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Content Details:

Eugene Owusu Afriyie (Author) *Hensco Oil Company Ltd*	**The Impact of the Current Global Economy on Ghana's Real Estate**

The Impact of the current global economy on Ghana's real estate is huge when it comes to inflation and exchange rates in the country. Real estate affects Ghana's economy because of the amount of household savings that goes into housing. The impact of the current global economy on real estate business in the country has exposed the weaknesses of price determinants in the market. For instance, home prices that are listed in foreign currencies remain stable while properties listed in local currency are subjected to daily changes because of the fluctuations in exchange rates. As a result, homebuyers remain vulnerable in the market because of the current economic distress world economies are facing. In the United States, for example, mortgage rates keep on rising while people continue to leave apartments in search of homes to buy. Home demand continues to increase while supply trails, making it a seller's market.

The current inflation rate in the country is reported to be 15.7 percent on a year-on-year basis. This indicates that prices of goods and services increased over the period by 15.7 percent for the month of February. No doubt that the current state of the country's economy is dangling which needs the real estate sector to stabilize.

The major driver of high inflation rate in the country is housing, water, electricity, and gas/fuel. This makes economic conditions a major driver of property prices and the real estate market.

Data available indicates that housing recorded the largest price increase representing 25.4 percent. This means that when prices of goods and services increase, housing prices increase at an alarming rate and that's why housing always leads to driving inflation in the country.

According to Global Property Guide, the rental market in Accra is relatively huge, representing 37.5 percent of all households living in rented apartments. Paying about $1,750 per month, producing a gross rental yield of around 11 percent to property rental developers. This estimated rent will escalate when prices of homes increase due to inflation.

Most households in the nation's hub for commerce sought housing in rental homes which accounted for the 40.4 percent of households in Accra claiming ownership of their houses while another 20.5 percent live rent-free. The remaining 1.6% of housing is employer-provided.

When households spend so much on housing it indicates that home prices continue to rise and this whole upward trend affects people's economic behaviour. The fact that when home prices increase, and people borrow and spend more will definitely affect the economy in the long run.

As we indicated earlier the country depends so much on imports and so any fluctuations in the exchange rate will reflect on the real estate market. The first thing you need to relate is that exchange rates mostly affect foreign investors in the real estate sector. When the country's exchange rate is not stable it affects foreign investors who patronize the market and subsequently pass it on to homeowners.

In every local real estate market, there's usually an influx of foreign investors in the market. This is because if the local currency is weak against the foreign currency the foreign currency will grow comparatively to that of the local currency, giving foreign investors more value for money and, hence, can buy more property. For instance, in Accra, home prices are listed in dollar terms and any time the cedi depreciates, home prices appreciate in value. This means that an average homeowner will have to carry more cedis to secure the same residential space he paid fewer cedis a month ago. Real estate investors who are aware of this would not risk listing properties in local currency as it easily depreciates over time.

Economic policymakers should know that when the domestic currency is weak the potential of inflation going up is high and if that happens the cost of borrowing could increase. The high cost of borrowing (interest rates) makes homes more expensive and less affordable.

When debt servicing becomes a problem for homeowners it reduces the demand for loans and housing. Undoubtedly, a strong currency depresses inflation and reduces interest rates. That's why the U.S always has stable mortgage rates.

Exchange rates do not have a direct impact on the interest rate you pay on your mortgage. Keep in mind that the value of a currency sometimes serves as an economic indicator of a country's stability. In other words, the value of the currency and real estate may sometimes grow separately and simultaneously.

The truth is that we want the inventory to increase and what's currently happening in world

markets is that more and more older people who were reluctant to put their houses on the market during the Covid now feel safer going to a small property or a retirement home.

Of Course, this is going to help buyers have more choices and obviously interest rates. The leveraging power that people have had in particular, two-income households to leverage their ability to borrow money has really allowed them to pay top dollar for these properties over the last few months. The residential real estate market goes in 16 years cycles. The last peak we had was about 2006 and before that, it was in 1990 that was before the recession hit.

So typically what happened in 2007/2008 was the results of the federal reserve raising their interest rates very quickly and very shortly and that led to a great amount of carrying cost on the 30-year mortgage which was intended to slow the economy in the United States. So, if they are going to do it so quickly in 2022, while they are still very conscious about wanting to get full employment before they get a little bit aggressive on raising rates, that means getting the unemployment rate down to the 3% range. Whenever the housing sector is in a bubble it gives a signal of an economic recession. Where the housing affordability index, which measures the percentage of the population who could afford the median-priced home kept slipping lower and lower, it gives a clear indication of recession.

Housing delivery in many developing countries is low due to high population growth, rapid urbanization, and low-income levels. The study explored the mortgage financing in the housing sector of Ghana. With the current effort at social and economic development by Third World countries, a study like this is significant, as it can contribute to the present knowledge in the area of mortgage financing. The populations for this study were made up of workers from formal sectors who qualified to access mortgage loan and mortgage providers. Primary data source was employed. It was found that mortgage financing largely depends on social and financial factors. These two factors have positive correlation with the mortgage performance with the formal explained most of the variations in mortgage performance. Some of the mortgage options identified were residential property for personal use or rental and mortgage for buy, build, and own a home. The study also identified high interest rate, high inflation rate and low-income levels of workers as some of the challenges facing the industry.

Keywords: Housing deficit, Population growth, Mortgage financing, Interest Rate, Exchange Rate

Ebrahim Salem Abdulqader Al-sakkaf (Author) *Lebanese International University*	**Factors Influencing Breakdown of Medical Equipment in Public Hospitals**

ABSTRACT

The objective of this study is to examine the factors influencing breakdown of medical equipment in public hospitals in Yemen. This study explores the issue of medical equipment breakdown in public hospitals in Yemen and its problems of long-time repairing and entering into service in terms of the three factors. The study examines these factors to find a way for medical equipment to work efficiently and serve patients with medical services. The data were collected from medical supplier companies and public hospitals in Yemen because they have the knowledge about the medical equipment issue in public hospitals, and they helped the researcher to get the results. The survey is an online questionnaire about the effect of financial aids, organizational neglect, and technological awareness on the breakdown of medical equipment in public hospitals. The population was taken from the medical supplier companies and public hospitals laboratories in Yemen. The sample includes biomedical engineers, operators, technicians, and management from medical supplier companies and the laboratory department of public hospitals. The number of questions distributed is 220. Only 151 participants responded to the questionnaire without any missing data. This is a deductive study that applies the quantitative approaches. The study provides recommendations to all people who are responsible in public hospitals for the sake of helping them to overcome the causes of the breakdown of medical equipment and serve a wide sector of people that need medical services and cannot afford the high cost of private hospitals. The study gives suggestions for future research; it suggests that other researchers expand the scope of the study by selecting some other public hospitals and examining other factors influencing breakdown of medical equipment in public hospitals.

Keywords: Factors, Breakdown of Medical Equipment, Public Hospitals, Financial Aids, Organizational Neglect, Technical Awareness, Biomedical Engineer, Maintenance, Yemen.

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CHAPTER 1
INTRODUCTION

1.1 Background

As Yemeni public hospitals consider the lifeline for all people in Yemen, it is necessary for them to be number one in health care to serve many people and maintain healthy lives for them. Nursing and medical staff in hospitals cannot serve patients without using medical equipment (Quinn, 1998). Today, we note that nearly all public hospitals in Yemen suffer from the periodical breakdown of medical equipment, out-of- work equipment and long-time repair. Sometimes, the medical device never works even if it is a new installation. Therefore, all these problems increase the budget of public hospitals, and they cannot serve patients properly.

A public hospital is a hospital that belongs to the government and gets financial support from the government ("Public hospital", n.d.). Public hospitals in Yemen give medical care to people for free or at least for a small amount of money in comparison to the expensive private hospital (All Answers Ltd, 2018). Public hospitals must be the references for all private hospitals in Yemen. They should be of interest to the Ministry of Health and people.

Not all public hospitals are equal. It depends on the buildings, divisions, furniture, type of medical equipment they have, the field of specialization, and the budget allowed by the Ministry of Health. All public hospitals have departments that should have medical equipment. For

example, a laboratory department needs chemistry analysis, immunology analysis, a blood analyzer, a centrifuge, blood gas analysis, a polymerase chain reaction analysis, and refrigerators. Other departments have specific medical equipment according to their need.

Medical equipment in public hospitals ranges from highly expensive to cheap, depending on the quality of the equipment, the country of the manufacturing, the reputation of the manufacturing, and the durability of the equipment. Medical equipment cannot be bought directly by the manager or sales officers of public hospitals. Medical equipment is bought from the suppliers of medical equipment companies in Yemen through three ways. First, if public hospitals have the money for renewing or opening new departments, they prepare a list of files for the type and specifications of medical equipment. Then they process tenders and announce them in newspapers. After that, they buy the specific medical equipment from the winning medical company that provides the suitable descriptions with a suitable price. The second way of buying medical equipment is done through organizations. Most organizations in Yemen provide support for public hospitals by visiting them, and seeing whether there are any shortages in some departments according to hospitals' needs. Then the organizations contact medical companies and buy the required medical equipment, or they can use tenders. The third way of buying medical equipment involves only medical equipment that requires reagents to operate or cannot work without these reagents. This happens when buying equipment for laboratory departments or kidney departments. Supplier companies offer medical equipment free of charge in exchange for consuming the target of reagents in a year, depending on the cost of medical equipment. Some targets range between twenty and forty thousand dollars yearly. Then hospitals have the rights to own medical equipment after four or five years if they commit to the target of the contract.

It is not easy to get all or some of medical equipment for public hospitals due to the bad circumstances the country is going through. Therefore, medical equipment must be preserved to work with normal condition and serve as many people as possible, but this does not happen in most public hospitals. Medical device needs maintenance and attention by an operator first and second by a biomedical engineer service of the supplier company. The task of an operator is to perform daily maintenance according to the guideline of a company, but this does not happen actually due to one or all of the three factors influencing breakdown of medical equipment. The task of biomedical engineering service is also to perform the PPM, but this task is performed

only in the first year of buying a medical device due to a one-year warranty. It cannot be performed after the second year due to mostly the factor of financial aids.

Medical equipment requires two types of parts. One is the consumable parts, which must be replaced after some time or after several hours. Medical equipment in this case is consumed during operations, and the examples of such equipment are like lamps, oxygen sensors, reaction cells, and measuring cell. The other type is spare parts. These devices must be replaced with defective parts while repairing medical equipment like PCB boards, liquid pump, x-ray tubes and others. Public hospitals must have the inventory for these two types of parts (Bektemur, Muzoglu, Arici & Karaaslan, 2018).

In this study, the researcher focuses on three factors that influence the breakdown of medical equipment in public hospitals. The first factor is the financial aids, which are considered the most important factor because medical device will not work without them. In addition, if the lifetime of medical equipment passes, it must be replaced with new and updated equipment (Kim & McCue, 2008). The second factor is the organizational neglect as a result of the situation in the workplace. Neglect can be caused by the operator, the head of a department, the maintenance department, and the management of hospitals (Manyisa & van Aswegen, 2017). The last factor is the operator's technical awareness of skills such as development programs, trainings, and quality controls (Gregory & Crispin, 2014).

1.2 Problem Statement

Some public hospitals have deviated from their main assigned function of medicine (Bajpai, 2014). These public hospitals should persist to offer healthcare to all social classes of people for a prolonged period (All Answers Ltd, 2018). However, sometimes, people who do not afford to pay money cannot get healthcare from public hospitals because of the breakdown of medical equipment. On the other hand, people who afford to pay never go to public hospitals because they know that their medical equipment is out of work or has permanent malfunctions without maintenance.

In some countries, private hospitals try to buy all the medical equipment to compete with public hospitals and give patients a full service. Patients in those countries prefer to go to public hospitals to take the full services because public hospitals have the bigger, modern and updated medical equipment compared to private hospitals (All Answers Ltd, 2018).

When we make a comparison between our public hospitals in Yemen and public hospitals in other countries, we can find some factors which cause the breakdown of medical equipment, and such factors are related to the bad reputation of hospitals. One of the important factors is financial aid. If public hospitals have a problem with financial aid, they will face difficulty in keeping or maintaining a good service and healthcare for patients (Akinleye, McNutt, Lazariu & McLaughlin, 2019). Medical equipment needs attention and maintenance by operators and the maintenance departments of public hospitals which cannot continue working if there are financial problems. The cost of PPM must be determined by service biomedical engineers of the supplier companies, and that needs $3500 yearly if we are talking about the immunology analyzer for a specific model used in a laboratory department. For example, if maintenance is not performed on time, the immunology analyzer will break down or stop working. Furthermore, medical equipment needs suitable UPSs to avoid any technical breakdown in case of the electrical power supply cuts during an operation. Otherwise, the cost of repairing will be high, which cannot be afforded by public hospitals due to the lack of financial aid and this leads to breakdown of medical equipment. To conclude, if there are problems with the financial aids in public hospitals, there will be carelessness towards patients due to the breakdown of medical equipment (Akinleye et al., 2019).

All public hospitals in Yemen suffer from organizational neglect. The reason may be that employees are working under difficult circumstances, which leads to neglect of the maintenance by operators of medical equipment (Manyisa & van Aswegen, 2017). Working together as a team will help to avoid the breakdown of medical equipment, but it must be noted that every operator of medical equipment depends on other workers to perform his daily maintenance. Everyone wants to complete his tasks to leave the hospital, and they do not care about medical equipment due to the shortage in technical awareness. They need trainings in personal skills and get development programs (Gregory & Crispin, 2014).

The researcher wants to discuss this topic because this topic has not been discussed by anyone in Yemen. The researcher explored diverse research that dealt with the breakdown of medical equipment in hospitals to support the argument of the study. He explored how to reduce hospitals' equipment downtime, the conceptual framework to determine medical equipment

maintenance in hospitals using RCM method, medical equipment maintenance manual, and guideline to medical equipment management.

Some internally reports in the public hospitals mentioned that due to the shortage in the financial resources, the number of the breakdown of medical equipment is increasing, because there is no attention to the PPM and periodically check on the medical equipment, also the organizational neglect and technical awareness to the employees are another factors to increases the number of the breakdown of medical equipment.

1.3 Research Questions

In this study, the researcher seeks to examine the factors influencing the breakdown of medical equipment in public hospitals. Therefore, the research questions are as follows:

Q1. What is the impact of financial aids on the breakdown of medical equipment in public hospitals?

Q2. What is the impact of organizational neglect on the breakdown of medical equipment in public hospitals?

Q3. What is the impact of technical awareness on the breakdown of medical equipment in public hospitals?

1.4 Research Objectives

It can be noted that nearly all public hospitals in Yemen suffer from a fast breakdown of medical equipment, so patients cannot get the full services by public hospitals. The purpose of this study is to achieve the following objectives related to the factors:

- Examining the impact of financial aids on the breakdown of medical equipment in public hospitals
- Examining the impact of organizational neglects on the breakdown of medical equipment in public hospitals
- Examining the impact of technical awareness on the breakdown of medical equipment in public hospitals

1.5 Significant of the Study

This study is important because it explores whether there are problems in most public hospitals that give full-service healthcare to patients. One of these problems is the breakdown of medical equipment, which negatively affects the health sector and the reputation of public hospitals, and leads to shifting to private hospitals by most patients. The study aims to examine the impact of

the factors of financial aids and organization neglect and technical awareness on the breakdown of medical equipment.

On the other hand, this study adds the correct plan to the practical aspects of the management of hospitals by preventing wasted time, the cost of repairing, training the staff of hospitals on cultural awareness and the importance of healthcare for citizens. Public hospitals are considered the common property of people and must be preserved to serve for a longer period.

1.6 Scope of the Study

This study focuses on the important factors that influence the breakdown of medical equipment in most public hospitals all over Yemen. The factors include financial aids, organizational neglect, and technical awareness. The targets of this study are the people working in the field of health, like biomedical engineers, operators, technicians, heads of departments, and managers in laboratories of public hospitals.

The survey is an online questionnaire distributed via WhatsApp to the targets to see their responses to the factors (financial aids, organizational neglects, and technical awareness) influencing the breakdown of medical equipment, which will help us to reduce the breakdown of medical equipment in public hospitals in Yemen and serve a wide variety of patients.

1.7 Definitions of Terms

The essential concepts used in this study are six: public hospitals, breakdown of medical equipment, maintenance, financial aids, organizational neglects and technical awareness.

1.7.1 Public Hospitals

Public Hospitals are government hospitals consisting of buildings with different departments, and each department has medical equipment. Public hospitals employ different people with different specializations. Every employee has a function according to his degree of specialization. The main function of public hospitals is to diagnose, treat, and perform operations for all people. Public hospitals are under the control, observation, and finance of the Ministry of Health (Fralick, Piercey & Scarborough, 2020).

1.7.2 Breakdown of Medical Equipment

Breakdown of medical equipment refers to out of service or out of work medical devices in hospitals due to several reasons such as not using the medical equipment according to the user manual, users' neglect, problems in the electrical power supply, problems in many parts of the

medical device, environment condition, incorrect maintenance, and low durability of the machine or the system (Intermed, 2020).

1.7.3 Maintenance

Maintenance is the process in which medical equipment can be repaired to ensure it returns to the operation mode of the industrial standard. Maintenance can be performed by the BMETs or by the biomedical engineering service of the supplier company (Salim & Mazlan, 2019).

1.7.4 Financial Aids

Financial aids are the amount of money given to public hospitals, so that they can offer healthcare service to patients for free or for a small amount of money. The amount of money given by the government depends on the yearly budget of healthcare. Financial aids can be given as a donation by any organization or benefactor. The financial aids also help public hospitals to buy medical equipment, give the salaries and perform maintenance for medical equipment to prevent its breakdown (Snider, 2019).

1.7.5 Organizational Neglect

Organizational neglect is defined as the absence of interest at work and commitments to business tasks entrusted to supervisors or line managers due to lack of interest in the staff by the management. Things that can make workers interested in work are bonuses, trainings, certifications, and upgraded pay. The result of organizational neglect in public hospitals is costly and exorbitant as people cannot get suitable healthcare (Kampen, 2015).

1.7.6 Technical Awareness

Technical awareness refers to the human ability to understand the technological environment and use them in daily life in a suitable manner to serve people. Technical awareness depends on personal skills, team development, and communication skills. Technical awareness requires trainings, reading, and keeping up to date with the new daily development of new inventions of new machines and software programs (Gregory & Crispin, 2014).

1.8 Research Organizing

This study contains five chapters. Chapter 1 includes the background, the problem statement, the research questions, the research objectives, the significance of the study, the scope of the study, and the definitions of terms. Chapter 2 is a review of the previous studies about the factors influencing the breakdown of medical equipment, which focuses on financial aids, organizational

neglects, and technical awareness (the independent variables), and the breakdown of medical equipment (the dependent variable). Chapter 3 describes the methodology of the study, which includes the research design, the population, the sample of the study, the instrumentation, data collection tools, and the scale of validity and reliability. Chapter 4 presents the result and findings of the study, and analyzes the data using a Google form analyzer. Chapter 5 discusses the findings, evaluation, recommendations, limitations, future research, and conclusion.

1.9 Summary

This chapter is an introduction to the study which includes the study background, the problem statement, the research questions, the research objectives, the significance of the study, the scope of the study, the definition of terms, and the research organizing.

CHAPTER 2

LITERATURE REVIEW

1.1 Introduction

Chapter 2 focuses on the three factors influencing the breakdown of medical equipment in public hospitals. The three factors are financial aids, organizational neglect and technical awareness. This chapter reviews the previous studies about the three factors. Previous studies varied in terms of talking about one factor or more. Some of them talked about two and three factors together, and some talked about these factors in the context of public and private hospitals in the healthcare sector. Other studies talked about these factors in a different sector other than healthcare. All previous studies helped the researcher to improve factors that negatively affect the success of projects. The types of such studies include books, journals, and research studies. This study describes the factors mentioned using a deductive approach.

1.2 Public Hospitals

A public hospital is a government healthcare facility offering medical services such as treatment, diagnosis, operations, and dispensing medicines according to the type of diagnosis of patients. A public hospital contains different departments equipped with furniture and specific medical equipment. Public hospitals' employees have different functions, and specialists are distributed into two types: specialists responsible for technical work like treatment, diagnosis, operations surgical and medicines, and specialists responsible for administrative work (Non-Professional Services) like admitting, purchasing, accounts, human resources, financial, marketing, information technology, housekeeping, laundry, and warehouses (Fralick et al., 2020).

A public hospital contains different departments that have specific functions in a hospital like a laboratory department, radiology department, intensive care unit department, pediatric intensive care unit department, emergency department, outpatient department, ward department, operation surgery department, recovery department, dialysis department, psychiatric department, nursing department, dietary department, rehabilitation department, central sterilization department, obstetrics, and gynecology department. These departments have medical equipment according to the needs of the department. Furthermore, a hospital contains a pharmacy department, mechanical department, maintenance department, central supply department, and insurance department (Henderson, 2019).

Yemeni Public hospitals are considered the main hospitals which have a bigger number of beds. The larger the number of beds, the larger the hospital will be to accommodate the largest possible number of patients (Akinleye et al., 2019). Most people who do not have healthcare insurance tend to go to public hospitals because they are less expensive than private hospitals ("Wooster Community Hospital," 2019).

1.3 Breakdown of Medical Equipment

Breakdown of medical equipment is the stage in which medical equipment is out of service and stops to serve patients with the diagnosis, monitoring, therapy, and treatment. Breakdown of medical equipment is an issue that occurs to the medical device due to problems with electrical supply, misuse by operators, the end of lifetime of the medical device and lack of maintenance according to the guideline or supply company recommendation. Other marks of breakdown occur when the quality of the device made by the factory is not solid to override the working load. Another cause is the environmental circumstances that increase the probability of the breakdown of any part of medical equipment (Intermed, 2020).

Tadia and Kharate (2020) noted that most causes of the breakdown of medical equipment are human mistakes. They also noted that 40% of the breakdown of medical equipment in public hospitals is attributed to mistakes by operators or the engineers, the electrical power supply or UPSs, and mechanical problems. They analyzed the steps for solving the problems of breakdown of medical equipment by the maintenance department in case there is a complaint in public hospitals as shown in Figure 2.1.

Figure 2.1 The steps for solving problems of breakdown of medical equipment in a public hospital by the maintenance department.

Another cause of the breakdown of medical equipment in public hospitals is the failure that happens to medical equipment at any time. There is no time or schedule for this type of failure to medical equipment. Sometimes, the availability of qualified biomedical engineers is not possible. Even if the qualified biomedical engineer is found to repair the failure, there will be a lack of spare parts to fix this problem, which leads to taking a long time till the medical equipment in a hospital returns to the operation mode (Thapa, Saldanha & Prakash, 2018).

1.4 Maintenance

Maintenance is a step of the procedure to repair medical equipment, or it is a way to preserve medical equipment in the working mode to serve people with healthcare services like monitoring, diagnosis, therapy and treatment (Tadia & Kharate, 2020). There are two types of maintenance: preventive maintenance and corrective maintenance. Preventive maintenance is a type of maintenance that requires planning by qualified service engineers of a supplier company. Therefore, it is named planned preventive maintenance (PPM), which performs the maintenance before any failure or breakdown for any medical equipment. This helps to decrease the number of failures or breakdowns of medical equipment in public hospitals. Qualified service engineers of a supplier company follow the procedure and the checklist of the PPM for specific medical equipment and replace the required parts during the PPM visit like kit maintenance for half a year, kit maintenance for one year, kit maintenance for two years, and kit maintenance for four years. The impact of the PPM is to increase the lifetime of medical equipment in public hospitals

and predict if any part needs to be replaced before breakdown. The increasing number of medical equipment breakdowns indicates poor PPM performed by the service engineers and leads to a decrease in the lifetime of medical equipment (Hupjé, 2018).

Corrective maintenance is the process of repairing the breakdown or failure of medical equipment in public hospitals. This type of maintenance is performed after the breakdown or emergency of medical equipment compared to the PPM, which is performed before the breakdown of medical equipment. Corrective maintenance requires the availability of qualified service engineers and the availability of spare parts in stock (Al-Bashir, Al-Tawarah & Jawwad, 2017). If corrective maintenance is not performed on time due to a lack of qualified service engineers or spare parts, it will cost public hospitals and patients dearly.

There are different levels of maintenance needed for the breakdown of medical equipment in public hospitals. Each level depends on the type of breakdown and the type of medical device. When talking about the type of breakdown, some breakdowns like cleaning the filters and the probe, and checking the cables are easy and can be repaired by an operator. However, some breakdowns, like checking the fuse and the power supply socket, can be repaired only with the help of biomedical engineering in departments of maintenance in public hospitals. Some breakdowns like a failure in power supply, in any mechanical parts and in the PCB parts can be repaired with the help of biomedical engineering in departments of maintenance in public hospitals. Finally, some breakdowns can be repaired only by qualified service engineers of a supplier company. Regarding the type of machine in maintenance, some machines, like CT scan and MRI or complex machine or any medical equipment under warranty or contract with the supplier company, need to be repaired or perform the PPM by qualified service engineers. Some medical equipment can be repaired by biomedical engineers of maintenance departments of public hospitals (“Ministry of Health and Family Welfare,” 2010).

1.5 Financial Aids

“Financial aids” is defined giving assistance or help from one side that has a financial ability to another side that needs financial aids. There are many forms of financial aids like aiding students in scholarships to study, aiding a family to be afford expensive life requirements or for paying salaries to teachers, aiding hospitals to give healthcare to patients, aiding people to create their projects or own business, and aiding universities to open or furnish new departments (Martin, 2020).

Another definition of financial aids is the amount of money given to a specific type of people to complete a part-time of a specific job to encourage them to depend on themselves to get money. This type of aid is offered by the government, colleges, universities, employers, social unions, education lenders, foundations, private scholarships, and fraternal organizations to help people in education, healthcare, projects and other types of benefits (Kantrowitz, 2020).

In this study, financial aids are referred to as the aids given to public hospitals in Yemen. Accordingly, financial aids are defined as a group of aids which are introduced by a local government, donors, companies, organizations, international and neighboring countries to help public hospitals in Yemen to service patients get healthcare.

The factor of financial aid is very important in Yemeni public hospitals. It is considered the core of healthcare because without financial aid, public hospitals cannot provide healthcare services to patients who cannot afford the price of healthcare services like monitoring, diagnosis, treatment and therapy. These services cannot be provided without biomedical equipment which needs financial aid. The factor of financial aid has the ability to continue the processing of healthcare by making medical equipment work without breakdown and stops (Snider, 2019).

Biomedical equipment needs PPM and repairing to continue working, which is very costly. The cost varies from one machine to another. The PPM for a specific medical device like Cobas e411 is used in laboratory departments of public hospitals to assist doctors in diagnosis and give the correct medicines is cost for $3000 (M. S. Aldalali, personal communication, November 14, 2021).

According to A. S. Alqadasi (personal communication, November 14, 2021), the PPM needs $300 for kit maintenance for half a year, and nearly $3800 for yearly maintenance. The cost of randomly spare parts ranges between $200 and $12000, depending on the type of spare parts required to repair machines to return to a working mode. Some public hospitals prefer to contract with a supplier company to avoid the high cost of spare parts and repair. The contract may be for one year, two years or five years. The cost of the contract for the type of Cobas e411 is between $5000 and $7000 yearly. This cost will increase every year because the lifetime of medical equipment will decrease and the number of breakdowns will increase. Therefore, supplier companies need to increase the cost of the contract. If public hospitals do not have a financial budget in this case, there will be no PPM and repairing, which will lead to wrong diagnosis and decrease in patients' care and safety (World Health Organization, 2012).

Previous studies on financial aids. Akinleye et al. (2019) conducted a study to measure the effect of the finance of government hospitals in New York State (NYS) on the quality of medical service and patients' safety. They found strong and stable financial matters in public hospitals. Improving the quality of providing medical services to patients with low cost is achieved by maintaining good quality of medical equipment. The study indicated that when a hospital has strong financial aids, it will give medical services of good quality.

Akinleye et al. (2019) found that the accuracy of diagnosis and medicine affects patients' healthcare service when a public hospital faces a financial crisis due to external factors like the local economy problems of the country. They concluded that if a hospital has a stable and strong financial status, it will provide good healthcare with a systematic plan for servicing patients with good quality. This type of systematic plan helps to choose the correct resources and correct management in hospitals, which will benefit the preservation of medical equipment and protect it from breakdown. The study indicated that strong and stable financial aids would help in getting the correct diagnosis by medical equipment.

Public hospitals have an over-reliance on erratic government funding and agreements with organizations and charitable supporters, which is considered a disadvantage and puts public hospitals at high risk of financial shortage. Public hospitals cannot provide a medical service with good quality when compared with private hospitals that have a good financial return. Financial aid in Yemeni public hospitals is affected by the economic crisis in the country, which has led to difficulty in obtaining financial aid from the government (Myser, 2016). This study indicated that public hospitals completely depend on the financial aid that comes from the government, organizations, and charities, which has a negative effect on medical services.

According to Kim and McCue (2008), old medical equipment needs to be replaced because its lifetime has passed, and cannot serve patients properly. Therefore, public hospitals need capital investment like financial aids or donations to be able to purchase or refurbish all the necessary medical equipment to serve patients properly. The results of their study showed that public hospitals must preserve medical service provided to patients and meet public healthcare desires by extending and promoting medical equipment owned by public hospitals and adding new departments and services. This cannot be achieved without financial investment or financial aids which need strong management to predict the plan growth for public hospitals. The results of the

study showed that public hospitals need to have financial aids for repairing, refurbishment, and renewing medical equipment in hospitals.

The financial stability of public hospitals, which forms the foundation of the healthcare system, determines its viability. To do this, public hospitals must have competent and stable financial management (Curtis & Roupas, 2009).

Medical equipment in public hospitals requires much money for repairing and performing PPM, especially those devices used in radiology and laboratories. Furthermore, the financial aid will help public hospitals not only in the PPM and repairing, but also in choosing the suitable durability and strong medical equipment as a first stage and in regulating cost as a second stage. As shown in Table 2.1, financial aids will assist to build maintenance departments in public hospitals by providing the necessary resources like biomedical engineers, engineering tools, stock of the spare parts, and contract with the supplier companies to perform the repairing and PPM needed (World Health Organization, 2012). This study indicates that financial aids help to select medical equipment with durability and perform the PPM and repairing required for medical equipment.

Table 2.1

Financial Resources Required for Maintenance Program

	Initial cost	Operation cost
Physical Resources	Space, tools, test equipment, computer resources, vehicles.	Operation, utilities, maintenance, calibration.
Human Resources	Recruiting, initial training.	Salaries, benefits, turnover, continuing education.
Direct Maintenance	(Not applicable)	Service contracts, parts and materials, travel, shipping.

According to Dong (2015), when a country faces an economic crisis, the healthcare field will be negatively affected, and the consequences will appear. Public hospitals will not be able to get financial aids from the government and cannot get the profit from patients because public

hospitals are giving medical services to patients with low cost depending on the financial aids coming from the government. The conclusion of Dong's research (2015) is that a hospital might close and no longer service will be given to patients due facing a financial crisis. However, some public hospitals do not close and continue working with low quality. When public hospitals work with low quality, patients will tend to go to private hospitals to get good service. Sometimes public hospitals advise patients to go to a private healthcare center or private hospitals to get good medical service. The study by Dong (2015) indicated that public hospitals cannot provide medical services if there are no financial aids from the government due to financial crisis.

According to Bajpai (2014), some public hospitals keep providing medical healthcare to the community even if there are some difficulties with the resources like the lack of financial aid. Therefore, intelligent workers will move from public hospitals to private hospitals because they are looking for the best chance and best salaries. The study showed that intelligent workers would leave public hospitals for private hospitals to get the best salaries, which means the impact of financial aids on medical services in public hospitals.

According to Heever (2009), the country's government in South Africa allocates a yearly budget to every local health division for providing resource requirements like human resources, financial resources, and medical equipment to give health care services to patients.

Public hospitals need regular and consistent financial aids to provide medical services to patients continuously (Stuart, 2020). Because of a crisis in a country, most public hospitals cannot deal with a financial crisis and need professional management to decrease the negative impact on medical services such as working condition of medical equipment (Stuart, 2020).

When there are poor financial aids in public hospitals in the US, hospitals cannot respond to patients and remain in a health care system to face public health terrorizations. Therefore, public hospitals in the US need rules and sustainable finance to help make a strong base of public health (Alfonso, Leider, Resnick, McCullough & Bishai, 2021). On the other hand, Alfonso et al. (2021) concluded that strong healthcare in public hospitals in a country means priorities are supported with financial aids by the government. In contrast, when there is poor health care in public hospitals in a country, there will be no financial aid by the government. To sum up, the previous four studies indicated that public hospitals must have stable financial aids to continue providing medical services to patients.

According to Bektemur et al. (2018), biomedical engineers in maintenance departments of public hospital are responsible for future financial planning in maintenance departments because without financial resources in public hospitals, biomedical engineers will not be able to perform any repairing and PPM for medical equipment. Financial resources have a strong influence on the health care service. Financial programs can cover the cost of spare parts and labor cost to repair medical equipment. Therefore, there are a lot of medical supplier companies with different brands and a strong financial program in hospitals can choose the strongest brand. This study indicates that financial aids in public hospitals will assist biomedical engineers to perform the maintenance required to keep medical equipment in a working mode.

When public hospitals do not receive financial aids from the government due to a financial crisis in the country, hospitals will not be able to serve patients with good medical service. Therefore, the best way is to transfer the business from public hospitals to private hospitals control (privatization) to improve the financial performance and introduce the health care service to people (Ramamonjiarivelo, Weech-Maldonado, Hearld, Pradhan & Davlyatov, 2020).

Heever (2009) pointed out that when a public hospital faces a financial crisis, it is not necessary to get financial aids from the government or any organizational donation. However, there are some points the hospital should take into consideration for controlling and enhancing the financial performance. First, the hospital needs a professional in financial issues. For instance, a financial officer needs to control the expenditure, coordinate with the maintenance department to perform the schedule PPM and prevent any emergency breakdown in medical equipment. A professional also needs to charge a nominal fee for the services provided to patients, disburse the financial reward for the employees who work extra to motivate them, perform the necessary training for the employees, and pay other expenses.

Serra, de Almeida and Ferreira (2013) pointed out that the lack of financial resources like turnaround failures, inadequate management, and turnaround strategy to the demise of an organization affects organizations. Romero, Ventas, Barrio and Torres (2013) argued that public financial aids are effective because they improve recipients' performance in the beginning and increase the existence of variations in the average values of efficiency indicators according to the type of help received. The previous two studies showed that the lack of financial aids affects hospitals' managements and consequently affects the healthcare service provided to patients.

1.6 Organizational Neglect

Neglect is usually progressive and begins with a habit if there is no plan by employees or monitoring from leadership management (Kampen & Henken, 2017). Neglect is a type of abuse by humans caused by a lack of attention, often via carelessness or contempt for others' needs. There are many types of neglect such as physical neglect, emotional neglect, financial neglect, self-neglects, and organizational neglect (Massey-Stokes, 2018).

Organizational neglect is a form of dissatisfaction about a current job followed by less productivity during work, disobedience for the line manager order, less effort given at work, not arriving on time and talking for a long time at break time. Job neglect can be infectious to some employees because some employees can show unwanted behavior alike (Karimi, Gilbreath, Kim & Grawitch, 2014).

According to Harpwood (2001), neglect in the workplace is referred to as a lack of or inability to oversee and govern an organizational development for an extended period. Neglect is made by lack of making the performance demands and performing working standards results in patterns of negative interaction between management and employees (Kampen, 2015). In a tough lawful sense, neglect involves more than negligence or thoughtless attitudes whether in omission or commission. It also involves the complex of obligation, breach, and loss incurred by the person to whom the duty is owed (Addison, 1972).

Studying the factors of neglect in an organization, especially in public hospitals, is important to know the causes that lead to employees' neglect. Neglect in the workplace, especially in public hospitals with medical equipment, is very unimaginable. It affects patients and the resources of hospitals. According to Addison (1972), negligence can be a criminal offense because it shows such a complete disregard for the lives and safety of others, which amounts to a crime against the state, and neglectful people ought to be punished. A supervisor can have a significant effect on employees' neglect in the workplace because he is directly supervising employees (Karimi et al., 2014). It is very important to address neglect in public hospitals because if it is not treated, it will become a habit for employees (Kampen & Henken, 2017). Neglect is very risky to public hospitals, especially when there is no alarm coming to business (Kampen, 2015). Therefore, it is very important to raise awareness of employees about the risk of neglect in public hospitals because they are working to serve people and save the resources of public hospitals. Neglect is

very bad for the growth of the Yemeni economy, especially these days during the financial crisis in Yemen.

Previous studies on the organizational neglects. Most breakdowns of medical equipment are caused by the neglect of operators and technicians in public hospitals (Bektemur et al., 2018). According to Salim and Mazlan (2019), the misuse of medical equipment by operators or technicians is the cause of the breakdown of medical equipment in public hospitals, which is named the carelessness of the hospital staff. The two previous studies indicated that the breakdown of medical equipment is attributed to neglect and misuse of operators.

According to Karimi et al. (2014), in American public hospitals, employees take a long time to eat their lunch, and they perform their personal tasks in surfing the Internet and chatting with friends during the working hours. Employees also get out of work during the working hours and let colleagues do their tasks. Generally, Karimi's study indicated that there is job neglect by employees in public hospitals in the US.

Manyisa and van Aswegen (2017) pointed out that organizational neglects are affected by the working condition factors (employees working around or the working environment in public hospitals, employees' working load during their duty, long working hours, shortage of employees, lack of bonuses and rewards, lack of healthcare insurance and others).

According to Kampen (2015), neglect in an organization is caused by the doubt between the management and employees. Kampen (2015) pointed out that the management must be fast in responding to employees to overcome any organizational neglect. Otherwise, maintaining personal dignity is a priority for employees over providing service to patients and achieving the organization's goals. To sum up, the two previous studies showed that when there is no interest in employees by the management of an organization, it will lead to organizational neglect by employees.

According to Dash and Jena (2020), neglect in the workplace appears in employees' act. Neglect can be seen through incomplete objectives, carelessness about the organization rules, permitting to break the laws, distrust, and bad attitudes towards the management and customers. Neglect will be a risk to the organization's objectives in the long term. Maybe the causes of neglect in the workplace are discrimination, harassment, and carelessness about employees by the line managers, supervisors, and colleagues in the organization. Dash and Jenan's study showed that

employees' neglect in an organization is attributed to discrimination, harassment of the line managers and supervisors.

Prolong neglect in the workplace depends on several factors in an organization. The factors can be the organization's development history, the features of major processes, the board of directors' dedication, senior management and support staff's attitudes concerning potential neglect, and direct supervisors' posture (Kampen & Henken, 2017).

Neglect in the medical sector costs many millions of pounds in England, and the rising rate is 25% annually. Furthermore, neglect in the medical sector affects patients and decreases the financial resources of hospitals (Towse & Danzon 1999). The medical sector suffers from neglect financially. Therefore, it is important to start investing in employees' training to increase the technical awareness about serving patients. According to Quinn (1998), healthcare sectors lose a lot due to clinical negligence by operators. The two previous studies showed that there is negligence in the healthcare sector, and it is very costly to public hospitals.

According to Harpwood (2001), medical negligence in Britain causes the loss of nearly sixteen new hospitals due to allegations by patients who were subjected to mistreatment and misdiagnosis resulting from this neglect. Harpwood (2001) pointed out that not all mistakes in the treatment or mistakes in diagnosis are considered negligence. The medical staff works with great effort, but sometimes the situation of a patient is very hard to survive during the operations. This study indicated that neglect in healthcare causes a loss in the budget of a hospital because compensation is requested by patients.

1.7 Relationship between Financial Aids and Organizational Neglects

When a public hospital has a strong financial income like cash flow or support of financial aids, it will employ staff with good quality and experience, commitment and responsibility to their work. When a public hospital rewards the staff via bonuses and high salaries , it will get the loyalty (Akinleye et al., 2019).

Akinleye et al. (2019), pointed out that when public hospitals face a financial crisis, the staff starts to neglect their working duties or submit their resignation and search for a new job in other hospitals, which consequently affects the medical health services.

There is a lot of neglect by employees who cannot get enough salaries in public hospitals due to lack of financial aids. Those employees tend to move from public health sectors to private health sectors, which affects the healthcare community (Bajpai, 2014). According to Kampen (2015),

the best way to eliminate employees' neglect in the workplace is by building a strong relationship between management and staff. Furthermore, it is much recommended to support the staff using financial rewards. When there is a poor quality of financial performance in public hospitals, there will be a bad medical service situation due to the neglect by employees who cannot receive the motivation in public hospitals and tend to search for other jobs in other positions (Heever, 2009). According to Kampen and Henken (2017), most neglect in an organization is attributed to the management of the organization. The reason can be the general manager, the line manager, the head of a department and the supervisor. When employees are not satisfied financially, they start to neglect the workplace due to lack of response from the management to their demands for extra rewards or increase in the monthly salary.

Karimi et al. (2014) stated that, "Supervisor's behaviors are associated with job neglect." Therefore, the best way to decrease employees' neglect is to decrease the negative effect superintendents because when there is a negative effect of superintendents on employees, employees tend to neglect the workplace and they do not do their job perfectly. All in all, superintendents have the ability to support employees either negatively or positively.

According to Hickson (2014), the success of a project cannot be achieved without managing the financial and human resources. Therefore, when there is good financial support for a project, the project manager can plan, process and complete the project successfully. However, if there is a shortage or no financial support for a project, the project cannot bring the human resources, which leads to the project failure.

1.8 Technical Awareness

Technical awareness refers to the person or people who are attentive to the recent technology, which has become popular and accepted in our lives, and they can be used to serve people in the market and industry. It also includes the ability of a person or people to understand the usefulness of technology in the success of business ("Technology trend awareness," 2016). Hosman and Comisso (2020) defined the concept of awareness as a perception of a phenomenon. They argued that the operationalization of awareness is extremely challenging because it is a relative notion with many different interpretations. Therefore, awareness is defined as the capacity to notice patterns in a given environment and manage new problems without having to know all of the system's contemporaneous aspects. Hosman and Comisso also defined the combination of socio-technical awareness as the capacity to perceive patterns and settings within

socio-technical systems. Socio-technical awareness includes the capacity to comprehend and develop new interactions with technology within the complex socio-technical systems in which humans and technologies interact.

Technical awareness is the activities of the brain about how someone can get access to the objects and how someone is aware of this type of object (Clifford, Arabzadeh & Harris, 2008). Technical awareness is a sense of responsibility by the operator, technician, and biomedical engineer of the medical devices they use to reduce the number of breakdowns in public hospitals (World Health Organization, 2012). The awareness of using tools by biomedical engineers is needed to help them perform the PPM and corrective maintenance and use the Internet to access training, seminars, online development, and computer skills to communicate with others and supplier companies.

Situation awareness means the ability to move around, operate equipment, or manage a system with the most up-to-date cognizance or awareness. Situation awareness has arisen as a psychological concept in the applied behavioral science field, akin to intelligence, alertness, attention, tiredness, stress, compatibility, and workload (National Research Council, 1998).

Technical awareness in the healthcare sector is important to improve and keep technology up to date. When an operator, technician, or biomedical engineer has technical awareness about medical equipment in public hospitals. They can maintain medical equipment in a working mode without breakdown because they have knowledge about different medical equipment. Technical awareness helps to reduce the time consumption to perform the treatment or diagnosis for patients. It also helps to send the result directly to patients' mobile phones without wasting time ("Technology trend awareness," 2016). It is very important that employees have training and skills during work because the investment in employees' training in the medical sector is very important to reduce technical errors with patients (Towse and Danzon 1999). It is important that surgeons, for example, have technical awareness to gain a deeper understanding of the technical features of medical devices (Campanile & Campanile, 2020). Employees' technical awareness is considered an extremely successful investment in the future (Palka, Brodny & Stecul, 2017).

Technical awareness needs training and experience which is very important to decrease the risk of using medical equipment (Quinn, 1998). Many patients will benefit from technical knowledge since they will be able to view the results of their tests on their computers or mobile phones.

They can access the site of a hospital or laboratory to see the result on their mobile phone. ("Technology trend awareness," 2016).

Previous studies on technical awareness. Public hospitals need skilled, trained, and experienced employees like operators, technicians, and biomedical engineers to deal with biomedical equipment. They will be aware of dealing with medical equipment during their work. Operators or technicians, for example, will be aware of using biomedical equipment and performing daily maintenance, calibration, and quality control to test whether medical equipment is working in normal conditions without any errors. Technical awareness of biomedical engineers will help to perform the PPM (when, where, and how), and predict and prevent any breakdown for medical devices (World Health Organization, 2012). The study showed that staff that deals with medical equipment must have technical awareness to help decrease the breakdown of medical equipment.

According to a journal article by Bajpai (2014), good public hospitals with awareness of medical equipment provide patients with a good service because they know good medical equipment for treatment and diagnosis. All of this can be done with a good education program for the staff of public hospitals, especially those who have the intelligence to convert this science into practical life in big challenging circumstances in healthcare service. The study showed that technical awareness of staff would maintain a good condition for medical equipment.

Roughly 55% of technicians lacked the necessary educational qualifications to handle medical equipment, and about 15% were not provided training when the equipment was purchased. Likewise, some managers are not aware of the importance of the maintenance procedures and management of maintenance to get smooth and effective operation of their organizations (Tadia & Kharate, 2020).

Operators, technicians, and biomedical engineers of public hospitals need training by a supplier company to have technical awareness to prevent any breakdown of a medical device resulting from misuse (Bektemur et al., 2018). To sum up, it is important for staff dealing with medical devices to have training to deal with medical equipment.

One of the most important things to keep medical equipment working is fast repairing after the breakdown, which requires an inventory of spare parts available in public hospitals. This can be done by experienced, trained, and skilled biomedical engineers in maintenance departments.

Furthermore, trained and skilled clinical staff will help to keep medical equipment in operation (World Health Organization, 2011).

According to Karimi et al. (2014), when an organization selects a supervisor, it is very important to use the selection technique and conditions like experience, management training, objective setting, and feedback responsive to ensure the supervisor has technical awareness. According to Salim and Mazlan (2019), the breakdown of medical equipment occurs due to many factors. One of these factors is the misuse of operators and technicians due to low skills and training and lack of technical awareness. The previous three studies showed that the staff and management should have necessary skills and experience for technical awareness to help reduce the breakdown of medical equipment.

According to Thapa et al. (2018), reducing the breakdown of medical equipment is achieved by performing periodic training for biomedical engineers on how to handle medical equipment during the hopper cleaners and sterilization by any department of a hospital to prevent any damage to the PCB or any parts of medical device. Training is important to prevent the steam from entering a medical device and to check it after the cleaner and sterilization to enhance the lifetime of medical equipment, and this positively affects the financial stability of a hospital. Finally, the study mentioned that a biomedical engineer must have training of technical awareness to deal with medical equipment.

Iyer and Bandyopadhyay (2000) pointed out that training employees in any organization should be both technical training and awareness training. Awareness training will help employees to learn the methods of limiting risks and loss of data, equipment, and supplies for many sorts of probable interruptions. On the other hand, technical training involves the knowledge of technical failures due to unreliable equipment and applications, power outages, and the system's failure to satisfy users' expectations. The study indicated the necessity of technical awareness training.

According to Al-Bashir et al. (2017), medical equipment in developing countries is misused by operators, and there is no suitable maintenance due to the lack of technical awareness by maintenance departments in hospitals. Medical supplier companies reported that customer training is not enough as the main factor because technical awareness is necessary for employees to prevent the breakdown of medical equipment. Furthermore, the quality of medical devices, using inappropriate devices, low level of information, lack of documentation and plan of services are causes of the breakdown of medical equipment in any health sector (Quinn, 1998). The two

previous studies pointed out that operators and biomedical engineers need required training and information to get technical awareness.

The team members in any organization need to have technical awareness of the diversity field with good knowledge and collaborate with each one. Therefore, it is very important to know the needs of an organization and the importance of technical awareness in this field, and recommend hiring experienced staff (Gregory & Crispin, 2014).

Everyone can keep himself updated to improve technology awareness skills by reading particular topics and attending seminars about the newest technology in the relevant sites. Technological news can be followed on Twitter, Facebook, and other social media ("Technology trend awareness," 2016). The two studies pointed out that technical awareness needs to be up to date with the new technology and inventions in the healthcare field. With the increasing awareness of healthcare and wellness issues, patients will soon begin to take a larger role in the whole care process. Many new-age apps dealing with preventive and continuous monitoring of health are already driven by healthcare consumerism ("Technology's role in addressing India's healthcare challenges." n.d.).

According to Hosman and Comisso (2020), when a person uses information and communication technologies for technical awareness, he can access digital gadgets or the Internet to benefit from devices, connectivity, or training, which may be provided by governmental organizations, non-governmental organizations or development agency programs. Hosman and Comisso's study opposes communications rules that may hinder or encourage firms and governments to invest in infrastructure and maintenance in order to offer inexpensive connectivity in a given place. To conclude, the two previous studies indicated that using technology in healthcare is one of the reasons for increasing technical awareness.

Palka et al. (2017) pointed out that the major problem of technical awareness of the new technological machine is the lack of appropriate training for the staff about a new technological machine. Furthermore, they found the lack of handling skills and technical knowledge and the fear of the unknown by employees are reasons for low technical awareness. The study showed that the lack of technical awareness is attributed to the lack of training for the staff.

1.9 Relationship between Financial Aids and Technical Awareness

Akinleye et al. (2019) argued that as public hospitals have a financial strength, there would be a plan for their staff to be developed by a training program. A management department in public

hospitals must consider the awareness of technology during choosing the proper medical devices required. As financial aids are important in public hospitals for upgrading and purchasing medical devices, it is very important to have a staff that has experience and technical awareness for decision making and choosing the proper medical equipment in public hospitals to last a long lifetime in the future. Furthermore, the financial aid will help employees to have the training required and will increase the technical awareness because public hospitals with strong financial support can prepare and manage the training schedule for their employees by arranging with a supplier company or the manufacturer (World Health Organization, 2012). The financial stability in public hospitals helps to perform a training program for biomedical engineers in the maintenance departments of hospitals. Training may include a workshop, preparing a stock of spare parts required for fast responding to any breakdown of medical equipment, the tools needed for repair, calibration and adjustment, and reducing the time of medical equipment breakdown (Thapa et al., 2018). A training program does not necessarily require financial load by hospitals; it can be done by the supplier of medical companies after installation of new medical devices (Palka et al., 2017).

1.10 Theoretical Framework

The chart in Figure 2.1 shows the relationship between the breakdown of medical equipment in public hospitals and the three factors: financial aids, organizational neglects and the technical awareness. Figure 2.1 shows the independent variables: financial aids, organizational neglects and technical awareness and the dependent variable: the breakdown of medical equipment in the public hospital.

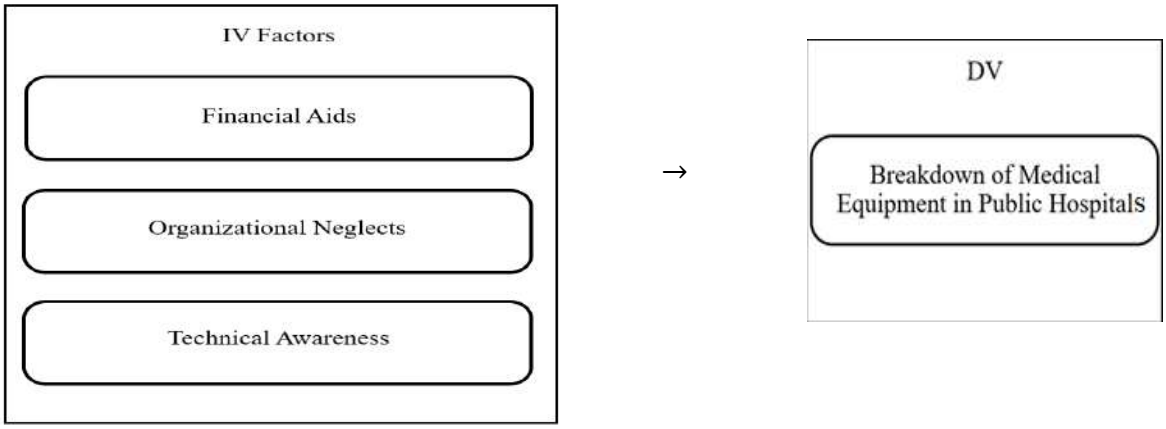

Figure 2.2 Theoretical framework.

1.11 Hypothesis Development

Based on the review of previous studies, there is a relationship between the breakdown of medical equipment in public hospitals and the three factors: financial aids, organizational neglect, and technical awareness. Therefore, the hypotheses were developed to answer the three research questions are the following:

H1: There is an impact of financial aid on the breakdown of medical equipment in public hospitals.

H2: There is an impact of organizational neglect on the breakdown of medical equipment in public hospitals.

H3: There is an impact of technical awareness on the breakdown of medical equipment in public hospitals.

1.12 Summary

Chapter 2 reviews the previous studies on the impact of the independent variables: financial aids, organizational neglect, and technical awareness on the dependent variable: breakdown of medical equipment in public hospitals. Some studies examined these factors in the healthcare sector, and other studies examined these factors in other fields other than the healthcare sector. Finally, this chapter discusses the development of the theoretical framework and hypothesis development.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains how the study is conducted in order to collect data, test hypotheses and answer research questions. It also presents the instrument used in this study, and the data analysis technique followed to test the relationship between the independent variables: financial aids, organizational neglect, and technical awareness and the dependent variable: breakdown of medical equipment in public hospitals.

3.2 Research Design

Quantitative research is a method of investigating objective hypotheses by looking at the relationship between the variables. This approach is one of the deductive approaches, as it builds upon existing theories to test and validate these theories (Sukamolson, 2007).

Qualitative research is a comprehensive inductive approach to learning, which entails exploration. Qualitative research may also be defined as a detect model that takes place in a natural context and allows a researcher to build a degree of depth via active participation in the actual events in which a researcher can build a theory from observation (Williams, 2007).

The main difference between quantitative research and qualitative research is that quantitative research answers to study problems that necessitate numerical or statistical data, whereas qualitative research necessitates textual data (Williams, 2007). Another difference is that quantitative research requires confirming the theory, whereas qualitative research requires observation to build a new theory (Williams, 2007).

This study is deductive in nature and is based on quantitative research design. The study is conducted in the healthcare sector of Yemeni hospitals to describe the impact of the factors like financial aids, organizational neglect, and technical awareness as independent variables that influence the breakdown of medical equipment which is a dependent variable in public hospitals.

Exploratory research explores the problem faced by a researcher to provide visions and understanding for more accurate analysis. It focuses on the exploration of concepts and ideas (Surbhi, 2017). However, a descriptive study is a sort of scientific study that focuses on defining the features of a certain person, group, situation or phenomenon. It comprises particular forecasts, a person or group's characteristics or functions, and the recounting of facts. This type of study reduces bias and increases reliability (Surbhi, 2017).

When we have an idea about something in the world, we need to perform formal processing verification about this idea using statistical methods. This is exactly a hypothesis testing study, which arises from theories and is used by scientists to test specific forecasts (Bevans, 2021).

The main difference between exploratory research and descriptive research is that exploratory research is flexible and unstructured and has non-probability sampling and no pre-planned design for analysis, whereas descriptive research is rigid and structured and has probability sampling and a pre-planned design for analysis (Surbhi, 2017). This study is descriptive in nature as it

describes the factors influencing the breakdown of medical equipment in public hospitals in Yemen.

There are two types of research investigation. One is the causal study that examines the relationship between cause and effect. This means a change in the independent variable, and it leads to a change in the dependent variable (Bhasin, 2020). The other one of research investigation is the correlation study, which is defined as the relationship between two variables using statistical analysis without using experimental research. A change in one variable leads to a change, increase or decrease or no change, in the other variable (Wu et al., 2021) The main difference between a causal study and correlation study is that a causal study involves a cause-and-effect relationship between variables, whereas a correlation study is a statistical indicator of the relationship between variables. This study follows the causal type of investigation as it examines the effect of independent variables or factors: financial aids, organizational neglect, and technical awareness on the dependent variable, breakdown of medical equipment in public hospitals.

It is important to use questionnaire survey tools to help collect the data from the target audience. The questionnaire of this study is an online survey and it has features like cost-saving, reaching people quickly, respondent anonymity, flexibility for respondents over where and when to complete their questionnaire, and data accuracy. The questionnaires were distributed to the target audience who are working in the healthcare sectors in public hospitals and medical equipment supplier companies in Yemen.

3.3 Population and Sampling

The population in research is the number of targeted audiences or a group of people required by a researcher to perform the research investigation. For example, customers may visit a specific mobile application to buy international brand clothing. The element is a single member of the population (Sekaran & Bougie, 2019). The sampling is a subset of the group if we talk about the entire customers who visit a specific mobile application to buy international brand clothing. For instance, if there are 800 visitors, the researcher will take 250 of the 800 visitors as a sample of the study (Sekaran & Bougie, 2019)

2.3.1 Population

The population of this study comprises the healthcare sectors of laboratories in public hospitals and medical supplier companies in Yemen. The number of the population is 500. The participants are employees in different functions in laboratories of public hospitals, and they deal directly with medical equipment. They are operators, technicians, biomedical engineers, and managers, and biomedical engineers and application services who work in medical supplier companies. They have different ages, genders, qualifications, and experience.

2.3.2 Sampling

The sample of this study includes biomedical engineers working in the maintenance departments of public hospitals, and biomedical engineers working in medical supplier companies. The sample also includes operators, technicians, managers of laboratory departments in public hospitals, and the application services workers in the medical supplier companies in Yemen. The sampling was taken from public hospitals in Sana'a: Al Thawra Modern General Hospital, Al Jumhoury General Hospital, Kuwait University Hospital, Military General Hospital, National Blood Transfer Research Center, National Center of Public Health Laboratories, and Al Sabeen Maternity and Childhood Hospital. In Mukalla City, the public hospitals include Ibn Sina General Hospital, National Blood Transfer Research Center, and National Center of Public Health Laboratories. In Seiyun City, the public hospitals include Seiyun General Hospital, Tarim General Hospital, National Blood Transfer Research Center, and National Center of Public Health Laboratories. In Ibb City, the public hospitals include Al Thawra Modern General Hospital. The medical supplier companies in Sana'a are Dieda Corporation, Biolab Corporation, and Natco Al-Razi Company. The sample is convenience sampling because the population who are conveniently available to provide the information (Surbhi, 2017). The sample size in this study is 220 individuals who are the most favorably placed to provide the required information.

3.4 Instrumentation

A questionnaire is a group of questions which can be arranged and sent by a researcher to responders in order to collect the research data. A questionnaire is considered a quantitative design to collect data. It can be given out in person or sent out electronically to responders. The specifications of a questionnaire are less expensive and require less time compared to an interview, but it is prone to errors and sometimes it gets no response from respondents to the questionnaire (Sekaran & Bougie, 2019).

A questionnaire consists of four parts. The first part is about the demographic and general information of responders like the gender, age, level of education, level of experience, and job title. The second part is about the measurement about the independent variable of the financial aids. The third part includes the measurement of the independent variable of organizational neglect. The fourth part consists of the measurement of the independent variable of technical awareness. Under the measurement of the variables, responders are requested to specify their level of agreement with items by using a 5–point Likert scale (5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree).

3.4.1 Financial Aids Measurement

Measuring the financial aids involves the formulation of some questions from other studies talking about financial management. Some of the questions of this research were formulated through the researcher's experiences after they were reviewed by the judgment commission at the LIU (see Appendix A).

3.4.2 Organizational Neglect Measurement

Measuring organizational neglect involves the formulation of some of the questions from other studies talking about organizational neglect in organizations. Some of the questions were formulated through the researcher's experiences after they were reviewed by the judgment commission at the LIU (see Appendix A).

3.4.3 Technical awareness Measurement

Measuring the technical awareness involves the formulation of some of the questions from other studies talking about technical awareness. Some of the questions were formulated through the researcher's experiences after they were reviewed by the judgment commission at the LIU (see Appendix A).

3.5 Data Collection

Data collection is defined as the process of acquiring and measuring information on the research study's goal variables in any field either business, government, or academic purposes (Bhandari, 2020). There are two types of data. The first one is primary data which is collected by a researcher to understand and solve the topic problem in research. This type of data is collected via surveys, interviews, or experiments. The second type is the secondary data, which is found in previous researches, institutes, universities, and other sources. This type of data is required for verifying data files. The difference between primary data and secondary data is that primary data

are involved in research problems and take a long time and money to be collected. However, the secondary data not specific, so they are quick to be obtained in the researcher's needs. They are not expensive and are considered past data (Wagh, 2021).

In this study, the researcher used primary data collected from online questionnaires and secondary data collected and improved from previous research about financial aids, organizational neglect, and technical awareness.

There are three methods for collecting data. The first one is the interview method. It is defined as a one-on-one situation in which two persons meet. The interviewer asks questions, and the interviewee gives answers that have information needed for research data (Hickson, 2014). The second one is the questionnaire, which is a group of questions arranged and sent by a researcher to respondents in order to collect data required by a research study (Sekaran & Bougie, 2019). The third method of data collecting is the observation method, which is defined as the technique used by a researcher to observe people over long periods of time and converse with them about what they are doing, thinking, and saying in order to gain better knowledge of a social group under investigation (Sekaran & Bougie, 2019). The type of data collection method used by the researcher in this study is the online survey. There are advantages to online surveys. It is much easier and faster. A researcher can access persons in remote regions and can reach difficult-to-contact participants. An online survey is known for its simplicity of automated data collection and it saves time and effort for researchers (Wright, 2005). Another benefit of an online survey is that it is far more convenient to send responses by clicking a button rather than going to a post office (Lefever, Dal & Matthíasdóttir, 2007).

2.6.1 Instrumentation Translation

The questionnaire of this study was written in English. Then it was translated to Arabic because it is easier for the respondents to understand the questions and give the correct answer in Arabic. The researcher translated the questionnaire by using Google Translate, and it was reviewed by the researcher’s supervisor at the LIU.

2.6.2 Administration of Questionnaire

The researcher used a Google form to design the questionnaire, and the respondents' answers were collected by using the Google form. The participants needed between ten to fifteen minutes to complete the survey. The online survey was left available for two weeks, and the repeated

response button was disabled to prevent the redundancy of the same respondents. Each respondent received the survey link via a WhatsApp text message with instructions.

2.7 Scale Validity and Reliability

The terms "reliability" and "validity" are used to measure the quality of research (Middleton, 2019). The scale validity refers to how well observations correctly reflect the behavior you are interested in, whereas reliability refers to the consistency of the results of measurement, which take much time in different events and give the same results (Sekaran & Bougie, 2019). Reliability is involved in situations when two or more respondents give the same result in the same test at a different time (Cheung & Tai, 2021). The measurement of the score obtained must be consistent across the time by using a collection of individuals at one time and by using it again with the same collection of individuals later. Any measurement has a different result today from the previous result at a previous time is considered unreliable (Price, Jhangiani & Chiang, 2015). When researchers create a research design, it is important to create the reliability and validity of the variables involved in the study. When researchers perform a study on the variables of the same individuals at a different time, the same result must be obtained to ensure that the result is stable, precise and reproducible. However, if a different result is obtained on the same individuals and at a different time, it means the answer obtained is not correct and the researcher cannot depend on the data results (Middleton, 2019). Schnell (2018) says, replication is a fundamental foundation of research; without it, how can we be sure a study wasn't duplicated only due to measurement error.

The scale reliability of the questionnaire of this study was measured by using Cronbach's Alpha to ascertain the internal consistency. Table 3.1 shows the output of the Cronbach Alpha test to all the questions of the questionnaire. The amount of reliability coefficient for the total survey for all factors is 84.3%, which means that the questionnaire is good and reliable ("Cronbach's Alpha: Simple definition, use, and interpretation," 2021).

Table 3.1

Cronbach Alpha

Variable	Cronbach Alpha	No. of Items
Financial Aids	72.9%	9
Organizational Neglects	66.0%	9
Technical Awareness	80.7%	8
All Variables	84.3%	26

2.8 Data Analysis

The method of data analysis is critical for answering the study questions (Sekaran & Bougie, 2019). This study utilizes the SPSS for analyzing the data collected from the questionnaires. The SPSS offers statistical methods like correlation analysis, descriptive statistics, one sample test, and reliability analysis. The correlation coefficient defines the direction and strength of the link between the variables (Sekaran & Bougie, 2019). The reliability evaluation is checked to ensure that the measures are fit for purpose. The descriptive analysis was used to define the respondents' characteristics. One sample test was used to test the hypothesis (Beers, 2021). Frequency analysis is a type of descriptive statistics that is useful in the field of statistics to deal with the number of times something is repeated ("What is frequency analysis," 2013).

2.9 Summary

Chapter 3 discusses the research methodology for the population sample, instrumentation, data collection, and analysis of the study. It describes how the population and sample were selected. It also describes how the questionnaire was designed and distributed to the participants. Finally, this chapter gives information about the data analysis conducted using statistical tools.

CHAPTER 4
DATA ANALYSIS

3.1 Introduction

Chapter 4 presents the data analysis to test the research hypotheses, which focuses mainly on the factors influencing the breakdown of medical equipment in public hospitals in Yemen. This chapter starts with data screening and describes the sample profile of the selected respondents presented as statistical frequency through figures and tables. Furthermore, the descriptive statistics is explained to determine the importance of the research variables. The chapter also presents the results of the correlation analysis, which explains the relationship between all variables. At the end of this chapter, the hypothesis testing is explained to know whether the research hypotheses are supported.

3.2 Data Screening

According to Subramanian (2020), before you undertake any statistical studies, make sure your data is clean and ready to go in order to analyze the relevant questionnaire data of the targeted sample. In this study, 220 questionnaires were sent to participants, but only 151 questionnaires were received. The questionnaire was kept available to the participants for two weeks, from December 24, 2021 to January 7, 2022.

4.2.1 Erroneous Data Entry

The researcher thinks that there were no data entry errors, for the responses in the generated excel file were in words rather than numbers, and the data codes were reversed from words to numbers.

4.2.2 Missing Values

Because the questionnaire was provided to the respondents online and all of the items were answered, there are no missing values in the study data.

4.2.3 Normality Assessment

Table 4.1

Normality Assessment

	Skewness	**Kurtosis**
Financial Aid	-.495	.726
Organizational Neglects	.082	.134
Technical Awareness	-.099	-.119

In Table 4.1, all the values of kurtosis and skewness are within ±1, indicating that the data followed normal distribution. Therefore, parametric tests are to be used in the inferential statistics.

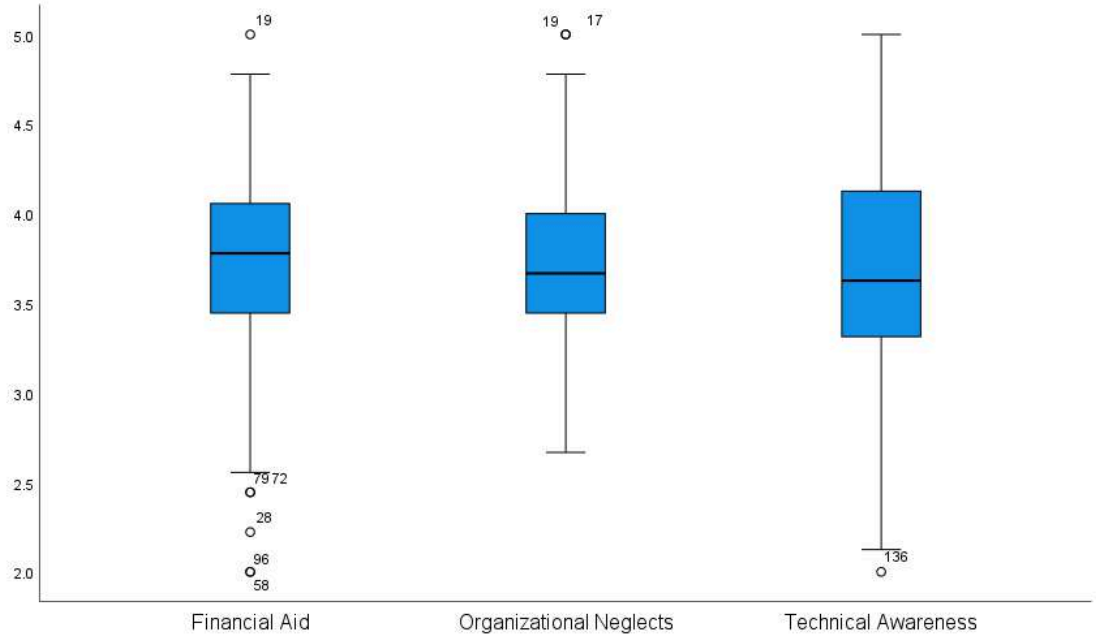

Figure 4.1 Univariate outliers.

Figure 4.1 shows the boxplot for six outliers in the Financial Aid, two outliers in the organizational neglects, and one outlier in technical awareness. These outliers are not excluded because they are not extreme and data is within normal distribution.

4.2.4 Checking the Quality of the Responses

There are no constant responses in the data. All respondents show variation in the responses.

Table 4.2

Unusual Cases or Out-of-Range Values

	Minimum	Maximum
Financial Aid	2.00	5.00
Organizational Neglects	2.67	5.00
Technical Awareness	2.00	5.00

There are no unusual cases in the data, and the data has no out-of-range values. Table 4.2 shows the minimum and maximum values with all of the values falling between 1 and 5.

4.2.5 Response Bias

The data was randomly divided into two groups in order to check the response bias. An independent T-Test was run to examine whether there are differences between the groups for all the dimensions of the study.

Table 4.3

Response Bias

	t	p
Financial Aid	.842	.201
Organizational Neglects	-1.251	.153
Technical Awareness	-1.085	.140

As shown in Table 4.3, all T-Test values are not statistically significant ($p>0.05$), indicating that there is no response bias in the data of the study.

Levene T-Test was run to examine whether the variance between the two randomly selected groups is homogenous. As shown in Table 4.4, all F values are not statistically significant ($p>0.05$), indicating that the variance of the data is homogenous. This supports what is mentioned earlier; there is no bias in the responses of the study.

Table 4.4

Response Homogeneity

	Levene's Test for Equality of Variances	
	F	Sig.
Financial Aid	3.213	.075
Organizational Neglects	2.495	.116
Technical Awareness	3.448	.065

4.2.6 Data Management Procedures

For achieving the inferential statistics, the codes of financial aid and technical awareness were reversed in order to meet the hypotheses of the study. Code 5 was changed to 1, code 4 was changed to 2, code 1 was changed to 5, code 2 was changed to 4, and code 3 remained as it is. Table 4.5 shows the details of the code change.

Table 4.5

The Code Change

Label	Code	Reversed label	Reversed code
Strongly agree	5	Strongly agree	1
Agree	4	Agree	2
Strongly disagree	1	Strongly disagree	5
Disagree	2	Disagree	4
Neutral	3	Neutral	3

4.3 Sample Profile

The sample size of this study is 15. The sample was taken from different laboratory of public hospitals in Sana'a, Mukalla, Seiyun, and Ibb. The survey questionnaire was sent to 220 employees: heads of departments, biomedical engineers, technicians, and others. Only 151 questionnaires were received. Therefore, the response rate is 68.6%, Table 4.6 summarizes the questionnaires' results. The characteristics of the respondents are explained using a frequency analysis in the next subsection.

Table 4.6

Questionnaire Response Rate

Response	Frequency/Percentage
Number of questionnaires was sent	220
Number of received questionnaires	151
Number of not return questionnaires	69
Response Rate	68.60%
Number of incomplete questionnaires	0
Number of analyzed questionnaires	151

3.3.1 Gender Frequency

Table 4.7 and Figure 4.1 show 70.2% (106) of the respondents are male, and 29.8% (45) of the total respondents are female. Gender is widely used as a segmentation criterion.

Table 4.7

Frequency Analysis of Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	106	70.2	70.2	70.2
Female	45	29.8	29.8	100
Total	151	100	100	

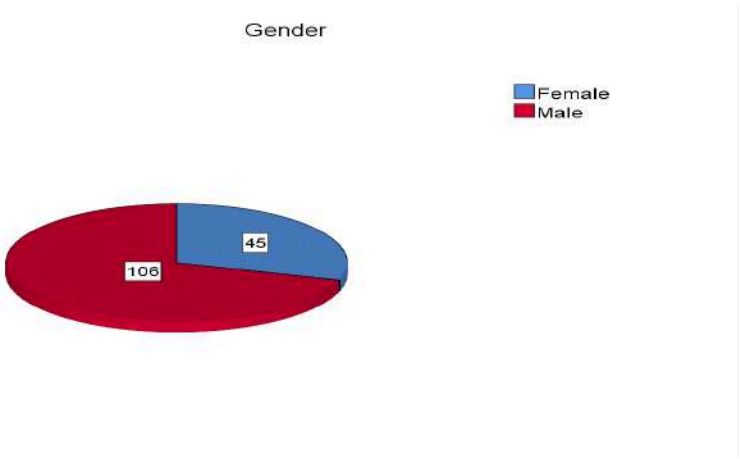

Figure 4.1 Frequency analysis of gender.

3.3.2 Age Frequency

Table 4.8 and Figure 4.2 show the age frequency. The frequency distribution of this demographic variable shows that respondents aged between 35 and 45 years old have the highest percentage (47.7%). The respondents aged between 25 and 35 years old get the second rank (37.7%). The respondents who are more than 45 years old get the third rank (11.9%). The respondents whose age is less than 25 years old have the lowest rank (2.6%). The number of respondents is 151.

Table 4.8

Frequency Analysis of Age

	Frequency	Percent	Valid Percent	Cumulative Percent
Under 25 Years	4	2.6	2.65	2.65
25-35 Years	57	37.7	37.75	40.4
35-45 Years	72	47.7	47.7	88.1
More than 45 Years	18	11.9	11.9	100
Total	151	100	100	

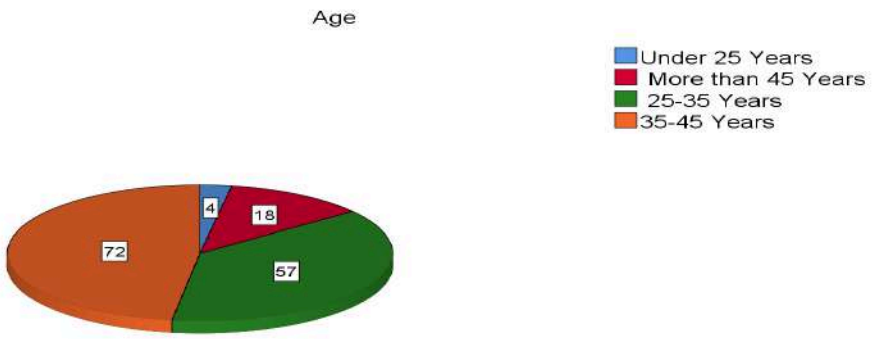

Figure 4.2 Frequency analysis of age

3.3.3 Education Frequency

The respondents participating in this study have different educational qualifications. Table 4.9 and Figure 4.3 show the differences in the education of the respondents. The frequency distribution of this demographic variable indicates that most of the respondents have a bachelor degree (59.6%.) The second rank is scored by the respondents who have a diploma degree (20.5%), followed by the respondents holding a master degree in the third rank (16.6%.) The respondents holding a PhD. degree represent 2%, and the respondents with high school certificates represent 1.3%.

Table 4.9

Frequency Analysis of Education

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
High School	2	1.3	1.3	1.3
Diploma	31	20.5	20.5	21.8
Bachelor	90	59.6	59.6	81.4
Master	25	16.6	16.6	98
PhD	3	2	2	100
Total	151	100	100	

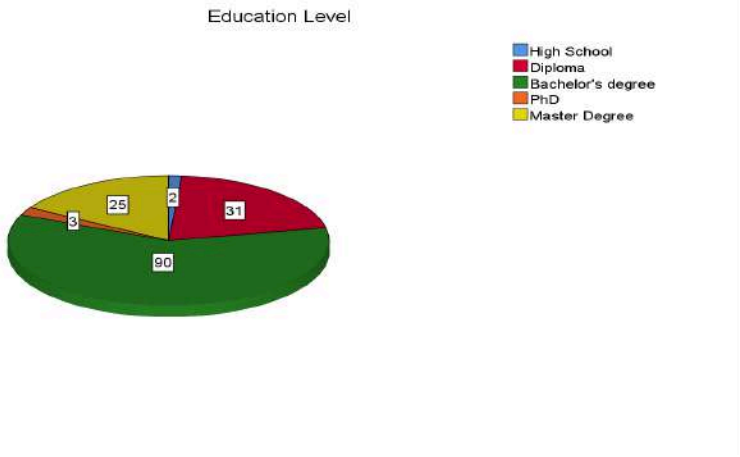

Figure 4.3 Frequency analysis of education.

3.3.4 Position Frequency

The respondents have different positions. Table 4.10 and Figure 4.4 show the different positions of the respondents. The frequency distribution of this demographic variable shows that the highest percentage is scored by the technicians (43.7%), who deal directly with medical equipment. The second rank is scored by the heads of departments with a percentage of 25.8%. The third rank is scored by biomedical engineers with a percentage of 18.5%. The fourth rank is scored by other positions like administrators who do not deal directly with medical equipment with a percentage of 7.3%. The fifth and sixth ranks are scored by doctors and nurses with percentages of 3.3% and 1.3% respectively.

Table 4.10

Frequency Analysis of Position

	Frequency	Percent	Valid Percent	Cumulative Percent
Head of Department	39	25.8	25.8	25.8
Doctor	5	3.3	3.3	29.1
Technician	66	43.7	43.7	72.8
Biomedical Engineer	28	18.5	18.5	91.3
Other Position	11	7.3	7.3	98.7
Nurse	2	1.3	1.3	100
Total	151	100	100	

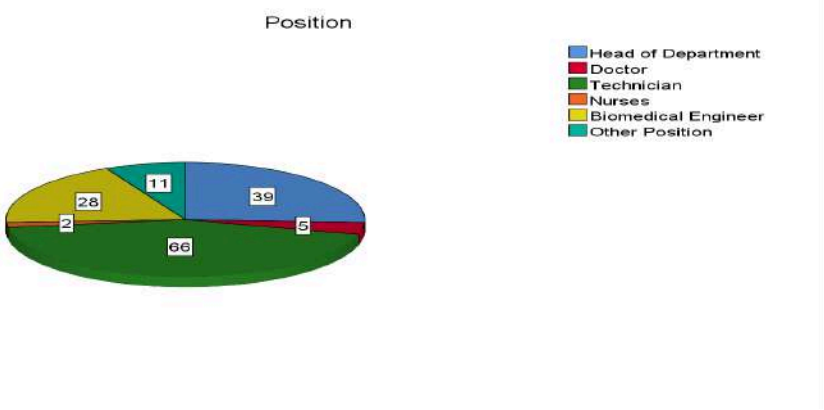

Figure 4.4 Frequency analysis of position.

3.3.5 Experience Frequency

The respondents have different years of experience. Table 4.11 and Figure 4.5 show the different years of experience of the respondents. The frequency distribution of this demographic variable shows that the highest rank (65.6%) is scored by respondents who have more than ten years of experience. The second rank is scored by respondents who have experience between five and ten years with a percentage of 22.5%. The last rank is scored by respondents who have less than five years of experience with a percentage of 11.9%.

Table 4.11

Frequency Analysis of Experience

	Frequency	Percent	Valid Percent	Cumulative Percent
More than 10 Years	99	65.6	65.6	65.6
Between 5 to 10 Years	34	22.5	22.5	88.1
Less than 5 Years	18	11.9	11.9	100
Total	151	100	100	

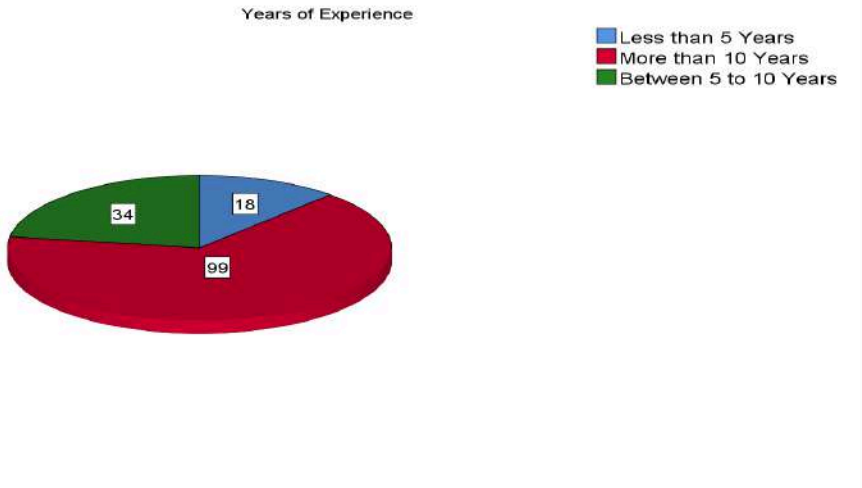

Figure 4.5 Frequency analysis of experience.

3.4 Descriptive Statics

The content of descriptive analysis includes the means and standard deviation for independent variables and are explained in the following sub section. Table 4.12 shows the range of answers used to describe the Likert scale of questionnaire.

Table 4.12

Range of Answer Options of the Likert Scale

Range	Agreement
4.21 – 5.00	Strongly Agree
3.41 – 4.20	Agree
2.61 – 3.40	Neutral
1.81 – 2.60	Disagree
1.00 – 1.80	Strongly Disagree

3.5.1 Descriptive Statics of Financial Aids

Table 4.13

Descriptive Statistics of Financial Aids

No	Items	N	Mean	Std. Deviation	Agreement
1	Public hospitals in Yemen are completely dependent on financial aids.	151	3.79	0.940	Agree
2	When there is a lack of financial aids in public hospitals, the hospital cannot perform the medical service adequately to the patient.	151	3.99	0.891	Agree
3	Financial aids help public hospitals maintain their needs from spare parts for emergency cases.	151	3.86	0.938	Agree
4	In hospitals, financial aids help the maintenance department to conduct all the maintenance needs on medical equipment.	151	3.56	1.105	Agree
5	In hospitals, financial aids will help to improve the environmental conditions required to decrease the breakdown of medical equipment.	151	3.62	0.992	Agree
6	The supervisor in hospitals fairly distributes the rewards between each employee.	151	2.35	1.041	Disagree
7	When there is financial aid in a hospital, it is best to choose medical devices from international brand companies.	151	4.55	0.763	Strongly Agree
8	Training budgets assigned to employees participate in decreasing the level of medical breakdown faced by your hospital.	151	3.95	1.002	Agree
9	Financial aids will help to contract with external companies to perform the maintenance, which will help to reduce the breakdown of medical equipment.	151	3.67	1.100	Agree
	Total	151	3.7	0.551	Agree

Table 4.13 shows the descriptive statistics of Financial Aids. Item 7 has the first rank with a mean of 4.55 (Strongly Agree), and a standard deviation of 0.763, which indicates that medical equipment bought from international brand companies is an important factor in decreasing the level of breakdown of medical equipment in public hospitals. Item 2 has the second rank with a mean of 3.99 (Agree), and a standard deviation of 0.891. Item 8 has the third rank with a mean of

3.95 (Agree), and a standard deviation of 1.002. Item 3 has the fourth rank with a mean of 3.86 (Agree), and the standard deviation of 0.938. Item 1 has the fifth rank with a mean of 3.79 (Agree), and a standard deviation of 0.940. Item 9 has the sixth rank with a mean of 3.67 (Agree) and a standard deviation of 1.100. Item 5 has the seventh rank with a mean of 3.62 (Agree) and a standard deviation of 0.992. Item 4 has the eighth rank with a mean of 3.56 (Agree) and a standard deviation of 1.105. Item 6 has the last rank with a mean of 2.35 (Disagree) and a standard deviation of 1.041, which confirms that the lack of supervisors' fair distribution of reward among employees may increase the rate of medical equipment breakdown. In conclusion, the general average of the items of variables is 3.7with the mean (Agree), and the standard deviation is 0.551.

3.5.2 Descriptive Statics of Organizational Neglect

Table 4.14

Descriptive Statistics of Organizational Neglect

No	Items	N	Mean	Std. Deviation	Agreement
1	In your hospital, employees work and deal with medical equipment honestly and faithfully.	151	3.12	0.864	Neutral
2	In your hospital employees who work with the medical equipment share responsibility for tasks.	151	3.47	0.893	Agree
3	The engineering department in your hospital follows up the planned preventive maintenance by the supplier companies.	151	2.78	1.039	Neutral
4	When there is an emergency requested in hospital to repair a medical device, there is a fast response by the engineers.	151	3.37	1.093	Neutral
5	The principle of reward and punishment in avoiding fault and continuing work will reduce organizational neglect in the hospital.	151	4.10	0.900	Agree
6	The follow-up for employees by managers in hospitals will enhance the work and decrease the organizational neglect regarding the medical equipment.	151	4.32	0.779	Strongly Agree
7	I have been assigned to the right medical device as per my knowledge and experience.	151	3.64	0.920	Agree

No	Items	N	Mean	Std. Deviation	Agreement
8	Any financial crisis in your public hospital will cause organizational neglect from employees.	151	3.88	0.945	Agree
9	Paying attention to the financial rewards of the employees in the hospital will automatically enhance the productivity of employees and decrease organizational neglect.	151	4.54	0.681	Strongly Agree
	Total	151	3.69	0.471	Agree

Table 4.14 shows the descriptive statistics of organizational neglect. Item 9 has the first rank with a mean of 4.54 (Strongly Agree) and a standard deviation of 0.681. This indicates that rewards of employees are a very important factor in decreasing the breakdown of medical equipment in public hospitals. Item 6 has the second rank with a mean of 4.32 (Strongly Agree) and a standard deviation of 0.779. Item 5 has the third rank with a mean of 4.10 (Agree), and a standard deviation of 0.900. Item 8 has the fourth rank with a mean of 3.88 (Agree) and a standard deviation of 0.945. Items 7 has the fifth rank with a mean of 3.64 (Agree), and a standard deviation of 0.920. Items 2 has the sixth rank with a mean of 3.47 (Agree) and a standard deviation of 0.893. Item 4 has the seventh rank with a mean of 3.37 (Neutral) and a standard deviation of 1.093. Item 1 has the eighth rank with a mean of 3.12 (Neutral) and a standard deviation of 0.864. Item 3 has the last rank with a mean of 2.78 (Neutral) and a standard deviation of 1.039, and this indicates that one of the main reasons for the increase of breakdown of medical equipment in public hospitals is the lack of following up the preventive maintenance suggested by supplying companies. To sum up, the general average of the items of variables is 3.69 with the mean (Agree), and the standard deviation is 0.471.

3.5.3 Descriptive Statics of Technical Awareness

Table 4.15

Descriptive Statistics of Technical Awareness

No	Items	N	Mean	Std. Deviation	Agreement
1	Employees who work with medical equipment in hospitals have the needed training at their jobs.	151	2.93	1.078	Neutral
2	Employees working with the medical equipment in hospitals show a very high professional attitude.	151	3.26	0.913	Neutral
3	Supplier companies provide enough training, documents, and instruction after installing new medical devices in hospitals.	151	3.29	0.970	Neutral
4	Training and the seminars performed to employees in hospitals will help to increase technical awareness.	151	4.17	0.883	Agree
5	You feel a good impression about the amount of information regarding the operation manual of the medical device presented in hospitals.	151	3.56	0.861	Agree
6	Specialist staff certification in hospitals contributes to improving performance and reducing the breakdown of medical equipment.	151	4.06	0.947	Agree
7	Technical staff in hospitals dealing with technologically advanced medical equipment help to reduce the number of breakdowns to medical devices.	151	3.91	0.904	Agree
8	The level of education and years of experience in hospitals will help to prevent/decrease the number of the breakdown of medical equipment.	151	4.36	0.706	Strongly Agree
	Total	151	3.69	0.595	Agree

Table 4.15 shows the descriptive statistics of technical awareness. Item 8 has the first rank with a mean of 4.36 (Strongly Agree) and a standard deviation of 0.706. This indicates that recruiting educated and experienced staff are the most influential factor in decreasing the breakdown of

medical equipment in public hospitals. Item 4 has the second rank with a mean of 4.17 (Agree) and a standard deviation of 0.883. Item 6 has the third rank with a mean of 4.06 (Agree) and a standard deviation of 0.947. Item 7 has the fourth rank with a mean of 3.91 (Agree) and the standard deviation of 0.904. Items 5 has the fifth rank with a mean of 3.56 (Agree) and the standard deviation of 0.861. Items 3 has the sixth rank with a mean of 3.29 (Neutral) and a standard deviation of 0.970. Item 2 has the seventh rank with a mean of 3.26 (Neutral) and a standard deviation of 0.913. Item 1 has the last rank with a mean of 2.93 (Neutral) and a standard deviation of 1.078, and this indicates that the lack of adequate training among the staff is the main factor for increasing the breakdowns of medical equipment in public hospitals. To conclude, the general average of the items of variables is 3.69 with the mean (Agree), and the standard deviation is 0.595.

3.6 Correlation Analysis

The correlation analysis is a phrase that describes the strength and link between two or more quantitative variables. This analysis is built on the statement of a straight line score obtained by participants (Gogtay & Thatte, 2017). Correlation analysis indicates whether the hypothesis is providing evidence to be supported or not (Sekaran & Bougie, 2019).

3.7.1 Construct Validity

Construct validity refers to convergent validity and discriminant validity. However, convergent validity refers to the correlation between the overall mean of the dimension and its items (Sekaran & Bougie, 2019). The items should be significantly correlated with the dimension ($R>0.400$), and those dimensions should account for at least 16% of the variance of each item. Discriminant validity indicate that the dimensions of the study are different from each other, and they are not highly correlated ($R<0.90$).

3.7.2 Convergent Validity

As shown in Table 4.16, the dimension of financial aids is significantly correlated with its items ($p<0.001$), indicating that the dimension accounts for more than 16% of the variance of each item. Therefore, the convergent validity is achieved, and the items measure what they are intended to measure.

Table 4.16

Convergent Validity of Financial Aid

	Financial Aid	
	R	**p**
FA1	.365	.000
FA2	.444	.000
FA3	.731	.000
FA4	.712	.000
FA5	.742	.000
FA6	.369	.000
FA7	.458	.000
FA8	.524	.000
FA9	.683	.000

As shown in Table 4.17, the dimension of organizational neglect is significantly correlated with its items ($p<0.001$), indicating that the dimension accounts for more than 16% of the variance of each item. Therefore, the convergent validity is achieved, and the items measure what they are intended to measure.

Table 4.17

Convergent Validity of Organizational Neglect

	Organizational Neglects	
	R	**p**
ON1	.497	.000
ON2	.614	.000
ON3	.600	.000
ON4	.658	.000
ON5	.513	.000
ON6	.534	.000
ON7	.580	.000
ON8	.265	.001
ON9	.382	.000

As shown in Table 4.18, the dimension of technical awareness is significantly correlated with its items ($p<0.001$), indicating that the dimension accounts for more than 16% of the variance of each item. Therefore, the convergent validity is achieved, and the items measure what they are intended to measure.

Table 4.18

Convergent Validity of Technical Awareness

	Technical Awareness	
	R	**p**
TA1	.652	.000
TA2	.661	.000
TA3	.662	.000
TA4	.677	.000
TA5	.619	.000
TA6	.667	.000
TA7	.711	.000

3.7.3 Discriminant Validity

Table 4.19 shows that the dimensions of the study have a statistically significant correlation with each other. The correlation between the dimensions is between 0.318 and 0.654, indicating that the correlation is not greater than 0.90. Thus, the dimensions of the study are discriminant.

Table 4.19

Discriminant Validity

	Financial Aid	**Organizational Neglects**	**Technical Awareness**
Financial Aid	1		
Organizational Neglects	.322	1	
Technical Awareness	.318	.654	1

3.8 Hypotheses Testing

H1: There is an impact of financial aid on the breakdown of medical equipment in public hospitals.

H2: There is an impact of organizational neglect on the breakdown of medical equipment in public hospitals.

H3: There is an impact of technical awareness on the breakdown of medical equipment in public hospitals.

To test these hypotheses, one sample T-Test was conducted to compare the hypothesized mean (3) with the calculated mean of each dimension. As stated earlier, the means of financial aid and technical awareness are reversed.

Table 4.20

Sample T-Test

	N	Mean	SD	t	p
Financial Aid	151	2.2973	.55460	-15.570	<.001
Organizational Neglects	151	3.6917	.47126	18.036	<.001
Technical Awareness	151	2.3204	.60872	-13.720	<.001

As seen in Table 4.20, the results show that the financial aid has a negative impact on medical equipment breakdown (t=-15.570, p<.001), indicating that the calculated mean is significantly lower than the hypothesized mean. In other words, if the financial aids decrease, the medical equipment breakdown increases. Therefore, the first hypothesis is supported.

The organizational neglect has a positive impact on the medical equipment breakdown (t=18.036, p<.001), indicating that the calculated mean is significantly larger than the hypothesized mean. The increase of organizational neglect leads to an increase in the level of breakdowns of medical equipment. Therefore, the second hypothesis is supported.

The technical awareness has a negative impact on the medical equipment breakdown (t=-13.720, p<.001), indicating that the calculated mean is significantly lower than the hypothesized mean. In other words, when the technical awareness decreases, the medical equipment breakdown increases. Therefore, the third hypothesis is supported. Table 4.21 summarizes the results of the hypothesis test.

Table 4.21

Hypothesis Test Results

H#	Statement	Result
H1	The impact of financial aids on the breakdown of medical equipment in public hospitals.	Accepted
H2	The impact of organizational neglect on the breakdown of medical equipment in the public hospital.	Accepted
H3	The impact of technical awareness on the breakdown of medical equipment in public hospitals.	Accepted

3.9 Summary

This chapter discusses data screening, frequency analysis, descriptive statistics, correlation analysis, and the hypothesis test. The chapter presents the findings collected from the respondents based on the data gathered. The correlation analysis indicates a correlation between the variables. In addition, this chapter tests the hypotheses H1, H2, and H3, and all of these hypotheses are accepted.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Recapitulation of the Study

The purpose of this study is to examine the factors influencing the breakdown of medical equipment in public hospitals. The study targets the staff of health care sectors in public hospitals and medical supplier companies in Yemen. The sample of this study includes biomedical engineers working in the maintenance departments of public hospitals and biomedical engineers working in medical supplier companies. The sample includes operators, technicians, managers working in the laboratory departments of public hospitals and the application services workers in the medical supplier companies in Yemen. The questionnaire was designed and sent to the participants online via WhatsApp. The questionnaire was sent to 220 participants, but only 151 valid responses were received. The Cronbach's Alpha is 84.3% for all questions of the questionnaire, whereas the response rate is 68.6%.

The result of the correlation between the dimensions ranges between 0.318 and 0.654, indicating that the correlation is not greater than 0.90. and this means there is no regression. Instead, one sample T-Test was conducted to compare the hypothesized mean (3) with the calculated mean of each dimension.

5.2 Discussion

The primary objective of this study is to examine the factors influencing the breakdown of medical equipment in public hospitals in Yemen. To achieve this, the research hypotheses were developed to answer the three main research questions.

Q1. What is the impact of financial aids on the breakdown of medical equipment in public hospitals?

Answer. Research hypothesis H1 was developed. It assumes that there is an impact of financial aids on the breakdown of medical equipment in public hospitals. The result of one sample T-Test

for financial aid shows that there is a negative impact on medical equipment breakdown (t=-15.570, p<.001), indicating that the calculated mean, which is equal to 2.2973, is significantly lower than the hypothesized mean (3).

Q2. What is the impact of organizational neglect on the breakdown of medical equipment in public hospitals?

Answer. Research hypothesis H2 was developed. It assumes that there is an impact of organizational neglect on the breakdown of medical equipment in public hospitals. According to the results of one sample T-Test, organizational neglect has a positive impact on the medical equipment breakdown (t=18.036, p<.001), indicating that the calculated mean, which is equal to 3.6917, is significantly larger than the hypothesized mean (3).

Q3. What is the impact of technical awareness on the breakdown of medical equipment in public hospitals?

Answer. Research hypothesis H3 was developed, and it assumes that there is an impact of technical awareness on the breakdown of medical equipment in public hospitals. The results of one sample T-Test indicate that technical awareness has a negative impact on the medical equipment breakdown (t=-13.720, p<.001), indicating that the calculated mean, which is equal to 2.3204, is significantly lower than the hypothesized mean (3).

5.3 Recommendations

The study gives the following recommendations:

1. Public hospitals must manage and monitoring financial resources to help provide medical services to patients.
2. It is very important for managers, supervisors, and line managers to take care of public hospitals' employees through fair distribution rewarding, medical insurance, and other bonuses to decrease organizational neglect.
3. Employees in public hospitals must share the responsibilities, knowledge, tasks, and information related to medical equipment, which in turn contributes to decreasing the breakdown of medical equipment.
4. Set regular training by coordination between public hospitals and medical supplier companies for employees' development to increase technical awareness.

5. Public hospitals need to pay attention to applying the PPM to their medical equipment to increase the operation time and decrease the repairing cost.

6. The selection of medical equipment from brand companies with high durability machines will help to decrease the breakdown of medical equipment and save the cost of repairing.

7. Medical supplier companies should make regular check to the medical equipment in public hospitals to ensure the efficiency of medical equipment.

8. The government must take the necessary to support the public hospitals, and determine an annual budget to support these hospitals.

5.4 Limitations

This study aims to examine the factors influencing the breakdown of medical equipment in public hospitals in Yemen. One of the limitations of this study is the difficulty to reach all public hospitals in Yemen. Another limitation is that the period of the study is limited to six months, which prevents the researcher from getting more questionnaire responses. Another limitation is the inability to access some useful literature sources without paying for them. Finally, it was difficult to get some questionnaires from some previous studies.

5.5 Future Research

This study gives some suggestions for future researchers. First, future researchers may need to expand the scope of this study to enhance the variety of perceptions and results. Second, future researchers can develop the same research in other public hospitals in Yemen. Third, researchers should search for other factors or variables influencing the breakdown of medical equipment in Yemen. Finally, it is worth mentioning that some important factors like contracts, currency exchange fluctuations, trade barriers, planning, control, scope and requirements may influence the breakdown of medical equipment in public hospitals and they need to be studied.

5.6 Conclusion

This study examines the factors influencing the breakdown of medical equipment in public hospitals in Yemen. Based on the literature review, the researcher found evidence that financial aids, organizational neglect, and technical awareness affect the breakdown of medical equipment in public hospitals. In addition, the researcher reached an approval for the three hypotheses related to the impact of financial aids, organizational neglect, and technical awareness on the breakdown of medical equipment in public hospitals.

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Ashley Agyekum (Author) *Komfo Anokye Teaching Hospital*	**The Impact of Digital Leadership on Organizations Performance: the Mediating Role of Innovative Capabilities in the Banking Industry of Ghana**

Abstract

This research will explore the role of digital leadership within organisational performance and how it mediates innovative capability in the banking sector. The general objective of the study was to investigate the impact of digital leadership on organizational performance with mediating role of innovative capability in the banking sector in Ghana. Specifically, the objectives of the study were a) to analyze the relationship between digital leadership and an organization's performance in the banking sector. b) to investigate the relationship between digital leadership and innovative capabilities in the banking Sector. c) to investigate the relationship between innovative capability and organizational performance in the banking sector. d) to assess the mediating role of innovative capability on the relationship between digital leadership and organizational performance in the banking sector. In line with the general and specific objectives, literature was reviewed on the concepts of digital leaders, organizational performance and innovative capability. The research was approached quantitatively. Primary data was collected via a structured questionnaire. The employees of various banks were used for the study as the target population of the study. The study employed the simple random and purposive sampling techniques. The data was analyzed based on 172 responses, using the SPSS software. The results of the study indicated that there was a significant and positive relationship between digital leadership and organizational performance; between digital leadership and innovative capability; between innovative capability and organizational performance and the mediating role of innovative capability of digital leadership on organizational performance.

Keywords: Digitalized Leadership, Organizational Performance, Innovative Capabilities, Transformational Leadership

1. Introduction

Today, the banking sector is one of the fastest-growing sectors showing sustained pace despite the slowdown affecting the economy. World over, this sector's growth is spurred by the rising number of online banking and mobile apps, customers can perform banking transactions anytime, anywhere. Investing in the banking industry leads to economic growth by improving return on investment for banks. A good banking system is important to reduce the burden on customers. Customers no longer have to wait in long queues at the bank or worry about bank hours. However, to be more concise, the procedure of information improvement from the physical to the digital level generally comes under the heading of digitalization (Collin et al., 2015). Leaders who follow technological 62 development in the field of leadership must have the skills to influence, encourage, direct, direct and mobilize others (Anak Agung Sagung & Sri Darma, 2020). Nevertheless, technology has brought new opportunities and changes to other industries and the way the market works overall, therefore the banking sector in order to adapt to these changes and trends had to change the classic face-to-face system. Furthermore, banks may have to modify their products, business processes of services, and their organizational structures and architecture probably, to keep pace with the digital change (Balkan, 2021). In 2021, opening a bank account, depositing money or taking a loan has taken a whole other meaning because of ATMs, E-banking, telephone banking and other versatile options. However, according to (Carbo-Valverde, 2017): "Although a basic assumption of technology improvement is the ability to make things simpler, from a strategic point of view, many financial institutions are facing digitalization as a conundrum". Improving performance is considered as one of the most important objectives for the organizations (Nwankpa, 2016). In strategic management, resource base view (RBV) theory of the firm has been accepted as one of the most dominant theoretical perspectives (Newbert, 2007). RBV has been used to explain sources of better Performance whether operational performance or financial performance (Adnan, 2018; Flynn et al, 2017). According to the Ghana Statistics Service, as of the third quarter of 2021, finance and insurance activities in Ghana contributed over 3.43 billion Ghanaian cedis (GHS), roughly 499.4 million U.S. dollars, to the country's Gross Domestic Product (GDP). This was a decrease from the preceding quarter, when the value added was around 3.7 billion GHS, around 541.5 million U.S. dollars. Within the period reviewed, the GDP contribution of finance and insurance services in

Ghana fluctuated between a minimum of approximately 2.8 billion GHS and a maximum of roughly 4.2 billion GHS.

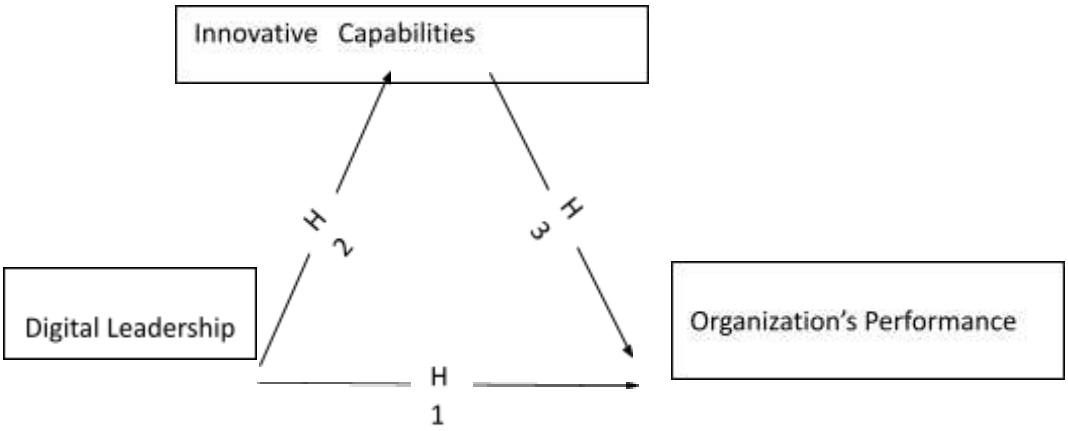
2.1 Theoretical background

This chapter provides an in-depth literature review on the topic of "Digital Leadership and Organizational Performance: Mediating Role of Innovative Capabilities." The review aims to explore the existing body of knowledge, identify research gaps, and synthesize the key findings from relevant studies. Banks as financial institutes may be defined in various ways as stated by (Prbhavati K & Dinesh G P, 2018): “The bank is a financial institution which deals with debits and credits. It lends, accepts and deposits money, builds the gap between the lenders and the borrowers. Banks are not only dealing with money but are also producers of money”. The banking industry is becoming more technologically savvy due to the rapid growth of mobile technologies. While some financial institutions have deferred the development of mobile applications, this move has essentially become mandatory in recent years (The Hartman Team, 2021). In strategic management, resource-based view (RBV) theory of the firm has been accepted as one of the most dominant theoretical perspectives (Newbert, 2017). RBV has been used to explain sources of better Performance whether operational performance or financial performance (Adnan, 2018; Flynn et al, 2017). RBV regards the firm as a bundle of resources and suggests that their attributes significantly affect the firm’s competitive advantage and, by implication, its performance (Barney, 2016). Resource based view (RBV) assumes that the firm can create long term sustainable competitive advantage by leveraging their internal resources which are heterogeneous, rare, non-substitutable, and inimitable to implement value-creating strategy that cannot be easily duplicated by competing firms (Barney, 1991). IT capabilities or IT competency is defined as how the firm use technologies to manage its information effectively. While IT is the generic terms used to refer to computer, telecommunications, programs, etc. (Tippins and Sohi, 2003). There has been a mind-set shift from IT process view to IT capability view in literatures. IT capability or IS capability approach has become more common than traditional strategic information system approach (Carcary, 2016).

2.2 Research framework

Building on the background literature discussed above, Figure 1 illustrate the research model. The study proposed that digital leadership has a positive effect on organization performance through the mediating effect of innovative capabilities.

Figure 1: Research Model



A conceptual framework for investigating the relationship between digital leadership and organizational performance; between digital leadership and innovative capability; between innovative capability and organizational performance and how innovative capability mediates the relationship between digital leadership and organization's performance.

2.3 Hypothesis

In strategic management, resource-based view (RBV) theory of the firm has been accepted as one of the most dominant theoretical perspectives (Newbert, 2017). RBV has been used to explain sources of better Performance whether operational performance or financial performance (Adnan, 2018; Flynn et al, 2017). RBV regards the firm as a bundle of resources and suggests that their attributes significantly affect the firm's competitive advantage and, by implication, its performance (Barney, 2016). Therefore, we propose that:

H1: Digital leadership has a positive impact on organization's performance.

H2: Digital leadership has a positive impact on innovation capability.

H3: Innovation capability has a positive impact on organization's performance.

H4: Innovation capability mediates the relationship between digital leadership and organization's Performance.

3.1 Methods

This case study is based on quantitative methodology using primary data. Questionnaires which serve as one of the most vital primary sources of data was the primary research instrument in this study. Physical or online questionnaires was sent to collect data. They are also an indirect way of data collection as questionnaires serve as an intermediary between the researcher and the

interviewee (Lejeune, 2014). Closed-ended structure of questions was used for the purposes of this study. The measures outlined in the study questionnaire are innovative capabilities as the mediating variable, digital leadership as the independent variable and organization performance as the dependent variable. The digital leadership scale was developed based on (Mihardjo et al., 2019; Sasmoko et al., 2019. This scale consists of ten items: for creativity "e.g., the organization's leadership styles are characterized as supportive of new ideas. The organization's performance section was developed based on (Akdere & Egan, 2020; Chiarelli, 2021; Wang et al., 2020). This variable considers as a construct that consists of four items "e.g., employee engagement and satisfaction. Innovation capability section was developed according to (Aljanabi, 2020; Migdadi, 2020; Saunila, 2020). This section consists of nine items: for product innovation e.g., organizations use the acquired knowledge and resources to develop new products and services, for process innovation. The items were measured using a 5-point Likert scale of 1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree.

3.2 Reliability

The Cronbach Alpha was used to evaluate the questionnaires' reliability in collecting data for the study. For validating the study scale's reliability, a Cronbach Alpha of 0.70 is regarded sufficient. The content reliability of the surveys was assessed using pre-existing questionnaires with tested questions and constructs.

Table 3.1: Cronbach Alpha Results

Constructs	Cronbach Alpha
Digital Leadership	0.885
Organizational Performance	0.761
Innovative Capabilities	0.800

3.3 Validity Test

Validity refers to the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests, which is used in research to measure if data collected is reliable and meaningful, DeVellis, R.F (2016). Face validity was assessed in the study by interviewing experts in the study's constructs. Content validity assesses the extent to which the items or questions in a measurement tool adequately cover the entire range of concept being

measured. By adopting instruments that have already been used in other studies and having a strong representation of the study themes, the study assured content validity.

4.1 Results

The sample size for the study was 200 respondents. However, 172 respondents answered the questionnaires issued. Thus, the study achieved 86% response rate. This information is illustrated in Table 4.1.

Table 4.1: Showing the Response Rate of the Survey

	Distributed	Received	Percentage (%)
Survey	200	172	86

4.2 Correlation Analysis

The study employed correlation analysis using the bivariate Pearson correlation technique in SPSS to measure the direction and strength of the constructs of the study. The results of the correlation analysis showed that there is a significant positive correlation between digital leadership and organizational performance ($r = .649$, $p < .01$); digital leadership and innovative capabilities ($r = .580$, $p < .01$); and organizational performance and innovative capabilities ($r = .682$, $p < .01$).

4.3 Hypothesis Results

Table 4.2 provides information on the summary of the results of the study.

Table 4.2 Summary of Results

	Hypothesis	Results	Remarks
H1	There is a significant positive effect of digital leadership on organizational performance	Positive and Significant	Supported
H2	There is a significant positive effect of digital leadership on innovative capabilities	Positive and Significant	Supported
H3	There is a significant positive effect of innovative capabilities on organizational performance	Positive and Significant	Supported
H4	Innovative capabilities mediate the relationship between digital leadership and organizations' performance	Positive	Supported

5.1 Summary of the findings

As indicated earlier, in the first chapter of this study, the aim of this research was set to determine the extent to which digital leadership influences innovative capabilities and organizational performance in the banking sector.

5.2.1 Effect of Digital Leadership on Organizational Performance in the in the Banking Sector

The results of the study (B = 0.601, P < .01) showed that digital leadership positively and significantly influence organizational performance in the banking sector. This implies that the practice of digital leadership yields in the growth of organizational performance.

5.2.2 Effect of Digital Leadership on Innovative Capabilities in the Banking Sector

Again, the study's analysis (B = 0.470, P < .01) specified that digital leadership influences innovative capabilities in the banking sector. This implies that innovative capabilities improve when digital leadership is adopted.

5.2.3 Effect of Innovative Capabilities on Organizational Performance in the Banking Sector

The results of the study showed that innovative capabilities positively and significantly influence organizational performance in the banking sector. (B = 0.781, P <.01). This implies that organizational performance improves when innovative capabilities are employed.

5.2.4 Mediating role of innovative capability on the relationship between digital leadership and organizational performance in the Banking Sector.

The result showed that innovative capabilities play a mediating role in the relationship between digital leadership and organizational performance. This means that digital leadership has a significant direct effect on innovative capabilities (Beta = 0.470), and innovative capabilities, in turn, have a substantial direct effect on organizational performance (Beta = 0.781).

5.3 Conclusion and recommendation

The objective of the study was to investigate the impact of digital leadership on innovative capabilities and organizational performance in the banking sector. The study reviewed literature on the variables of the study. The researcher developed the hypothesis of the study based on prevailing literature and the theory of reasoned action. The study adapted a quantitative research design and also adopted the descriptive and explanatory research purposes. Data analysis was based on 172 employees of the banking sector, using the SPSS. The results of the study indicated that there was a significant and positive relationship between digital leadership and organizational performance; between digital leadership and innovative capabilities; between innovative capabilities and organizational performance; and innovative capabilities mediates between digital leadership and organizational performance. Based on this paper's points and case study it can be concluded that the most important fact that it is crucial from now on is that banks upgrade their system constantly to keep up with the digitalizing era. Therefore, this suggest that there should be constant investing in the technological area by digital leaders in order to challenge the competition or maintain its stability.

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Nwankwo Johnson Alozie (Author) *University of Port Harcourt*	**Audit Quality and Financial Performance of Food and Beverages Enterprises in Nigeria**

Abstract

This study examined the relationship between audit quality and the financial performance of food and beverage enterprises in Nigeria. The study adopted an ex-post facto research design since the data was in existence before the research commenced. The population for the study comprised all food and beverage firms in Nigeria, from 2009 to 2018, which are 72 food and beverage firms. The study focused on a period of 10 years, from 2009 to 2018. The sample for this study comprised the 5 food and beverage companies in Nigeria whose annual financial report contained complete data for all the variables under investigation. The data was analyzed using: Panel data analysis approaches of Panel multiple regression techniques with the aid of E-views 9 Package. The results reported in this study showed that audit quality and financial performance measures do not have a statistically significant relationship; this result agrees as well as disagrees with several previous studies. The study, therefore, concluded that quoted food and beverage firms in Nigeria cannot improve their financial performance by simply having the right audit quality. Hence, it was recommended amongst others that the food and beverage firms in Nigeria should not consider increasing their auditor's size as it is not significantly impacting their financial performance rather, they should consider those other things that can be done in order to have an effective audit committee, like diversity in terms of gender, religion, region, ownership, etc.

Index Terms— Audit quality, corporate accountability, financial audit, financial performance.

I. INTRODUCTION

Financial performance which assesses the fulfillment of a firm's economic goals has long been an issue of interest in managerial research. Firm financial performance relates to the various subjective measures of how well a firm can use its given assets from primary mode of operation to generate profit. Kothari (2001) defined the value of a firm as the present value of the expected future cash flows after adjusting for risk at an appropriate rate of return. To Eyenubo, (2013) it is the success in meeting pre-defined objectives, targets and goal within a specified period. Qureshi, (2007), put forward four different approaches in which the value of a firm has been identified in corporate finance literature. These are: the *financial management approach* which focuses on the evaluation of cash flows and investment levels before identifying and assessing the impact of financing sources on firm value; the *capital structure approach* which studies the impact of capital structure changes on the value of firm and how different factors impact directly or inversely the debt and equity component of the firm capital structure; the *resource based approach* which explains the value of firm as an outcome of firm's resources; and finally, the *sustainable growth approach* which is a summary of the above three approaches to firm value, taking into account the firm's operating performance, its investment and financing needs, the financing sources, and its financing and dividend policies for sustainable development of firm's resources and maximization of firm value.

Audit quality can be defined in two dimensions: first, detecting misstatements and errors in financial statement and second, reporting these material misstatements and errors. Due to the fact that these characteristics are largely unobservable, different proxies have been used by researchers to measure audit quality like: audit size, audit hours, audit fees, reputation, litigation rate and discretionary accruals. Audit quality is subject to many direct and indirect influences. In tandem with the stakeholder theory, perceptions of audit quality vary amongst stakeholders depending on their level of direct involvement in audits and on the perspective through which they assess audit quality. Audit quality may be perceived from any of three fundamental perspectives: inputs, outputs, and context factors. Inputs to audit quality, apart from auditing standards, include the auditor's personal attributes such as auditor skill and experience, ethical values and mind-set.

Increased concerns regarding corporate accountability in various developed nations have been associated with the need for appropriate Audit which involves risk management and internal control systems. Audit Quality is recognized to influence financial reporting and strongly impact on investors' confidence. Conventionally, external auditors play critical and highly challenging roles in assuring the credibility of financial reports. Audit quality plays an important role in maintaining an efficient market environment; an independent quality audit underpins confidence in the credibility and integrity of financial statements which is essential for well-functioning markets and enhanced financial performance. Furthermore, enhancing disclosure quality increases transparency and facilitates investors to better assess firms' performance. Initially, fraud detection was considered the primary objective of the audit process until approximately the middle of 20th century. The main objective of auditing has changed from fraud detection to verification of financial statements. This is because the audit profession wanted to avoid legal suits by businesses and the general public. Four types of opinion usually emerge from the audit function unqualified, qualified, and adverse and disclaimer of opinion after examining, based on the data obtained from that organization. The type of opinion is usually the outcome of the audit exercise performed by the audit firm. Audit is an important part of the regulatory and supervisory infrastructure and thus an activity of significant public interest. Auditors, by performing their audits in accordance with the Generally Accepted Auditing Standards (GAAS), will attest to the fairness of corporate financial reports and, the reports issued (clean, reserved, abstention from giving opinion, contrary) have a clear impact on the decisions which might be made by the users of this report. When the financiers of organizations have confidence and trust in the audited financial report of an organization, they are bound to pour in more funds into the organization, which in turn results in increased financial performance.

Statement of the Problem

Financial reports are supposed to provide relevant information to the external parties of an organization. It is thus important that financial reports provide truthful and accurate financial information to enable shareholders and other interested parties to make decision wisely. Lack of accuracy in financial reporting will lead shareholders and prospective investors to make wrong judgment about the organization. Incidentally, the heavy reliance placed on accounting numbers (as it measures the direction of business entity as well as decision base by different users of

accounting information) has provided an incentive for managers to manipulate earnings to their own advantage. This manipulation that is not supposed to go unchecked by auditors has often led to the eventual collapse of firms of various sizes and even called to questions the integrity of auditors and characteristics of audit firms. The credibility of financial information is vital to the growth of any economy. Auditors on their part are expected to be independent and objective in the discharge of their responsibilities because as the report of external auditors in corporate financial statement is seen as providing key assurance and protecting the interest of shareholders. However, one of the most vexing problems in the financial world today is the emphasis placed on ensuring the independence of external auditors as a result of recent corporate Scandals. In the real world, when business entities collapse the consequences are usually enormous. The oversight function of the auditor is placed under scrutiny when a business whose financial statement once showed no indication of any failure suddenly becomes bankrupt. As a follow up to the oversight function, the independence of the auditor in such circumstance would be in doubt. Many studies have been conducted on the relationship between audit firm characteristics and quality of financial reporting. The studies are however based largely on US and European data, thus reflecting the advanced economies environment. Few of the studies used data from emerging economies such as like Nigeria. Little is known about the relationship between audit quality and firms' financial performance in Nigeria particularly, using data on food and beverage firms. It is therefore pertinent to conduct a study that will fill this literature gap. Moreover, this study used two audit qualities variables to investigate their effects on the financial performance of food and beverage firms in Nigeria. Hence gap to be filled in the literature because most of the studies in this area focused on usually one aspect of audit firm characteristics.

Objectives of the Study

The aim of this research was to examine the relationship between audit quality and financial performance of food and beverages companies in Nigeria. The specific objectives were to:

1. Determine the relationship between audit size and earnings per share of food and beverages companies in Nigeria.
2. Examine the relationship between audit size and return on capital employed of food and beverages companies in Nigeria.

3. Evaluate the relationship between audit committee financial expertise and return on capital employed of food and beverages companies in Nigeria.

4. Evaluate the relationship between audit committee financial expertise and earnings per share of food and beverages companies in Nigeria.

Research Questions

The following research questions guided this study.

1. What is the nature of the relationship between audit size and earnings per share of food and beverages companies in Nigeria?

2. How does audit size relate to return on capital employed of food and beverages companies in Nigeria?

3. How does audit committee financial expertise relate to return on capital employed of food and beverages companies in Nigeria?

4. What is the relationship between audit committee financial expertise and earnings per share of food and beverages companies in Nigeria?

Research Hypotheses

To make the study operational, the following specific hypotheses were tested:

H01: There is no significant relationship between audit size and earnings per share of food and beverages companies in Nigeria.

H02: There is no significant relationship between audit size and return on capital employed of food and beverages companies in Nigeria.

H03: There is no significant relationship between audit committee financial expertise and earnings per share of food and beverages companies in Nigeria.

H04: There is no significant relationship between audit committee financial expertise and return on capital employed of food and beverages companies in Nigeria.

Significance of the Study

This study will measure the impact of monitoring systems, such as the audit committees. Decision makers can assess these monitoring systems' role in improving how shareholders view the firm's financial performance. Providing shareholders with reliable and viable information regarding corporate governance increases the accuracy and effectiveness of their decisions. This study will assist in improving investors and stock market participants' decision-making process.

When various aspects of the audit qualities are measured, investors' knowledge in evaluating the reliability of the financial reports will increase. It will also enable them to be more alert to the management's ability to manipulate accounting earnings. Corporate governance authorities or regulators (such as CBN, SEC etc.), especially in Nigeria, could utilize this study as practical and viable evidence to develop or review corporate governance regulations and recommendations.

II. METHODOLOGY

This study adopted ex-post facto research since the data was in existence before the research commenced. Therefore, the study adopted ex-post facto design since the variables were not within the control of the researcher. The population for the study comprised all food and beverage firms in Nigeria, from 2009 to 2018, which are 72 food and beverage firms. The study focused on a period of 10 years, from 2009 to 2018. The sample for this study comprised the 5 food and beverage companies in Nigeria whose annual financial report contained complete data for all the variables under investigation. It should be noted that out of the 72 food and beverage firms in Nigeria, the study (sample size) comprised those that have been trading consistently for the study period (that is from 2009 –2018). This was to eliminate the problem of missing data which would violate the precision and completeness principle. This study utilized secondary data and data was collected by means of content analysis which was obtained from the annual financial reports of food and beverage firms, annual investors' reports, magazines and articles related to the financial performance of food and beverage companies in Nigeria. Quantitative data from secondary sources, which are audited financial statements of the food and beverage companies from 2009 to 2018, were used in this study. This period is chosen because the International Financial Reporting Standard was adopted in Nigeria in the year 2011.

This study examined the relationship between audit quality and financial performance of food and beverage companies in Nigeria using secondary data.

Independent Variables	**Measures**	**Dependent Variable**	**Measures**
Audit quality	- audit size -Audit committee financial expertise	Financial performance	-Return on capital employed -Earnings per share
Control Variables:	- Firm Size - Leverage		

The data were gathered from the annual reports of food and beverage companies from 2009 to 2018 which were presented in tabular forms.

Methods of Data Analysis

The data that was collected by the researcher was analyzed using: Panel data analysis approaches of Panel multiple regression technique with the aid of E-views 9 Package. The unit root of the panel data, the estimated results (which we got by first of all applying pooled ordinary least square [Pooled OLS] approach and then comparing it with fixed and random effect model of panel data analysis, and after that a cross-section dependence test was carried out on each of the statistical approaches to ascertain the correlation among firms with the aid of E-views 9.

Panel Multiple Regression Technique (Panel Least Square Regression)

Panel multiple regression analysis was used to test the relationship between the predictive variable (audit quality) and the criterion variable (financial performance)

Panel Data Regression analysis

It is a statistical method that is used in econometrics to analyze two-dimensional, particularly cross-sectional and longitudinal, panel data. The data are usually collected over time and over the same individuals and then a regression is run over these two dimensions. The two approaches of panel data regression are: fixed effect model and random effect model.

Fixed Effects Model

It is a statistical model in which the model parameters are fixed or non-random quantities. In panel data where longitudinal observations exist for the same subject, fixed effects represent the subject-specific means. It is commonly used to reduce bias in the estimation of causal effects in observational data by eliminating large portions of variation thought to contain confounding factors (usually by including dummy variables for the missing or unknown characteristics).

Random Effects Model

It is also known as variance components model. It is a statistical model that is applied where the model parameters are random variables (probability distribution that represents the likelihood that any of the possible values would occur). It is used when we have lots of levels, relatively little data on each level and uneven sampling across levels.

Preliminary test

Unit root tests are tests for stationary in time series. Stationary means that the statistical properties of a time series do not change over time. A time series has stationary if a shift in time does not cause a change in the shape of the distribution. Stationary is important because a lot of useful analytical tools, statistical tests and models rely on it. The function of unit root test in the study was to investigate the stationary of pooled data. Preliminary test was carried out to find out the most appropriate model between panel least square and fixed effect model using likelihood ratio – redundancy effect test. Furthermore, test was carried out to find out the most appropriate between panel least square and random effect model using Breusch-pagan LM test. Breusch-Pagan test is used to test for heteroscedasticity (circumstance in which the variability of a variable is unequal across the range of values of a second variable that predicts it) in a linear regression model. Also, a Hausman test was carried out to find out between random effect and fixed effect to get the most preferable. Hausman test evaluates the consistency of an estimator when compared to an alternative less efficient estimator which is already known to be consistent.

Decision Rule:

If the P-value < 0.05 level of significance, we reject the null hypothesis.

If the p – value ≥ 0.05 level of significance, we shall fail to reject the null hypothesis.

Model Specification

Mathematical model

FP = f (AS, ACFE)

FP = ROCE, EPS

ROCE= $a_0 + a_1AS + a_2ACFE + a_4FSize + a_5FLev$

EPS = $a_0 + a_1ACS + a_2ACFE + a_4FSize + a_5FLev$

Econometrics model

The econometrics model is as stated below:

FP = $a_0 + a_1AS + a_2ACFE + a_3FSize + a_4FLev + e$

ROCE = $a_0 + a_1ACS + a_2ACFE + a_3FSize + a_4FLev + e$ ……(1)

EPS = $a_0 + a_1ACS + a_2ACFE + a_4FSize + a_5FLev + e$ ……...(2)

Where:

FP = Financial performance

AQ = Audit Quality

ROCE = Return on Capital Employed

EPS = Earnings Per Share

AS = Audit Size

ACFE = Audit Committee Financial expertise

FSize = Firm Size

FLev = Firm Leverage

a_0, a_1, a_2,a_3, a_4, and a_5 are the correlation coefficients.

e represents error term.

The Apriori Expectation is that a_1–$a_5$is >= 0

Control Variables

This study mainly focuses on audit quality and financial performance of food and beverage companies in Nigeria. However, it is important that other factors must be controlled. Those factors may not be related to audit quality yet may also contribute to improving financial performance (Kiel & Nicholson, 2003).

The control variables (firm size and firm leverage) are used in this study to control for possible relevant effect other than the explanatory variables. Some authors, such as Kinney and McDaniel (1989) found that larger firms have better internal controls, better information systems, and more resources and therefore the potential for increased quality reporting that leads, in turn, to improved firm performance. However, firm size influence on corporate governance is evident in the findings that show large companies to be less effective compared to the smaller ones because although they meet government requirements, they have higher agency issues and more ambiguity (Patro et al., 2003).

Firm size is a factor that affects governance. Booth et al. (2002) and Peasnell et al. (2003) stated that governance structures could be substituted, and that a firm should choose the most appropriate governance options. The more complex an entity becomes; the more sophisticated governance structures and processes are required. Larger firms have higher agency costs as larger spans usually allow greater managerial discretion and opportunism, which in return requires increased monitoring.

However, large organizations have higher capacity to generate funds, avoid financial constraints, and use their available funds to invest in viable projects more than smaller firms do. It is certain that as the firm size changes, different characteristics of the board, particularly the audit committee, might be affected. Therefore, this study uses the firm size as a control variable to investigate the impact of audit quality on firm performance.

Firm size (FSIZE) is measured as a natural logarithm of total assets (Sharma et al.,2009).

The other control variable used was the firm leverage. It can be justified by the belief that any firm performance measure needs to be adjusted for systematic risk of the firm.

As stated by Grossman and Hart (1982) and Jensen (1986), leverage is seen as a positive signal of firm value, and management-leveraged entities have devoted themselves to creditors in order to have a level of cash flow needed to cover interest and principal payments. Several studies use leverage as one of the control variables (for instance; Ehikioya 2007). Therefore, we control for the leverage adding the variable firm leverage (FLEV) which is measured as a percentage of total debt to total assets.

III. RESULTS

Food and beverage firms in Nigeria panel data for a period of ten years, that is 2009 to 2018, entailing two independent variables and two control variables in both model 1 and model 2, are all arranged in this work. In this study there are five food and beverage firms and they are all quoted in Nigeria. The panel data which of course is a time series on a cross-section of food and beverage firm's data presented in appendix 2 includes the following variables ACS, ACFE, ROCE and EPS for the 5 food and beverages companies.

Data Analysis and Result

This study was embarked on to examine the effect of audit quality on financial performance of Nigerian food and beverage firms. And so, study hypotheses are tested based on balanced sample of five Nigerian food and beverage firms in Nigeria, though Nigerian food and beverage firms whose accessible data are not complete for every single variable in the models were left out from the analysis. The unit root of the panel data, the estimated results (which we got by first of all applying pooled ordinary least square [Pooled OLS] approach and then comparing it with fixed and random effect model of panel data analysis with the aid of E-views 9, and their interpretation presented afterwards.

Data Statistics

See Table 1 for the descriptive statistics of the study variables which we consider helpful in improving our ability to figure out the unique features of the different variables in the pooled cross-sectional time series data. Give or take, the observations were 130 on the statistics, which include mean, standard deviation, Skewness, kurtosis and Jarque-Bera, these statistics helped to depict the distributions of the data over the sample period. The variables are ROCE, EPS, AS, ACFE, FSIZE, and FLEV.

Table 1: Descriptive Statistics

	)ROCE	' EPS	ACS	ACFE	I FSIZE	FLEV
Mean	0.114734	0.383863	6.000000	1.338462	16.54406	5.696532
Median	0.059290	0.259326	6.000000	1.000000	14.81018	5.437776
Maximum	8.271834	8.735455	8.000000	3.000000	22.10156	38.99508
Minimum	-0.737478	-21.18194	4.000000	0.000000	11.19145	-7.219782
Std. Dev.	0.731482	2.338344	0.373544	0.812250	3.387246	6.237580
Skewness	10.76635	-5.735765	-0.895806	-0.079253	0.191589	2.901713
Kurtosis	120.8318	58.71480	21.66667	2.354451	1.467857	15.27821
Jarque-Bera	77718.28	17526.90	1904.794	2.393392	13.51072	999.0180
Probability	0.000000	0.000000	0.000000	0.302191	0.001165	0.000000
Sum	14.91539	49.90216	780.0000	174.0000	2150.728	740.5492
Sum Sq. Dev.	69.02355	705.3530	18.00000	85.10769	1480.073	5019.056
Observations	50	50	50	50	50	50

Source: E-views 9 output from the investigator's desk

From Table 1 above we can see the mean of earning per share (EPS), return on capital employed (ROCE), (AS), (ACFE), and (FLEV) of 9.89, 0.36,9.07, 12.82, and 13.55 respectively for the sampled 5 quoted Nigerian food and beverage firms in Nigeria between 2009 and 2018 period. When we compare the two chief variables of concern, namely: EPS and ROCE (dependent indicators), while EPS bares greater variability (it's SD = 32.49), where SD is standard deviation, ROCE displays a minor variability (SD. = 0.844342). Virtually all the variables were positively skewed, apart from ACS with an adverse skewness coefficient (SK = --0.106758). Consequently,

earnings per share, return on capital employed, ACFE was crowded over the mean estimate rather than under the mean estimate. Respectively they have a distribution skewed to the right or say a positively skewed distribution. Conversely agency monitoring cost (ACS) because it has distribution that is skewed to the left. In addition, all the kurtosis coefficients, EPS (K = 529.5851), ROCE (K =577.8720), ACS (K = 3.179178), ACFE (K =4.518217) and FLEV (K = 4.829095), are fine because they are over average kurtosis of 3 for average distribution, indicating that the variables have a leptokurtic distribution. Principally, the Jarque-Bera test unmistakably exhibits that ACS (p-value > 0.05) has normal distribution while the rest of the variables do not have a normal distribution because their Jarque-Bera p-value < 0.05.

Unit Root Analysis

Our methodology in chapter three indicated that panel data stationary is necessary for the reliability of the outcome of the study's analysis. Hence, every variable's panel stationary was investigated in this subsection. The panel data stationary test commonly is used here and is presented in Table 2 below.

Table 2: Panel Data Stationary Test (Unit Root Test Results)

Variables	Levin, Lin & Chu t*	Order of integration
(AS)	0.0000**	1(0)
(ACFE)	0.0000**	1(0)
(FSIZE)	0.0000**	1(0)
(FLEV)	0.0000**	1(0)
(EPS)	0.0000**	1(0)
(ROCE).	0.0000**	1(0)

The Levin, Lin & Chu t stationary tests results Table 2 above shows that both the independent and dependent variables are stationary at level, hence trying to get rid of unit root is unnecessary. There are several approaches to panel analysis, thus Park (2010) suggests that to find out the most suitable approach, it is helpful to carry out tests, like: Likelihood Ratio test, to determine whether fixed effect model measure up to PLS, and Breusch-Pagan Lagrange Multiplier (LM) test for random effect model. Hausman test would be needed if we find both fixed and random effects to be more appropriate than Pooled OLS. See section 4.2.2 for the test results.

Testing for the most Suitable Econometric Model for the Data Collected

Park (2010) suggested three kinds of tests when dealing with panel data analysis, which include: Likelihood Ratio Test, Breusch-Pagan LM Test, and Hausman Test.

***Likelihood Ratio Test (LRT) is also called Redundant Fixed Effects Tests*:** this test has an underlying hypothesis, that Pooled Least Square (PLS) model fits the data better than Fixed Effects model. After LRT we then proceeded to Breusch-Pagan LM test.

***Breusch-Pagan LM Test*:** this test has an underlying hypothesis that PLS model fits the data better than Random Effects model.

If the result of the LRT shows that fixed effects model is better than PLS model, while Breusch-Pagan LM Test shows that PLS model is better than Random Effects model, then it means that fixed effects model is better than both PLS and random effects models, but if Breusch-Pagan LM Test outcome shows that random effects model is better than PLS, then we will carry out a Hausman test to find out whether random effects model fits the data better than fixed effects model.

Hausman Test has an underlying hypothesis that Random Effects model is more appropriate than Fixed Effects model.

Model Specification Test Results

Likelihood Ratio Test results for Model 1 & 2

Table 3: PLS vs. fixed effects for Model 1

Redundant Fixed Effects Tests

Equation: Untitled

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.613890	(12,112)	0.8266
Cross-section Chi-square	8.281165	12	0.7628

The p-value associated with the cross-section F-statistic is 0.8266, while the p-value associated with the Chi-square is 0.7628 and both are more than 0.05 significance level, which provides strong evidence for the null hypothesis underlying the Likelihood Ratio Test, which states that PLS model better fits the data than fixed effects model. This suggests that there is no disregarded

heterogeneity amongst the Nigerian food and beverage firm's data if PLS model is employed in the analysis of model 1 of this study.

Table 4: PLS vs. fixed effects for Model 2

Redundant Fixed Effects Tests

Equation: Untitled

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	1.720251	(12,112)	0.0715
Cross-section Chi-square	21.991129	12	0.0376

The p-value associated with the cross-section Chi-square is 0.03, which is less than 0.05 significance level, and this provides strong evidence against the null hypothesis of LRT, that PLS model better fits the data than fixed effects model. This indicates that there is a disregarded heterogeneity amongst the Nigerian food and beverage firm's panel data if PLS model is used in the analysis of model 2 of this study.

Breusch-Pagan LM Test results for Model 1 & 2

Table 5: PLS vs. random effects for Model 1

Lagrange Multiplier Tests for Random Effects

Null hypotheses: No effects

Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis Cross-section	Time	Both
Breusch-Pagan	1.284356 (0.2571)	0.244502 (0.6210)	1.528858 (0.2163)

The Breusch Pagan LM test result in Table 5 above shows a statistic of 1.528858 and an associated p-value of 0.2163, which both indicate evidence for the null hypothesis that Panel Least Square (PLS) model better fits the data than random effects in our econometric model 1.

Furthermore, the Breusch Pagan LM test as well as Likelihood Ratio test showed that pooling the panel data does not in any way disregards heterogeneity in the industry because the data is poolable.

Table 6: PLS vs. random effects for Model 2

Lagrange Multiplier Tests for Random Effects

Null hypotheses: No effects

Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis Cross-section	Time	Both
Breusch-Pagan	1.528124 (0.2164)	0.929468 (0.3350)	2.457592 (0.1170)

The Breusch Pagan LM test result in Table 6 above shows a statistic of 2.457592 and an associated p-value of 0.1170, which both indicate evidence for the null hypothesis that PLS model better fits the data than random effects in our econometric model 2.

In addition, because Likelihood Ratio test showed that pooling the data will amount to disregarding the unobserved heterogeneity in the observations, as a result, the data is not pool able, rather fixed effects model is most suitable in the analysis of Model 2

Research work estimates

Table 7: Model 1: Estimation results

Dependent Variable: ROCE

Method: Panel Least Squares

Date: 09/23/21 Time: 15:10

Sample: 2009 2018

Periods included: 10

Cross-sections included: 5

Total panel (balanced) observations: 50

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.535958	1.110362	0.482688	0.6302
AS	-0.007132	0.172819	-0.041268	0.9671
FSIZE	-0.013026	0.021314	-0.611161	0.5422
FLEV	-0.014871	0.010659	-1.395110	0.1655

R-squared	0.038577	Mean dependent var	0.114734
Adjusted R-squared	-0.000190	S.D. dependent var	0.731482
S.E. of regression	0.731552	Akaike info criterion	2.257758
Sum squared resid	66.36085	Schwarz criterion	2.390105
Log likelihood	-140.7542	Hannan-Quinn criter.	2.311535
F-statistic	0.995088	Durbin-Watson stat	1.359627
Prob(F-statistic)	0.423647		

Table 7 presents the results of this study's model 1. These results were obtained using Pooled Least Square (PLS). The results show that the coefficient of ACS is -0.007132, and this suggests a negative relationship between AS and ROCE, but the associated p-value which is 0.9671 is more than 0.05 level of significance, which essentially indicates an insignificant negative relationship. The result also shows that ACFE has a coefficient of 0.086848, suggesting a positive relationship, but the associated p-value is 0.3113, which in fact reveals that no significant relationship exit between ACFE and ROCE. Similarly, the result showed that the coefficient of the control variables FSIZE and FLEV are -0.013026 and -0.014871 respectively indicating negative relationship but with associated p-values of 0.5422 and 0.1655, there is no significant relationship.

See the comparative results of fixed effect and random effect models in appendix 1.

Table 8: Model 2: Estimation results

Dependent Variable: EPS

Method: Panel Least Squares

Date: 09/23/21 Time: 18:02

Sample: 2009 2018

Periods included: 10

Cross-sections included: 5

Total panel (balanced) observations: 50

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.214623	5.152866	-1.011985	0.3137
AS	0.544457	0.587326	0.927011	0.3559
ACFE	-0.083256	0.339467	-0.245254	0.8067
FSIZE	0.093613	0.201221	0.465225	0.6427
FLEV	0.001174	0.038423	0.030559	0.9757

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.168110	Mean dependent var	0.383863
Adjusted R-squared	0.041841	S.D. dependent var	2.338344
S.E. of regression	2.288901	Akaike info criterion	4.621909
Sum squared resid	586.7758	Schwarz criterion	5.018952
Log likelihood	-282.4241	Hannan-Quinn criter.	4.783240
F-statistic	1.331367	Durbin-Watson stat	2.311933
Prob(F-statistic)	0.186450		

Table 8 presents the result of this study's model 2. This result was obtained using Fixed Effects model. The result shows that the coefficient of ACS is 0.544457, and this suggests a positive relationship between AS and EPS, but the associated p-value which is 0.3559 is more than 0.05 level of significance, which as a matter of fact indicates an insignificant positive relationship. The result also shows that ACFE has a coefficient of -0.086848, suggesting a negative relationship, but the associated p-value is 0.8067, which in effect reveals that no significant relationship exit between ACFE and EPS. Correspondingly, the result showed that the coefficient of the control variables FSIZE and FLEV are 0.093613and 0.001174respectively indicating positive relationship but with associated p-values of 0.6427and 0.9757, there is no significant

relationship. See the comparative results of panel least square and random effect models in appendix 3.

Test of Hypotheses

Here the various hypotheses stated earlier on in chapter one of this thesis are tested. The p values of panel least square serve as the basis of testing hypotheses 1 to 3, whilst the p-values of fixed effects multiple regression model served as the basis for testing hypotheses 4 to 6.

Testing the relationship between auditor's size and return on capital employed of Nigerian food and beverage firms in Nigeria.

$H0_1$: There is no significant relationship between auditor's size and return on capital employed of food and beverage firms in Nigeria.

HA_1: There is a significant relationship between auditor's size and return on capital employed of food and beverage in Nigeria.

Examining hypothesis one in line with how it was stated in this test's model 1, with return on capital as the dependent variable and auditor's size as the independent variable, the p-value of panel least square estimation of model 1 was applied in ascertaining the test outcome

Decision Rule:

Hypothesis one rejection or acceptance was based on the p-value estimated, if less than 5% we reject, if otherwise the null hypothesis is accepted.

In the statistical analysis of the relationship between auditor's size and return on capital employed of food and beverage in Nigeria, the result presented in Table 7 in relation to this showed a p-value of 0.9671, which suggests clearly that there is no significant relationship between them.

$H0_2$: There is no significant relationship between auditor's size and earnings per share of food and beverage in Nigeria.

HA_2: There is a significant relationship between auditor's size and earnings per share of food and beverage in Nigeria.

Testing hypothesis two along the lines of how it was stated in model 2, with earnings per share as the dependent variable and auditor's size as the independent variable, the p-value of the fixed effect estimation of model 2 was used in establishing the test up shot.

Decision Rule:

Hypothesis two rejection or acceptance was based on the estimated p-value, if less than 5% we reject, if otherwise the null hypothesis is accepted.

By virtue of the statistical test of the relationship between auditor's size and earnings per share of food and beverage in Nigeria, the result presented in Table 8 in relation to this showed a p-value of 0.3559, which indicates undoubtedly that there is no significant relationship between them.

$H0_3$: There is no significant relationship between audit committee financial expertise and return on capital employed of food and beverage in Nigeria.

HA_3: There is a significant relationship between audit committee financial expertise and return on capital employed of food and beverage in Nigeria

Hypothesis three testing was in accordance with the model 1that was set out in the study methodology, with return on capital employed as the dependent variable and audit committee financial expertise as the independent variable, the p-value of the panel least square effect estimation of model 1 was used in corroborating the result of the test.

Decision Rule:

Hypothesis three rejection or acceptance was based on the estimated p-value, if less than 5% we reject, if otherwise the null hypothesis is accepted.

Following the statistical model of the relationship between audit committee financial expertise and return on capital employed of food and beverage in Nigeria, the statistical analysis result presented in Table 7 on this revealed a p-value of 0.3113, which point to the fact that there is no significant relationship between them.

$H0_4$: There is no significant relationship between audit committee financial expertise and earnings per share of food and beverage in Nigeria.

HA_4: There is a significant relationship between audit committee financial expertise and earnings per share of food and beverage in Nigeria.

The testing of hypothesis four was according to model 2that was set out in the study methodology, where earnings per share as the dependent variable and audit committee financial expertise as the independent variable, the p-value of the fixed effect model estimation of model 2 was used in providing empirical evidence for the result of the investigation

Decision Rule:

Hypothesis four rejection or acceptance was based on the estimated p-value, if less than 5% we reject, if otherwise the null hypothesis is accepted.

As a result of the statistical model of the relationship between audit committee financial expertise and earnings per share of food and beverage in Nigeria, the statistical analysis result presented in Table 8 on this revealed a p-value of 0.8067, which point to the fact that there is no significant relationship between them.

IV. DISCUSSION OF FINDINGS

The results reported in this study showed that audit quality and financial performance measures do not have statistically significant relationship; this result agrees as well as disagrees with several previous studies.

The finding on audit committee financial expertise and its impact on financial performance indicates insignificance in the influence of financial expertise of audit committee on the two financial performance ratios (ROCE and EPS). It is observed that increasing the number of the auditor's size with financial expertise does not really improve the financial performance, which is consistent with the argument of Ehikioya (2009) as well as Jensen and Meckling (1976) that corporate governance does not account for corporate performance. It is also consistent with the findings of Koutoupis and Bekiaris (2019), Zhou, Owusu-Ansah, and Maggina (2018) who empirically found insignificant relationship between background, skills and financial performance.

The findings in this study, on the other hand, does not support the findings of Dakhlallh (2020), Oroud (2019), Ashari and Krismiaji (2019), Olayinka (2019), as well as Shehu (2017) that financial expertise helps to improve financial performance. The findings also do not support the views of Krishnan and Visvanathan (2008) who maintained that accounting expertise within boards contributes to greater monitoring by the audit quality (AQ) and leads to enhanced performance. In respect of audit committee chairman having an auditing or accounting background, one could follow Spira (1999) who believes and thinks that the absence of relationship between financial expertise of audit quality and financial performance in this study is as a result of the fact that most of the audit committee chairmen do not have auditing background or recent sufficient experience.

And lastly, the inclusion of firm size and firm leverage as control variables suggested that the observed insignificant relationship between audit quality and financial performance in previous studies (like, Ojeka, Iyoha, &Obigbemi, 2014; Ebere & Ibanichuka, 2016; Yusuf, Bambale, &Abdullahi, 2018; Zhou, Owusu-Ansah, & Maggina, 2018; and Olayinka, 2019) was not spurious, and that other factors outside the board's control might be responsible for Nigerian food and beverages firms' financial performance.

V. CONCLUSION

Several past investigations suggest that auditor size and financial expertise influence financial performance (Oroud 2019; Dakhlallh, 2020).In spite of this, the outcome of this study point toward the fact that size and financial expertise have no predictive power on the financial performance of food and beverage firms in Nigeria, this is in agreement with the findings of Olayinka (2019).

The two-audit quality investigated in this study such as auditor size and audit committee financial expertise and exhibited inability to predict the two financial performance indicators employed in the study: ROCE and EPS. This finding toed the line of the findings of Olayinka (2019) further inferring that auditor size and financial expertise of members of the committee are not the solutions to poor financial performance or to agency problem. So conclusively, audit quality does not show that they influence financial performance of food and beverage firms quoted in Nigeria.

These findings disagree with mixed patterned results of previous literatures that have examined the variables. The findings of this study show clearly that the agency theory that suggests that the board of directors through their monitoring role would contribute to the achievement of organizational goal does not work in all contexts because there are several environmental factors that might make it impossible. On the other hand, supporters of stewardship theory argue that having more directors in a committee will add to effectiveness and produce higher result (Al Mamum et al., 2013). This study's findings did not support the resource dependence model that suggest that the board of directors could support the management in the achievement of organizational goals (Wang, 2009). However, the finding demonstrates a neutral cause; it does not matter the size, the financial expertise, frequency of meeting or otherwise; the outcome of financial performance remains unchanged whatever the board's choice is.

To help achieve a robust finding, the audit quality was controlled using firm size and leverage. For both firm size and leverage, the regression coefficients are negative as well as insignificant. Thus, our study, like previous studies, provides findings that are consistent with some previous findings and inconsistent with some others as well but provides a complete conclusion to the debate.

We, therefore, can conclude that quoted food and beverage firms in Nigeria cannot improve their financial performance by simply having the right audit quality.

VI. RECOMMENDATIONS

The findings of this study revealed that audit quality have no statistically significant effect on quoted food and beverage firm's financial performance in Nigeria. Following this finding, the researcher makes three important recommendations:

1. Firstly, the food and beverage firms in Nigeria should not consider increasing their auditor's size as it is not significantly impacting on their financial performance rather, they should consider those other things that can be done in order to have an effective audit committee, like diversity in terms of gender, religion, region, ownership, etc.
2. Secondly, the food and beverage firms should not focus so much on the financial expertise of audit committee members rather emphasis should be placed on the experience and commitment of each member.
3. In addition, future authors should investigate the relationship between audit quality and financial performance extensively, by adding new variables such as experience and independence.
4. Currently, audit committee supervises the internal audit activities and evaluates the performance and the independence of external audit. Therefore, the audit committee is supposed to help the board of directors to achieve the supervision of regulation and advice published by the BDL as well as the central bank of Nigeria.

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Anagboso Tochukwu Christian (Author) *University of Port Harcourt*	**Cloud-based Computing to Manage Accounting and Enhance the Financial Performance of Publicly Listed Banks in Nigeria**

Abstract

The study examined the relationship between cloud computer-based accounting and the Financial Performance of Banks. The respondents were managers of quoted banks in Nigeria. The cross-sectional field survey of the research design was used for the study. The hypotheses were tested using tie Pearson's Product Moment Correlation Coefficient and regression analysis statistical tools by the application of the SPSS Version 20.0. Results indicated that there is a significant relationship between directors' quality and profitability between directors' shareholdings and return on equity; between board independence and earnings per share; and between board size and dividend per share. The study concluded that corporate governance in banks is a process where control and regulatory measures are applied to ensure that set goals are achieved for the greater benefit of all stakeholders. The study recommended amongst others that Banks in Nigeria should apply corporate governance principles to assess their performance as well as avoid conflict of interest in their governance process by fashioning out ways to promote the independence of their board of directors.

Keywords: Cloud-Based Computing. Manage Accounting, Enhance Financial Performance, Publicly Listed Banks. Nigeria.

Introduction

Numerous studies have been conducted over time to determine how investors and business stakeholders can trust the utilization of their resources (Clarke & Dela, 2008). This perspective is rooted in the agency theory, which mandates organizational management to consistently act as stewards for resource owners. Financial performance is typically crucial in ensuring that business operations align with set objectives (Adrian, 2009). Heidi and Marleen (2003:4) argue that effective banking supervision is impossible without robust financial performance. Mayes, Halme, and Aarno (2001) note that changes in bank ownership in the 1990s and early 2000s significantly

transformed the governance of global banking organizations, raising critical policy research questions. The key question is: how do these changes impact bank performance? Countries need robust, resilient banking systems with efficient computer-based accounting, especially considering the international wave of mergers and acquisitions that has impacted the banking industry in the past (Qi, Wu & Zhang, 2000). This will enhance institutions' ability to thrive in an increasingly open environment.

The Asian crisis and the relatively poor application of computer-based accounting systems in Nigeria have made financial performance a focal point in development debates. The absence or poor implementation of computer-based accounting practices has led to the downfall of many international and local companies. A prime example is the 2008 financial crisis, which saw the abrupt end of numerous financial institutions and organizations. In the United States, corporate governance was heavily criticized following a series of high-profile company collapses - Enron and WorldCom shocked the business world with their extensive unethical and illegal operations. Large trusted companies from Parmalat in Italy to multinational newspaper group Hollinger Inc., Adephia Communications Company, Global Crossing Limited, Tyco International Limited revealed significant problems in their financial performance. Even the esteemed New York Stock Exchange had to dismiss its director (Dick Grasso) due to public outrage over excessive compensation.

In emerging markets, the banking industry, like other sectors, has experienced numerous collapses. These include Savannah Bank Plc, Allstates Trust Bank Ltd, Society Generale Bank Ltd in Nigeria, The Continental Bank of Kenya Ltd, Capital Finance Ltd, Consolidated Bank of Kenya Ltd and Trust Bank of Kenya among others (Akpan, 2007). Specifically in Nigeria, the absence of effective financial performance in financial institutions led to the downfall of several banks. This was a period when bank owners did not distinguish between bank assets and personal investments, and insider abuses such as lending without due process to relatives were rampant. This led to a significant reduction in the number of banks from 89 to 25, causing a negative impact on the economy with effects such as loss of investment value, poor or no returns on investment, no profitability and hence no dividend payments, and zero earnings per share.

Despite having robust computer-based accounting financial performance structures, many of these collapsed companies had issues due to the close relationship between their board and advisers. The independence and quality of directors are seen as crucial factors. Directors have a fiduciary duty to act in the best interests of the company. This study aimed to investigate the computer-based accounting and financial performance of quoted banks in Nigeria.

Purpose of the Study

The aim of this study was to examine the relationship between cloud computer-based accounting and the financial performance of listed Banks in Nigeria. The specific objectives were to:

1. ascertain the effect of cloud computer-based financial accounting information systems and the financial performance of listed banks in Nigeria.

2. determine the relationship between Directors' Shareholdings and Return on Equity (ROE).

Research Questions

In view of the objectives of the study, these research questions were addressed to guide the study:

1. How does director quality affect Profitability?

2. What is the relationship between Directors Shareholdings and Return on Equity (ROE)?

Research Hypotheses

The following research hypotheses were formulated in the study.

$H0_1$: There is no significant relationship between Directors' Quality and Profitability of computer-based accounting applications.

$H0_2$: There is no significant relationship between Directors Shareholdings and Return on Equity (ROE).

Significance of the Study

This study evaluated the impact of cloud computing-based accounting on the financial performance of listed banks in Nigeria. It also aims to shed light on the extent of compliance

with various sections of best practice codes by banks that report on their corporate governance and identify areas where they face challenges. The information will be useful for boards of directors in comparing their banks' performance with that of their competitors. The study will act as a reference for future research. Additionally, it will offer insights into how bank managers can implement wise strategies to manage their organizations effectively.

Methodology

The cross-sectional census approach was used in this study. This is because the study population was small, that is less than 30. There is therefore need for sampling. The target population for this study was all quoted Banks in Nigeria. However, given the difficulty involved in conducting an effective study of all quoted Banks in Nigeria, the study was limited to an accessible population. Consequently, the accessible population of the study was all quoted Banks in Rivers State. Available data from the 2022 statistical bulletin of the Central Bank of Nigeria reveals a total of 15 quoted Banks located in Rivers State. The source of data used for the study was the secondary data. This is because the study examined the relationship between Cloud Computer-based accounting and the financial performance of banks. The information for the study was obtained from the 2022 statistical bulletin of the Central Bank of Nigeria, the fact book of the Nigeria Stock Exchange and the websites of the studied banks. However, primary data was used only to obtain the demographic features of the respondents. The bio-data of the respondents, such as age bracket, sex, level of education, name of bank, and marital status were obtained for the study by the use of questionnaires.

Operational Measures of Variables

The study examined the relationship between computer-based accounting and the financial performance of banks. The independent variable is Cloud Computer-based accounting and it has the following dimensions; directors' quality, directors' shareholdings, board independence, and board size. On the other hand, the dependent variable is financial performance which has the following measures; profitability, return on equity (ROE) earnings per share (EPS), and dividend per share (DPS). Directors Quality: This is the proportion of directors with more industry experience over those who are less experienced. We had directors from the age of 60 and above as experienced directors and those below the age of 60 as less experienced.

Directors Shareholding: This is considered as the directors with the controlling shares in the banks.

Board Independence: This is measured by the ratio of non-executive directors over the total number of directors in the banks.

Board Size: This is the total or sum of all directors be it executive or nu- executive directors in the banks.

Profitability: This is revenue less expenses.

Return on Equity: This is net income divided by shareholders' equity. Earnings per Share: This is the total earnings divided by the total number of shares of banks.

Dividend per Share: This is the total amount of dividend paid divided by the total shares that are outstanding.

Model Specifications and Variable Definition

The available data were intended to comprise a number of features of the companies such as Directors' Quality (DQ), Directors' Shareholdings (LS), Board Independence (BI), and Board Size (BS) (dimensions of independent variables). Directors' quality is considered to be the ability to apply experience in managing the affairs of the organization. The directors who had attained the age of 60 years and above were considered experienced persons with the potential of director quality. In this study, we value of 0.64.

Directors Shareholding is a situation where the director of the board is a majority shareholder and thus prevents an external party from controlling the organization's affairs. In this study, we considered the majority shareholder as one who has more than 50% of the total shareholdings. In this study, this gave us a value of 0.62.

Board Independence is considered to be the number of non-executive directors on the board. The proportion for board independence was obtained by dividing the number of non-executive directors by the total number of directors in each bank and a value of 0.59 was obtained.

Similarly, the total number of directors both executive and non-executive were considered as the Board Size of the banks. The study had an average of 14 for the surveyed banks.

Another important aspect of the study is the identification of the measures of financial performance, which included profitability (PRT), return on equity (ROE), earnings per share (EPS), and dividend per share (DPS). The values of the measures of financial performance were obtained from the records of the Nigeria Stock Exchange 2013.

Profitability for lie surveyed banks gave an average value of 0.17; the average value of dividend Per Share --0 .09; the average value for Earnings Per Share -- 0.39; and Return on Equity -- 0.051. There is a general agreement that these variables are good indicators of financial performance (Williamson, 1998, 2002).

The symbolic form of the model specification was adopted in this study. Each equation provided by the model specification is meant to test each of the hypotheses; that is, the four equations are required to test one hypothesis each that was developed in the study.

$\beta 0 + \beta 1DQ + ut$ ……Eqn 1

Where;

PTR (profitability, measure of financial performance); (Dependent variable 1)

Constant

Directors Quality (DQ) (Independent variable 1)

$\beta 0 + \beta 2DS + ut$…….Eqn 2

Where;

ROE (return on equity, the measure of financial performance); (Dependent variable 2)

Constant

Directors Shareholdings (DS) (Independent Variable 2)

Error term

$\beta 0 + \beta 3B1 + ut$……Eqn 3

Constant

Board Independent (BI) (Independent Variable 3)

ut = Error term.

$\mu_4 = \beta) + \beta 4BS + ut$ ……..…..Eqn 4

Where;

μ = DPS (dividend per share, measure of financial performance); (Dependent Variable 4)

β0 = Constant

β4 = Board Size (DS) (Independent Variable 4)

ut = Error term.

The research hypotheses developed in this study were analyzed and tested by the use of Pearson's product-moment correlation coefficient (FPMC) statistical tool and regression analysis. The PPM (evaluates the strength of the relationship or going togetherness of the two sets of data. The coefficient of correlation ranges between -1 and +1. A positive correlation coefficient means that the two variables are directly related: that is high values of one variable give corresponding high values of the other variable (when r= 1, we have a perfect positive correlation). A negative correlation coefficient means two variables are inversely related, that is high values of one variable give correspondingly decreased values of the other variable, when r=1, we have a perfect negative correlation) (Anastas, 199). In addition, if the values for calculation are more than 30, the z-test statistical tool is used however, if the values are below 30, the t-test statistical tool is applied. The coefficient of correlation is denoted as r. According to Anastas (1999), regression analysis is a type of causal forecasting. This type of forecasting considers a number of variables that are related to the variable that is going to be predicted. Once these related variables have been determined; a statistical model can be built and used to forecast the variables of interest. Regression therefore is the study of the relationship among these variables. The purpose of Regression analysis may be to predict or estimate the value of one variable from known or assumed values of other variables related to it. The statistical package for social sciences (SPSS) was used to test the hypotheses version 20.0.

Results and Discussion

The hypotheses testing was done by the use of Pearson's Product Moment Correlation Coefficient statistical tool with the application of the SPSS package version 20.0. The test was adopted because the data collected for the study was measured on an ordinal scale. In addition, the regression analysis was also applied in testing the hypotheses so as to examine their relationships. More so, to guide the analysis and interpretation of the results from the hypotheses tested, Dana's (2001) correlation decision scale framework was adopted, and it is categorized thus: (a) ±0.00 – ±0.19 (very weak); (b) ±0.20 – 0.39 (weak); (c) ± 0.40 – 0.59 (moderate); (d) ± 0.60 – 0.79 (strong); (e) ± 0.80 – 0.99 (very strong); and (f) ± 1 (perfect).

Nonparametric Correlations Matrix: Software package for Social Sciences (SPSS) Output for PPMC on the variables.

	PPMC (r)	DQ	DS	B1	BS	PRT	B1	BS	PRT
DQ	Correlation Coefficient Sig. (2-tailed) N	1.000 82							
DS	Correlation Coefficient Sig. (2-tailed) N	.604* 000 82	1,000 82						
B1	Correlation Coefficient Sig. (2-tailed) N	.679* .000 82	.702* .000 82	1.00 0 82					

BS	Correlation Coefficient Sig. (2-tailed) N	.673* .000 82	.681* .000 82	.630* .000 82	1.000 82				
PRT	Correlation Coefficient Sig. (2-tailed) N	.777* .000 82	.729* .000 82	.733* .000 82	.708 82	1.000 82			
ROE	Correlation Coefficient Sig. (2-tailed) N	.756* .000 82	.786* .000 82	.753* .000 82	.798* 82	1.000 82			
EPS	Correlation Coefficient Sig. (2-tailed) N	.720* .000 82	.703* .000 82	.781* 82	.729* .000 82	.743* .000 82	.713* 82	1.000 82	
DPS	Correlation Coefficient Sig. (2-tailed) N	.726* .000 82	.714* .000 82	.773* .000 82	.763* 82	.791* .000 82	.740* .000 82	.718* 82	1.000 82

SPSS Output, Version 20.0

DQ = Directors Quality; DS = Directors Shareholding;

B1 = Board Independence; BS = Board Size;

PRT = Profitability; ROE = Return on Equity;

EPS = Earnings Per Share; DPS = Dividends Per Share

Test of Hypothesis 1:

Ho_1: There is no significant relationship between Directors' Quality and Profitability.

Table 1A: The Descriptive Statistics

Variables	Mean	Standard deviation
PRT	0.1601	0.116
DQ	11.011	1.001
Error Term	.6700	0.354

The results of the Descriptive Statistics provided the mean and standard deviation for each variable for corporate governance and financial performance. Concerning the values of Table IA above, the mean value of profitability (PRT) was 0.1601 and the standard deviation was 0.116. Directors' quality has a mean value of 11.011 and a standard deviation of 1.001. There is a difference between the mean of directors' quality and the error term. The mean values for firm size and error term are 11.011 and .6700 respectively. there is a big difference between the standard deviation of firm size and error term.

Table 1B: Correlation

Variables	Pearson Correlation	Significant
PRT	0.777	0.000
DQ	-0.584	0.000

The analysis above revealed a significant relationship between directors' quality and profitability with a significant value of 0.000.

Table 1C: Regression Analysis

Variables	Std. Error	Beta	T-value	P-value
(Constant)				
PRT	0.007	0.042	2.064	0.007
DQ	0.012	-0,021	-1.001	-0.033

Other values of Regression Analysis

Statistic	Value
R-Squared	0.864
Adjusted R-Square	0.811
F-Statistics	91.201
Prob (F-Statistics)	0.000

The result above reveals the influence of Directors' Quality on Financial Performance. Results show that financial performance and (directors' quality are positively related. R-square reveals that only 86.4% of variations in the dependent variable (PRT) are explained by the variations in the independent variable. The adjusted R-square is slightly below the R-square with a value of 81.1%. F-statistics shows the validity of the model as its value 91.201 is well above its Prob (F-statistics) value of 0.000.

Consequently, from the above hypothesis, we assumed that there is no significant relationship between Directors' Quality and the profitability of banks. From the analysis, the correlation between Directors' Quality and profitability reveals a coefficient (r) of .777, indicating an inverse correlation between the two variables, with a p-value of .053 significant at only 0.05%. This indicates a significant effect between Directors' Quality and the profitability of banks. On the premise of these results, since the negative effect is significant, we, therefore, reject the null hypothesis and accept the alternate hypothesis which states that there is a significant relationship between Directors' Quality and profitability. This invariably means that the Directors' Quality must be considered while making financial decisions that can provide corporate profitability. The significant relationship found between Directors' Quality and the profitability of banks is

consistent with the conclusion drawn by (Adrian, 2009). They have reported a significant relationship between director quality and the performance of a firm. We therefore argue that Directors Quality leads to better performance where most of the board members play a passive role in monitoring the firm (Fisher, 2010).

Test of Hypothesis 2:

$H0_2$: There is no significant relationship between Directors Shareholding and Return on Equity (ROE).

Table 2A: The Descriptive Statistics

Variables	Mean	Standard deviation
ROE	0.1621	0.119
DS	11.014	1.003
Error Term	.6900	0.357

The results of the Descriptive Statistics provided the mean and standard deviation for each variable for corporate governance and financial performance. Concerning the values of Table 1B above, the mean value of return on equity (ROE) was 0.1621 and the standard deviation was 0.119. Directors Shareholding has a mean value of 11.014 and a standard deviation of 1.003. There is a difference between the mean of directors' shareholding and the error term. The mean values for the director's shareholding and error term.

Table 2B: Correlation

Variables	Pearson Correlation	Significant
ROE	0.786	0.000
DS	-0.591	0.000

The analysis above revealed a significant relationship between DS and ROE with a significant value of 0.000.

Table 2C: Regression Analysis

Variables	Std. Error	Beta	T-value	P-value
(Constant)				
ROE	0.010	0.060	2.074	0.011
DS	0.014	-0.027	-1.004	-0.038

Other values of Regression Analysis

Statistic	Value
R-Squared	0.877
Adjusted R-Square	0.914
F-Statistics	91.222
Prob (F-Statistics)	0.000

The result above reveals the influence of directors' shareholdings on ROE. Results show that ROE and Directors' shareholding are positively related. R-square reveals that only 87.7% of variations in the dependent variable (ROE) are explained by the variations in the independent variable. The adjusted R-square is slightly below the R-square with a value of 81.1%. F-statistics shows the validity of the model as its value 91.222 is well above its Prob (F-statistics) value of 0.000.

Therefore, the result of the hypothesis using Pearson's Product Moment Correlation coefficient provided a coefficient (r) value of .786 indicating an inverse correlation between the two variables, with a p-value of .051 significant at only 0.05%. We therefore reject the null hypothesis which states that there is no significant relationship between Directors Shareholdings and Return on Equity (ROE). This significant relationship could be based on the fact that directors' shareholdings can influence all the workers of the banks to redouble their efforts in doing their jobs in order to achieve a return on equity. This is in line with the views of (Clarke & Dela, 2008). The capacity of a director to become the majority shareholder of the company provides the organization with enough avenues for improved performance as the director would

ensure prudent, efficient, and effective means of using corporate resources to achieve set objectives.

Conclusion

The study's empirical analysis verified a positive link between cloud-based accounting and financial performance. It was found that cloud-based accounting could improve financial performance, provided factors such as the quality of directors, their shareholdings, board independence, and board size are accounted for (Williamson, 2002; Guest, 2009). The study noted that cloud financial performance processes, which necessitate effective control mechanisms, can offer a robust method for managing an organization's activities to meet its objectives. Based on these findings, it can be inferred that corporate governance in banks involves the application of control and regulatory measures to ensure goal attainment for the maximum advantage of all stakeholders.

Recommendations

Considering the findings of this study, the following recommendations are made:

1. Banks in Nigeria should encourage segregation of duties for effective financial performance principles application.

2. Directors of the Banks in Nigeria should intensify their oversight functions to ensure optimal performance and to check all forms of regularities.

3. Banks should avoid conflict of interest in their governance process by fashioning out ways to promote the independence of their board of directors.

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Saeed Herawi (Author) *Indonesian International Islamic University*	**The Impact of Renewable Energy development on Saudi Arabia's Economic Growth**

Abstract

The objective of this study is to identify the impact of renewable energy consumption on economic growth in Saudi Arabia. In this study we used quantitative approach with autoregressive distributed lags bound test for cointegration, and a related error correction model to analyze the data. The data collected from the World Bank covering the period of 1990-2021. An analysis of the study used a set of variables, in which Renewable energy consumption, Carbon Dioxide emission and trade consider as independent variable and the dependent variable is GDP per capita. The result showed that renewable energy consumption has an adverse and insignificant impact on economic growth in Saudi Arabia in the short test relationship. In the long run, however, it has a positive statistically significant effect on the economic growth. The current study suggests modification of the regulations governing renewable energy sources in order to achieve significant and favourable short-term economic growth. Additionally, the Kingdom of Saudi Arabia Vision Plan 2030 will continue to be implemented, and through it, the National Renewable Energy Program will effectively support the Kingdom's economy, develop its human resources, and encourage investments from both international and domestic businesses.

Keywords: Renewable energy consumption (REC), Economic growth (GDP), Autoregressive Distributed Lags Model (ARDL), Carbon Dioxide Emission.

1. Introduction

Global economic activity is fueled by energy. By 2030, it is anticipated that total energy demand would have increased by 21% as a result of growing populations, rising living standards, and increased consumption. At the same time, governments all over the world are looking for ways to provide energy while reducing greenhouse gas emissions and other environmental effects due to growing worries over climate change. Investment and infrastructure decisions taken today in the energy sector lock in associated costs and benefits for at least a few decades. They also have

an important effect on how well the energy sector supports economic growth overall (IRENA, 2016). Investment in renewable energy has received significant attention in recent years on a global scale in an effort to achieve sustainable economic, social, and environmental development policies. From job creation to resource efficiency and the environment, the energy industry affects the health and sustainability of the whole economy. Significant changes in the industry can have a significant impact on the entire economy. As a result, there is a strong link between energy use and development (Safa, 2017). The industrial revolution witnessed a significant shift in manufacturing technology away from manual labor and toward machines, as well as an increase in the use of coal burning to produce steam. Numerous studies have found a strong positive correlation between the demand for energy and global growth. More precisely, when compared to the other Middle Eastern nations, Saudi Arabia has the greatest energy usage (Krane, 2019). By the end of 2019, the Kingdom of Saudi Arabia's average oil consumption was 4.3 million barrels per day (bpd), up from an average of 4.1 million bdp in 2018 (SME, 2020). By the end of 2018, Saudi Arabia had consumed about 289.9 terawatt hours, a 0.42 % more than the last year. (Rambo, 2017), the primary factor contributing to the significant growth of the non-oil sector is the consistent annual growth rate of 4.5 percent between 2010 and 2019. Additionally, a fertility rate of 3.2 percent per year from 2012 to 2017 has also played a role in this growth. Another influential factor is the extensive use of water desalination, which has resulted in high domestic energy consumption in the region. According to (Negewo et al, 2012), it will take about 8 million bpd of oil production to meet domestic energy demand by 2050. This high level of domestic energy use should limit the Saudi government's capacity to export more oil barrels in the short term. As a result, it is essential for the Saudi government to exert control over the rising domestic energy consumption. For Saudi Arabia, using renewable energy as a supplement to its current energy sources could ease the country's dependence on fossil fuels. Several renewable energy projects are being carried out in the area, all of which are helping to grow local companies. Furthermore, if carbon emissions were decreased in the regional economy, Saudi Arabia could make a greater contribution to the fight against climate change. Since the Saudi government spends so much on healthcare, keeping its citizens healthy can save money. Investing in renewable energy can help Saudi Arabia's economy become one that is dynamic, sustainable, and stable (Negewo, 2012). The development of renewable energy sources

and investment in renewable energy have been priorities for Saudi Arabia during the past few years. A renewable and sustainable energy supply of 9.5 GW is the goal set forth in Saudi Vision 2030 for the year 2030. By 2030, Saudi Arabia wants to raise the number of investments in this industry by 40 billion dollars, including 30 billion for renewable energy sources (EIA, 2019). This is in order to meet these goals. By giving renewable energies a larger share of the energy consumed—rising from 42% in 2020 to 52% in 2030—it also aims to change the composition of the energy used. Although Saudi Arabia does not have a dedicated framework for renewable energy investment, the Saudi government has established a number of steps to encourage investment in the area. It has a significant potential for renewable energy sources, but there is little scientific study that examines and analyzes the Saudi renewable energy sector in all terms that may affect economic in that sector. In addition, choosing the best investment scenario in Saudi Arabia for the foreseeable future is challenging despite the potential availability of a variety of renewable energy investment scenarios and alternatives. Furthermore, knowledge of all the considered essential elements in the transition to totally renewable energy sources is still limited. As a result, there is a rising need for national research on renewable energy sources.

1.1 Research Objectives

The primary objective of this study is to measure and analyze the relationship between the renewable energy consumption and economics growth in Saudi Arabia. We must raise awareness of the need to use conventional energy resources wisely so that future generations can benefit from them. We must also find ways to transition Saudi Arabia to a renewable energy economy and encourage investment in this area. By emphasizing the environmental risks of fossil fuels and the need for alternative energy sources, we can advance the research and development of renewable energy. The analysis makes use of time series data from the World Bank from years 1990 to 2021. The use of a single model or set of procedures that may not be appropriate for generalizing the results is one of the primary difficulties in research on quantifying the contribution of renewable energy to economic growth. However, there are relatively few studies that thoroughly examine the relationship between renewable energy and energy efficiency, as well as its economic impact. Therefore, this study looks for this connection between kind and long-term time. The Augmented Dickey-Fuller unit root test, and the autoregressive distributed

lags bound test, and a related error correction model will all be used in the implementation of this study.

1.2 Research Question

"How does the consumption of renewable energy affect economic growth in Saudi Arabia??"

The question raised by our research in the area of renewable energy and its role in achieving a sustainable economy is that there is an increasing demand for energy in the face of dependence on fossil fuels, which are in danger of being exhausted, and due to Harmful emissions, without taking into account an environmentally sustainable economy and its unsustainability, raises research questions on renewable energy different sources and their relationship to economic growth.

1.3 The importance of the study

Energy plays the role of a driver of economic activity, and it is demonstrated by the important and growing role that energy plays in all the world's economies, whether in developed or developing countries alike, whether oil or non-oil and whether renewable or non-renewable. And increasing economic activity in order to achieve positive economic growth requires an increase in energy consumption, and achieving sustainable economic growth requires the provision of renewable, sustainable and guaranteed energy supplies. For this reason, all countries of the world are seeking to provide these energy supplies and thus develop energy policies in the medium and long term whose goal is to secure their energy requirements, including ensuring their energy security (Kraft, 1978). Hence the importance of the effective role that the development of infrastructure can play in the path of transformation towards a renewable energy economy as one of the basic pillars for advancing economic growth.

The importance of the study lies in the fact that it addresses one of the most frequently discussed topics among economic researchers by searching for the accuracy of the relationship that exists between the consumption of renewable electrical energy and economic growth, especially in light of the fluctuations in traditional energy prices on the one hand and the negative effects of the latter on the environment on the other hand. The results will give some guidance on what exists in the literature on the nature of the relationship, which will help policy makers in developing appropriate energy policy and determine the optimal methods to achieve the best

possible economic benefit, on the other hand, it is considered an important economic issue, as its importance lies in the necessity of investing in the field of renewable energies in order to achieve economic growth. The importance of this study is also highlighted by examining the role that renewable electrical energy plays in stimulating economic growth and the effects resulting from the nature of this relationship.

Despite the many studies related to the issue of consumption of renewable energies in developed and developing countries, which in itself shows the importance of this study, this study is important in choosing a country that relies heavily on oil exports, which makes it vulnerable to price fluctuations and thus the impact on energy. In addition, its contribution to greenhouse gas emissions. Most important of all, the Kingdom of Saudi Arabia launched the 2030 Vision for Sustainable Development, which aims to transform its economy from an oil-dependent economy to a diversified, innovative and competitive economy. Vision 2030 includes a special clause related to the renewable energy market. This clause aims to increase the volume of renewable energy production by 50% by 2030, with a focus on solar and wind energy (SME, 2021). Which makes this study a valuable addition to an accurate and clear understanding of the relationship between renewable energy consumption and economic growth, as well as its economic dimensions in the Kingdom of Saudi Arabia.

2. Literature Review

There are many studies that have dealt with topics related to renewable energies, and below we will list some of them:

(Mankiw, 2007) states that economic growth represents a nation's national output, which determines the rate of change in its standard of living. In reality, one of the primary objectives for national development in underdeveloped countries may be a high rate of economic growth. It is possible to detect a direct correlation between economic expansion and the rise in social production of products and services. An increase in production of products and services could boost social wellbeing.

(Niu et al.,2013) examined the link between energy use and human development. They used panel data for 15 countries. They also selected human development, GDP per capita and urbanization rate. The research results show that there is a long-term two-way causal relationship

between electricity consumption and the five indicators. The report also recommends integrating electricity into basic public services and improving access to electricity for low-income groups, thus promoting human development.

(Belaid & Youssef, 2017) investigated the relationship between environmental issues, the use of all energy sources, and Algeria's economic development. The research made use of data from 1980 to 2012. The Granger causality test and an autoregressive distributed lad model were both utilized in the study to analyze the data and determine the connection between the variables in Algeria. The outcomes demonstrated long-term unidirectional causality. Renewable energy could be a key driver of economic growth and job creation in Algeria, according to the research.

Renewable energy and economic development nexus were the subject of (Khobai, 2018) study. The data examined in the study included 1997 to 2012. In order to analyze the data, the study utilized Granger causality tests and a VAR model. The study's results revealed that there is causal relationship between economic development and the electricity, and the usage or the production of renewable energy actually increase the economic growth. As a result, the author's recommendation was that the South African government take proactive measures to adopt energy policies that do not impede economic growth.

Using the Canning and Pedroni long-term causality test, (Apergis and Danuletiu, 2014) studied the relationship between the usage of renewable energy and economic growth for 80 nations. For the entire sample as well as for the various areas, the two authors demonstrated the presence of a long-term positive causation between renewable energies and real GDP. The link of the consumption of renewable energy and economic expansion suggests that renewable energy is crucial for both economic development and environmental quality. In the same vein.

According to (Tiba and Omri, 2017) IRENA (International Renewable electricity Agency), KSA could utilize 25% less fossil fuels in the electricity and water sectors by 2030. The Saudi Aramco Oil Company owns the largest solar installation in the world, which is located on KSA's parking lot. Since this occurrence, the KSA has diversified its economy and promoted development by investing in RnSe, altering its domestic power structure, and projecting a global energy leadership image. One of the environmental advantages of the greater accessibility of RnSE resources is the preservation of a clean environment. These elements lead to an increase in

employment vacancies, a decrease in the trade imbalance, and a reduction in greenhouse gas emissions. For instance, in 2008, the average global market rate for a comparable GCC utility was 50.4 SAR/kWh, however Saudi government subsidies resulted in an overall cost for the KSA of just 0.15 SAR/kWh. However, the price of solar energy has dropped from US $101/kWh to about US.

More recently, (Saidi and Omri, 2020) utilized vector error correction model estimate and ordinary least squares approaches to investigate how well renewable energy promoted economic growth and decreased CO2 emissions in the case of 15 countries. According to the findings, there is both a short- and long-term causal association between economic growth and renewable energy.

Finally, we cite (Bilan et al., 2019) research. The authors studied to see how a nation's gross domestic product is affected by its usage of renewable energy sources, CO2 emissions, macroeconomics, and political stability. RES, like people and capital resources, have an effect on GDP for EU nations. The findings also show that the correction retracts as economic expansion raises the use of renewable energy sources. Finally, the research shows that nations that are candidates for membership in the EU and those that might be candidates should support the growth of renewable energy. Finally, the research shows that nations that are candidates for membership in the EU and those that might be candidates should support the growth of renewable energy.

3. Methodology

In this part, we will discuss measuring the impact of renewable energy consumption on economic growth by using standard and statistical performance in the applied study. This study is quantitative research that makes use of time series data acquired from the World Bank (WDI, 2021) that cover the years 1990 to 2021. Using renewable energy consumption, Carbon dioxide emissions, and trade as the control variables. Table 1 presents the Description and measurement of all variables for this study.

Symbol	Variable	Description	Unit
GDP	GDP per capita	Gross domestic product per capita.	constant 2015 US$
REC	Renewable Energy Consumption	Renewable energy consumption is the share of renewable energy in total final energy consumption.	% of total final energy consumption
Co2	Carbon dioxide emissions	Carbon dioxide emissions from all sources	Metric tons
TR	Trade	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	% of GDP

Table (1): Description of the Variables.

The study will analyze via E- views program the chosen variables renewable energy consumption and economic growth in KSA using an autoregressive distributed lags bound test for cointegration and a related error correction model. To do this, we use GDP as dependent indicator and we start from the following relationship: The linear econometric model can be written as in equation 3:

$$\text{Log (GDP)}=\beta_0+ \beta_1 \text{REC}_t + \beta_2 \text{Co}_{2\,t}+ \beta_3 \text{TR}_t + € \qquad 3$$

Whereby,

Dependent variable:

Log (GDP)= Natural logarithm of gross domestic product per capita

Independent Variables:

REC= Renewable Energy Consumption, TR= Exports and Imports, Co2= CO2 emissions

€ = Error term, t= period, $\beta_{0\text{-}3}$= Constants

3.1 Unit Root

Before implementing the autoregressive distributed lags (ARDL) model, tests of the unit root are first estimated. If the variables are discovered to be stationary, this is done to ascertain the degree of integration of the variables and prevent issues with misleading regressions. We utilize the Augmented Dickey-Fuller test at level and at first difference to examine the stationarity of the data. In each test, the alternative hypothesis of stationarity is compared against the null hypothesis of unit root. The null hypothesis of unit root is rejected and the conclusion drawn that

the series is stationary if the computed ADF test statistic is greater than the critical values at the 1%, 5%, and 10% level of significance (Dickey, D., Fuller, W., 1979). The properties of the all the variables included in the perspective model are examined in this study. When the date is determined to be stationary, it means that its variance, mean, and covariance remain constant throughout time, the analysis's findings are trustworthy, and the results can be used to predict the economy's future growth.

3.2 Autoregressive Distributed Lags Model and Long Run Test

The study examines the consumption of renewable energy and the growth of the Saudi economy using the Autoregressive Distributed Lags model put forth by (Pesaran et al., 2001). Only a few studies in KSA have examined the topic in depth. But this study employs This model to test the short- and long-term correlations between the dependent variable and the independent one and to check the consistency of the results of the of the research in the literature section. The model for both short-term and long-term relationships can be expressed as follows, as illustrated in Equation 3.2 below:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots\ldots + \alpha_p y_{t-m} + \beta_0 x_t + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \ldots\ldots\ldots + \beta_q x_{t-n} + \varepsilon_t \qquad 3.2$$

m and n= the numbers of years, ε_t=Error term, α_i= coefficients for short-run and β= coefficients for long-run relationship and i = is the indicator of the lag. The ARDL model for long run relationships can be specified as given in Equations 3.2.1 to 3.2.4 below:

$$LGDP = \beta_{01} + \sum_{i=1}^{p} k_{11} LGDP_{t-i} + \sum_{i=1}^{q} k_{21} REC_{t-i} + \sum_{i=1}^{q} k_{31} Co2_{t-i} + \sum_{i=1}^{q} k_{41} trade_{t-i} + \varepsilon_t$$

$$3.2.1 \quad REC = \beta_{02} + \sum_{i=1}^{p} k_{12} REC_{t-i} + \sum_{i=1}^{q} k_{22} LGDP_{t-i} + \sum_{i=1}^{q} k_{32} Co2_{t-i} + \sum_{i=1}^{q} k_{42} trade_{t-i} + \varepsilon_t$$

3.2.2

$$Co2 = \beta_{03} + \sum_{i=1}^{p} k_{13} Co2_{t-i} + \sum_{i=1}^{q} k_{23} REC_{t-i} + \sum_{i=1}^{q} k_{33} LGDP_{t-i} + \sum_{i=1}^{q} k_{43} trade_{t-i} + \varepsilon_t$$

$$3.2.3 \quad Trade = \beta_{04} + \sum_{i=1}^{p} k_{14} trade_{t-i} + \sum_{i=1}^{q} k_{24} REC_{t-i} + \sum_{i=1}^{q} k_{34} Co2_{t-i} + \sum_{i=1}^{q} k_{44} LGDP_{t-i} + \varepsilon_t$$

3.2.4

3.3 ARDL- ECM (Error Correction Model) and Short Run Test

This paper utilizes the ECM model to analyze the short-term relationships between the variables after confirming the end of a long-term relationship through the bounding test. By employing a simple linear transformation, a short error correction model can be derived from the main ARDL model. This ARDL-ECM model is represented by equations 3.3, where the term enclosed in brackets, ECTt-1, serves as the error correction term. It is expected to have a negative value and be statistically significant, indicating the adjusted differences in the short-term variables and representing the coefficient of the speed at which the system adjusts towards long-run equilibrium. The model is expressed as follows in equation 3.3:

$$Y_t=a_0+b_1X_t+\pi(ECT_{t-1}) + \varepsilon_t \qquad 3.3$$

3.4 Diagnostics Tests

Serial correlation

The Breusch-Godfrey Serial Correlation test will be used in the study to identify serial correlation in the model.

Heteroskedasticity

The Breusch-Pagan-Godfrey test will be used in the study to determine whether or not the estimated model meets the homoscedasticity requirement.

Normality test

To determine if the residuals of the estimated model are normally distributed and to ensure that the normality criterion of linear models has not been violated, and Jarque-Berra histogram normality test will be used.

Stability tests

In order to make sure the stability of the estimated coefficients, this research paper will employ the CUSUM SUM plus Ramsey RESET tests to assess the validity of the model.

4. Results & Discussion

As shown in Tables 2 of the study, the ADF unit root test was run. According to the test results in Table 2, all of the variables are integrated of I(1) and stationary at the first difference. But in order to perform a better analysis, The study will utilize variables in their first difference form to estimate the associations, which makes the ARDL model suitable for analysis.

Variables	t-statistic	1% value	5% value	10% value	P- value
GDP	-5.536045	-3.670170	-2.963972	-2.621007	0.0001
REC	-4.406580	-3.679322	-2.967767	-2.622989	0.0016
Co2	-3.663250	-3.670170	-2.963972	-2.621007	0.0102
Trade	-4.339803	-3.670170	-2.963972	-2.621007	0.0019

Table (2): ADF unit root test at first difference.

Table 3 shows the descriptive statistics for the variables chosen to provide an overall understanding. the GDP per capita is on average 18407.57 US$with a maximum value of 20508.12 US$. Renewable energy consumption ranges between 0.9% and 5 % of total final energy consumption. Trade ranges between 52.07% and 96.102%. Co2 ranges 10.7 % and 17.25%. The series of GDP is negatively skewed and positively skewed for all other variables. based on kurtosis test, all variables are less than 3 which means they are Platykurtic curves except for renewable energy consumption, the Kurtosis is larger than 3, which means it is a Leptokurtic curve. Except for renewable energy consumption regarding the normality test, the outcome of the study's Jarque-Berra shows that the residuals are distributed properly.

Sample: 1990 2021

	GDP	REC	CO2	TRADE
Mean	18407.57	1.677568	13.38825	71.85987
Median	18195.46	1.000000	13.06912	68.99882
Maximum	20508.12	5.000000	17.25783	96.10264
Minimum	15561.48	0.903233	10.70976	52.07659
Std. Dev.	1288.820	1.134389	2.062511	11.48211
Skewness	-0.129334	1.477203	0.335762	0.441083
Kurtosis	2.159490	4.007958	1.730062	2.286758
Jarque-Bera	1.031156	12.99266	2.751582	1.715907
Probability	0.597155	0.001509	0.252640	0.424029
Sum	589042.3	53.68219	428.4239	2299.516
Sum Sq. Dev.	51492749	39.89200	131.8725	4087.006

Table (3): Summary statistics.

All the variables are integrated at the first difference according to the unit root results, and the E-Views program automatically determined the ideal lag length criterion to apply in the study, as shown in figure 1. According to the AIC criteria, the results demonstrate that the lag can be used to estimate both short- and long-term associations. As demonstrated in Table 4, by utilizing the ARDL Bounds test, the study will continue to examine the cointegration relationships.

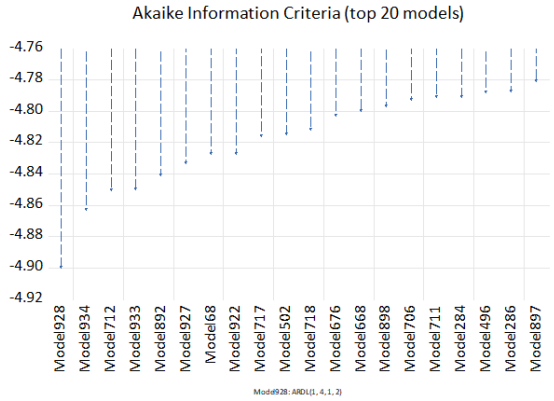

Figure (1): Optimal lag length criterion (AIC)

The rsults of the test for cointegration was used in the study to check for long-term correlations between the model's variables as demonstrated in Table 4. The f-statistic is 12.66503, which is above the thresholds for significance at all levels. This suggests that we reject the null hypothesis H_0 that there are no long-term relationships among the variables and come to the conclusion that there are long-term relationships. Equations 3.2.1 to 3.3 from the study above will be used to evaluate both the short- and long-term relationships.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	12.66503	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Table (4): Bounding test to cointegration.

Upon conducting the short run test as depicted in Table 5, it becomes evident that there is a negative relationship between renewable energy consumption and dependent variable (economic growth) in Saudi Arabia. Specifically, a 1% increase in independent variable (renewable electricity consumption) in the short run has an insignificant impact on economic growth, leading to a decline of 124% while considering other factors unchanged. These results suggest that the utilization of renewable energy has not been successful in expediting short-term economic growth. As a result, policymakers and governments in Saudi Arabia are urged to revise

regulations pertaining to the use of renewable energy sources with the aim of promoting and accelerating economic growth in the short term.

ARDL Error Correction Regression
Dependent Variable: DLOG(GDP)
Selected Model: ARDL(1, 4, 1, 2)
Case 2: Restricted Constant and No Trend
Date: 06/14/23 Time: 20:53
Sample: 1990 2021
Included observations: 28

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REC)	-1.240117	0.681035	-1.820929	0.0874
D(REC(-1))	-8.166159	1.192889	-6.845701	0.0000
D(REC(-2))	-7.044470	0.925744	-7.609525	0.0000
D(REC(-3))	-4.096272	1.016300	-4.030573	0.0010
D(CO2)	0.026439	0.006761	3.910647	0.0012
D(TRADE)	0.003058	0.000565	5.414960	0.0001
D(TRADE(-1))	0.004960	0.000892	5.557430	0.0000
CointEq(-1)*	-0.849565	0.095489	-8.896990	0.0000

R-squared	0.863958	Mean dependent var	-6.14E-05
Adjusted R-squared	0.816343	S.D. dependent var	0.037083
S.E. of regression	0.015892	Akaike info criterion	-5.211049
Sum squared resid	0.005051	Schwarz criterion	-4.830419
Log likelihood	80.95469	Hannan-Quinn criter.	-5.094687
Durbin-Watson stat	1.951042		

* p-value incompatible with t-Bounds distribution.

Table (5): Short run relationships.

The findings also show a short-term positive and significant correlation between the second variable which is carbon dioxide and dependent variable (economic growth). In the short run, a 1% rise in carbon dioxide emissions causes economic growth to increase by 2.64%, ceteris paribus. These findings show that Saudi Arabia's economic growth depends on the use of fossil fuels and non-renewable electricity sources. This request that the government reconsider its CO2 emission regulations aims to lessen the country's reliance on fossil fuels and the harm that air pollution does to the environment.

Furthermore, a relationship between the last variable trade and short-term economic growth has been found. Ceteris paribus, a 1% rise in trade will significantly lead to an increase in economic growth of 0.30%.

Table 5 shows that the value of R-squared is 0.8639, meaning that the independent variables account for 86.39% of the variation in the model, while the error term accounts for the remaining 13.61%. This outcome demonstrates the model's goodness of fit, which should be 70% or higher for a trustworthy model, as is strongly advised. Additionally, Table 5 shows that the ECT term has a statistically significant value of -0.849565, which suggests that 85% of the error in the

dependent variable is corrected annually towards long-run equilibrium. Long-term relationships continue to be examined in the study, as seen in Table 6.

According to the findings in Table 6, the study evaluated the long-term relationships. The findings show that consumption of renewable electricity and economic growth are positively correlated and statistically significant. Long-term economic growth will rise by 758%, ceteris paribus, for every 1% increase in the consumption of clean energy. This outcome implies that usage of renewable energy is significant for Saudi Arabia's economic growth.

Furthermore, according to the findings presented in Table 6, a significant long-term relationship exists between CO2 emissions and economic growth. Specifically, for each 1% increase in CO2 emissions, economic growth in Saudi Arabia rises by 5.34%, all other factors held constant. This result suggests that CO2 emissions are playing a role in stimulating economic growth within the country. Consequently, the government has a responsibility to align its policies and actions regarding CO2 emissions with the objective of fostering economic growth. Moreover, there is a long-term inverse relationship between independent variable (trade) and Saudi Arabia's economic growth. Long-term economic growth will decline by 0.1624% for every 1% rise in trade, ceteris paribus. To be able to increase economic growth, the government must evaluate and change its trade policy.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REC	7.585044	0.972276	7.801329	0.0000
CO2	0.053401	0.005228	10.21397	0.0000
TRADE	-0.001624	0.000652	-2.492922	0.0240
C	10.45056	0.062321	167.6902	0.0000

EC = LOG(GDP) - (7.5850*REC + 0.0534*CO2 -0.0016*TRADE + 10.4506)

Table (6): Long run relationships.

4.1 Residual Diagnostics Test

According to Table 7 below, several diagnostic tests has been performed. And based on the finding there are no correlation nor heteroskedasticity in the model we selected. In Addition, regarding the normality test, the outcome of the study's Jarque-Berra shows that the residuals are

Test	Normality	Serial Correlation	Heteroskedasticity		Ramsey's RESET test
	1.209783	0.285671	0.654205		2.899551
P-Value	0.546134	0.1250	0.6508		0.0110

distributed properly. Finally, the model is appropriately specified, according to the results of the study's Ramsey's RESET test for misspecification.

In order to determine the stabibility of the cofficient, the study performed the cumulative sum of recursive residuals test. Since the plots are inside 5% confidence interval crucial bands, the CUSUM graphs shown in Figures 2 demonstrate model stability.

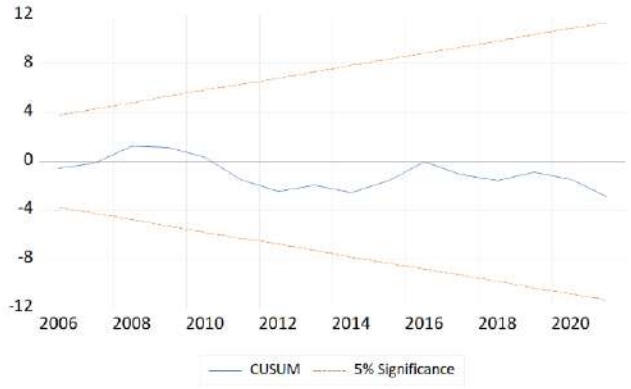

Figure (2): CUSUM

Conclusion

The study examines the relationship between Saudi Arabia's economic growth between 1990 and 2021 and the consumption of renewable energy. In order to control the order of integration and prevent the issue of misleading regressions, the Augmented Dickey-Fuller unit root test was used in the study. The ARDL Bounds test was used in the study, which discovered cointegration linkages between the variables. To test for short- as well as for the long-term relationships between the model's variables, the study used the ARDL model. Therefore, based on actual data, the report recommends the following policies:

First and foremost, the Saudi Arabian government needs to reform its laws regarding the use of renewable energy sources and the disclose method. Thus, in the short term, it may be able to dramatically and favorably improve economic growth. Additionally, by hastening the process of

renewable energy, which has significant long-term effects. As a result, the country can diversify its economy, reduce its dependence on oil revenues, and create new opportunities for economic growth. This shift can lead to the development of new industries, job creation, and increased foreign investment.

Secondly, Economic growth has been proven to be boosted by carbon dioxide. and it is a short-term economic benefit, it is crucial for policymakers and the government in Saudi Arabia to recognize the long-term risks and consequences associated with heavy reliance on fossil fuels. By reviewing policies, promoting renewable energy, and embracing a low-carbon economy, Saudi Arabia can mitigate environmental impacts, position itself for future economic success, and contribute to global efforts in addressing climate change.

In the long term, it is advisable for Saudi Arabia to re-evaluate its trade policies, as they could pose a threat to the growth of their economies. This could be achieved by establishing a congenial setting that encourages the promotion of exports and the diversification of the economy. Additionally, the country can improve its competitiveness by attracting foreign direct investment, increasing market access, and fostering the growth of strategic industries.

The primary aim of the research was to examine the relationship between the consumption of renewable energy and the economic growth of Saudi Arabia. To achieve this objective, the study utilized an Autoregressive Distributed Lags Model ARDL model to demonstrate both short and long relationship. After thorough analysis, it was determined that although renewable energy usage exhibited a negative, yet insignificant, short-term relationship, it had a positive long-term relationship. To gain further understanding, future studies should consider alternative models and incorporate additional observations to gain new perspectives.

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Obidike Ikechukwu Franklin (Author)

University of Port Harcourt, Rivers State Nigeria

Auditing Practices on the Financial Performance of Manufacturing

Abstract

This study empirically investigated the influence of auditing practices on the performance of manufacturing industries in Rivers State Nigeria. To accomplish the research objective, ten manufacturing companies were selected, with a sample size of one hundred representatives. The independent variable was represented by internal audits, while the dependent variables included return on capital and return on investment. Primary data was collected through questionnaires distributed to the accounting departments of the chosen firms. The data was then analyzed using a Spearman correlation coefficient. The study found that internal audit has a positive and significant effect on the return on investment and return on capital employed for the selected firms. These findings led to the conclusion that internal audit practices are a crucial factor in the financial performance of manufacturing companies, particularly in terms of return on investment and return on capital employed. The study recommended the implementation of robust internal policies to enhance the effectiveness of internal audits and improve performance. By adhering to auditing practices, the management of listed manufacturing firms in Nigeria can enhance their financial performance. This will ensure that all financial transactions are properly accounted for, instilling greater trust and confidence in users of financial statements regarding the quality of audited reports. The study also advises that the management of listed manufacturing firms should engage the services of reputable external auditors and audit firms.

Keywords: Auditing Practices, Financial Performance, Manufacturing Companies, Return on Investment, Nigeria.

Introduction

The importance of audits and audit reports is well-established in academic literature, as noted by (Fukukawa & Mack, 2011; Hogan & Wilkins, 2008). Several theories have been proposed to justify the role of audits within an organization. For example, the policeman theory posits that the purpose of an audit is to detect, uncover, and deter fraud. The lending credibility theory argues that an auditor's primary function is to lend credibility to financial statements. The agency theory proposes that auditors are appointed to serve the interests of both third parties and management. These theories all assume that auditors have valid evidence to back up their opinions and that such evidence should be given significant consideration if audits are to remain relevant in today's business environment. The need for audits stems from the potential conflicts of interest between stakeholders and managers. As Arens, Best, Shailer, Fidler, Elder and Beasley (2011) pointed out, the demand for audit services can be triggered by several factors. These include the distance between the users and preparers of financial statements, conflicts of interest among users of these statements, the complexity of economic transactions, and the anticipated impact of financial statements on decision-making. Given that the audit report serves as a communication medium between the auditor and the users of the report, it must be clear, objective, and seen by users as a reliable source of information. The report's relevance implies that it should influence decision-making; otherwise, users of financial statements will disregard the report and not factor it into their decision-making process. The report's impact on decision-making suggests that it should contain informative content that can influence investment decisions, credit decisions, and share prices. Numerous studies have examined the relationship between auditing and the performance of publicly traded companies (Rahman & Ali 2006; Hope & Langli 2007). However, these studies have yielded inconclusive results regarding the relationship between auditing and corporate performance. Consequently, this study aims to investigate the impact of auditing practices on the performance of manufacturing firms in Nigeria.

Aim and Objectives of the Study

The major aim of this study was to investigate the effect of auditing on the financial performance of manufacturing companies in Nigeria. However, the following are the specific research objectives:

1. To examine the nature of the relationship between internal auditing practices and the return on investment of manufacturing firms in Nigeria.
2. To examine the nature of the relationship between internal auditing practices and the return on capital employed by manufacturing firms in Nigeria.

Research Questions

The following understated research questions guided this study;

1. What is the nature of the relationship between internal auditing practices and the return on investment of manufacturing firms in Nigeria?

2. What is the nature of the relationship between internal auditing practices and the return on capital employed by manufacturing firms in Nigeria?

Research Hypothesis

The following hypotheses were formulated to guide the study;

$H0_1$: There is no significant relationship between internal auditing practices and the return on investment of manufacturing firms in Nigeria.

$H0_2$: There is no significant relationship between internal auditing practices and the return on capital employed by manufacturing firms in Nigeria.

Significance of the Study

This research is crucial given the recent efforts by regulators to find ways to safeguard and enhance the trustworthiness of financial statements in the business sector. It also serves as a response to the current appeal by the International Accounting Auditing Standard Board's Framework for Audit Quality. This framework aims to increase awareness of the essential aspects of audit quality, motivate key stakeholders to seek methods to enhance audit quality and

promote more extensive dialogue among key stakeholders on the subject (IAASB, 2014). The study is also noteworthy as it concentrates on issues pertaining to auditing and financial reporting that pose a risk to the existence of audit firms of all sizes, as well as the ongoing operations of corporate entities. As such, the study plays a vital role in ensuring the reliability of financial data. This is not only for identifying potential corporate scandals but, more importantly, for ensuring the survival of the accounting and auditing profession and fostering a robust financial and capital market. Consequently, this study offers significant benefits to auditors, regulators, managers, professional accounting organizations, current and prospective shareholders, and researchers.

Methodology

The study is survey research design oriented. It was designed in a way that the population covers the entire staff of the accounting firms who are assumed to have full knowledge of the research problem. The target population for this study consists of all the manufacturing firms in Rivers State. However, due to limited time and easy access to required information, this study was limited to an accessible population of ten (10) manufacturing firms as follows:

Table 1: Sample Size Distribution

S/N	Company	No of Respondents
1	Easterm Bulkcem	10
2	First Aluminum	10
3	Nigeria Bottling company	10
4	Nigeria Engineering works	10
5	Flour Mills Limited	10
6	Berger Paints Ltd	10
7	Norman Industries Ltd	10
8	Dufil Prima Foods	10
9	Best Aluminum	10
10	Delta Plastic	10
	Total	**100**

Source: Survey Data 2023.

The sampling for this study constituted of top-level management, middle-level management and low-level management of the ten selected manufacturing firms in Rivers State. The sample size used for this study was determined mathematically using the Yaro Yemen's formula:

Where: n = Sample Size Sought

N = Population (100)

e = Level of Significance (5%)

The sample size sought (n) is:

n = 80

A researcher-structured questionnaire titled "Audit Evidence Quality and Credibility of Financial Statement: A Survey of Manufacturing Firms in Rivers State Questionnaire (AEQCFSASMFRSQ)" was used to gather information from the subjects. The instrument consists of two sections A and B. Section A sought data on the demographic characteristics of the respondents as regards their sex, marital status, name of firm, educational qualification, age, and length of service. Section B requested data on factors that determine the effect of audit evidence on the credibility of financial statements. A 40-structured item rated on a 5-point Likert attitudinal rating scale of strongly agree (SA) agree (A) strongly disagree (SD) disagree (D) and undecided (UND) was used Thus:

- Strongly Agree
- Agree
- Strongly Disagree
- Disagree
- Undecided

The respondents are required to tick each item in the appropriate column that mostly represents their opinion based on their degree of agreement or disagreement with the statement. The instrument was validated by three experts while the reliability of the instrument was determined through a pre-retest method. Here the questionnaire was administered to a sample of twenty (20) employees who were not included in the original sample of the study. After a period of two (2) weeks, the same copies of the instrument were re-administered to the same subjects. Their responses at the two intervals were correlated using the Cronbach Alpha. The result of the Cronbach Alpha indicates 0.97 and this implies that the instrument was reliable. Direct delivery and retrieval method of the questionnaire was used to collect data while the Spearman rank correlation coefficient with the aid of the Statistical Package for Social Sciences, (SPSS) Version 22.0 was used as the data analysis method. The correlation coefficient ranges from −1 to 1. A

value of 1 implies that a linear equation describes the relationship between X and Y perfectly, with all factors affecting Y held constant for which Y increases as X increases. A value of −1 implies Y decreases as X increases. A value of 0 implies that there is no linear correlation between the variables.

Results

Table 2: Pearson Correlation for Internal Audit, Return on Investment and Return on Capital Employed

			Internal Audit	ROI	ROCE
Pearson Correlation	Internal Audi	Correlation Coefficient	1.000	.600**	.655**
		Sig. (2-tailed)	.	.000	.000
		N	80	80	80
	ROI	Correlation Coefficient	.600**	1.000	.655**
		Sig. (2-tailed)	.000	.	.000
		N	80	80	80
	ROCE	Correlation Coefficient	.682**	.655**	1.000
		Sig. (2-tailed)	.000	.000	.
		N	80	80	80

Source: Survey result 2023

Table 2 above shows the result of the data analyses. The result shows that there is a positive correlation of 0.60 between internal auditing and the return on investment (ROI) of manufacturing companies implying that the relationship between the variable is 60% hence, an increase in audit practice is predicted to lead to an increase in return on investment (ROI). The results further indicate that there is a positive correlation between internal audit and the return on capital employed (ROCE) manufacturing companies of 65.5%. implying that increased internal audit practice will lead to an increase in return on capital employed (ROCE).

Hypotheses One: There is no significant relationship between internal auditing practices and the return on investment of manufacturing firms in Nigeria

The results of the data analysis showed that the significance level (p-value) for the coefficient of internal audit practice and return on investment is 0.00. This is less than the required critical

p-value of 0.05 for the rejection of the null hypothesis. Thus, we reject the null hypothesis and conclude that there is a significant relationship between the internal audit practices of manufacturing companies and their return on investment.

Hypotheses Two: There is no significant relationship between internal auditing practices and return on capital employed by manufacturing firms in Nigeria

The results of our data analysis showed that the significance level (p-value) for the coefficient of internal audit practice and return on capital employed is 0.00. This is less than the required critical p-value of 0.05 for the rejection of the null hypothesis. Thus, we reject the null hypothesis and conclude that there is a significant relationship between the internal audit practices of manufacturing companies and their return on capital employed.

Discussion of Findings

This study aimed to evaluate how auditing practices influence the performance of manufacturing companies in Rivers State, with profitability indicators serving as the dependent variable and internal audits as the independent variables. The research found that both internal audits have a statistically significant impact at the 5 percent level, leading to the rejection of the proposed hypotheses. These results indicate that auditing is crucial in shaping financial performance. The results suggest that the management of these manufacturing companies effectively uses corporate assets to increase shareholder wealth. This supports both the agency theory and the policeman theory of auditing. The findings align with those of Francis and Wilson (1988), who observed that agency costs influence the selection of a more reputable auditor, and DeFond (1992), who discovered a correlation between changes in agency costs and audit quality. However, they contradict Nichols and Smith's (1983) findings, which did not observe a positive abnormal stock market response to firms announcing a switch to higher quality auditors.

Conclusion

The study's findings on the impact of auditing practices on manufacturing firms, particularly regarding internal control practices, concluded that there is a positive and significant correlation between internal audits and the firms' performance. This performance is measured by return on assets, return on capital employed, and return on investment. The implementation of internal audit practices can significantly affect a business's operations and potentially influence the firm's ability to maintain competitiveness.

Recommendations

Based on the findings and conclusion of this study, the following recommendations are made:

1. Companies should ensure strong internal policies that enhance the effectiveness of the internal audit to achieve increased performance.

2. Management of quoted manufacturing firms in Nigeria can improve the financial performance of their firms by complying with auditing practices. This will help ensure that all financial transactions are in order; and give the users of the financial statements more trust and confidence in terms of the quality of audited reports.

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Hamidreza Rezaei (Author) *Asfalt Tous Co*	**A Novel Model for Redesigning Humanitarian Relief Logistics Network: Optimization via a Decomposition Algorithm**

Abstract

It is undeniable that the humanitarian relief logistics (HRL) network must be assessed periodically to see how much changes turned up in potential demands and population distribution could make the network vulnerable and alter its optimality. This paper addresses the novel problem of redesigning the existing humanitarian relief logistics network including suppliers, distribution centers, and demand nodes, whereas previous studies devoted their attention to design of relief logistics networks. The proposed model considers the uncertainty for earthquake magnitude that generates the scenarios of link failure and relief demands. The proposed stochastic approach overcomes this uncertainty through two-stage stochastic programming in which relocation strategies (whether existing distribution centers should remain, be consolidated, or phased out), rehabilitation decisions and other strategic measures are determined in the first stage and operational decisions are made in the second stage. To solve the model, a Benders' decomposition method is developed and applied. To validate the model applicability and provide in-depth and multi-faceted examination of a problem in its real-life setting, a case is used retrieving location data from GIS. The results indicate definite merits of the proposed redesigned network compared with current configuration, when dealing with various earthquake scenarios. Moreover, when facing increased problem size, a comparison of solution methods indicates the superior capability of Benders' decomposition in terms of solution quality and computational time.

Index Terms— Benders' decomposition, Relief logistics network re-design, Relocation, Uncertainty modeling.

I. Introduction

Disasters whether natural or man-made must be identified as an extremely negative risk that can result in calamitous consequences in terms of social, financial, and infrastructural challenges. These disasters increasingly occur throughout the world and in Iran. According to global statistics, Iran is one of the most seismically active regions, exhibiting a significant number of faults that can affect almost the entire country. For example, the western border of Iran (Pol-e Zahab) experienced a devastating earthquake in 2017 in which more than 500 people died and more than 7000 people were injured. Therefore, disaster management measures must be updated and improved to alleviate the suffering and lessen the destruction which occurs in the aftermath of such events.

A review of the terminology of the disaster management cycle shows that this cycle can be classified into four phases: mitigation and preparedness phases before disaster occurrence, and response and recovery phases after the disaster. The present study focuses primarily on the preparedness and response phases, as two of these four main phases which are relevant to disaster management. To clarify the roles of each of the above-mentioned phases before and after a disaster, the mitigation phase deals with proactive and long-term activities that reduce probability of occurrence or impact (occasionally both) of disaster effects. For example, long-term decisions such as the transfer of residents from a seismically active region to a safe area, or investment in rehabilitation and preventive maintenance of infrastructures are some cases in point (Peeta et al., 2010; Üstün et al., 2015, Pribadi et al., 2021). The preparedness phase refers to those strategies and problems that design and provide robust infrastructures and relief logistics networks prior to the occurrence of a disaster in order to hedge against its aftermath (Rezaei-Malek et al., 2016; Condexia et al., 2017, Wuyang, Y., 2021). When a disaster happens, the response phase includes responsibility and accountability for certain emergency roles such as evacuation (Xu et al. 2016), search and rescue (Huang et al., 2015, Gharib et al., 2022) response to requested relief goods (Ahmadi et al. 2015, Davoodi and Goli 2019), and restoration of closed links (Aksu and Ozdamar, 2014, Rezaei et al., 2018, Rezaei et al., 2018 ,Yaşa et al., 2022). Also, the recovery phase is the last phase of disaster management and is commonly initiated after the response phase. This phase addresses measures for restoring the affected area back to its normal pre-disaster state (Cavdaroglu et al., 2013). The preparedness and response phases have received more attention in recent years, as opposed to the mitigation and recovery phases. Designing a reliable logistics network for the preparedness phase in dealing with disasters can avert widespread devastation and loss of lives; or conversely, absence of a proactive strategy in the preparedness phase would undoubtedly lead to unstable responses in further phases.

Now, let us consider the optimality gap between current logistics network and best one occurs in the context of relief logistics network not a business case when the current relief logistics network could not be optimized properly. It is very clear that the uncompensated consequences of this gap in particular, facing the death or physical injuries, falls overwhelmingly on society. The problem of redesigning models for humanitarian purposes is highlighted in real cases when the state-of-the-art designing models can not consider the current facilities, assets and echelon's relations. Accordingly, if a redesigning model performs well, the gap between existing networks and optimal configuration is expected to decline following the corrective measures to be taken based on redesigning strategies. In this regard, the objective of the model may be cost minimization considering shortage penalties in the constraints or reduction in the potential losses, assuring the prompt assistance. The current study addresses the redesign of relief logistics networks in the preparedness and response phases due to the critical importance of these phases in providing a reliable infrastructure and logistics network for confronting disasters. To this end, certain strategic decisions are revised including the opening, closing or consolidation of existing distribution centers as well as echelon relations. In addition, recent experiences and lessons learned from occurred earthquakes disclose that in past disasters, if the effect of being accessible and connective for links and roads strength had been taken into account in preparedness phase, the response measures could have saved the more injured people. Therefore, the rehabilitation decisions have been modeled for roads and routes. It is not far from our realistic mind that the redesigning strategic decisions for reconfiguration cannot rely on deterministic parameters such as demands or route damages in a changing environment. Hence, a stochastic relief logistic network re-design model (SRLNRM) has been developed in the present study. To incorporate the uncertain parameters to the proposed model for SRLNRM, two-stage stochastic programming is examined in which strategic decisions are related to the preparedness phase and operational decisions in the second stage are associated with the response phase.

II. Literature Review

In order to alleviate the disastrous consequences of an earthquake, both preparedness and response phases have gained increasing attention over the past few years. In this regard, Rawls and Turnquist (2010) have formulated a two-stage stochastic problem in which the first stage decisions deal with fixed costs of facilities in a RNLM and in the second stage, the cost components related to flow of commodities, storage costs and other operational costs have been considered. In their problem, demands and link failure are two stochastic parameters and in order to improve the solving approach, the Lagrangian L-shaped method (LLSM) has been developed. They decomposed the problem into

master problem and sub-problems. The difference between LLSM and Benders' decomposition is the approach of adding the feasibility and optimality cuts obtained by sub-problems. The LLSM solves sub-problems separately for each scenario for generating the multi-cuts while Benders' decomposition creates a cut at each iteration to converge the upper and lower bounds. Later, Rawls and Turnquist (2012) proposed chance constraints in their subsequent research as well as the timely needs of the evacuees (first 72h). Moreover, Noyan (2012) developed the risk approach proposed by Rawls and Turnquist (2010) considering conditional value at risk (CVaR) in a risk-averse two-stage stochastic programming instead of a risk neutral approach. Vargas-Florez et al. (2015) proposed a humanitarian supply chain under uncertainty in the preparedness and response phases. They ascertained disaster occurrence risk in potential areas by multiplying the probability and impact of an event in a real case study. They also drew up models for the fair distribution of relief goods so that the threshold was determined for each regional shortage. Ahmadi et al. (2015) developed a mathematical model that determines the location of depots (in preparedness phase) and vehicle routing under network failure (in response phase) on last mile distribution after an earthquake. To overcome the uncertainty of time for timely responsiveness during the response phase, they applied two-stage stochastic programming. Some studies have addressed Location with Relief Distribution and Stock Pre-positioning (LRDSP) considering bi-objective or multi-objective programming as well as consideration of uncertain environments for relief logistics network design in preparedness and response phases. In this regard, Rezaei-Malek et al. (2016) proposed an augmented-constraint approach for balancing objectives including total cost, expected time, priority, and demand-weighted utility levels of the delivered relief commodities in the LRDSP. Also, a few other studies in the preparedness phase and the response phase have used the ε-constraint approach to cope with multi-objective problems (Üstün et al., 2015). Huang et al. (2015) proposed resource allocation and distribution in the response phase in order to maximize lifesaving efficacy, minimize the delay of humanitarian aid and maximize equity of humanitarian relief. Vosooghi et al. (2022) presented a redesign model for relief supply chain so that the main focus was on response phase and preparedness phase and accessibility decision have not considered in their model.

Considering together all surveyed studies demonstrates that they have contributed to literature of HRL through designing more comprehensive problem being more completely compatible with the reality. However, it turns out that the studies related to disaster management have not paid proper attention to this side of real cases that nowadays, each region across the world has at least one relief logistics network that has been designed beforehand. It seems similar to the surveyed studies related to warehouse redesigning or reconfiguration of supply chain, redesigning models in the context of

RLNM can provide a novel stream to take advantage of improving the existing network based on reality. If such redesigning models would propose, the disaster managers can proceed a holistic approach to find an optimal configuration considering all assets in the existing network.

III. Problem Statement

To illustrate the reconfiguration strategy, Fig. 1 depicts the structure of the existing model and a redesigned three-tier relief logistics network, which includes suppliers, distribution centers, and demand nodes. As depicted in the figure, two primary DCs (Disaster Centers) should be considered: existing DCs (gray) and candidate DCs (white). Additionally, Fig. 1 depicts a single supplier, nine DCs (including two new DCs under consideration), and twenty demand nodes. If the proposed redesigning model is implemented, some of the existing DCs may be deemed redundant, necessitating the consolidation or closure of those structures. Furthermore, network improvements may require the establishment of a new DC (*) or the consolidation of one of the existing DCs (redundant DCs) with the newly established DC for capacity and storage deployment (**). In this hypothetical situation, one DC is identified as redundant and recommended for consolidation (**), another is entirely redundant (***), and the remaining DCs are considered active.

Moreover, establishing the second new DC is not permitted (****). The relationships between suppliers, DCs, and demand nodes are also redesigned in the redesigned model, considering the total number of facilities, their capacities, associated infrastructures, and destruction scenarios.

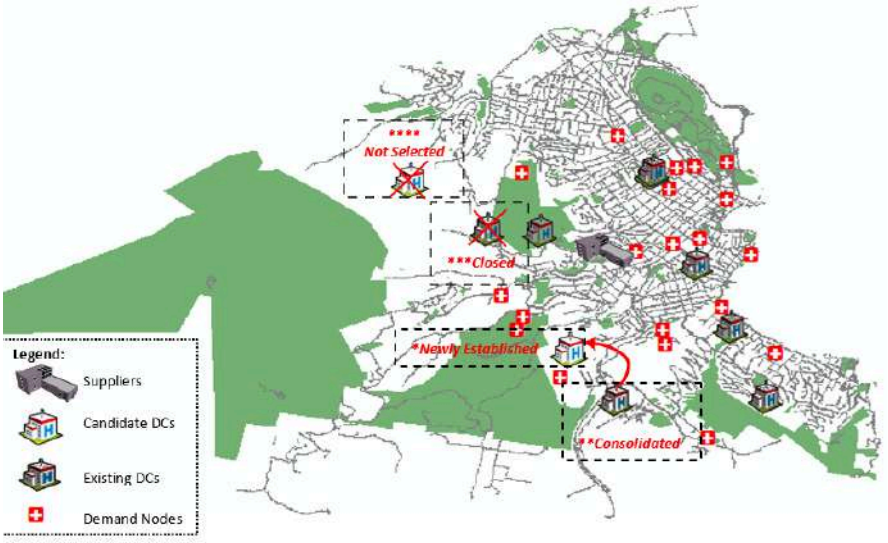


Figure 1. A sample for reconfiguration of relief logistic network (ArcGIS Map)

The proposed model considers the following assumptions and limitations:

The proposed model considers the following assumptions and limitations:

The redundant DC's capacity, storage, and mobilizations can be shared and consolidated with a single destination DC (existing or newly established); if this is not possible, the redundant DC must be phased out.

Relief supplies are to be transported along main roads, allowing for transport in all directions.

Roads and links can be activated following the occurrence of a disaster if they are deemed available and safe because of (a) intrinsic resistance to the main shock or (b) rehabilitation during the preparedness phase.

The effects of the main shock are considered destruction scenarios that influence demand and road failure.

Failure of roads occurs at the main shock (i.e., initiation of the response phase).

Supplier locations are known, but since these privately operated facilities cannot be sold or consolidated, only revisions to downstream networks' contacts with suppliers can be made.

Potential locations of candidate DCs and demand nodes are known.

Flow is only permitted to be transported between two consecutive levels. The flow between facilities is not permitted at the same stage.

IV. Mathematical Model

This section presents a redesigned mathematical model for a three-tiered relief logistics network. Unmet demands at each demand node will affect the objective function penalizing shortages. Additionally, the uncertainty of damage scenarios may influence demand levels and road failure scenarios.

1.1 Nomenclature

Before introducing the mathematical model, the following summarizes the notation for the sets, indices, parameters, and decision variables used in the model.

Sets and Indices:	
I	Set of suppliers, indexed by $i = 1,..., \|I\|$
EJ	Set of existing DCs, indexed by$e = 1,..., \|EJ\|$
NJ	Set of new eligible DCs, indexed by$n = \|EJ\| + 1,..., \|EJ\| + \|NJ\|$
J	Set of all DCs, indexed by$j = 1,..., \|J\|, J = EJ \cup NJ$
K	Set of demand nodes, indexed by $k = 1,..., \|K\|$
R_{jk}	Set of routes between *j* and *k* indexed by, $r_{jk} = 1,..., \left\|R_{jk}\right\|$
C	Set of commodities, indexed by$c = 1,..., \|C\|$
S	Set of destruction scenarios, $s = 1,..., \|S\|$
T	Set of the time periods,$t = 0,..., \|T\|$(t=0: pre-disaster or preparedness phase)
Parameters:	
P_s	Occurrence probability of scenario s
SW_{cks}	Shortage weight of commodity *c* at demand point *k* at response phase if scenario *s* occurs
PR_{cijts}	Cost per unit for procurement and transportation of commodity *c* from supplier *i* to *DC j* if scenario *s*occurs (for *t=0*, values for all scenarios are equal)
TR_{cjkrs}	Shipment cost per unit of commodity *c* from *DC j* to demand node *k* thorough *r*-th route at response phase if scenario *s*occurs
IC_{cjt}	Storage cost per unit for relief goods *c* at *DC j* during preparedness phase if scenario *s*occurs
FC_j	Fixed cost of handling and maintenance for active *DC j* in the preparedness phase
RV_j	Estimated revenue of using the usable spaces of *DC j* for cultural and social purposes in preparedness phase
NC_n	Fixed cost of establishing new eligible *DC n* (excluding fixed cost of handling and maintenance)
CB_e	Income from phasing out redundant *DC e* (sale of land and building)
CRL_{ej}	Overhead costs required for consolidating *DC e* to *DC j*
CCP_{cj}	Cost per unit for capacity mobilization of the *DC j* (commodity *c*)
$CPRL_{ce}$	Throughput capacity of the commodity *c* at *DC e* available to be consolidated with other active *DCs*
$FRH^{j,k,r}$	Fixed cost for rehabilitation of route *r* between *j* and *k* in the preparedness phase
FL^0_{rjks}	Binary accessibility status of the *r-th* route between *j* and *k* before rehabilitation decisions (predicted by experts based on the *s-th* main shock which may occur)
P^{MAX}_{cit}	Maximum procurement capacity of commodity *c* prepared by supplier *i* at the beginning of period *t*
CP^{MAX}_{cj}	Maximum capacity of *DC j* for commodity *c*
CP^0_{cj}	Initial capacity of *DC j* for commodity *c*
IN^0_{cj}	Initial inventory of commodity *c* at existing *DC j* (it is zero for the new *DCs*)
IRL_{ce}	Throughput relief goods *c* in *DC e* available for consolidation
D_{cks}	Demand of node *k* for relief goods *c* if scenario *s*occurs
μ_c	Capacity coefficient of commodity *c (m3/Qty)*

CY_{rjk}	Available capacity of the *r-th* route between *DC j* and demand node *k* for transportation in the response phase
Decision Variables (Continuous Variables):	
X_{cijts}	Quantity of relief goods *c* provided by supplier *i* for *DC j* at period *t* if scenario *s* occurs (for t=0 in the preparedness phase, *X* must be equal for all scenarios as per (Eq. 14))
Y_{cjkrs}	Quantity of relief goods *c* shipped from *DC j* to the demand node *k* through *r*-th route if scenario *s*occurs
W_{cks}	Shortage of *c* at demand point *k*, if scenario *s*occurs
II^{0}_{cj}	Inventory level of commodity *c* being held at *DC j* in the preparedness phase
CP_{cj}	Capacity needed to be internally extended (for commodity *c*) in *DC j* (excluding consolidated and equipped capacity from other *DCs*)
	Decision Variables (Binary Variables):
Z_{ej}	Consolidation decision of *DC e* to *DC j* (*DC e* is consolidated in *j* if $e \neq j$and $Z_{ej} = 1$)
Z_{jj}	Decision variable for keeping *DC e* open if$Z_{ee} = 1$or establishment decision of the new *DC n* if $Z_{nn} = 1$ ($Z_{jj} = Z_{ee} \cup Z_{nn}$)
$RH^{j,k,r}$	Rehabilitation decision to strengthen the *r-th* route of *j* and *k* before earthquake

1.2 Objective Function

The proposed objective function of the mathematical model is to minimize the relief logistics network costs (*f*) as follows:

$$Min\ f = \left[\sum_{j\in J}(FC_j - RV_j).\ Z_{jj}\right]^{(1-1)} +$$

$$\left[\sum_{n\in NJ} NC_n.\ Z_{nn}\right]^{(1-2)} - \left[\sum_{e\in EJ} CB_e.\ (1 - Z_{ee})\right]^{(1-3)} + \left[\sum_{e\in EJ}\ \sum_{j\in J,(j\neq e)} CRL_{ej}.\ Z_{ej}\right]^{(1-4)}$$

$$\sum_{(e\neq j)} e \in EJ \quad ^{(1-5)} + \left[\sum_{j\in J}\ \sum_{k\in K}\ \sum_{r\in R_{jk}}\ \sum_{l\in L} RH_l^{j,k,r}.\ FRH_l^{j,k,r}\right]^{(1-6)} + \qquad (1)$$

$$[\sum_{c\in C}\sum_{i\in I}\sum_{j\in J}\sum_{t\in T}\sum_{s\in S} P_s.PR_{cijts}.\ X_{cijts} +$$

$$\sum_{s\in S}\sum_{c\in C}\sum_{j\in J}\sum_{k\in K}\sum_{r\in R_{jk}} P_s.\ TR_{cjkrs}.\ Y_{cjkrs}](1 - 8) \quad +$$

$$^{(1-9)}$$

$$[\sum_{c\in C}\sum_{j\in J} IC_{cj}\ .\ II_{cj}] \qquad + \sum_{s\in S}\sum_{c\in C}\sum_{k\in K} P_s.\ SW_{cks}.\ W_{cks}(1 - 10)$$

The objective function considers both the fixed and operating costs of the redesigned model. The first two terms (1-1 and 1-2) denote the costs of maintaining existing DCs, the revenue generated by existing DCs for secondary purposes such as cultural and social activities (1-1), and the costs of

establishing new DCs (1-2). The income generated by an ineffective or redundant DC phase-out is denoted by terms (1-3). Consolidation and capacity expansion costs are included in terms (1-4) and (1-5), while rehabilitation costs are included in terms (1-6). Additionally, cost components 1-7, 1-8, and 1-9 represent the costs associated with transportation, procurement, and storage linked with redesigning the relief logistics network. The final term (1-10) represents shortage costs.

1.3 Constraints

This section discusses the constraints on the proposed model. Constraint (2) ensures that routes identified as blocked (high-risk routes) can be rehabilitated during the response phase. Relation (3) indicates that a route is safe to use for distribution during the response phase, regardless of whether it is intrinsically resistant ($FL^0=1$) or has been rehabilitated ($RH^{j,k,r} = 1$) prior to the disaster.

$$RH^{j,k,r} \leq (1 - FL^{0}_{rjks}), \forall j \in J, k \in K, r \in R_{jk}, s \in S \quad (2)$$

$$\sum_{c \in C} Y_{cjkrs} . \mu_c \leq \left(RH^{j,k,r} + FL^{0}_{rjks}\right). CY_{rjk}, \forall j \in J, c \in C, k \in K, r \in R_{jk}, s \in \quad (3)$$

Constraint (4) details the relief goods that may be requested during the response phase in each scenario. Thus, this would result in recognition of shortages, as mentioned in the objective function (1).

Relation (5) specifies the maximum throughput of relief goods supplied by each supplier during the pre-and post-disaster horizons (pre-disaster $t=0$ and post-disaster $t=1$).

$$\sum_{j \in J} \sum_{r \in R_{jk}} Y_{cjkrs} + W_{cks} \geq D_{cks}, \forall c \in C, k \in K, s \in S \quad (4)$$

$$\sum_{j \in J} X_{cijt\,s} \leq P^{MAX}_{cit}, \forall c \in C, i \in I, t \in T, s \in S \quad (5)$$

According to Relation (6), the sum of a DC's initial capacity, consolidated capacity, and internal expansion cannot exceed the DC's maximum capacity. Inequalities (7) and (8) specify the maximum storage capacity for emergency supplies during the preparedness and response phases, respectively.

$$\sum_{(e \neq j)} e \in EJ) \leq \left(CP^{MAX}_{cj} - CP^{0}_{cj}\right). Z_{jj}, \forall c \in C, j \in J \quad (6)$$

$$\sum_{(e \neq j)} e \in EJ + CP^{0}_{cj}. Z_{jj}, t = 0, \forall c \in C, j \in J, s \in S \quad (7)$$

$$\sum_{(e \neq j)} e \in EJ + CP^{0}_{cj}. Z_{jj}, t = 1, \forall c \in C, j \in J, s \in S \quad (8)$$

Equalities (9) and (10) establish the pre-and post-disaster flow balances and inventory levels for DCs, respectively (inventory equilibrium). The pre-disaster storage level for each DC is determined in relation (9) based on its own initial storage, relief goods provided by consolidated DCs, and goods ordered as a precautionary reserve prior to the occurrence of the disaster. Additionally, relation (10) ensures that post-disaster relief is quantitatively equivalent to the order made at that time horizon plus any remaining storage from the previous time horizon (preparedness phase).

$$\sum_{(e \neq j)} e \in Ej, t = 0, c \in C, j \in J, s \in S \tag{9}$$

$$\sum_{r \in R_{jk}} \sum_{k \in K} Y_{cjkrs} = II^{0}_{cj} + \sum_{i \in I} X_{cijts}, t = 1, c \in C, j \in J, s \in S \tag{10}$$

Inequality (11), on the other hand, ensures that an existing DC cannot be consolidated with another unless the destination DC remains operational. The cardinality of the set $|EJ|$ is determined by the summation of the constraints $Z_{ej} \leq Z_{jj}$ with an equal right-hand side (RHS) to alleviate the constraints. Similarly, constraint (12) considers the condition mentioned above as a destination for newly established DCs.

$$\sum_{e \in EJ} Z_{ej} \leq |EJ| Z_{jj}, \forall j \in EJ \tag{11}$$

$$\sum_{e \in EJ} Z_{ej} \leq |EJ| Z_{jj}, \forall j \in NJ \tag{12}$$

Additionally, inequality (13) ensures that redundant DCs can be consolidated into a single destination DC, simplifying the process. Equality (14) imposes an equivalent value on the corresponding decision variables for relief goods dispatched in the pre-disaster horizon (*t=0*) for all scenarios. Constraints (15) and (16) ensure that the decision variables are non-negative and are binary in nature.

$$\sum_{(j \neq e)} j \in J \leq 1, \forall e \in EJ \tag{13}$$

$$X_{cijt1} = X_{cijts}, t = 0, \forall c \in C, j \in J, k \in K, r \in R, s \in S\{\ \} \tag{14}$$

$$X_{cijts}, Y_{cjkrs}, II_{cjts}, CP_{cj} \geq 0 \tag{15}$$

$$Z_{ej}(e \neq j), Z_{jj}: (Z_{ee,} Z_{nn}) = \{0, 1\}, RH^{j,k,r} \in \{0, 1\} \tag{16}$$

V. Solving Approach

This section describes the concepts of Benders' decomposition algorithm (*BD)*, and then, how the proposed model is modified to be solved by *BD*. In this regard, some related cutting planes are designed for the SRLNRM.

Solving mathematical models is dependent on the problem dimensions and the modeling structure. In the *SRLNRM*, these parameters are subject to uncertainty due to operational costs, demand, and road failure, where these parameters are denoted by $\left(\tilde{PR}, \tilde{TR}, \tilde{d}, \tilde{FL^0}\right)$. Benders' decomposition divides the original problem (*OP*) into two problems: a master problem (*MP*) containing strategic variables and a primal sub-problem (*PSP*) comprising linear programming based on fixed variables obtained from *MP* (Benders, 1962). The decomposition approach aims to resolve the complicating variables ($\bar{Z}$ and $\bar{RH}$) obtained through *MP* before solving linear programming in *PSP*. In other words, *SRLNRM* decomposes into *MP* (17) and *PSP* (18). To simplify the decomposition approach, X_{cijts} will be replaced by X^0_{cij} for the preparedness phase and X^1_{cijs} for the response phase.

Master Problem (MP):

$$Min\ f = \left[\sum_{j\in J}(FC_j - RV_j).\ Z_{jj}\right]^{(1-1)} + \left[\sum_{n\in NJ} NC_n.\ Z_{nn}\right]^{(1-2)} - \left[\sum_{e\in EJ} CB_e.\ (1 - Z_{ee})\right]^{(1-3)} + \left[\sum_{e\in EJ}\ \sum_{j\in J,(j\neq e)} CRL_{ej}.\ Z_{ej}\right]^{(1-4)} + \sum_{(e\neq j)} e \in EJ^{(1-5-1)} + \left[\sum_{j\in J}\sum_{k\in K}\sum_{r\in R_{jk}}\sum_{l\in L} RH^{j,k,r}_l.\ FRH^{j,k,r}_l\right]^{(1-6)} \quad (17a)$$

$$Eqs.\ (2),\ (11),\ (12)\ \wedge\ (13) \quad (17b)$$

Also, the *PSP* can be stated as follows:

$$Min\ [\ ] + [\sum_{c\in C}\sum_{i\in I}\sum_{j\in J} PR^0_{cij}.\ X^0_{cij}\ +^{(1-7-1)} \sum_{c\in C}\sum_{i\in I}\sum_{j\in J}\sum_{s\in S} P_s.PR^1_{cijs}.\ X^1_{cijs}\ + (1-7-2)$$

$$\sum_{s\in S}\sum_{c\in C}\sum_{j\in J}\sum_{k\in K}\sum_{r\in R_{jk}} P_s.\ TR_{cjkrs}.\ Y_{cjkrs}](1-8)\ + \quad (18a)$$

$$[\sum_{c\in C}\sum_{j\in J} IC_{cj}\ .\ II_{cj}]^{(1-9)} + \sum_{s\in S}\sum_{c\in C}\sum_{k\in K} P_s.\ SW_{cks}.\ W_{cks}(1-10)\ _{S.t.}$$

$$\sum_{c\in C} Y_{cjkrs}.\mu_c \leq \left(RH^{j,k,r} + FL^0_{rjks}\right).\ CY_{rjk}, \forall j \in J, k \in K, r \in R_{jk}, s \in S \quad (\psi^1_{jkrs}) \quad (18b)$$

$$\sum_{j\in J}\sum_{r\in R_{jk}} Y_{cjkrs} + W_{cks} \geq D_{cks}, \forall c \in C, k \in K, s \in S \quad (\psi^2_{cks}) \quad (18c)$$

$$\sum_{j\in J} X^{0}_{cij} \le P^{0MAX}_{ci}, \forall c \in C, i \in I \quad (\psi^{3}_{ci}) \quad (18d)$$

$$\sum_{j\in J} X^{1}_{cijs} \le P^{1MAX}_{ci}, \forall c \in C, i \in I, s \in S \quad (\psi^{4}_{cis}) \quad (18e)$$

$$\sum_{(e\neq j)} e \in EJ) + CP^{0}_{cj}.Z^{-}_{jj}, \forall j \in J, c \in C \quad (\psi^{5}_{cj}) \quad (18f)$$

$$\sum_{(e\neq j)} e \in EJ + CP^{0}_{cj}.Z^{-}_{jj}, \forall j \in J, c \in C, s \in S \quad (\psi^{6}_{cjs}) \quad (18g)$$

$$\sum_{(e\neq j)} e \in Ej, \forall j \in J, c \in C \quad (\psi^{7}_{cj}) \quad (18h)$$

$$\sum_{r\in R_{jk}} \sum_{k\in K} Y_{cjkrs} = II^{0}_{cj} + \sum_{i\in I} X^{1}_{cijs}, \forall j \in J, c \in C, s \in S \quad (\psi^{8}_{cjs}) \quad (18I)$$

Where Z^{-} and RH^{-} denote the vector of strategic variables including redesigning and rehabilitation decisions obtained from *MP*.

Furthermore, where $\psi^{1},\ldots,\psi^{8}$ is the set of dual variables associated with the constraints mentioned above (*18b -18I*). The dual model of *PSP,* abbreviated as *DSP,* can be reformulated as follows:

$$Max\ DSP = -\sum_{j}\sum_{k}\sum_{r}\sum_{s} \psi^{1}_{jkrs}.(RH^{-j,k,r} + FL^{0}_{jkrs}).CY_{rjk} + \sum_{c}\sum_{k}\sum_{s} \psi^{2}_{cks}.D_{cks} - \sum_{i}\sum_{s} \psi^{3}_{ci}.P^{0Max}_{ci} - \sum_{c}\sum_{i}\sum_{s} \psi^{4}_{cis}.P^{1Max}_{ci} -$$

$$\sum_{c}\sum_{j}\sum_{(e\neq j)} e \in EJ + CP^{0}_{cj}.Z^{-}_{jj} \quad (19a)$$

$$-\sum_{c}\sum_{j}\sum_{s}\sum_{(e\neq j)} e \in EJ + CP^{0}_{cj}.Z^{-}_{jj} + \sum_{c}\sum_{j}\sum_{(e\neq j)} e \in Ej$$

$$-(\mu_{c}\psi^{1}_{jkrs}) + (\psi^{2}_{cks}) + (\psi^{8}_{js}) \le P_{s}.\ TR_{cjkrs} \quad (19b)$$

$$-(\psi^{3}_{ci}) - (\psi^{5}_{cj}) - (\psi^{7}_{cj}) \le PR^{0}_{cij} \quad (19c)$$

$$-(\psi^{4}_{cis}) - (\psi^{6}_{cjs}) - (\psi^{8}_{js}) \le P_{s}.\ PR^{1}_{cijs} \quad (19d)$$

$$-(\sum_{s} \psi^{6}_{cjs}) + (\psi^{7}_{cj}) - (\sum_{s} \psi^{8}_{cjs}) \le IC_{cj} \quad (19e)$$

$$(\psi^{2}_{cks}) \le P_{s} SW_{cks} \quad (19f)$$

$$\psi^{1}_{jkrs}, \psi^{2}_{cks}, \psi^{3}_{ci}, \psi^{4}_{cis}, \psi^{5}_{cj}, \psi^{6}_{cjs} \ge 0, \left(\psi^{7}_{cj}, \psi^{8}_{cjs}\right) \in \Re \quad (19g)$$

Benders' decomposition is implemented by initially solving the *MP* and then fixing Z^{-} and RH^{-} in *DSP*. If *DSP* is solved with a feasible solution under normal conditions, *MP* iteratively uses the dual values as inputs in the subsequent iteration. Let Π denote the polyhedron determined by the *DSP*'s constraints in this regard. Extreme points (Π_{p}) and extreme rays (Π_{r}) can be used to represent each feasible point (if any) in the polyhedron. Except under conditions where *DSP* has a feasible solution,

Π might be unbounded or infeasible. In the case of infeasibility and according to duality theory, when $\Pi = \{\ \}$, *PSP* is either infeasible or unbounded for linear programming. When *DSP* is infeasible, since Π is independent to ZandRH(see constraints (19b)-(19g)), therefore, *DSP* will remain infeasible regardless of the values of ZandRH. In this regard, if *PSP* is infeasible for all ZandRH, it will be infeasible and unbounded if there is at least one ZandRH based upon *PSP* that is feasible.

To summarize the alternatives for *OP*, it can be understood that when *PSP* is unbounded, *OP* will be unbounded, and when *PSP* is infeasible, *OP* will be infeasible. Notably, the first iteration will reveal the infeasibility of *DSP*, and if *DSP* is infeasible due to the independence of Π and strategic decisions (ZandRH) obtained by *MP*, it will also be infeasible in subsequent iterations. At that point, a decision can be made to discontinue the algorithm. However, the proposed model has evolved to include at least one feasible *MP* solution and one *DSP* solution to avoid the *DSP* being infeasible. It can be proven that the existing configuration is a feasible solution for the proposed model (see A.6 in Appendix). Thus, infeasible *DSP* as a termination condition (Fig. 4) that directly depends on *MP* infeasibility will not occur.

On the other hand, an unbounded *DSP* occurs when at least one extreme ray generates feasible solutions, such as $x^{-} = \Pi_p + \lambda.\ \Pi_r$ with an infinite value for λ. These extreme rays (Π_r) can be detected because they cause *DSP* to become unbounded according to the relationships described in (22a-22c). The reformulation of *DSP* is represented in (20a –20c).

$$Max\ DSP:\ c^T \psi \quad (20a)$$

$$A\Psi \leq b \quad (20b)$$

$$\Psi \geq 0 / \Psi \in \Re \quad (20c)$$

All extreme rays can be determined as follows:

$$A\Pi_r \leq 0 \quad (21a)$$

$$I.\ \Pi_r = 1, (I \text{ is unit matrix}) \quad (21b)$$

$$\Pi_r \geq 0 \textit{or free variable} \quad (21c)$$

For maximization problem (*DSP*), extreme rays that lead to unbounded objective function can be obtained as:

$$A\Pi_r \leq 0 \quad (22a)$$

$$c^T.\ \Pi_r = 1 \quad (22b)$$

$$\Pi_r \geq 0 \textit{or free variable} \quad (22c)$$

However, if the DSP is feasible, an optimality cut is applied to *MP*, and the *MP* objective function determines the lower bound (*LB*). Concerning unbounded *DSP*, modified *DSP* (*MDSP*) is solved as

per relevant constraints (22a-22c) to detect extreme rays. Moreover, in addition to the optimality cut, *MP* considers a feasibility cut to prevent the problem from becoming unbounded.

Optimality Cut:

$$lb \geq -\sum_{j\ k\ r\ s}\sum\sum\sum\sum \psi'^{1}_{jkrs}.\left(RH^{j,k,r} + FL^{0}_{jkrs}\right).CY_{rjk} + \sum_{c\ k\ s}\sum\sum\sum \psi'^{2}_{cks}.D_{cks} - \sum_{i\ s}\sum\sum \psi'^{3}_{ci}.P^{0Max}_{ci} - \sum_{c\ i\ s}\sum\sum\sum \psi'^{4}_{cis}.P^{1Max}_{ci} -$$

$$\sum_{c\ j}\sum\sum_{(e\neq j)} e \in EJ \ + \ CP^{0}_{cj}.Z_{jj}$$

$$-\sum_{c\ j\ s}\sum\sum\sum_{(e\neq j)} e \in EJ \ + \ CP^{0}_{cj}.Z_{jj} + \sum_{c\ j}\sum\sum_{(e\neq j)} e \in Ej \ + \left[\sum_{j\in J}(FC_j - RV_j).Z_{jj}\right]^{(1-1)} +$$

$$\left[\sum_{n\in NJ} NC_n.Z_{nn}\right]^{(1-2)} - \left[\sum_{e\in EJ} CB_e.(1 - Z_{ee})\right]^{(1-3)} + \left[\sum_{e\in EJ}\sum_{j\in J,(j\neq e)} CRL_{ej}.Z_{ej}\right]^{(1-4)}$$

$$\sum_{(e\neq j)} e \in EJ \ ^{(1-5-1)} + \left[\sum_{j\in J}\sum_{k\in K}\sum_{r\in R_{jk}}\sum_{l\in L} RH^{j,k,r}_{l}.FRH^{j,k,r}_{l}\right]^{(1-6)}$$

Feasibility Cut:

$$-\sum_{j\ k\ r\ s}\sum\sum\sum\sum \psi'^{1}_{jkrs}.\left(RH^{j,k,r} + FL^{0}_{jkrs}\right).CY_{rjk} + \sum_{c\ k\ s}\sum\sum\sum \psi'^{2}_{cks}.D_{cks} - \sum_{i\ s}\sum\sum \psi'^{3}_{ci}.P^{0Max}_{ci} - \sum_{c\ i\ s}\sum\sum\sum \psi'^{4}_{cis}.P^{1Max}_{ci} -$$

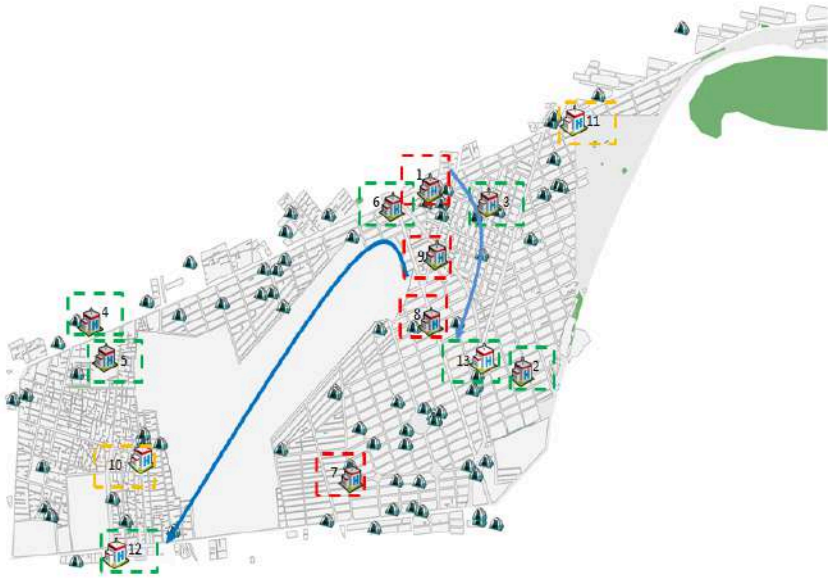
$$\sum_{c\ j}\sum\sum_{(e\neq j)} e \in EJ \ + \ CP^{0}_{cj}.Z_{jj} \qquad (24)$$

$$-\sum_{c\ j\ s}\sum\sum\sum_{(e\neq j)} e \in EJ \ + \ CP^{0}_{j}.Z_{jj} + \sum_{c\ j}\sum\sum_{(e\neq j)} e \in Ej \ \leq 0$$

6. Redesigned Network Configuration

In this section, the proposed reconfiguration for the considered case has been solved for all scenario numbers (solved by GAMS software, CPU: Core i5, 2.4 GHz, with 8 GB of RAM) and as a sample, a specific problem considering 10 scenarios is illustrated in Figure 2. In this regard, the current configuration and changes made for a new configuration are illustrated in Figure (provided by Arc Map GIS software V. 10.2). According to the proposed model, optimal values for each decision variable related to DCs are listed in the bottom of figure.

Therefore, it is optimal to locate additional *DCs* (new *DCs* 12 and 13) to better cover the requested relief goods during the response phase. Moreover, *DC* 1 must be consolidated with *DC* 13 and DC *9* with *DC* 12. In addition, another optimal strategy for redesigning the relief logistics network is phase-out of existing *DC* 7 and 8.



- *Existing DCs:* $Z_{2,2}$, $Z_{3,3}$, $Z_{4,4}$, $Z_{5,5}$, $Z_{6,6}$, $Z_{9,9}=1$, $Z_{7,7}$, $Z_{8,8}=0$
- *New DCs:* $Z_{12,\ 12}$, $Z_{13,\ 13}=1$,
- *Consolidation:* $Z_{1,\ 13}=1$, $Z_{9.12}=1$

Figure2. Redesigned DCs based on the proposed model

In this section, the performance of the solving methods in terms of computational time, iteration number and convergence rate are evaluated. Table 1 presents the results of the proposed model (*P*2: SRLNRM) as well as computational time consumed by B&B, and BD. According to the table given, Benders' decomposition can solve the problem even for 100 scenarios while B&B cannot find the optimal solution. Among all solving approaches, BD reduces the computational time for the problem with 10, 20 and 100 scenarios. It is apparent that for a 100-scenario problem, B&B can not provide any solution, while BD not only proposed a solution, but the quality of solution with neglectable gap can be considered as global optimal.

Table 1. Performance of solving approaches for solving the proposed model (SRLNRM)

No.	*# of scenarios*	B&B (E+11)	*Time (Sec.)*	*BD* (E+11)	*Time (Sec.)*
1	3	3. 56162	*11*	3. 56162	*16*
2	5	3. 00567	*25*	3. 00567	*27*
3	10	2. 33637	*179*	2. 33637	*47*
4	20	2. 25668	*621*	2. 25668	*69*
5	100	-	*>3600*	5. 39463	*74*

VI. conclusion

In this paper, we aimed to propose a stochastic redesigning model and its appropriate solving approaches. Some contributions have been taken into account in the proposed model including redesigning strategies for facilities, relation modifications based on the new status of facilities and infrastructures, and consideration of road rehabilitation. The proposed model provides analytical and managerial insights for evaluating the existing configuration compared to the optimal redesigned network and approaching the existing network toward the optimal network.

To cope with the uncertainty, two-stage stochastic programming was proposed to consider strategic variables (here and now) and operational decisions (wait and see) in a changing environment especially for uncertain costs, demands, and road failure. Comparison of redesigned relief logistics network and existing network demonstrates that SRLNRM provides considerable cost improvement. Indeed, the proposed model overcomes many of the barriers associated with consideration of current facilities and infrastructure in the redesigned model as well as the integration of preparedness and response decisions.

In order to solve such an optimization problem with the considerable number of scenarios, both classic B&B and *BD* were considered. As discussed, BD outperformed the other approach in terms of computational time, and convergence quality.

As the future research, it can be suggested that the other solution approaches (meta-heuristics approaches) can be applied in the proposed model and results can be compared with the proposed solving approach. To better modeling, some features like the attention to congestion and traffic jam of roads can be modelled in the future researches.

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Ahmad Ghahari (Author)

Alborz Science University

Farshid Sahba

An analysis on the profitability in short-lived economic enterprises

Abstract:

Economic enterprises are created for the purpose of profitability and Capital Increase. Every investment has costs from the beginning, and after some time it will be profitable. Profit is obtained when the income exceeds the cost. So the founders of economic enterprises should be able to estimate the time and duration of profitability and the total amount of profit in order to make better decisions. In this article, profit forecasting equations are presented according to the equation of revenue and cost curve, and a solution is provided to increase profits beyond the forecasts in short-lived economic enterprises.

Keywords: Benefit, Economic enterprise, Break-even point, Income, Cost

Introduction:

Short-lived economic enterprises that live six months to ten years are looking for more economic profit in a shorter time. The goal of investors in these companies is not to build brands or legacy companies. They want to use a part of their capital in services, manufacturing goods, or commerce in order to take advantage of the current environmental, social, economic, and government conditions sooner and more. The capital of such enterprises can range from thousands to millions of dollars, and profits are usually obtained in the second half of the company's life. At the end of the life of each short-lived economic enterprise, investors withdraw the principal and profit of their capital and go to a new investment, and with the rotation of the trailing capital in several short-lived economic enterprises, a significant profit is obtained with low risk. To increase the profit in short-lived companies, the productivity factor should be increased to reach the desired profit in a short time, for this purpose, innovative and special methods should be used to increase the income and reduce the cost, so that the profit can reach the maximum possible in a short time.

Basic text

Because the economic enterprise is planned based on economic benefits, more profit makes the enterprise more powerful.

An economic enterprise has inputs and outputs like any other system.

The financial input of an economic enterprise is its cost and its financial output is its income.

It is clear that in order to reach stable conditions, one should try to make the output greater than the input, thus increasing the productivity factor.

In other words, the following inequality must hold and the fractional side of the equation should be as large as possible:

$$\frac{\text{Income}}{\text{Cost}} > 1$$

The correct flow of input and output leads to a deposit in the system, which is called profit, and the profit is obtained based on the following equation:

Income - Cost = Benefit

Profit is actually the fruit of an economic enterprise, the result of which is the growth of the enterprise or direct financial benefits for the shareholders.

So the profit should be increased and this goal can be achieved by increasing the income or decreasing the cost or doing both at the same time.

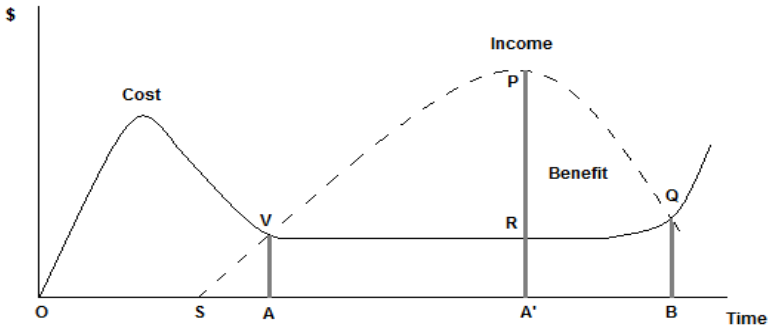
$$\text{Income}\uparrow \ \vee \ \text{Cost}\downarrow \Rightarrow \text{Benefit}\uparrow$$

$$\text{Income}\uparrow \ \wedge \ \text{Cost}\downarrow \Rightarrow \text{Benefit}\hat{\uparrow}$$

But the economic enterprise does not only have no income from the beginning, but also has relatively high pre-operational costs.

The graph below shows the curve of income and cost in the life span of an economic enterprise.

Income cost chart (1)



Pre-exploitation costs (between points O to A in the diagram of Figure 1) can be the cost of buying or mortgage the property, buying equipment or software, advertising and marketing and market analysis, government expenses and obtaining a work permit, the cost of hiring and training employees or guiding shareholders, designing a conceptual model and business plan, building structures or facilities, or purchasing energy and raw materials.

These costs can be provided from partners' contributions or bank loans or pre-sale of goods or services.

The cost is there from the first day after the decision to start the company, but the income is not obtained before the start of production or services (after exploitation).

As it can be seen in the diagram, the costs reached a maximum after the start of the work and then decreased and remained relatively constant or slightly fluctuating for months and years. But in the long term and when equipment wears out, or new competitors enter the market, or consumer tastes change, it increases slowly (around point Q in the diagram of Figure 1).

The income also grows slowly after being obtained and reaches its peak after a few months or years (point P in the diagram of Figure 1).

Then, as equipment wears out, or internal technology becomes outdated, competitors enters, consumers' tastes or needs change, government regulations change, or environmental conditions change, it slowly decreases. (the interval from point P to Q in the diagram of Figure 1)

As it was said at the beginning of this article, the basic goal of an economic enterprise is to make the income bigger than the cost.

But at the beginning of the business, this demand does not happen and the daily cost is more than the daily income.

Fortunately, in the right economic conditions, after a period of time with the reduction of the cost and the increase of the income, there comes a day when the daily income is equal to the daily cost, which is called the apparent initial break-even point (point A in diagram one).

This is a promising point, but it does not mean profit in the company or permission to withdraw profit from the financial cycle of the company, because the sum of huge costs before exploitation, which is the area under the cost graph from point O to point A, has not yet been compensated. In other words, the sum of the total income has not yet equaled the sum of the total expenses until this step.

To find point A, having the equation of the cost curve and the equation of the revenue curve based on the time variable (t), we make and solve the following equation.

Income(t) = Cost(t)

After finding the root of the equation in terms of t, we will have one or two roots.

If both numerical roots are positive, the smaller number is the value of A and the larger number is the value of B in the diagram, which we will discuss further.

But if we have only one positive root, it is A, and the economic model does not have point B in that condition, which is an ideal condition but unattainable in reality.

To find the point where the sum of the total income equals the sum of the total cost up to that step (point A' in diagram 1), the following equation must also be solved.

$$\int_0^{A'} \text{Income}(t)\,dt = \int_0^{A'} \text{Cost}(t)\,dt$$

By finding the root of this equation, the exact value of A' is obtained.

A' is called the real initial break-even point, and after that time point, profit can be taken from the company.

But as mentioned earlier, after a long time, the income will slowly decrease and the cost will increase slowly, and finally the day will come when the daily income will be equal to the daily cost again (point B in the diagram, which was previously told how to calculate it). This is called the apparent break-even point. This is the point at which the business should be stopped because continuing past the boundary point B will bring the firm to a point called the true break-even point. Where, for the second time, the total income of the company is equal to the total cost of

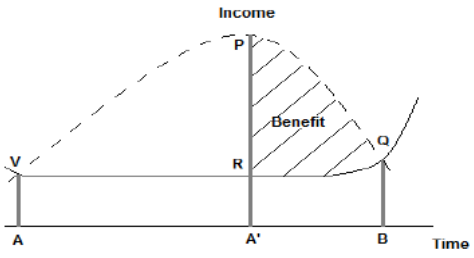
the company, and the total profit becomes zero, and the operation of the economic enterprise becomes futile in its entire life.

Based on these analyses, the shareholders of the economic enterprise at point A can be happy and hopeful, and take profit from point A' to B and finish the work at point B.

The total profit in the period A' to B is calculated by solving the following equation.

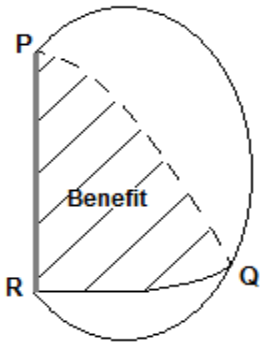
$$\int_{A'}^{B} \text{Income}(t)\,dt - \int_{A'}^{B} \text{Cost}(t)\,dt = \text{Benefit}$$

The total profit is marked with a hatch in Figure 2.



Now we turn to the analysis of Benefit polygonal in chart 2.

We should try to make this PQR triangle-like polygon close to the shape of a circle (chart 3).



The circumscribed circle that surrounds the triangle has a larger area than the triangle and gives a higher total profit.

Based on geometric models, the complete area of a circumscribed circle of a triangle is approximately 2.4 to 3.2 times the area of the inscribed triangle.

In our proposed model, the area of the incomplete circumcircle can be up to 2 times the area of the Benefit triangle-like polygon.

But how can such a change in the behavior of the income curve and the cost curve be created?

We must create changes in the behavior of the income and cost curve so that the income curve becomes more convex and the cost curve more concave in the time period A' to B.

Doing one or more of the following options is a way to change the behavior of the income curve and increase its convexity:

- Selecting and offering only one special product or service from our range of products or services (the one that has been the most profitable based on monthly analysis)
- Very low-cost short-term advertising with high effect, such as viral advertising
- Re-adjustment of devices and equipment to increase the quantity and quality of production
- A small change in the appearance or packaging of the goods
- Changing the name of goods or services
- Stand-up, short, and low-cost trainings for employees, especially in the customer affairs department
- Non-material change in employee welfare matters (playing music, friendly behavior with employees, …)
- Temporary price reduction of goods or services and amazing short-term discounts
- Selling used equipment
- Selling waste

It is necessary to remember that choosing any of these methods should be free of cost or with very little cost because increasing the convexity of the revenue curve should not increase the cost curve or create convexity in it.

In order to temporarily reduce the cost and create a concavity in its curve, the following methods are also suggested:

- Re-adjustment of devices to reduce waste
- Lay off of employees
- Stand-up, short, and low-cost trainings for employees, especially in the production or service sector
- Removing obsolete and inefficient equipment that wastes energy, time or materials
- Delivery, collection, and transportation of waste to waste buyers

- Buying raw materials, fuel, or energy at special discounts
- Reviewing, or discarding costly and ineffective or slow-acting advertisements
- Returning rented units and spaces or rented equipment which are no longer useful
- Ending the advance payment for the purchase of materials, monthly or annual charges, the cost of renewing the work permit and any future expenses that are logically no longer needed if the company ceases to operate

Care must be taken to ensure that cost reductions have zero or negligible reductions in revenue. In other words, only ineffective and unnecessary costs should be reduced.

Finding these parameters can be done by data mining on the income parameter and each of the cost parameters separately.

On this basis, with the strategies of cross-sectional increase of income and cross-sectional reduction of cost at the same time, in the period from A' to B, profit can be optimized, and this means more profit in time, which is the basic goal of economic enterprises and shareholders' investment, especially In short-lived companies.

Weaknesses and strengths of the model:

Weaknesses:

- It is difficult to obtain the income and cost curve before starting the economic enterprise, which should be adapted from similar and active enterprises.
- In unstable economic environments, the equation of income and cost is sometimes strongly influenced by external factors and behave differently from predictions, which disrupts pre-calculations.
- Applying the methods proposed in the article to change the behavior of the income and cost curve has the risk of creating disorder and chaos in the system.
- The income and cost curve which should be adapted from similar and active enterprises, is difficult to obtain before the start of the economic enterprise.

Strengths:

- If we have income and cost curves, estimating the amount and time of profitability is not a complicated process.

- The solutions proposed to change the behavior of the income and cost curve are not complicated and expensive.
- The presented equations and model can be generalized to long-lived economic enterprises with some changes.

Conclusion:

A short-lived economic enterprise can be set up for investment and profit. In every economic enterprise, by having the equation of the income and cost curve, it is possible to predict the time and amount of profit and also determine the right time to end the business.

Based on the proposed geometric model, in order to make more profit in short-lived economic enterprises, it is possible to optimize the behavior of the revenue and cost curves by making small changes in revenue generation and cost, until the profit reaches twice the predicted amount.

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Andrew Chan (Author) *Department of Management, City University of Hong Kong*	**How to Teach Leadership and Business Ethics to Millennials Better**

Abstract

Business students have plenty of opportunities to mingle with successful business leaders, and they form an impression of them through meeting, listening to, interacting, or even work-shadowing them. While these chances have their merits, any student's own cognitive process in subsequently applying management concepts to real-life contexts is inevitably mediated by their own background, up-bringing, education, and personal experience which may be subjective and biased. In this project we enhance students' learning experience and let them conduct syntheses and evaluation of the leadership styles, social responsibility and ethical standards of business leaders by using the computer-assisted qualitative data analysis software (CAQDAS) called ATLAS.ti. Here we ask students to conduct semi-structured interviews with leader executives to talk about social responsibility, business ethics and leadership, and then they transcribe the verbatim interview into text transcripts. Students were provided with an opportunity to synthesize knowledge by employing the CAQDAS whose artificial intelligence and machine learning algorithms are based partly on principles of lexical semantics.

Introduction

The millennial generation is believed to have a strong mentality of civic mindedness, global citizenship and a propensity to feel personally responsible in making a change in their respective communities or sphere of influence (Klenke, Martin & Wallace, 2016). University graduate employability was enhanced in a learning experience project at this university that resonates with millennial values and beliefs. The research project investigator helped students to *synthesize* together facets of the leadership styles, ethics and social responsibility of the business executives and leaders whom they interviewed. "Leadership" is one of the most significant topics in business management studies. Companies large and small around the world spend approximately US$46 billion annually on leadership development programs (Carroll, Singaraju & Park, 2015). Rising expectations from employers to put emphasis on training socially responsible and ethical

leaders among their graduate-employees prompt us to think about how to meet the market demand and boost graduates' employability. With Bloom's taxonomy in mind, this project was intended to nurture our future student-leaders and better enable them to synthesize and evaluate ethics and leadership knowledge. The students own self-reflection and evaluation of the learning outcomes were considered to have better instilled into the minds of our millennials so that they internalize the noble values to become socially responsible leaders and do all the correct things in a chaotic world eventually.

Under the guidance of the project investigator, tuition and coaching of 57 students who took business management courses were firstly coached how to develop an interview guide and to conduct semi-structured interviews about ethics, social responsibility and leadership with established and successful business executives and leaders. Secondly, they transcribed and coded the interview transcripts. Thirdly, they analyzed the interviews and the verbatim transcripts using contemporary servant leadership and ethical, CSR leadership models and with the help of ATLAS.ti CAQDAS software.[1] Guided by basic and jargon-free lexical semantics, students employ qualitative data analysis software to unveil layers of meanings and semantic contexts that are sometimes embedded within the *raw data* or *text* (i.e., verbatim transcripts of an interviewee's spoken discourse in natural language).[2]

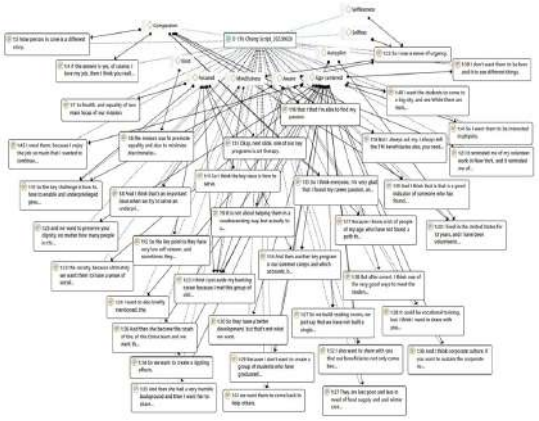
Conventionally, for any student who *listens to* business leader talks, one forms an overall impression, given healthy and legitimate biases which is fair enough but the nuance or richness of what was really said is often lost somewhere between the lines. When anyone's speech or discourse is articulated, the strings of imaginative clusters of terms that s/he uses, the lexicon and vocabulary deployed by the speaker-interviewee, his/her sentiments and the tenor of what was spoken, the summative meaning of his/her discourse can only be interpreted by another discrete listener-researcher subjectively, in his or her own terms.[3] Only when the verbatim transcript is

[1] ATLAS.ti (v22) can easily import HTML/PDF files, audio and visual data, images, documents and social media data. It analyzes qualitative data and can generate deep insights automatically and interactively, leveraging the latest AI machine learning algorithms.

[2] Natural language is dynamic and people write and speak using imaginative clusters of related words around a topic. Such clusters of terms concerning a topic travel around together and throughout the speech/text to form concepts and often the meaning and sentiments are implied by the context. Lexical semantics shed light on the contexts using a rule-based calculation of word proximity and correlations of words in the text.

[3] Natural language is dynamic and complex. People write and speak using imaginative clusters of related words around a topic such as leadership, social responsibility and ethics. Such clusters of terms concerning a topic travel around together and throughout the speech/text to form concepts and often the meaning and sentiments are implied by the context. Context has a texture-like property which lexical semantics will analyze the contexts using a rule-based calculation of word proximity and correlations of words in the text. These lexical semantic rules are encapsulated in an algorithm within commercial CAQDAS like

handed over to more objective and closer semantic analysis with artificial intelligence and machine-learning algorithms can the verbatim "data" reveal further, often overlooked, higher-tier categories or concepts. For example, the relationship between CSR, leadership styles and ethical principles held by an executive-interviewee when s/he talks about them is mediated by sentiment and use of lexicon or imaginative clusters of related words around a topic. These contexts, tenor, sentiments and nuanced meanings are often overlooked, diluted, or mis-interpreted by a novice who listens to tape-recording of the interview or merely reads the written speech-discourse. In this case, we trained students to display the interviewees' spoken verbatim data using high resolution qualitative data analysis based on lexical semantic algorithms. The 57 student-researchers were better able "visualize" the nuances better, like in Figures 1 & 2.



Figures 1 & 2. CAQDAS Data Visualization (Network Diagram & Word Cloud)

The reason is the powerful interactive visualizations provided a bird-eye view and hence a deeper understanding of what was said and unsaid. The results in network diagram and word cloud contained information displayed with codes that have been previously developed by student-teams and these codes acted subsequently as cues to search for more systematic derivations of finer verbalized elements within those the leadership models which came from the mouths of the interviewees. For example, the notion of "compassion" now becomes an organizing device which encapsulates higher concept categories are now displayed in a user-friendly networked fashion in Figure 1 network diagrams. Therefore, the 57 students

Leximancer, NVivo, ATLAS.ti which can produce powerful interactive visualization amenable to further human-researcher interpretations because the meaning (of what the leader-interviewee say) hence becomes emergent from the text itself and not predetermined with "healthy" bias of the interviewers. In other words, verbatim script on the topic, after subject to software analysis can now reveal further high-level concepts displayed in immersive, interactive visualizations and manifested in data exports, delivering the key ideas and actionable insights that are needed for synthesis and researcher's evaluation.

re-examined the spoken expressions of the interviewees in newer light, and in a neater and thought-stimulating manner.

In these data-visualizations, much broader perspectives became available in a clearly parsimonious fashion, for example, what the respondent had inside his mind about the "acts of leading". These newly re-organized information or perceived *affordance*[4] via data visualization enabled students to exercise their discretion and make further human judgment. Under the auspices of the investigator, students were able to make sense of, interpret, synthesize the speakers' nuanced intentions as well as assess and evaluate the interviewee's leadership qualities, his/her personal standards and values underlying ethics, CSR and leadership. The illustrations below will elaborate these points further.

Methodology

ATLAS.ti is a Computer-Assisted Qualitative Data Analysis Software which helps researchers to systematically categorize interview transcripts. ATLAS.ti stores the audio-visual recording, displays the captions of the discourse word-by-word in slow motion, transcribes the captions into verbatim texts so that researchers can easily listen to the recordings. The software can be used to carry out thematic analysis, textual analysis to find out patterns, frequencies, similarities or differences of these verbatim transcript data. Firstly, the group-based ATLAS.ti software were used for 57 students to simultaneously collaborate on-line. These students were formed into teams of 5-users each and then coached in manual coding (See Figure 3 below).

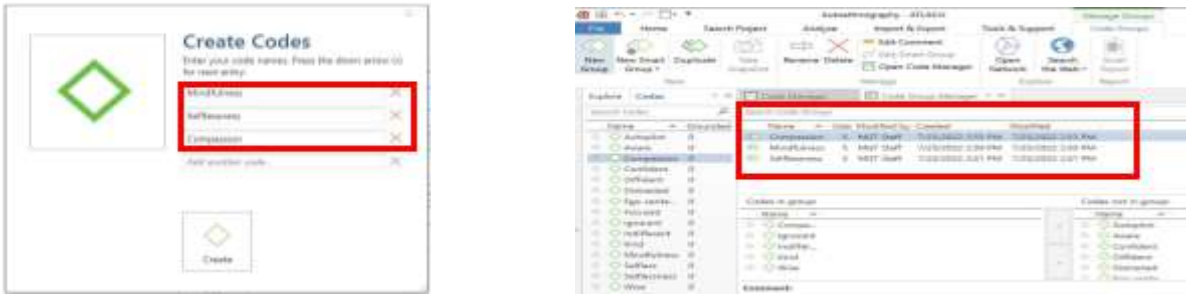


Figure 3. Codes created based on the MSC Leadership Model (Hougaard & Carter 2018)[5]

[4] "*Affordance*" is a use or purpose that a thing can have, that people notice, or implicitly understand, as part of the way they see, experience or interact with it.

[5] See Reference.

Secondly, after pre-setting the coding requirements, interview transcripts could be detected by the software. For example, in the excerpt in a live interview between business students with the first interviewee: a philanthropist called Mr To Chung was a case in point (See excerpt below). For example, if a code named "aware" is created, ATLAS.ti software could detect texts including dialogues in interview transcript with the text-search tool called "Auto-Coding". It automatically selected related synonyms like *"concern"* (02:00:08-02:00:25), or relevant phrases like *"Seeing is believing"* (01:22:25-01:22:46), or even a full sentence like *"Every year, we actually understand their need a lot more."* (01:06:20-01:06:40). Therefore, relevant contents were traced according to the "codes" so that the discourse of the interviewee were further analyzed, as in Figure 4.

*"Student A: The second question is, you know, I heard that you have been a successful banker before you do the job, and I wonder why would you do the charity work full time as a beginning. Mr. T (successful business leader): After I graduated from Harvard, I started working on Wall Street, first with Lehman Brothers and then with UBS, and then because I worked in New York for four years and then UBS relocated me to Hong Kong and then I started working in Hong Kong. **I think I put aside my banking career because I met this group of children and their need is very urgent, (Identified as "Mindfulness")** because I see that they, if we don't have them now. Then we are going to miss that opportunity forever because they will drop out of school, and they will go to big cities, they will be street children, some of them will find other jobs and they would miss the opportunity of education forever. **So, I saw a sense of urgency. (Identified as "Mindfulness")** It's not like I it's not like a big career change. **I was more like a firefighter. I saw a fire. This is very urgent, so I get off from my investment banking bus or investment banking wagon, and then try to put out a fire as a firefighter. (Identified as "Selflessness") Some people always see a big sacrifice. (Identified as "Selflessness") To me, I think it is very thankful, a gift that I'm able to find my passion. (Identified as "Compassion")** Because I know a lot of people of my age, who have not found a path they kept working for a job for a long time but it wasn't there was there was no passion, they just they just keep going because they got paid. **I always tell the beneficiaries to find a job that you have the passion." (Identified as "Compassion")***

Figure 4. Excerpt of Interview Transcript with Mr. To Chung, Founder of Chi Hang Foundation (02:13:27-02:20:30)

Thirdly, by applying qualitative analysis with CAQDAS ATLAS.ti to these transcripts, more layers of meanings were displayed as a result of immersive, interactive data visualization in form of diagrams, including tree diagram, hierarchical diagram, organic diagram, or word cloud, to name a few (See Figures 5 & 6 below). Students were better able to make connections among social responsibility, business ethics and then assessed the leadership styles of business executives.

Figures 5 & 6. Visualization Output in the Form of Organic Diagrams

Fourthly, in this step, they coded individually and then compared their collective outcomes to achieve *synthesis,* which is, paraphrasing Bloom, "by putting together elements and parts so as to form a whole". Teams synthesized and compared among themselves those interactive visualizations which were facilitated by *displays* showing correlations among meanings and sentiment, higher categories and concepts. Students in different teams compared these interpretations among themselves and synthesized different versions with theoretical models of ethical decision-making, CSR models and leadership styles of different business executives whom they interviewed. They composed their analyses and shared with other teams to carry out final evaluations.

Results

To summarize, in regards of project outcome deliverables, students will be able to :

- Obtain first-hand data based on interviews with real-life business leader;
- Integrate rich and context-sensitive descriptions of discourse on leadership integrated with ethics, CSR and leadership models;
- Carry out qualitative analysis using ATLAS.ti software amenable to synthesis and evaluation;
- Enhance their interview skills and qualitative research skills;

- Obtain the executive interviewees' feedback of their interpretations, for verification and triangulation purposes;
- Carry out self-reflections, post-project evaluation of the grant, and then close the learning loop;
- Internalize the values of ethical business, social responsibility and leadership.

Paraphrasing Bloom (1956), *evaluation* in this project engenders judgments about the "value of material and methods for a given purpose". Students who took courses in *Management*, General Education courses *Business and Hong Kong Society,* and *Loving Work, Work to Love* were invited to pass judgments about the value and how meaningful this project is in widening their perspective about working knowledge in business ethics of their interviewees. Here are three elements in the evaluation process:

1.) Before the start of the project, participating students have completed a pre-training questionnaire about their prior knowledge and competence in ethics, CSR and leadership. After the administering of this project the same students completed a follow-up questionnaire to gauge those changes in their behaviors, attitude, values and beliefs about the topics.

2.) They were asked to submit self-reflection reports and describe their observations and impressions about this learning journey.

3.) Executive-interviewees were subsequently invited back to give feedback for triangulating the students' learning outcomes and project deliverables. This step has helped to assess the extent of closeness between the leaders' own perceptions vis-a-vis the learners' interpretations and assessment of their interviewees' leadership styles, social responsibility values and ethics standards.

Students' own self-evaluations as well as their feedback about the overall learning experience were included as project deliverables. They are intended for wide disseminated to obtain a sense of the scalability of this project for further adoptions in other courses or campus learning experience, for example, exchanging ideas about similar efforts that are made by University's Career and Leadership Centre. Natural language discourses, interview transcripts, audio- and video-recordings, twitter and you-tubes, and social media resources of internal and external constituencies were also intended for general showcasing of the results.

Conclusion

In conclusion, a common way that business students learn about ethics, CSR and leadership through chalk-and-talk teachings is contrasted with the novel chance offered in this teaching project. Here students obtained first-hand information, received coaching in semi-structured interview using an interview guide, practice qualitative research skills, and accomplished higher order *synthesis* of this corpus of knowledge. This project has been entirely teaching oriented and learner-centered. It was considered as genuine in its pedagogical design, sincere in its intellectual appeal and genuine in its aims with the ultimate benefits of students in mind. The purpose of teaching development. Finally, the aim of broad dissemination of enhancement of pedagogical methods in teaching ethics, leadership and CSR better to millennials in our classrooms was achieved.

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