. Consequently it is important to note that dependability overrides all other customer purchase decision criteria, example, irrespective of how cheap products/services of an organization. In a retail outlet if the waiting queues are long, products are regularly out of stock, service is always late or delivery is always delayed, customers will always shift their loyalty to more dependable competitors (Gregory, 2015).

In a turbulent environment, organizations change their products or services or the way they carry out business. This is called flexibility. It is the capability to adapt in way that is reversible as opposed to re-engineering which is irreversible (Neely, 2012). Operations need to be flexible. This means changing what is done, how and when it is done in order to confer upon customers product or service flexibility, product mix, flexibility volume and delivery flexibility. According to Neely,(2012) flexibility measures the ability of a supplier to shorten lead times earlier agreed on when the situations demands or upon request, e.g. if a manufacturer requires a supplier to delivery raw materials thirty days before the scheduled due date is the supplier flexible enough to respond to this requirement? Flexibility speeds up response, saving time and maintains dependability (Slack, 2011).

Cost efficiency means low price. David et al,(2016), aver that manufacturing related costs are direct product costs, manufacturing overhead costs and inventory costs. They urge that the best competing organization is that which puts concerted effort to reduce costs through various rationalization strategies like, automation from mechanizations, just in time inventory control approach out sourcing among others to provide a competitive edge over competitors (Kuria, 2014). Quality means consistency in conforming to the needs of customer. It's about doing things right first time. The influence of quality on customer's satisfaction or dissatisfaction is so pronounced such that it is the major performance dimensions that customers use to judge product or service (Otavio et. al., 2017). The concept covers a broad array of dimensions in product/service that include performance features, fitness for purpose, conformance, durability and, serviceability. In services, operations, quality entails personalizedattention, consistency, dependability,knowledgeability, courtesy, empathy and safety (Vencataya, 2015).

Wairimu(2014) argued that in as much as the above stated dimensions are the epitome of competitiveness, success for an organization occurs if it increases its productivity and reducesits costs. Productivity is the input –output ratio; a measure of the efficiency of an organizations operations. According to him therefore, in order to achieve success there needs to be a blend of +improved productivity, cost reduction, capacity balancing, system reliability and availability; as drivers of success.

2.4.1Capacity Planning Practices andOperational Performance.

Operations managers use Capacity planning to minimize the trade-off between resources performance and quality by balancing between resource deployment and the related costs and quality. Quality and resource performance are important as they impact on the ability of the service industry to achieve added value for their customer(Prajogoa and Goh,2005). Capacity planning and adoption of a Just-In-Time approach increases efficiency, eliminates waste of money, resources and time and improve the overall profitability. Implementation of capacity strategy improves the visibility of the organization making it easier to monitor and control(Sernola, 2011). Capacity utilization rate driven by capacity planning influences the performance of any organization and a nation too according toIraki (2014).The scholar argues that capacity utilization can have far reaching impact on an organization's growth even more than plant expansion. On the economic front, a nation that utilizes the resources at its disposal can achieve greater economic growth than embarking on very expensive investments.

2.5 Empirical Studies

As a practice it is conventional for any organization to equip itself to with the most likely or forecasted demand. Capacity planning is a major component in the designing of a system since it involves many decisions with long-term implication for organization (Sheng,Mestry& Wang 2009).It is important to note that the primary objective of capacity planning is to match supply and demand. Here

forecasts provide vital information on future demand which helps in determining how much capacity will be required to meet the current and future demand

Strategic capacity planning aims to achieve a balance between the long-termorganizational capabilities with the long-term demand levels (Na Geng and Jiang 2010). Various reasons exist why firms engage in capacity planning. Chief among them is the frequent demand fluctuations, technological changes and perceived threats or opportunities (Guide and Spencer 2010). It is important to ensure that capacity balance exists. Where there's a gap between current and desired capacity, capacity is said to be out of balance. Two instances present excess capacity that results to high operation costs while under capacity results to strained resources and interdepartmental conflicts(Geng and Jiang 2010)

2.6 Summary of Literature Review and Knowledge Gaps

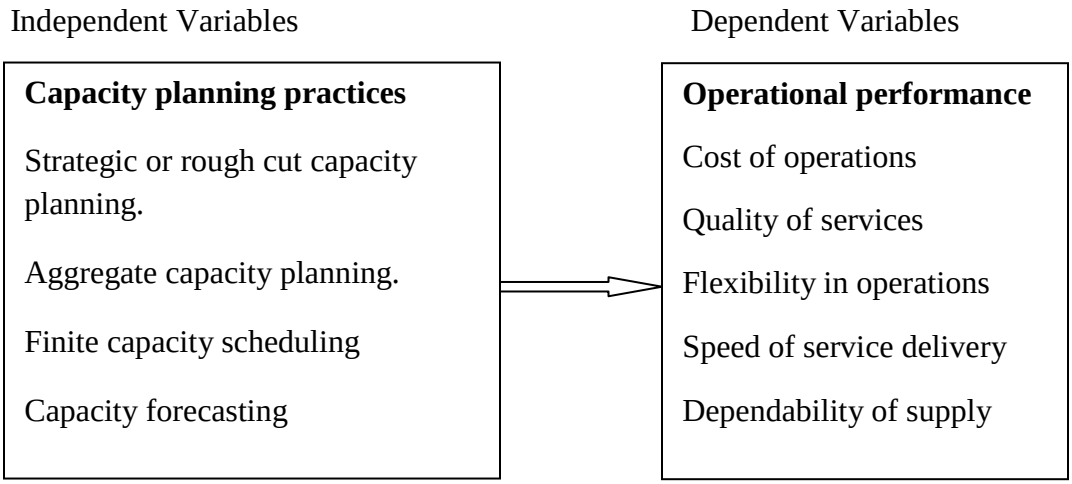
The literature review shows that capacity planning has a great impact on operational performance of firms. The different studies done indicate that capacity planning is an integral component of the corporate planning.Occurring at different levels in the management hierarchy it is revealed that planning capacity facilitates resource deployment necessary for implementation of the strategic objectives within the framework of the operations strategy. The empirical review has revealed that capacity planning practices are cascaded down the management hierarchy from the corporate level where Master production schedules is

developed, down to the functional levelwherethe production plan is broken down into day to day or product by product runs driven by demand.

Capacity planning drives capacity utilization. Capacity utilization rate has a great influence on the performance of any organization and a nation too. Iraki (2014) stated that capacity utilization can have far reaching impact on an organization's growth more than plant expansion. On the economic front, anation that utilizes the resources at its disposal can achieve greater economic growth than embarking on very expensive investmentsPerformance measurement is a process for quantifying efficiency and effectiveness of a firm. Major performance metrics relating to manufacturing firms are cost, speed, quality, flexibility time efficiency and dependability(Welukwe, 2013).According to Malonza (2014) a factory efficiency is a measure of the ability of a firm to stay in operation throughout the year. In the context of power generation, it is called availability. Speed is the time lapse between placement of an order and delivery. Neely appreciates the absence of a universal definition of quality but holds that it is about what is right for an individual. Flexibility is a measure of the ability of a system to adjust to demand requirements(Youniss, 2014).

2.7Conceptual Frame work

Figure 1: Conceptual Framework



Source: Researcher (2017)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The chapter captures details about the procedures and methods to be used to conduct the study. It will cover the research design, target population, sample size, data collection tools, and data analysis procedures.

3.2 Research Design

The study adopted descriptive researchdesign. Descriptive studies answer the what,where,why,how and when questions(Babbie,2010).Descriptive research is important since it is the foundation upon which correlation and experimental studies arebased(Mugenda,2008).It also enables a researcher to get quantitative data that can be analyzed using inferential and descriptive statistics besides the fact thatit enables a researcher to the describe the state of affairs exactly as they are without manipulating variables(Kothari, 2004).

3.3 Target Population

A target population is that specific population whose information is desired by the researcher (Kothari,2004). The population of interest in the study wasall the ten major hydropower stations under Kengen in Kenya. A census approach was used due to the small number of the target population. The operations and

maintenancedepartments will be the focus of this study since they are the ones directly involved in power generation.

3.4 Data Collection

Primary data was used in the study. It was collected using a questionnaire divided into three sections.Section (A)constituted the respondents bio data while section (B) constituted the capacity planning practices while section (C)constituted capacity planning practices and operational performance linkage to operational performance where the respondents were required to rate their responses using a five point Likert scale designed questionnaire. This questionnaire design was meant to enable the researcher gather the information of interest to the studyeasily. Questionnaires were administered through E-mail and drop and pick. Telephone follow up wasmeantclarify any question where necessary and also increase responserate. Questionnaires were administered to the operations managers and chief engineers per hydro station. This constitutedtwenty respondents interviewed in the study.

3.5Data Analysis

The questionnaires were checked for completeness and accuracy. Descriptive statistics was used to analyze the collected quantitative data to generate frequencies, percentages, means and standard deviations.Tables and other forms of appropriate graphical presentations were used for analysis. The information generated was interpreted and explained.

To determine which capacity planning practices are adopted by firm's frequency distribution tables, and bar graphs were used to analyze and present data.A computer aided package was used to perform a simple regression and correlation analysis todetermine the relationship between capacity planning practices and operational performance.

A multiple regression model of the form, $Y= B_1X_1+B_2X_2+B_3X_3+B_4X_4$summarized the study findings

Where,

Y = operational performance

X_1= Strategic or rough cut capacity planning.

X_2 = Aggregate capacity planning.

X_3 =Finite capacity scheduling

X_4 = Capacity forecasting

CHAPTER FOUR

DATA ANALYSIS, PRESENTASTION AND INTERPRETATION

4.1 Introduction

This chapter focuses on the analysis and findings of the study as set out in the research methodology. The results are presented on capacity planning practices and operational performance of the major hydropower generating stations in Kenya. To enhance quality of data obtained, Likert Scale was utilized where respondents responded to the research questionnaire on 1 – 5 point scale.

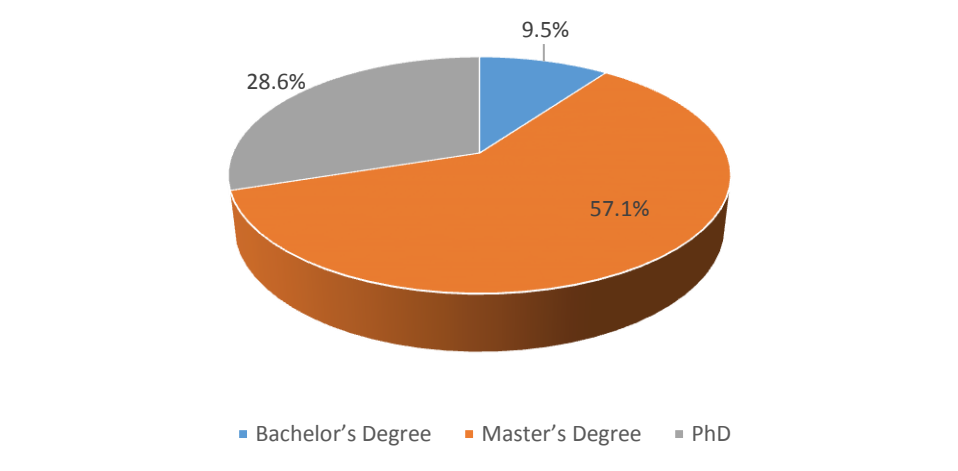
The study targeted all the major hydropower generation stations in Kenya and they were 20 in total thus a census. All the 20 questionnaires issued were filled and returned. This accounted for 100% response rate. This commendable response rate was made possible after the researcher made personal visits to the respective stations.

4.2 Bio Data

4.2.1 Academic Qualification

The study sought to determine the level of academic qualification of the respondents.

Figure 4.1: Academic Qualification



Source: Research Data, (2017)

From the study findings on table 4.1, it indicated that majority of the respondents 12 (57.1%) had a Master's Degree, 6 (28.6%) of the respondents were PhD holders while 2 (9.5%) of the respondents had Bachelor's Degree. This shows that the respondents were well educated and had enough knowledge to understand the information sought by this study.

4.2.2 Position in the Firm

The study sought to determine the positions held by the respondents in their respective organizations.

Table 4.1: Position in the Firm

	Frequency	Valid Percent	Cumulative Percent
Chief Engineer	8	40.0	40.0
Human Resource Manager	1	5.0	45.0
Manager Finance	1	5.0	50.0
Operations Manager	10	50.0	100.0
Total	20	100.0	

Source: Research Data, (2017)

From the study findings as shown in table 4.1, it indicates that majority 10 (50%) of the respondents were operations managers, 8 (40%) of the respondents were chief engineers, 1 (5%) and 1 (5%) was human resource manager and manager finance respectively. This shows that majority of the respondents were specialists in the area of operations thus having prerequisite know whom of the information sought by this study.

4.2.3 Name of the Organization

The study sought to establish the name of the organization where the respondents worked from.

Table 4.2: Name of the Organization

	Frequency	Valid Percent	Cumulative Percent
Gitaru Hydropower station	2	10.0	10.0
Kiambere Hydropower Station	2	10.0	20.0
Kindaruma Power Station	2	10.0	30.0
Kamburu Hydropower Station	2	10.0	40.0
Masinga Hydropower Station	2	10.0	50.0
Turkwel Hydropower Station	2	10.0	60.0
SonduMiriu Hydro power Station	2	10.0	70.0
Sagana Power Station	2	10.0	80.0
Tana Falls Power Station	2	10.0	90.0
Sangoro Hydro power station	2	10.0	100.0
Total	20	100.0	

Source: Research Data, (2017)

The study findings as shown in table 4.2 indicates that all the organizations that participated in the study were represented in equal measure. This is, each firm accounted for 2 (10%) representation in the study. The organizations involved Gitaru Hydropower Station, Kiambere Hydropower Station, Kindaruma Hydropower Station, Kamburu Hydropower Station, Masinga Hydropower Station, Turkwel Hydropower Station, SonduMiriu Hydropower Station, Sagana Power Station, Tana Falls Power Station and Sangoro Hydropower Station. All the ten companies were key power generating companies in Kenya, therefore provided reliable sources of information sought by this study.

4.3 Capacity Planning Practices

The study sought to determine the extent to which capacity planning practices were implemented in the hydropower generation companies in Kenya. The respondents were required to respond to the questionnaire using a 5 Point Likert Scale where 1 – No Extent, 2 = Little Extent, 3 = Moderate Extent, 4 = High Extent and 5 = Very High Extent.

Table 4.3: Capacity Planning Practices

Statement	Mean	Std. Dev.	N
Strategic Capacity Planning Evaluation of overall capacity level for capacity intensive resources that best supports the competitive strategy.	4.75	0.444	20
Determining capacity adjustments.	4.60	0.883	20
Capacity Forecasting Estimation of Expected Market Demand	4.55	0.510	20
Aggregate Capacity Planning Analysis of Demand Trends	3.95	0.945	20
Determination of Overall Output.	3.95	0.605	20
Measuring Aggregate Capacity Levels.	3.85	0.933	20
Finite Capacity Planning Scheduling Daily Work Times.	3.65	0.988	20
Personnel Scheduling.	3.60	0.995	20
Work Center Scheduling.	2.85	1.268	20

Source: Research Data (2017)

The study findings in Table 4.3 shows that majority of the respondents reported that strategic planning through evaluation of the overall capacity level for capital intensive resources that best supports the organization long range competitive strategy (personnel skills mix, plants, equipment or facilities and space) is

adopted at a very high extent in their respective organizations with a mean of (M = 4.75; SD = 0.444).

Also, other respondents reported that Aggregate Capacity Planning through determining capacity adjustment strategies in response to demand fluctuations and capacity forecasting through estimation of expected market demand are adopted at a very high extent with a mean (M = 4.60; SD = 0.883) and (M = 4.55; SD = 0.510) respectively.

On the other hand, other respondents reported that Aggregate Capacity Planning through analysis of demands trend, determination of overall output required measuring aggregate capacity levels were adopted at a high extent in their respective firms with a mean (M = 3.95; SD = 0.945), (M = 3.95; SD = 0.605) and (M = 3.85; SD = 0.933) respectively. Finite capacity planning through scheduling work times and personnel scheduling were also adopted at a high extent (M = 3.65; SD = 0.988) and (M = 3.60; SD = 0.995) respectively.

However, work center scheduling as an element of Finite Capacity Planning was reported by the respondents to be adopted at a moderate extent in the irrespective firms with a mean (M = 2.85; SD = 1.268).

4.4 Capacity Planning Practices and Operational Performance

4.4.1 Regression Analysis

The study utilized the regression analysis to determine the relationship of capacity planning practice on operational performance of the major hydropower generating stations in Kenya.

The regression model was as follows:-

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + e$$

Where

Y = Operational Performance

B_0 = Constant Term

B_1 to B_4 = Beta Coefficients (Capacity Planning Practices)

X_1 = Strategic Capacity Planning

X_2 = Aggregate Capacity Planning

X_3 = Capacity Scheduling

X_4 = Capacity Forecasting

e = Error of Margin

4.4.2 Strength of the Model

Table 4.4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.753[a]	.567	.176	.427

a. Predictors: (Constant), Capacity Forecasting-Anticipation with high degree of accuracy in the expected and required capacity ,Aggregate capacity planning - Efficient utilization of equipment and labor resulting to economy of scale, Capacity Scheduling -Optimization of facility and labor utilization, Strategic Capacity Planning -Budgeting, determination of capital intensive resources.

The findings on table 4.4 shows that coefficient of determination (the percentage variation in the dependent variable being explained by the change in the independent variable).

R^2 equals0.567 that is 56.7% of dependent variable being influenced by independent variable. This leaves out 43.3% as unexplained variables that were not captured in this study.

4.4.3 Analysis of Variance

Table 4.5: Analysis of Variance (ANOVA)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.801	4	1.200	1.644	.004[b]
	Residual	10.949	15	.730		
	Total	15.750	19			

a. Dependent Variable: Reliable power generation to meet market demands

b. Predictors: (Constant), Capacity Forecasting-Anticipation with high degree of accuracy in the expected and required capacity ,Aggregate capacity planning - Efficient utilization of equipment and labor resulting to economy of scale, Capacity Scheduling -Optimization of facility and labor utilization, Strategic Capacity Planning -Budgeting, determination of capital intensive resources.

The ANOVA findings on table 4.5 indicates that there is a correlation between the independent variables and the dependent variable with P- value of 0.004 that is less than 0.05. This therefore shows that the study is statistically significant.

4.4.4 Coefficient of Regression on Equation

Table 4.6: Coefficient of Regression Equation

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	4.045	2.613		1.548	.042
Strategic capacity planning-Budgeting ,determination of capital intensive resources	-.356	.466	-.184	-.764	.456
Aggregate Capacity Planning-Efficient utilization of equipment and labor resulting to economy of scale	.422	.166	.599	2.544	.022
Capacity Scheduling-Optimization of facility and labor utilization	.066	.214	.070	.306	.044
Capacity Forecasting-Anticipation with high degree of accuracy in the expected and required capacity	.051	.315	.037	.160	.025

a. Dependent Variable: Reliable power generation to meet market demands

There is both positive and negative relationship between the independent variables and the dependent variable. Therefore, the established multiple linear regression equation becomes:-

$Y = 4.045 – 0.356X_1 + 0.422X_2 + 0.66X_3 + 0.051X_4$

Where the constant 4.045 shows that if capacity planning practices such as strategic capacity planning, aggregate capacity planning, capacity scheduling and capacity forecasting all rated at zero the operational performance of the major hydropower generating stations in Kenya would be 4.045.

X_1 = - 0356 shows that one unit change in Strategic Capacity Planning results in – 0.356 units decrease in operational performance.

X_2 = 0.422 shows that one unit change in Aggregate Capacity Planning results in 0.422 unit increase in operational performance.

X_3 = 0.066 shows that one unit change in Capacity Scheduling results in 0.066 units increase in operational performance.

X_4 = 0.051 indicates that one unit change in Capacity Forecasting results in 0.051 units increase in operational performance.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter covers a discussion of the findings reported in chapter four, the conclusions of the study and also drawn and recommendations made. This chapter also provides areas for further research.

5.2 Summary of the Findings

The results of the study gives important insight on the relationship between capacity planning and operational performance of the major hydropower generating stations in Kenya. The findings of the study revealed that majority of the respondents indicated that strategic capacity planning through evaluation of the overall capacity level for capital intensive resources that supports the organizations long-term competitive advantage was adopted in their firm at a very high extent. Other respondents revealed that Aggregate Capacity Planning through determining capacity adjustment strategies in response to Demand Fluctuations and Capacity Forecasting through estimation of expected market demand are adopted at a very high extent in their firms as well. On the other hand, Finite Capacity Planning through Personnel Scheduling was adopted at a moderate extent.

5.3 Conclusion

Capacity Planning is regarded as a key component in operation management in any given firm. This is because it helps the organization to produce goods and services at its optimal level at a cost-effective and efficient manner. It also helps in elimination of wastes in general the operation management structure of an organization. Therefore, Capacity Planning in the major hydropower generating stations is even more significant because it contributes to a significant percentage to the National GDP. It is very important to note that from Capacity Planning Practices; Strategic Capacity Planning, Aggregate Capacity Planning, Finite Capacity Planning and Capacity Forecasting have been adopted in hydropower generation stations at a very high extent and a moderate extent as well. Therefore, more emphasis should be put in maintaining them and even improving on them so that operational performance in hydropower generation stations in Kenya will be sustainable in the long-run.

5.4 Recommendations

Hydropower generation plays a significant role in Kenya as economic growth. This is because the hydropower stations in Kenya generates enough power in terms of megawatts to the national grid and therefore contributing more to economic development. Therefore, capacity planning in hydropower generation goes hand in hand in creating efficiency, reduction of costs, and optimization of facility, labour utilization and quick response to demand fluctuations. Other key performance indicators of operational performance influenced by capacity

planning, real time service delivery, constant and reliable power generation to meet customers demand.

The study therefore recommends that all the hydropower stations in Kenya should embrace and implement capacity planning practices in their operations so as to maintain the high levels of operational performance in their respective firms as well as expanding their operations to more competitive standards.

Moreover, the study also recommends that the management to the hydropower generation stations in Kenya should review and continuously upgrade their capacity planning practices based on current technological advancement. The new technology should be used to implement capacity planning practices for sustainable growth and development.

5.5 Suggestions for Further Research and Limitations of the Study

The study suggests that more studies should be done on the current technologies being used in power generation and how they impact on operational performance of hydropower generating firms in Kenya.

More studies should also be conducted on capacity planning in the manufacturing sector in Kenya so that it would be easy to find out if there is some resemblance of issues in hydropower generation and manufacturing sector. Furthermore, there is need to conduct a study about capacity planning in devolved functions in Kenya and its impact in service delivery to know their potential areas for development and areas to improve on their capacity in general and eventually improving on service delivery to the Kenyan citizens promptly.

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APPENDICES

APPENDIX I: INTRODUCTORY LETTER

UNIVERSITY OF NAIROBI
SCHOOL OF BUSINESS

Telephone: 020-2059162
Telegrams: "Varsity", Nairobi
Telex: 22095 Varsity

P.O. Box 30197
Nairobi, Kenya

DATE 9/11/2015

TO WHOM IT MAY CONCERN

The bearer of this letter ISAAC MWANGI NDEGWA

Registration No D61/79312/2015

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

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

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

Thank you.

UNIVERSITY OF NAIROBI
SCHOOL OF BUSINESS
09 NOV 2017
P.O. Box 30197 - 00100, NAIROBI

PATRICK NYABUTO
SENIOR ADMINISTRATIVE ASSISTANT
SCHOOL OF BUSINESS

APPENDIX II: QUESTIONNAIRE

CAPACITY PLANNING PRACTICES AND OPERATIONAL PERFORMANCE OF THE MAJOR HYDROPOWER GENERATING STATIONS IN KENYA

PART A: BIO DATA

1. Academic qualification

   Bachelors degree ( ) Mastersdegree ( )

   PhD ( )

   Other qualification ……

2. What is your position in the firm?

   Chief engineer() Human Resource manager ( )

   Manager Finance ( ) Operations manager ( )

   Supervisor operations ( )

3. Name of the organization.....

PART B: CAPACITY PLANNING PRACTICES

4. To what extent have these practicesbeen implemented at your organization?

Use a scale of; 1=No extent, 2= little extent, 3 = Moderate extent, 4= High extent, 5=Very high extent.

CAPACITY PLANNING PRACTICES	**1**	**2**	**3**	**4**	**5**
Strategic capacity planning					
Evaluation the overall capacity level for capital intensive resources that best supports the organisation's long range competitive strategy(personnel skills and mix, plants, equipment or facilities and space)					
Aggregate capacity planning					
Determination of overall output required					
Analysis of demand trends					
Measuring aggregate capacity levels over the planning period					
Determining capacity adjustment capacity strategies in response to demand fluctuations					
Finite capacity planning					
Scheduling daily work times					
Personnel scheduling					
Work centre scheduling					
Capacity forecasting					
Estimation of expected market demand					

PARTC: CAPACITY PLANNING PRACTICES AND OPERATIONAL PERFOMANCE

5. Indicate using a tick (√) the extent to which the capacity planning practices below influenced the operational performance of the hydrostation.Rate using a scale 1-5 where

1=No impact, 2=Little extent, 3 = Moderate extent, 4= High extent, 5=Very high extent

CAPACITY PLANNING PRACTICES	**1**	**2**	**3**	**4**	**5**
Strategic capacity planning					
Budgeting: Determination of capital intensive resources					
Scalability: Facilities planning for expansion as need be (e.g. personnel, planning, facilities and space)					
Superior customer service					
Reliable power generation					
Aggregate capacity planning					
Balanced capacity to market demand					
Reliable power generation to meet market demands					
Quick response to demand fluctuations					
Efficient utilization of equipment and labour, resultingto economies of scale, wear and tear and elimination of idle capacity					
Improved rations from operations					
Capacity scheduling					
Real time service delivery					
Reliable customer service					
Speedy response to customer needs					
Cost effective operations					
Optimization of facility and labour utilization					
Capacity forecasting					
Anticipation with high degree of accuracy the expected demand and required capacity					

APPENDIXIII:LIST OF HYDROPOWER STATIONS IN KENYA

1. Kindaruma hydroelectric power station
2. Gitaru hydroelectric power station
3. Kiamberepower station
4. Masingahydroelectric power station
5. Kamburu hydroelectric power station
6. SonduMiriu hydroelectric power station
7. Tarkwelhydroelectric power station
8. Sang'orohydroelectric Power Station
9. Tanahydroelectric Power Station
10. Sagana Power Station