RELATIONSHIP BETWEEN SUPPLY CHAIN MANAGEMENT TECHNOLOGIES AND PERFORMANCE OF SHIPPING LINES IN KENYA: THE MODERATING EFFECT OF INTERNATIONAL MARITIME REGULATIONS

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2024

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DEDICATION

To my Parents Mr. Ethan Ndung'u and Mary Ndung'u for their: prayers, moral and financial support in the course of this study.

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ABSTRACT

Organizations are continually adopting new technologies with the sole aim of enhancing their operational efficiency. It is therefore imperative that shipping companies adopt these said technologies in order to do away with operational inefficiencies that are a major setback in this sector. The essence of this research was to analyze association between supply chain management technologies and performance of shipping lines in Kenya as moderated by international maritime regulations. The specific objectives of the study were to examine the relationship between localization technologies and performance of shipping lines in Kenya. To examine the relationship between sensor technologies and performance of Shipping lines in Kenya. To examine the relationship between communications technologies and performance of Shipping lines in Kenya. To examine the relationship between identification technologies and the performance of Shipping lines in Kenya. Research was majorly anchored on Technology acceptance model, as the main theory. On philosophical pining the study was underpinned by positivism and to gather in-depth information survey which was explanatory in nature was employed. Using random sampling 438 respondents were selected from the four sections of these companies to form sample size. Questionnaires were used to collect data for both pilot and main study. Data was analyzed using both descriptive and inferential statistics. The study findings showed that there is a positive relationship between supply chain management technologies and performance of shipping lines in Kenya. On specific objectives there was a positive relationship between localization technologies, Senor Technologies, Communication technologies and identification technologies. The study further indicated a positive association between localization technologies, Sensor technologies, Communication technologies and identification technologies as moderated by international maritime regulations. The study concluded that shipping lines should invest more in supply chain management technologies in order to improve their performance.

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LIST OFABBREVIATIONS AND ACRONYMS

AITS Automated Inventory Tracking System

AVL Automatic Vehicle location

COLREG Convention on the international regulations for preventing collisions at sea, 1972

CSCM Council of Supply Chain Management

CT Communication Technology

DDS Distribution Data System

DRP Distribution Requirement planning

ECTS Electronic Cargo Tracking Systems

EDI Electronic Data Interchange

EMEA Europe, the Middle East and Africa

ERP Enterprise resource planning

E-SC Electronic supply chain

GIS Geographical Information system

GPRS General Packet Radio Service

GPS Global Positioning Systems

GSM Global systems for mobile communication

ICT Information Communication Technology

IMRs International Maritime Regulations

IOT Internet of things

ISPS International Ship and Port facility security code,2002

IT Information Technology

IT Identification technology

KRA Kenya Revenue Authority

LOADLINE International Convention on Loadlines, 1996

LPI Logistics Performance Index

LT Localization Technology

MARPOL International Convention for the prevention of pollution from ships, 1973/1978

NACOSTI National Council of Science Technology and Innovation

PhD Doctor of Philosophy

RECTS Regional Electronic Cargo Tracking Systems

RFID Radio Frequency Identification

RFTs Radio Frequency Tags

SCEA Shippers Council of East Africa

SCM Supply Chain Management

SLP Shipping Lines Performance

SOLAS International Convention for the safety of life at Sea, 1974

ST Sensor Technology

TAM Technology Acceptance Model

UNCTAD United Nations Conference on Trade and Development

WMS Warehouse Management System

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

According to the Kenya Shippers Association report (2016) and the Kenya Competition Authority final report (2019), the logistics efficiency of Kenya's shipping sector is low compared to that of developed countries. This is evident in the country's customs clearance delays, delivery delays, insufficient track and trace capabilities, and high transportation costs. Kenya ranked 68th with a performance index score of 2.8 out of 5 in the 2018 World Bank study on worldwide shipping performance. Germany and Finland, two of the world's leading economies, both have ratings higher than 4.0, thus this is significantly lower. Importers, exporters, and suppliers of marine logistics services face a commercial risk due to inefficient logistics, which in turn impedes international trade. Since 2015, Kenya's liner shipping connectivity performance has averaged 17%, according to the UNCTAD (2021) report. In comparison to 39% in South Africa, 22% in Nigeria, and 69% in Morocco, this performance has had a little impact throughout the years. As a result, we must find ways to fix these shipping operations' inefficiencies immediately. The transportation of goods by water has a significant impact on national economies since it enables cross-border trade (Rodrigue and Notteboom, 2017). UNCTAD (2020) found that ships and other forms of maritime transport constitute as much as 90% of global trade. The blue economy is a model for national economic growth that prioritizes the responsible management of water resources. Several resolutions intended to accelerate the sustainable development of the blue economy were produced by the 2018 Global Conference on Sustainable Blue Economy, which was hosted by Kenya. Finding the right technology was one of these goals (Republic of Kenya Data Collection Survey on Blue Economy, 2018). Since

shipping firms deal with huge amounts of goods, it is crucial that they discover ways to be more efficient.

By making good use of the right technologies, these businesses can improve their performance. A number of researchers have shown that technological advancements are associated with better results. The benefits that technology delivers, such improving performance, are what fuel its widespread use by enterprises, according to Barros *et al*. (2015). Additionally, it was argued by Atieno (2014) and Cheptora, Osoro, and Musau (2018) that the utilization of technology positively affected the performance of organizations. In addition, according to Harris and Wang (2015), businesses can boost their performance by incorporating technology into their operations.

There are a number of ways to measure shipping companies' performance, just as there are for any other type of business. Finding out whether the company's goals have been fulfilled is the primary objective. Depending on the situation, different researchers use different performance measures. According to Karia and Wong (2013), shipping lines can be evaluated by looking at how much they minimize expenses. According to Sadovaya and Thai (2015), improved security and business resilience are all part of performance indicators. Ojwang (2016) stated that when technology is used in the shipping industry, key performance factors like feedback, cost, lead time, and service quality are enhanced. According to Namusonge and Mugambi (2016), one of the most important metrics for success in the shipping sector is profitability. Karibo (2019) echoes this sentiment, stating that increased sales and prompt delivery are critical performance indicators. Several researches have provided the groundwork for this investigation of the relationship between these technologies' use and the success of these companies.

1.1.1 Supply chain management technologies

1.1.1.1 Global perspective on supply chain management technologies

The success of shipping lines is associated with the efficient use of supply chain management systems, according to multiple worldwide studies. According to Bode and Weiss (2011), giving real-time information on the status of things throughout transit is one way technology can help reduce loss and risk in the transportation chain. But the studies only show how sensor and location technology help with avoiding losses and risks. Hence, additional research into this area is necessary to identify complementary technologies that could improve these companies' performance when utilized alongside the ones already mentioned.

According to Karia and Wong (2013), better performance is possible with well-executed technology deployment and exploitation. All of the aforementioned points to a link between shipping line performance and technological advancements. Nevertheless, more research is needed to determine whether and how logistical resource mergers and utilizations could improve performance.

Supply lines, often called logistics chains, can be made more efficient with the help of Radio Frequency Identification (RFID), says Hinkka (2013). Whether or not RFID is the only technology that improves performance is not stated in the paper. To learn how shipping lines and other supply chain participants might benefit from RFID technology, additional research is needed.

The shipping industry might benefit from the increased productivity and efficiency that communication technology offer. Muhammad, Saahar, Hasan, Fiah, and Nor's (2013)

conclusions are in agreement with this. According to the findings, performance is enhanced by only one kind of supply chain management technology. This emphasizes the importance of doing more studies to investigate the potential benefits of integrating various technologies to improve performance, especially for shipping lines.

A business can achieve operational benefits including reduced lead time, increased market presence, and better return on investment through the successful deployment and exploitation of suitable technology. The source is Lui (2015). A correlation between performance improvement and the use of disruptive technologies in IT was the focus of the research. Due to the lack of definitive proof from earlier studies, the present investigation seeks to answer the question of whether or not similar technologies may improve the efficiency of other industries, such shipping lines.

Using RFID and other Internet of Things (IoT) technology, wireless sensor networks can help keep track of temperature, humidity, shock, light, and humidity while shipments are in transit. Afterwards, the relevant parties participating in the logistics process receive this information (Himanka 2016). Logistics service providers' efficiency and effectiveness are correlated with their use of technology, according to the data given.

According to Tajfar and Gheysari (2016), there is a strong correlation between the IoT and the steps involved in production, acquisition, shipping, and receiving and giving back of products. Based on the findings, it is clear that this technology can improve organizational performance when put into practice. Using radio frequency identification (RFID) technology allows logistics organizations to save money, get data quickly, identify products easily, and ensure dependable delivery (Doan 2017). The research looks at how logistics operations might be made more efficient by using RFID

technology. However, alternative supply chain management technologies could potentially improve logistical performance when integrated with RFID, although this is not shown in the study.

Companies that invest in technology see improvements in areas like consumer happiness and security (Musa, Azmi, Shibghatullah, Asmala and Abas, 2017). Despite studies showing a correlation between GPS use and company performance, none have shown how other technologies can improve logistics service providers' (especially shipping lines') efficiency when combined with GPS.

Improving operational efficiency, visibility, and customer service are just a few of the benefits that can accrue to a business after adopting RFID technology (Khan, Haq, Ghouri, Raziq, and Moiz, 2017). The research only looked at one technology, but RFID isn't the only one that can boost a company's efficiency.

The Internet of Things (IoT) has improved supply chain processes and organizational performance, say Tharaka, Himanshu, and Shah (2018). A company's performance was found to be correlated with its employment of technology, according to the research. The purpose of the research was to identify potential applications of these technologies that could boost shipping companies' efficiency. Elango (2018) asserts that there are numerous stages in supply chain management that are positively affected by the use of ICT. These stages include planning, product delivery, and overall performance improvement. The study proves that there is a causal relationship between technological advancements and better results.

An extensive correlation between ICT and e-payment, e-traceability, website design, and customer satisfaction among e-logistics users was found in the study by Hameed, Nadeem, Azeem, Aljumah, and Adeyemi (2018). While information and

communication technology (ICT) is a technology that allows firm performance, the research results showed that other technologies can be used in conjunction with ICT to improve firm performance even further.

Technology allows businesses to track and trace, which is vital for their performance (Pham, 2018). Organizational gains are linked to technology utilization in the study. Unfortunately, there isn't enough proof in the research to show that shipping companies can improve their performance by using the same technologies.

A number of areas, including inventory management, delivery times, accuracy, and cost, are greatly improved by incorporating automation technologies into supply chain and logistics operations. Findings like these are in line with what Niraj (2019) found. Utilization of technology is associated with improved performance, according to the research. As a result, it implies that businesses might improve their performance by using automation technologies.

U-Thong, Jaturat, and Kingsida,(2020) state that a company's productivity is enhanced when radio frequency identification is used. The ability to monitor the flow of commodities is granted to the business by this. The study's results prove that there is a causal relationship between technological proficiency and improved output.

The ability to track and trace products across the supply chain is an essential part of logistics, and Marijan (2020) said that blockchain technology can enable just that. The study found a correlation between performance and the use of technology. Track and trace technology, according to Bolte and Goll (2020), can improve logistical performance if used properly. Additionally, the study proves that using technology leads to better performance. The applicability of these technologies to many areas of logistics still necessitates additional research.

1.1.1.2 International perspective on supply chain management technologies

A number of studies conducted on a global scale have found that technological adoption is positively correlated with business outcomes. Asuming, Kofi, and Chelbi (2011) state that the company's capacity to monitor counterfeit drugs has been enhanced and monitoring charges have been reduced by 6-7% due to the deployment of RFID technology. According to the study's findings, using the right technologies leads to better logistical performance. The research ignored alternative supply chain management technologies that, when used in tandem with RFID, could yield better results than those achieved alone.

Companies can improve their performance and save money by using auto identification systems (Urban and Darlington, 2011). The results of the study show that using the right technologies can improve an organization's performance. Nevertheless, it failed to take advantage of a combination of technologies to accomplish this task, instead relying just on one. Onyemejor (2015) asserts that the effectiveness of maritime logistics is highly related to the competitiveness of global trade. The research shows a relationship between the use of technology and the results of performance.

Enterprises' use of information and communication technology has allowed for performance improvement, according to Ayantoyinbo (2015). Findings indicate that using technology is associated with better performance. Nevertheless, it fails to establish whether information communication technology is the only factor enhancing performance in freight distribution and instead focuses on a single technology.

Using the Internet of Things has several benefits for businesses, according to Nomasu (2017). These include more efficient operations and easier access to critical data. On top of that, according to Oyebamiji (2018), tracking commodities in transit is made

possible with the help of technology like RFID, GPS, and autonomous vessel location systems. The researchers have proven that there is a link between a company's performance and its usage of technology.

According to Karibo (2019), a company's performance can be improved by better logistics management, leading to faster delivery and increased revenues. A company's performance is directly related to how it uses technology, according to the report. Businesses can improve their overall performance by integrating technology into their logistics management practices.

1.1.1.3 Regional perspective on supply chain management technologies

There have been a number of regional studies that link the use of these technologies to the success of shipping companies. Physically carrying products now takes less time and costs less money because to tracking technologies (Moh'd, 2016). The research also looks at how IT use relates to a company's bottom line.

Reducing shipping and trucking costs, improving trade and organizational logistics efficiency, and assuring timely delivery of goods and services are all significantly impacted by the usage of information systems, according to Mlimbila and Mbamba (2018). There is a connection between performance and the use of technology, as shown by the previous research. In order to boost logistical capabilities, policymakers should push for logistics participants to use information systems.

According to Kyomo (2019), logistics companies can improve their performance by utilizing information communication technology in systems including inventory management, fleet management, logistics integration, and information flow. A link between technological use and improved performance is demonstrated by the research.

He argued that in order to be more efficient, cargo transportation companies should use information and communication technologies.

Aikaruwa (2019) found that information and communication technology improves financial performance, which in turn benefits supply chain management strategies. The results of the study showed that using the right technology was associated with the company's success. Additionally, it recommended that the company make smart use of ICT to reap the most benefits.

1.1.1.4 Local perspective on supply chain management technologies

A number of local investigations have shown a correlation between technology use and efficiency. The benefits of logistical technology developments, according to Gwaro (2011), include more efficient operations, lower costs, happier customers, and, in the end, a competitive advantage for the firm.

Reduced accident rates, improved fleet availability, streamlined fleet operating processes (including refuelling and maintenance), fewer vehicle breakdowns, and drastically lower theft rates were all outcomes of GPS technology's installation and use. Consistent with what Waiyaki (2013) found, these results. A company's total effectiveness is directly correlated with its implementation of supply chain management technology, according to the research findings.

According to Atieno (2014), logistics companies' supply chain effectiveness is directly related to how they employ ICT. There is a link between using technology and improved performance, according to the research. Furthermore, it implies that businesses should use cutting-edge innovation to boost their efficiency. Logistics firms

that handle freight transportation can increase their operational efficiency and effectiveness by implementing IT strategies, according to Ndonye (2014).

According to Lukhoba (2014), tracking technologies are used to keep tabs on and find out where things or shipments are while they're being transported. This research looked at how the right technology choices affected the company's bottom line. Kithia (2015) asserts that logistics organizations' operational efficiency has been positively affected by e-logistics. In addition, this research established a connection between the use of suitable technology and improved performance.

Logistics organizations may boost their productivity, cut costs, shorten delivery times, and increase quality and competitiveness by implementing the right technology (Gacuru and Kabare, 2015). The use of technology and the success of a company are highly correlated. According to Macharia, Iravo, Tirimba and Ombui (2015), logistics organizations can improve their operational efficiency by utilizing technology. Organizations are encouraged to integrate their systems to improve performance, as the research indicates a correlation between technology and performance. Findings from this study highlight the need of more research into logistics service providers' experiences with IT implementation and its benefits.

Businesses' productivity has increased thanks to the widespread use of mobile phone technology. According to Abbas (2016), this is because it can deliver information and communication in a timely manner while transporting freight. According to the study's findings, businesses can boost their performance by adopting new technologies that are directly related to technology usage.

Kabiru (2016),states that the Kenya Revenue Authority (KRA) and the transporters' performance have been positively affected by the adoption of electronic cargo tracking

systems. The research proves that a company's productivity rises in tandem with its tech spending. Still, a better means of communication and a structure for teamwork had to be put in place. Concepts of operational performance are also proposed for integration.

The implementation of the Electronic Cargo Tracking System by the Kenya Revenue Authority has yielded favourable results, as stated by Mugambi (2017). Some of these benefits include shorter border clearance times, lower monitoring expenses, and less cargo diversion into the local market. The correlation between an organization's productivity and its technological implementation is the focus of this research.

The use of electronic customs has a direct bearing on the provision of services. The correlation may be seen in other areas, like systems for electronic customs revenue, risk analysis, and monitoring, which all work together to enhance service delivery (Sakhasia, 2017). The study looks at how a company's performance is related to how it uses technology.

According to Njeru (2017), tracking technologies allow for the rapid and accurate localization of cars and the observation of driver actions. The results of the poll show that logistics companies can improve their productivity by implementing tracking technology. The idea presented above is in line with Gakuubi's (2018) claim that logistics companies' performance is positively affected by the use of ICT.

According to Nyongesa (2018), RECTS was beneficial to transport commodities since it decreased transit time, stopped products from being dumped in the country, and guaranteed a rapid reaction. The study's findings show that technological advancements do impact on business outcomes. In order to meet the demands of tax authorities, it

suggests increasing the procurement of seals and spending more in human resources to better monitor transit products.

The customs product declaration, shipping processes, and pre-clearance authorizations are all positively impacted by the implementation of a single window system, according to Kabui, Gakobo, and Mwaura (2019). The study finds that technology does improve performance, and it suggests that other factors that impact the efficiency of cargo clearance at Mombasa port should be investigated further. Improvements in tax collection and savings for carriers due to less time spent at border posts have resulted from the use of tracking systems (Kilonzi and Kanai, 2020). Improvements in performance are directly correlated with the adoption and efficient utilization of appropriate technology, according to the study.

1.1.2 Shipping Lines Performance

The extent to which an organization has successfully accomplished its objectives and goals determines its performance. Research shows that these companies care most about timely delivery, reducing costs, improving security, providing superior customer service, increasing profitability, and growing their market share. According to Karia and Wong (2013), logistics organizations may boost performance while cutting operational expenses by effectively installing and utilizing the right technologies. Nevertheless, further research is needed to explore the optimal combination of logistical resources for firms to boost their performance.

According to Sadovaya and Thai (2015), shipping companies can improve their security, operational resilience, and customer results by establishing and using a framework for monitoring marine security. According to Munim and Schramm (2018), these companies' performance is significantly correlated with how they use technology.

The performance measures of these organizations have been studied at the regional level. Onyemejor (2015),states that two essential performance indicators are the Logistics Performance Index and the Global Competitive Index. According to Karibo (2019), shipping companies should prioritize on-time deliveries and increased revenues as key performance indicators.

There has been local research on shipping line performance indicators. According to Njagi et al. (2016), strategic management elements are the source of profitability, a key performance indicator in the shipping industry. Logistics companies have benefited greatly from technological improvements, which have allowed them to acquire a competitive edge, increase operational efficiency, decrease business expenses, and improve customer satisfaction. According to Maina (2017), shipping companies' bottom lines are affected by the costs of bunker, charter workers, insurance, and container management. There has to be more research in this area because the current study doesn't determine whether these costs can be cut with technology.

According to Ndonye (2014), the use of information technology is significantly correlated with the efficiency and effectiveness of freight transportation firms' performance. The port's logistical performance and efficiency are affected by the interconnected elements of dwell duration, quay crane, and clearance procedure (Nyema, 2014). According to Gacuru and Kabare (2015), businesses can reap benefits like higher quality, more competitiveness, and streamlined processes by making good use of technology.

According to Macharia et al. (2015), companies may boost their performance with the use of technology because it helps them save time and money. According to Ojwang (2016), shipping lines can improve its performance metrics like feedback, cost, lead

time, and service quality by utilizing technology. With a value of 0.866, the association between IT utilization and organizational effectiveness is very significant.

1.1.3 International Maritime Regulations

Ninety percent of the world's goods are transported by ocean shipping, an essential business. As a UN specialized body, the International Maritime Organization (IMO) is responsible for regulating and developing strategies to reduce ship-related marine pollution and to guarantee the safety and security of international commerce (Kenton, 2020).

According to Mwashigadi (2014), shipping lines' operating efficiency is negatively affected by a number of issues, including an inadequate information and communication technology infrastructure, political interference, bureaucratic procedures, and an inadequate integration of harmonized regulations.

According to Kombo (2018), bolstering coastal security is strongly correlated with marine policy. Maritime planning and the safety of coastal areas impact shipping lines' efficiency. Anna (2018) states that liner ship sales have dropped after the IMO 2020 standard went into effect. No matter how little impact on performance there may be, ships must follow the rules and regulations.

The International Maritime Organization (IMO) 2020 regulation seeks to limit the use of low sulphur marine fuel oil in transportation and mandates that ship owners use alternative fuels to comply. According to Van, Ramirez, Rainey, and Ristovski (2019), the company's expenditure has gone up because of this law. This already complicated web of relationships is further complicated by the International Maritime

Organization's (IMO) rulemaking process, which all shipping lines are required to follow.

Human risk variables affect marine pilotage operations, according to Oraith (2020). The International Maritime Organization has passed regulations requiring shipping companies to reduce human error, which has a negative impact on their efficiency. According to Njiru's (2020) research, the blue economy relies on the safety of marine ecosystems and the resources they contain. Shipping businesses are obligated to prioritize maritime security and must adhere to the laws set forth by the International Maritime Organization (IMO). Their day-to-day operations are greatly affected by this.

Inspections on shipping lines at ports to ensure they follow international marine standards cause extra delays in the logistics chain, according to Brewer (2021). Shipping lines are subject to port inspections, which add time and money to the cost of transporting products because of longer lead times.

1.2 Statement of the Problem

The country's economy is greatly influenced by shipping businesses because they facilitate worldwide trade. The majority of the amount of international trade is accounted for by maritime transport, as stated in the 2020 UNCTAD maritime transport study. So, we need to figure out how to make them work better. According to the data collection survey on blue economy in the republic of Kenya (2018), one strategy that was suggested during the 2018 blue economy conference in Kenya was the use of suitable technology. Kabiru (2016) asserts that logistics service providers' operational performance is positively affected by the use of supply chain management technologies. These technologies enhance the productivity and efficacy of these organizations, according to Lukhoba (2014) and Mugambi (2017).

Although this has great potential, operational inefficiencies have prevented Kenyan shipping lines from realizing it just yet. There are a lot of obstacles to logistical efficiency in the Kenyan shipping business right now. Customs clearance delays, delivery delays, insufficient tracking and tracing systems, transportation charges, and further delivery delays are all examples of these difficulties. Both the 2016 report from the Kenya Shippers Association and the 2019 final report from the Kenya Competition Authority detail these results. Nairobi came up at number 68 on the worldwide maritime performance index for 2018 (2.8 out of 5), as reported by the World Bank. Compared to top-performing nations like Finland and Germany, which have scores over 4.0, this one is far lower. International trade is impeded by logistical inefficiency, which poses an economic risk to those involved in maritime logistics, as well as importers and exporters.

Studies by Atieno (2014) and Cheptora, Osoro, and Musau (2018) provide credence to the idea that a company's performance can be greatly improved by the efficient application and usage of technology. Njeru (2017), Pham (2018), Marijan (2020), Kyomo (2019), and Kabui et al. (2019) all performed investigations. The use of technology has a positive impact on transportation companies' efficiency, according to all data. Nevertheless, the methods used in this study differ from those of the aforementioned researchers, who have narrowed their focus to a single technology. Few people have thought about how shipping companies might benefit from combining different approaches and supply chain management tools. The research aimed to investigate the relationship between these technologies and shipping companies' performance based on this understanding. The goal was to achieve outcomes like reduced costs, on-time delivery, excellent customer service, increased market share, and greater profitability. The research also endeavoured to assess association between

these technologies and performance of shipping lines as moderated by international maritime regulations. This would provide a solution to the ailing shipping lines logistics sub-sector.

1.3 Objectives of the study

The objectives that guided the study were the following

1.3.1 General objective of the study

The general objective of the study was to examine the relationship between supply chain management technologies and performance of shipping lines in Kenya as moderated by international maritime regulations.

1.3.2 Specific objectives

i. To examine the relationship between localization technologies and performance of shipping line in Kenya
ii. To examine the relationship between Sensor technologies and performance of shipping lines in Kenya
iii. To examine the relationship between Communication technologies and performance of shipping lines in Kenya
iv. To examine the relationship between Identification technologies and performance of shipping lines in Kenya
v. To examine the moderating effect of international maritime regulations on the relationship between supply chain management technologies and performance of shipping lines in Kenya.
    a. To examine the moderating effect of international maritime regulations on the relationship between Localization technologies and performance of shipping lines in Kenya.

b. To examine the moderating effect of international maritime regulations on the relationship between Sensor technologies and performance of shipping lines in Kenya.
c. To examine the moderating effect of international maritime regulations on the relationship between communication technologies and performance of shipping lines in Kenya.
d. To examine the moderating effect of international maritime regulations on the relationship between Identification technologies and performance of shipping lines in Kenya.

1.4 Research hypotheses

H_{01} There is no statistically significant relationship between localization technologies and performance of shipping lines in Kenya.

H_{02} There is no statistically significant relationship between sensor technologies and performance of shipping lines in Kenya.

H_{03} There is no statistically significant relationship between communication technologies and performance of shipping lines in Kenya.

H_{04} There is no statistically significant relationship between identification technologies and performance of shipping lines in Kenya.

H_{05} International maritime regulations have no statistically significant moderating effect on the relationship between supply chain management technologies and performance of shipping lines in Kenya.

$H_0$5a Relationship between localization technologies and shipping lines performance are not statistically significantly moderated by these regulations.

$H_0$5b Relationship between sensor technologies and performance of shipping lines are statistically significantly moderated by the said regulations.

$H_0$5c Relationship between communication technologies and performance of shipping lines is not statistically significantly moderated by these regulations

$H_0$5d Relationship between identification technologies and performance of shipping lines is not statistically significantly moderated by international maritime regulations.

1.5 Significance of the study

Shipping line managers will greatly benefit from the research findings since they address the vital aspects of logistics competitiveness and sustainability. The research findings will also help managers understand the various challenges faced by companies in Kenya's maritime logistics industry and provide solutions that work for them. Second, as they seek to maximize profits while retaining customers and reducing operational expenses, investors will also benefit from the findings. In addition, the recommendations given will provide policymakers with vital information that will help them formulate regulations that would allow this firm to expand.

Researchers will also find the results useful because they add to the growing amount of literature on logistics and supply chain management technologies, especially as it pertains to shipping line performance. Future scholars, especially those in Kenya, would do well to review the results of this research to fill the gap in our understanding of shipping line performance in developing countries.

1.6 Scope of the study

The focus was 53 shipping lines in Kenya business directory 2021. The research was conducted in Mombasa and Nairobi region since these are the places where the shipping lines that call at the port of Mombasa are located. The study was limited to

determining the influence of these technologies on performance of shipping lines' and the international maritime regulations moderating effect. The research study was further limited to specific objectives which are: to examine the relationship between Localization technologies, Sensor technologies, communication technologies and identification technologies and shipping lines performance in Kenya. Research also sought to determine the moderating effect of these regulations on the association between the independent and dependent variable. The research data was gathered by use of questionnaire that were administered to respondents from various departments of these firms namely; logistics, IT, sales and marketing and finance. The study was conducted in a period of three months stating from October- December 2022.

1.7 Limitations of the study

The organization's policy on confidentiality mainly limited respondents from answering the question due to the fear of exposing organizational confidential matters. However the researcher enabled respondents to overcome their fear by ensuring them that the answers were purely being utilized for academic purpose.

The respondents may not have been sincere when filling the questionnaire; this limitation was addressed by encouraging the respondents to be as honest as possible in their responses. The items of the questionnaire were set using simple language that can be easily understood by all the respondents.

1.8 Assumptions of the study

This study made three assumptions. The first assumption was that the respondents would answer the questionnaire honestly and factually. Since it would have taken time and effort to validate answers of each respondent the researcher assumed that the responses are honest. The second assumption was that the study respondents were conversant with the phenomenon being investigated or rather their firms were already

engaged in these practices. Third it was assumed that the firms are already using supply chain management technologies (localization, sensor, communication and identification technologies).

1.9 Operational definition of terms

Communication technologies -refer to technologies used in relying and delivering of the required information in the course of transportation.

Identification technologies- technology used to given verification of goods being transported such their nature and origin

International maritime regulations –refers to rules drafted and instilled by international maritime organization in for of conventions to facilitate maritime trade

Localization technologies - refer to technologies that to show position the of goods in During transit

Shipping lines' performance – a range of key performance indicators that show the degree to which a firm has achieved its objectives in terms of cost, time, profitability and customer satisfaction

Sensor technologies -are technologies that measure automatically environmental conditions that may affect the state of the goods bein transported

Supply chain management technologies- refer to a range of technologies that is used in enabling efficient performance of supply chain activities

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Review

According to Defee *et al*. (2009), theorizing helps direct research by establishing what variables to include in the study and how to draw conclusions from the data. This section laid the theoretical groundwork for the research by incorporating the technological acceptance model, the theory of task technology fit, and the theory of institutionalization.

The Technology Acceptance Model was the main tool used in the study, with additional support from the Task-Technology Fit Theory and the Institutional Theory. The goal of the task technology fit theory is to help in the process of selecting suitable technologies for implementation according to the tasks that will be supported by them. Not every technological advancement is a good fit for a company, according to this argument. The TAM is supported by institutional theory because shipping lines have adopted supply chain management technologies. This adoption is driven by the need to comply with industry laws and to maintain competitiveness.

2.1.1 Technology Acceptance Model

The other two concepts built upon this fundamental framework, which laid the groundwork for the research. It was postulated that shipping lines' performance could be affected by the use of location, sensor, communication, and identity technology. The Technology Acceptance Model (TAM), an updated version of Fred Davis's Theory of Reasoned Action, was first presented in 1986. According to Davis (1989), there are a number of elements that determine whether or not people would embrace new

technological innovations. One such model is the Technology Acceptability Model (TAM).

Perceived utility and simplicity of use are the two main components of the Technology Acceptance Model (TAM). According to Davis (1989), the term "perceived ease of use" refers to how confident people are that the technology they plan to utilize will be simple to operate. A technology's perceived utility is the extent to which a prospective user thinks it will enhance their ability to do a certain activity. Because the first TAM proved inadequate, Venkatesh and Davis (2000) proposed TAM2. Normativity, voluntariness, and the representation of social systems are all incorporated into TAM2. When trying to predict whether a worker will accept or reject a new piece of technology, these considerations are crucial (Venkatesh & Davis 2000). The study made use of these three features of this paradigm. Venkatesh and Bala (2008) proposed TAM3 as a solution to TAM2's shortcomings. Several factors were considered and integrated throughout the development of TAM3. These factors included human differences, system characteristics, social influence, and enabling environments. You can use these criteria to forecast how easy the system is to use and how beneficial people think it is. The likelihood that an employee will accept and make use of a given piece of technology is affected by these behavioural intents. Perceived usefulness and simplicity of use were two of the factors used in this study.

Logistics and procurement researchers have made heavy use of the Technology Acceptance Model. This idea was fundamental to the study of e-procurement adoption in a developing nation that was underdeveloped by Aboelmaged (2010). To better understand how employees are embracing e-procurement, Anshadh and Mahesh (2014) used this theory in their study of the updated Technology Adoption Model (TAM).

When studying how Indian businesses' organizational buyers felt about e-procurement services, Ramkumar and Jenamani (2015) used the technology acceptance model. As part of his study, Brandon (2018) examined the elements that impact the adoption of electronic procurement using the Technology Acceptance Model (TAM). Research conducted by Nyongesa (2018) utilized the Technology Acceptance Model (TAM) to examine the impacts of electronic cargo monitoring systems on the administration of shipping commodities.

According to the technological acceptance model, the main factors that determine the extent to which external factors affect the adoption and usage of a technology are its perceived usefulness and simplicity of use. The directives given to workers by upper management might influence how a company uses technology. The personnel must adhere to the stipulated regulations in such a situation.

A number of academics have voiced their disapproval of TAM. Bashange (2015) looked at how risk-aware Tanzanians who use mobile banking are. Instead of using TAM to uncover the elements that determine behaviour, she claims that most research views it as a dependent variable. The Technology Acceptance Model (TAM) was shown to ignore demographic variables including age and level of education in a 2013 study by Zahid et al. (2013) that examined the use of ICT by people with disabilities in Bangladesh. The openness and comfort level with utilizing technology to accomplish particular jobs might be affected by these elements. Research on TAM's shortcomings and critiques was carried out by Ajibade (2018). He claims that TAM doesn't take user behavior variables seriously enough, especially when it comes to subjective assessment approaches like gauging interpersonal influence and behavioral intention.

This study used the Technology Acceptance Model (TAM) to justify the use of technical solutions to improve shipping lines' performance. The shipping companies' supply chain management techniques include the use of localization, sensor, communication, and identification technology. The shipping companies are eager to adopt and employ these technologies because they are easy to use and will help them improve their operational efficiency.

2.1.2 Task Technology Fit Theory

Good Hue and Thompson developed the theory in 1995. Assuming the capabilities of the technology are suitable for the user's tasks, Irick (2008) and Furneaux (2012) state that employees' performance can be enhanced by the use of new technology. Timeliness of production, system dependability, user interactions, training easiness, permission, compatibility, and locatability are the eight components that make up the Good enough and Thompson (1995) theory's measurement. The researchers discovered that users' assessments of enhanced job performance and effectiveness as a result of using the system under study are significantly influenced by the combination of task technology fit measure and usage.

Use of this idea has helped a number of specialists shed light on why some companies embrace new technologies while others completely ignore them. The purpose of the study by Hsiao (2018) was to provide a theoretical basis for understanding how people interact with devices that rely on technology. The impact of transportation management systems on the efficiency of Kenyan third-party logistics providers' operations was the subject of research by Adisa (2017).

If technology is to improve an individual's performance, the idea goes, it has to be tailored to the specific job at hand. Those who subscribe to the notion hold that

technology can enhance performance so long as its features are congruent with the requirements of the activity at hand (Goodhue and Thompson, 1995).

The concept has its detractors and limitations since it recognizes that people could be forced to use a certain technology for a job rather than their own free will (Irick, 2008). In some cases, a user may feel compelled to use a system because they have no other choice. Use of a system, however, is no assurance of improved performance. The work of Irick (2008) is referenced. It is recommended to use the theory in combination with other theories, according to Goodhue and Thompson (1995).

In an effort to boost shipping businesses' efficiency, this study used theoretical concepts to explain why they choose specific technologies. It is critical to deploy technology that is in sync with the specific tasks carried out by different employees in order to eradicate inefficiencies and increase efficiency. When users' needs and the capabilities of supply chain management technologies are in sync, or at least compatible, logistic enterprises can boost their performance. To support the Technology Acceptance Model (TAM), this hypothesis states that if a technology isn't compatible with an employee's job duties, then they won't be willing to adopt it. The employee adopts and makes use of the technology if it is considered suitable, and the opposite is also true.

2.1.3 Institutional Theory

Shipping businesses have been using technology to stay competitive for a long time. This idea lends credence to the Technology Acceptance Model (TAM) by positing that, in the face of intense competition, transportation corporations will relentlessly adopt new technologies.

Institutional theory has been employed by a number of scholars. Using this idea as a foundation, Liu's (2015) research examined how IT innovations affected business

growth. Using data collected by the Kenya Revenue Authority and carriers, Kabiru (2016) analyzed how ETSs affected efficiency. In order to learn how electronic cargo monitoring systems affect Kenya-Uganda cross-border trade, Mugambi (2017) conducted research. The effect of tracking technologies on East African trade bloc members' ability to collect more money was studied by Kilonzi and Kanai (2020).

An entity's organizational structure becomes more homogeneous as a result of organizational pressures, as stated by DiMaggio and Powell (1991). According to Tolbert (2008), there are three types of pressure that businesses face when running their operations. One of these is coercive pressure from stakeholders and partner organizations. There are two sources of mimetic pressure that come from other successful groups. Unions and other groups representing workers in the workforce are a common source of normative pressure.

Because of its fundamental connection to power and interest, Marx and Weber argue that this notion is essentially flawed. Rather than depending on institutionalized institutions, Zucker (1996) argued that it is more useful to build direct measures of organizations in his empirical study on organizations. Mezias (1990) and Scarseltetta (1994) argue that when the power of the opposition grows, the level of institutionalization declines, which might have the opposite effect on the social standing of opposing forces. In addition, they argue that the size of the organization, the number of advocates, and the cost of investment are further elements that influence institutionalization.

These companies' selection of particular supply chain management systems can be better understood in light of this philosophy, which advocates for compliance with shipping industry norms and laws as well as their mandatory operational requirements.

In order to be competitive in the market and avoid penalties for non-compliance, they make sure to follow the established standards and regulations set by the regulatory authorities.

2.2 Empirical Literature Review

This section reviewed literature from previous scholars on the relationship between localization technologies, sensor technologies, communication technologies, identification technologies and performance of shipping lines in Kenya.

2.2.1 Localization Technologies

Technologies such as GSM, GPS, and TTS are all categorized as localization technologies. Their responsibilities include eliminating delays, identifying the location or status of a shipment during delivery, checking for route deviations, providing an accurate lead time estimate, tracking vessels, and mapping the route (Musa *et al*., 2017; Mucaendepe, 2018; Bolte and Goll, 2020). Furthermore, they must chart the course. The possibility of theft, delay, or loss is one of several dangers that the cargo faces throughout its voyage. An important step toward meeting the growing demands of logistics and the supply chain is the creation and use of localization technology. According to the results of this study, localization technology can assist in tackling these problems if used effectively.

Using localization technology to optimize logistics operations was studied by Michaelides, Michaelides, and Nicolaou (2010). Technological advancements in logistics optimization and localization were among the factors investigated in this study. The purpose of this research was to examine logistics operations in the UK with the aim of developing a tracking system that makes use of localization technology. Case studies and qualitative research approaches were both utilized in this work.

Information was gathered entirely through on-site interviews and observations. Managers of shipping lines, haulage businesses, container terminals, port officials, and other related professions filled out the survey. Furthermore, additional people were asked to fill out the survey. Investigating this further revealed that this technology greatly enhanced the efficiency of the logistical operations once put into place. The researchers concluded that this technology alone can help achieve performance in logistics operations after conducting the necessary investigation. In addition, its methodology and data collection techniques set it apart from competing solutions.

Musa, Azmi, Shibghatullah, Asmala, and Abas (2017) conducted research in which logistics service providers' use of GPS was the primary emphasis. An extensive report detailed the results of this investigation. This research looked at the Global Positioning System (GPS), breaking it down into its many parts and highlighting the advantages it provides logistical service providers. I did my best to assess the features of logistics service providers during my research in Malaysia. As a direct consequence of implementing these systems, several traits emerged, including reduced costs, increased safety and security, and satisfied customers. This study employed a descriptive research strategy and drew from a pool of 450 randomly selected participants. All of the information was culled from surveys, and inferential and descriptive statistics were used to analyze the results. The research found that customer happiness was the most important factor that encouraged logistics service providers to deploy GPS. The standard deviation for this variable was .674. The next two categories, safety and security (SD=.652) and cost reduction (SD=0.575), followed by that. Impressively, both of these groups did very well. According to the study's results, logistics service providers' traits significantly impact the usage of GPS navigation devices. The study

found that logistics service providers would profit from using GPS and recommended that they implement the technology.

Bolte and Goll (2020) investigated the methods and tools used to monitor shipments heading out of the country. Finding out what methods and trends are currently being used for outbound logistics track and trace was one of the goals of the Swedish study project. Two, we examine what Swedish retailers need to know to use tracing and tracking technologies into their outbound logistics processes. Explore potential applications of tracking and tracing technologies for Swedish merchants' outbound activities. The procedure continues with this third stage. All through the study, a qualitative research strategy was employed, and an exploratory research design was adopted. In order to analyze the collected data, grounded analysis was employed. Research showed that logistics department performance may be improved with the help of efficient and effective trace and track technology. Using this information, a conclusion was reached following the result. The study's results suggest that additional research into this field is needed to determine the technologies' applicability to other areas of logistics.

Research aimed primarily at assessing the impact of tracking and monitoring technologies on international logistics and supply chains (Shamsuzzoha, Ehrs, Addo-Tenkorang, and Helo, 2021). Global supply chain tracking and tracing systems and the advantages these systems offer to logistics service providers were the variables studied in this study. The purpose of the study was to examine these factors. The purpose of this Finnish study was to evaluate the technical capacities linked to the use of tracking and tracing systems in logistics and supply chain operations. The investigation took place in Finland. The investigation made extensive use of systems theory. The researcher used secondary sources and the descriptive research approach from the start

of the investigation to get the essential material. The study's results proved that companies might gain accurate and quick visibility into their logistical operations by using tracking and tracing systems. The approach taken during the investigation is different from the current one, and the report says nothing about what kind of tracking device was used throughout the probe.

Muchaendepi *et al*. (2018) examined the use of transport intelligence systems and their impact on the effectiveness of road freight transportation. The study's results show that the variables that were investigated were the transport intelligence system and organizational performance. The African country of Zimbabwe was the site of the research. It was determined that transport intelligence systems significantly impact the efficiency of road freight transportation. The idea of social systems provided the theoretical foundation for this study, which employed a survey research approach. Participation in the research was voluntary and received responses from 44 people. Using intelligent transportation systems improved the efficiency of freight operations on private highways, according to the study's results. Theory, methodology, and sample size are just a few areas where this study differs significantly from the one currently underway.

Oyebamiji (2018) set out to answer the question, "How can logistics companies in Nigeria use localization technology to boost their performance?" by surveying the industry. Technological innovations and their effects on logistics organizations and the companies that rely on them were the focus of this study. Aiming to meet one of four objectives, the study set out to examine the technologies used by logistics companies in Lagos. The second objective was to find out how logistics companies in Lagos fared with their security and cargo tracking systems. Three separate approaches can be used to study how logistics companies in Lagos have adapted to the rise of IT in terms of

customer care. Conducting studies on the effects of IT deployment on logistics businesses' efficacy in Lagos, Nigeria, is crucial. Making data collection and analysis more manageable was the goal of implementing the descriptive survey approach in the study project. A total of 80 individuals were asked to participate in the research by providing answers. These specific individuals were chosen for involvement from among the 10 logistics companies that were a part of the investigation. We used surveys to gather the data, and then we analyzed it with descriptive and inferential statistics. Logistics organizations' performance was significantly affected by the use of security and tracking systems, as indicated by a coefficient of 0.63. This came to light as a result of the inquiry. According to the results, it is possible to monitor and track goods in transit with the use of technologies like radio frequency identification, global positioning systems, and autonomous vehicle placement. This discovery is noteworthy. Although just a small percentage of logistics organizations regularly use these technologies, the research study demonstrated that they can increase overall company performance. The study's findings suggest that logistics companies should implement these technologies to maximize service quality and efficiency. In order to promote the adoption of these technologies by businesses, the government must create favourable conditions for their implementation. Methodologically, the present study differs from the prior one, which used a descriptive study design and was conducted in a developing country.

Specifically, Jonker (2016) looked into what happens to the supply chain when tracking technologies are implemented. The study's results indicate that tracking systems and their impact on organizational performance were the factors specifically examined. The study sought, among other things, to determine whether a logistical organization might achieve more efficiency through the use of tracking technologies; it was conducted in

South Africa. The second objective was to investigate the possibility that these technologies could improve the quality of service provided to clients. In addition to the survey questionnaire for primary data collection, a literature study was employed to get secondary data. Employees at Ferrochrome were the ones who filled out the survey, which was selected using a non-probability sampling method. The respondents chose and decided upon the total number of participants. After looking over the collected data, the researchers found that logistical operations are far more efficient after tracking systems are put in place. While the analysis was underway, this was proven. The theoretical underpinnings, data collection techniques, and sampling mechanism design of this study set it apart from its predecessors.

The effects of using localization technology in the maritime transportation sector were examined in a study by Tesfaye (2014). The purpose of the research was to examine the outcomes of this kind of use. Localization technology and cargo handling were the variables examined in this study within the framework of the maritime transportation sector. All of the experimental work took place in Ethiopia. Finding out how much of an impact localization technology has on maritime sector efficiency was the driving force for this survey. This study used both quantitative and qualitative methods to examine a topic related to the theory of systems. We utilized both interview schedules and questionnaires to collect the necessary data for the study. A total of fifty-six people provided answers inside the survey. The study used a propensity score matching design to achieve its objectives. The study found that organizations were able to boost their profitability, cut their expenditures, and shorten their delivery times by utilizing these positioning technologies.

In a related study, Lukhoba (2014) assessed how a corporation could gain a competitive edge by implementing cargo tracking. Tracking systems and the benefits received by

logistics service providers were the primary variables examined in the research. The primary goal of the research was to examine the difficulties often linked with utilizing DHL as a competitive approach for service delivery. In order to gain a competitive edge in service delivery, this study set out to examine the beneficial results that result from deploying cargo monitoring. The primary objective of the research was to learn more about DHL's cargo tracking system. The study's foundation was the resource-based idea, which posits that a business's operating environment is dynamic and ever-evolving. The research that was conducted was based on this premise. The study's major goal was to conduct an in-depth analysis, not to provide a general review of the findings, hence a qualitative research approach was used. Beyond this, it drew from variety of primary and secondary sources to compile all of the essential data. The research included a number of firms and individuals, including the chief executive officer, gateway managers, supervisors, regional operations officers, and the hub manager. Qualitative research approaches were utilized to evaluate the study material obtained through interviews. The research showed that shipments or commodities can be more easily located and identified with the use of tracking systems. This holds true irrespective of the nature of the shipment. It was determined that DHL's cargo tracking system can offer the corporation a leg up in terms of customer care compared to its rivals. Given the study's conclusions, the business should get liability insurance to protect its customer service operations. Due to the research's reliance on a case study of DHL, it is highly unlikely that the results can be applied to smaller logistics companies in general. This means that the results won't be applicable to other businesses in a broad sense. In terms of methodology and working hypothesis, the ongoing study differs from the one that was previously conducted.

The effectiveness of KRA and logistics businesses was assessed by Kabiru (2016) in relation to the electronic shipment tracking system. This study's findings were consistent with those of the studies mentioned previously. This study aimed to evaluate freight tracking technologies and their effects on improving administrative efficiency. The effects of these systems were the primary emphasis of the research. An exhaustive evaluation of the extent to which KRA and transporters have put these methods into effect was the objective of this investigation. By combining the results of the two methods, we can identify all the variables that influence how transporters and KRA employ these systems. Doing this will not be difficult at all. There are three separate approaches that can be used to evaluate the challenges that were experienced throughout the deployment of these cargo tracking systems. The theories of limits and institutional theory served as inspiration for this project, which applied an exploratory research approach. A total of 450 organization officials made up the target demographic, and 150 respondents were selected from that population to participate in the research. Analyses of the data collected from the inquiry made use of descriptive statistical approaches. In addition to displaying the data in a tabular fashion, these statistics also comprised percentages and the standard deviation. According to the results, everyone involved was able to work more efficiently after the system was put into place. The results allowed for this conclusion to be drawn. It was determined, based on the study's findings, that stakeholders must have a thorough understanding of the benefits they expect to get and well-defined system expectations in order to ensure the system's successful implementation. The successful implementation of the system depended on this. According to the study's suggestions, establishing a means of communication and a structure for collaborative project management is crucial. As an extra suggestion, it also recommends implementing concepts related to operational

performance. Furthermore, no details about supplementary factors used in conjunction with tracking technology to boost performance are provided by the study. Both the hypothesis and the research methodology used in this study are distinct from those in the one that is now underway.

Njeru (2017) looked into the possibility of developing a model for ship tracking. According to the results, this makes sense. Validating the proposed vehicle tracking model, identifying the difficulties transport managers encounter when tracking vessels, creating a model for corporate vessel tracking, and evaluating various appropriate models and architectures were all essential to the project's success. There was a combination of qualitative and quantitative methods used all through the study. At the end of the day, 341 people filled out the survey. After conducting additional research, it was discovered that the model, once implemented, can accurately detect and follow vehicles, as well as promptly track drivers' actions. After reviewing the inquiry's findings, it was determined that the developed model effectively tracked both vehicles and driver behavior. The National Transportation Safety Administration (NTSA) or another similar transportation regulatory agency was suggested as the ideal recipient of the concept. Having tracking capabilities is crucial for logistics businesses to efficiently carry out their tasks. The study only examined one kind of transportation, and its approach differs from the one now underway.

Kilonzi and Kanai (2020) sought to quantify the impact of tracking technology on logistical service providers and the potential for such technologies to enhance East Africa Trade Block member countries' tax collection. The investigation included tracking systems and the advantages they offered users as one of its features. This study set out to do just that—evaluate how three different tax losses affected revenue collection, operational performance, and revenue realization—as well as how those

losses affected the costs associated with revenue collection. Finding out how these three parameters relate to one another was the primary goal of the research. The theoretical underpinnings of this analysis came from the fields of transaction cost and institutional theory. The study employed an explanatory research approach to determine the sort of relationship that existed between the two variables. A grand total of 278 willing participants filled out the pool. This group comprised entry-level workers, middle managers, and upper-level executives, in that order. An analysis of the study's data was carried out using both inferential and descriptive statistics. Payment collection and expense reduction for logistics service providers were both improved by the introduction of tracking technologies. The main cause of this event was the reduction in the amount of time people spent at border crossings. Findings from the research indicate that these technologies have not been effective in lowering the time required for cargo clearance, the cost of staffing, or the number of items still lost in transit. Findings from the study suggest that East African nations should have a unified strategy on the use of ICTs at international borders. A lot of things, such the assumptions and research methods used, separate this study from the one that is currently underway.

2.2.2 Sensor Technologies

There are a variety of sensor technologies available at the moment, including Nano sensors, wireless sensor networks, and the internet of things. Skorna *et al*.(2011) states that these systems may capture data at predetermined intervals while monitoring a broad range of environmental characteristics in shipping containers and vessels. These parameters include temperature, humidity, shocks, and gases. This class includes, among other things, temperature and humidity. The authors Diallo and Sene (2012) argued in their paper that sensor data should fairly represent the environment as it is

right now. This is to make sure that if the commodities in transit are ever in danger, we can all pull together to deal with it. Furthermore, sensor technology has the potential to aid in preventing cargo tampering, notifying of cargo diversion, detecting defects in goods, improving transportation of ecologically sensitive items, and detecting counterfeit goods, among other uses. According to the findings of the following studies, sensor technologies significantly affect logistics performance.

The goal of the study by Weiss, Skorna, and Bode (2011) was to identify potential ways to reduce logistics-related risk and loss through the use of sensor technologies. Finding a way to achieve this was the driving force behind the investigation. The influence of sensor technology on the supply chain and the technology itself were two of many factors. The study set out to accomplish two goals during its American fieldwork. Firstly, it aimed to tally all the claims filed by transportation companies due to losses and risks that happened within a given time frame. Second, we wanted to know how many claims were submitted in total. The second purpose was to provide a framework that transportation businesses might use to their advantage when using sensor technology to avoid losses and risks. Claims made throughout the designated time period made up the sample size of 7284 for the research study, which used the purposive literature review approach. After reviewing the collected data using variance analysis, it was determined that using sensor technologies can help reduce supply chain risk and loss. This was made clear by analyzing the data. This is because these technologies may update you on the whereabouts of items while you're transporting them. This is due to the fact that these technologies enable the automated measurement of numerous factors, including humidity, temperature, pressure, chemical composition, acceleration, and chemical composition. This is the rationale behind the situation. The end result is that these technological advancements let us monitor the status of

shipments in progress, enabling timely remedial measures to be implemented. Logistics companies rely on this to a disproportionate degree because it ensures that their clients' products will arrive in perfect shape. Businesses should use technology-enabled risk management strategies to lessen the likelihood of loss and damage occurring during cargo transit, according to the study's conclusions. The study's setting in a rich country raises concerns that it could serve as a template for less developed nations. Maritime logistics, and shipping lines in particular, have been the subject of the present investigation. Although it covers a lot of ground, this study is primarily concerned with maritime logistics.

Himanka (2016) asserts that he has contributed to the progress of research in the logistics business by investigating the applications of Internet of Things devices. The benefits of utilizing logistics and the Internet of Things were the variables investigated in this study. The study set out to assess potential applications of Internet of Things devices in the logistics industry and was carried out in Finland. The inquiry was conducted using a case study methodology, with DHL designated as the unit of analysis. Researchers concluded that internet-connected equipment, such wireless sensor networks, can help keep an eye on the cargo's humidity, temperature, light, and shock levels while it's in transit based on the study's findings. Distributing this information to the appropriate individuals and organizations is the next step in the logistics process. Based on the research findings, logistical service providers can gain an advantage by utilizing IoT-connected equipment. According to the study's results, logistics service providers should establish standards for internet of things devices.

Based on their research, Hiekata, Wanaka, Mitsuyuki, and Ueno (2020) determined how the marine sector makes use of sensor technologies and the internet of things (IoT). Key topics of focus for this inquiry included sensor technology's properties and

its effects on the maritime industry. Japanese authorities oversaw the probe. Improving the use of internet-of-things-connected technology in marine transportation supply chain management was the driving force behind the research. A case study methodology was employed due to the nature of the research endeavour. Details pertaining to the marine sector and the internet of things were the major emphasis of the study. The goal of considering the simulation method was to identify the type of relationship between the two variables. Based on the study's findings, the maritime industry may greatly benefit from using IoT solutions, especially in the areas of ship damage control and overall profitability. This study differs from the current one in terms of the research approach and the scope of the geographical examination.

A study on the evolution of sensor technology in the maritime industry was conducted by Shaikh, Kamble, and Siddharath (2021). Aspects of operational performance and sensing technologies were the focus of the investigation. The study set out to examine the effects of sensor development on the shipping industry and the difficulties encountered while implementing this technology; it was carried out in Mumbai. The method used in the research was a comprehensive literature review. According to the study's results, the marine industry can benefit from using this technology to stay competitive. The second perk is that the shipping industry's efficiency and safety will also improve with the help of sensor technology. Comparing the two studies, it is clear that the second one used a different methodology.

Kuma,(2015) states that in order to enhance national security, a research was undertaken to examine how the marine industry could implement vessel traffic management systems. The research set out to examine how these systems were put to use. This study's variables included traffic management and its effects on marine companies. The research set out to determine how these systems contributed to better

marine security. The research was conducted at a location in Ghana. A variety of agents representing Ghanaian maritime stakeholders were surveyed using a qualitative research approach to compile primary data for this study's purpose. In addition to the international maritime authority, secondary data could also be obtained from the Ghana maritime authority. There is a statistically significant association between these systems' utilization and improved performance due to increased marine security, according to the study's findings. In contrast to the present study's emphasis on four critical categories of supply chain management technologies, the aforementioned research only looked at one type of technological innovation. Furthermore, the study's methodology sets it apart from its contemporaries.

The effect of digital technology on marine operations management was the focus of a study by Agrifoglio, Cannavale, Laurenza, and Metallo (2017). Technology and its effects on maritime operations were the key factors throughout the investigation. This study's setting was Italy. The purpose of the research was to examine how changes in digital technology have affected the administration of operations in the marine sector. Data was collected from participants using a questionnaire, and the research was conducted using the case study approach. Based on the study's findings, digital technology improves maritime operations administration. Methodologically and by focusing on digital technology more generally rather than on particular supply chain management systems, this study differs from the prior one.

Khan and Adediji (2017) sought to assess the efficacy of radar systems in controlling Congo River shipping lanes. The aforementioned study was comparable to this one. The radar system and its effects on marine traffic management were the primary foci of the investigation. The research mainly concentrated on these two factors. The purpose of this research was to ascertain the impact of radar systems on maritime traffic

management. Surveys were distributed to the relevant agency in charge of maritime personnel in order to collect primary data for the study. In order to augment the original data, relevant departments also provided supplementary data. As part of the procedure for evaluating the data, analysis of variance was utilized. The study found that these technology techniques greatly reduced the possibility of human error, which ultimately had a positive impact on marine traffic administration. This effect was substantial and could have positive outcomes. What distinguishes these studies from their predecessors is their reliance on secondary data and their singular focus on the radar system as a means of controlling maritime traffic.

In 2016, Ngumbi set out to build a model that would let the police department monitor and trace the vehicles they use. The study's principal objective was to assess how industry-wide performance is correlated with vehicle monitoring systems. Kenya served as the setting for the study activity. A solid grounding in the idea of task-fit technology was necessary for the research endeavour to take off. This study used an explanatory research strategy as its primary methodology. In all, 57 people participated in the excursion that made up the research sample. Analysis of the data collected from the questionnaires made use of descriptive and inferential statistical approaches. According to the study's results, the built model could detect and record the locations where police cars refuelled, as well as their overall usage. In terms of theoretical stance and sample size, there is a difference between the ongoing study and the one that is about to be conducted.

Research by Mugambi (2017) sought to ascertain the impact of sensor technology on cross-border business transactions between Kenya and Uganda. Electronic sensor systems and their impact on cross-border shipping were among the criteria studied in this study. The study was founded on the tenets of transaction cost theory as well as the

ideas of institutional theory. In order to derive findings about the links, the research looked at the structure of questions using an exploratory research design approach. Making inferences on the relationships was the driving force for the study. Government officials from both the headquarters and the border made up the thirty-person sample that participated in the study. The data that was collected was analyzed using descriptive and inferential statistical methodologies and approaches. According to the study's findings, the Kenya Revenue Authority's choice to implement an electronic cargo monitoring system has resulted in numerous beneficial consequences. This category includes, among other things, steps to reduce the time and effort needed to clear cargo at the border, the expense of monitoring cargo, and the likelihood of commodities being diverted into the local market. According to the study's conclusions, there was a positive impact on product transportation across the border between Kenya and Uganda when an electronic cargo tracking system was implemented. Conditions determine whether the results are acceptable for use in logistics procedures or not. In many respects, including the hypotheses being explored and the research methodology employed, the current study differs from this one.

Sakhasia (2017) attempted to ascertain the effect of computerized customs management on service supply by conducting the aforementioned investigation. The study's primary objective was to examine the effects of electronic technologies on service delivery. The study's overarching goal was to determine how the KRA Eldoret station's service quality will change in response to the implementation of an electronic customs clearing system. Eldoret, a city in Kenya, was the site of the investigation. To examine how the computerized customs revenue system has affected service delivery at the KRA Eldoret station, two approaches might be taken. When it comes to investigating how the e-customs risk analysis system has affected service delivery, the KRA Eldoret station

offers three separate approaches. The study's overarching goal was to assess how the KRA Eldoret station's service quality would change in response to the installation of an electronic customs monitoring system. In this study, the concept of capacity approach served as the foundation. Descriptive research was employed for this study; data was gathered through the use of interview schedules and questionnaires. Among the 198 exporters and customs agents who took part in the survey, two people from the KRA customs department and two staff from the agency made up the total number of respondents. Included in the sample were over 200 individuals. Numerous statistical techniques, such as document analysis, descriptive statistics, and inferential statistics, were utilized to delve into the data. The study's results show that using e-customs significantly improves the quality of service operations. The positive correlation makes this link stand out. There is a robust and beneficial relationship between service provision and service consumption through the implementation of electronic consumer revenue systems. There is a considerable positive association between the delivery of services and the adoption of the computerized customs risk analysis system. There is a strong and beneficial relationship between the two since there is a favourable association between service delivery and the use of electronic customs monitoring devices. The research proved that after implementing electronic customs, the Kenya Revenue Authority (KRA) saw an improvement in the quality of service they provided. The study's findings suggest that KRA should regularly update their software and emphasize the importance of ethics and responsibility to their employees and business partners. Also, KRA should think about making sure their software is always up-to-date.

It was the goal of Nyongesa (2018) to investigate the many ways in which RECTS influences transportation-related items. The impact of cargo tracking systems on

shipping operational performance was one of the aspects investigated in this study. The study's focus was on the connection between the two. All of the research took place in Kenya. First, the impact of shorter transit times on transit goods management; second, the importance of seamless product monitoring on transit goods management; third, the role of stakeholder transparency in transit goods management; and fourth, the role of accountability in key performance indicators for transit goods management were the objectives of the research. This study used a descriptive research strategy and built its investigation on top of the technological acceptance model. Various stakeholders from the transit goods management and Kenya revenue authority communities participated in the study. A diverse group of stakeholders comprised the sixty-person sample that participated in the study. A statistical analysis was performed using SPSS on the research data, and the results were displayed graphically and in tabular form. Products in transit benefited from RECTS, according to the study's results. This was because it helped expedite responses, decreased the amount of time commodities spent in transit, and decreased the amount of goods abandoned within the country. The study found that RECTs cut down on transportation management costs, but it couldn't stop people from dumping goods at the border. Findings from the study indicated that more seals should be procured to meet the demands of the revenue authorities, and that more investments should be made in human resources to reconcile the management of commodities in transit. The goal of making these two suggestions was to satisfy the authorities, thus they were both implemented. While the report acknowledges that RECTS can help firms improve their operational efficiency, it offers no additional criteria for this to really happen. A lot of things, such the assumptions and research methods used, separate this study from the one that is currently underway.

2.2.3 Communication Technologies

There are two types of communication technologies that are currently available: the universal packet radio system and the single window system. Using radio navigation satellites is an additional strategy. According to several studies (Choy *et al*. 2014; Bauk, Kapidani, and Schmeink 2017; Kyomo 2019), these technologies effectively provide the relevant parties with the real-time information needed for the transportation process. In order to move goods efficiently, this data is required. When used correctly, communication technologies can link the virtual and physical flow of goods, transmit data in real time, inform and engage customers, increase responsiveness to their needs, and promote productive collaboration. The employment of various forms of electronic communication can bring about these capacities.

In order to ascertain the relevance of communication systems in Malaysia's distribution and logistics sector, Muhammad, Saahar, Hasan, Fiah, and Nor (2013) developed a study. To be more precise, the research set out to determine how much of an impact communication platforms have on logistics companies' productivity. The motivation for this research came from three distinct goals. Investigating the communication methods used by logistics-related enterprises in Malaysia was the primary focus. There are two separate approaches that can be taken to analyze the communication network used by influential people in Malaysia's logistics industry. In order to determine what is wrong with the current communication channels used by Malaysia's logistics sector, three separate approaches can be taken. It was a quantitative study that used questionnaires to collect data from participants. The logistics industry participants were selected using more convenient sample procedures in order to meet the study's objectives. Nine hundred and fifty people met the criteria for the questionnaires that were sent, making them up the sample size. Statistical methods, encompassing both

descriptive and inferential approaches, were utilized to analyze the collected data. The first goal's research showed that, on average, mobile communication was the most common mode of interaction, with email communications coming in second. Discoveries made possible by the second objective led to the identification of three network tools in use. The following are the average ratings for these instruments: GPS 2.93, handheld 2.72, and BBM 3.22. Results from the investigation into the third objective showed that "red tape bureaucracy" was present with a mean score of 3.62 and that there was a 3.82 average for the lack of information and communication technology (ICT). Below are the results of the investigation. After looking into it, the researchers found that logistics companies heavily utilize mobile apps and technologies. The study came to this conclusion, among others. The resource scarcity was given an average score of 3.56, while the fast change was given an average score of 3.54. For starters, logistics companies wouldn't be as productive without ICT (information and communication technology). Another thing to think about is that the logistics department is the one who mostly uses the IT networks. In terms of the information and communication technologies used, the research suggested that the governing body upgrade and improve these systems. First things first: the internet connection's bandwidth needs to be enhanced so that it can serve the consumers more efficiently. Shipping lines are the subject of this study; logistics is a broad field with several subfields. Although the study's major emphasis was on logistics in general, shipping lines are the subject of this specific analysis.

Choy *et al*. (2014) conducted research to determine how technology in information and communication affects logistical operations' efficiency. The investigation's primary foci were the efficacy of information and communication technologies and the efficiency of logistical operations. This study set out to assess how these technologies affect logistics

supply chain efficiency. Based on the research that was conducted in China, the inquiry used the market-based view theory and the resource-based view theory as its foundation. The researchers in this study used a survey research approach, which included sending out questionnaires to gather information. A sample size of 230 persons is utilized in the research endeavour. A combination of descriptive and inferential statistical methods was employed to carry out the data analysis. Thus, it is reasonable to assume that these technologies, when used, improve logistical operations' efficacy and efficiency. Given the available evidence, one could draw this conclusion.

A study conducted by Bauk, Kapidani, and Schmeink (2017) examined how maritime-based business enterprises intelligently utilize information and communication technologies. This area of study has also been the subject of further research. Both the efficiency of maritime organizations and the efficacy of information and communication technology were included as variables in this research. The research was carried out in Croatia with the aim of determining the level of IT utilization by marine firms. In this specific research endeavor, the focus group study approach was employed. We used "purposeful sampling" to figure out how big of a sample to get for our study, and we polled the marine organizations that participated by sending out questionnaires to their respective representatives. The study found that marine companies who invested in information and communications technology (ICT) had better internal and external communications. The current study is using a different technique, and it is investigating a considerably wider range of businesses than this investigation, which is limiting itself to shipping lines.

Tharaka (2018) set out to find out whether there was any way that the exploitation of the internet of things may improve supply chain integration and performance. Conclusions drawn from the study point to an examination of IoT and organizational

performance as the defining features. The purpose of the Australian study was to investigate how the use of IoT affects the coordination of supply chain processes for improved efficiency. In order to find out how the retail supply chain in Australia might benefit from using the IoT to boost performance, there are two ways to go about it. Taking use of the advantages associated with the numerous suitable research methodologies, this study used a number of them. Five hundred and fifty-four individuals, including supply chain and IT managers, took part in the poll. In order to examine the data collected from the surveys, descriptive statistics were employed. To analyze the data obtained from the interviews for transcription, Nvivo 11 was used with an open-coding method. The research concluded that the effectiveness of supply chain operations is greatly improved by the internet of things. It is also thought to influence a company's internal processes and relationships with suppliers and customers. Consequently, a company's entire performance is improved through the utilization of the internet of things. One of the most common types of technology used in the IoT is RFID, which stands for radio frequency identification. Another type is ICT, which refers for information and communications technology. Both the supply chain's integration and the efficiency of its operations are improved by these technologies. It is very clear from the study's results that the retail sector can improve its performance with the help of the internet of things. According to the results, this is the inevitable conclusion. In order to include everyone in the supply chain, the study's findings suggest that the framework should be expanded. Distributors, producers, wholesalers, and others are all members of this group.

Ayantoyinbo (2015) set out to study how different forms of information and communication technologies affect the logistics of freight distribution. Two of the factors that were considered were the efficiency of freight distribution networks and the

efficacy of information and communication technology (ICT). Researching how ICT affects cargo allocation was the major goal of the Nigerian study. Data collection methods included the use of questionnaires, and the research followed a descriptive research strategy. The research was also carried out. A total of 77 people will make up the sample population for this study. A descriptive statistical analysis was performed in order to analyze the collected data. The study's results showed that businesses were benefiting from using ICT, which meant that their performance was going up. Findings from the study showed that logistics organizations' performance is improved when they use ICT. According to the research, the government should step in to help increase the use of ICT and increase awareness of its benefits. The report made this suggestion as one of its recommendations. To promote the use of new technologies, it is critical that public and commercial organizations prioritize the implementation of educational and training programs. For the simple reason that no other strategy has been found to stimulate the widespread use of these technologies. Beyond that, it is unclear from the study if ICT is the sole component leading to improved performance in the studied area of freight distribution. The research effort, which took place in a developing nation, conducted its findings using surveys. This tactic dramatically differed from the methodology used in the current investigation.

In their 2018 study, Mlimbila and Mbamba looked at how port logistics efficiency is affected by the use of information technologies. Finding a connection between the two was their primary objective. The efficiency of port operations and the state of the art in information and communication technologies were the main foci of the research. The specific goals outlined in the following paragraphs informed the research conducted in Tanzania. One approach to assessing its impact on shipping and transportation cost reduction (or "cost reduction") is to make use of information systems. There are two

ways that can be used to assess how information systems affect the supply of products and services. The study relied on applied statistics and the task-technology fit theory. A quantitative research strategy was employed in its execution. Questionnaires were sent out to people in order to gather data. People who took part in the survey comprised both employees and customers of the Dar es Salaam port. Importers, exporters, clearing and forwarding agencies, information and communication technology officers, and ordinary port personnel were each represented in the sample size by three individuals. A comprehensive evaluation of the research data was achieved by utilizing canonical analysis. According to the study's results, one of the main factors in the decrease of shipping and transportation costs was the employment of information systems. It was because of this that services and commodities were delivered more promptly. Thirdly, it strengthened companies' commercial activity capabilities and logistic implementation capabilities. Following the completion of the analysis, the researchers determined that the use of information technology greatly impacts the efficiency of port operations. Policymakers should encourage logistics industry professionals to use information systems, according to the study's results. People working in logistics would be able to hone their abilities in this field if this were to happen.

Kyomo (2019) set out to assess how cargo carrying businesses in Dar es Salaam, Tanzania, use information and communication technologies to improve the efficiency of their operations. Logistical performance and information and communication technology, or ICT for short, were chosen as the study's factors. To what extent does the flow of information affect the efficacy of ongoing logistical activities was the major motivation for this study. It is possible to use one of two approaches to study how fleet management affects logistics efficiency. To examine how inventory management affects the effectiveness of logistical operations, one might use one of three separate

methods. A total of four separate evaluation methodologies were employed to ascertain the impact of logistics integration systems on logistics efficiency. The current study was based on two theoretical frameworks: the resource-based view theory and the systems approach theory. Using descriptive research methods, the evaluation was conducted. From a pool of 350 individuals thought to represent the target demographic, 105 were selected at random to form the sample. Using a combination of qualitative and quantitative research methodologies, we were able to accurately evaluate the survey data. Enterprises engaged in logistics can benefit from information communication systems, which include inventory management, fleet management, logistics integration, and information flow, as the study discovered. The study's results show that, as compared to other approaches, logistics are much improved by using information and communication technologies. Findings from the study suggest that companies in charge of transportation should carefully examine the potential of utilizing information and communication technology to boost their overall performance. In regard to the theory and methods utilized, this study differs from the one that was previously discussed.

Onwuegbuchunam, Aponjolosun, and Ogunsakin (2021) investigated further in this area, focusing on how Nigerian ports make use of ICT. The purpose of this research was to trace the history of the link between ICT and port operational efficiency in order to fill gaps in our knowledge. The study set out to achieve three main goals: (a) identify the ways in which different terminals make use of information and communication technology (ICT); (b) examine how ICT is integrated into terminal operations; and (c) identify the factors that limit the use of ICT in port business operations. Due to the research, all of these goals were met. The study's methodology was based on survey research, and 86 people were surveyed for their participation. Comments were supplied

by a diverse group of individuals, including transportation businesses, clearing and forwarding agencies, stevedores, customs agents, port shipping company agents, and terminal owners. In order to get the necessary data for the research, an appropriately constructed questionnaire was used. In order to analyze the previously collected data, statistical methods, encompassing both descriptive and inferential approaches, were utilized. According to the study's results, efficiency in port operations is significantly correlated with the use of information and communication technologies. This study differs from the one that is currently underway in theory and approach. It also includes a wider variety of marine sector stakeholders. Nevertheless, zeroing in on a specific stakeholder is essential for achieving the desired results.

The purpose of Atieno's (2014) research was to examine how logistics firms' supply chain performance is affected by information and communication technologies. All of this was accomplished while the project was underway. The research team behind this report set out to dissect the IT industry's defining features and the ways in which those features affect logistics companies' bottom lines. The goal of the Nairobi-based research was to ascertain how logistics-related businesses make use of information and communication technology (ICT) throughout their supply chains. Considered from different angles, three separate methodologies can be used to investigate the difficulties encountered by logistics firms when trying to enhance their supply chain performance through the use of ICT. In order to examine the relationship between the individual variables, this study used descriptive research as its research strategy. The analysis found that thirty of the most significant logistics companies currently operating in Nairobi were the intended target audience. Two individuals from each of these businesses were selected to take part in the study, for a grand total of sixty people. Questionnaires served as the data collection tool, and descriptive statistics were utilized

for the data analysis. Tables and charts were used to display the data visually after it had been logically organized. The use of inferential statistics enabled us to accomplish this by determining the degree of correlation between the dependent variables and the independent factors. Researchers found that logistics companies' supply chain effectiveness was 57.4 percent related to how much they used information and communication technology (ICT). The evidence pointed to this being true. Findings from the study indicate that logistics companies can greatly benefit from the use of information and communication technology (ICT) to streamline their supply chains. Implementing state-of-the-art technology is crucial for companies looking to boost their performance, according to the report. Maintaining competitiveness in the numerous marketplaces in which supply chains operate requires meticulous strategy selection. When it comes to logistics, evaluating the lead time is crucial for firms to reap the benefits it brings. The third point is thus reached. This study's methods differed from the story's.

In order to determine how much of an impact e-logistics has on logistics institutions' overall performance, Kithia (2015) conducted research. The fundamental motivation for the study was to learn how e-logistics solutions impact logistics firms' productivity. The research was carried out in Kenya with the idea of examining the extent to which operational logistics firms' efficiency is affected by the installation of e-logistic technology. Research showed that the resource-based perspective and the transaction cost theory were both significant. The research employed a case study methodology for its examination. One hundred and seventy-seven employees from Maersk Kenya limited were involved in the study. A total of 75 participants were selected for the study using a mix of stratified and purposive random sampling methods. The Statistical Package for the Social Sciences (SPSS) was utilized for the analysis that followed the

data collection from the questionnaire. Study results show that logistics companies' operational efficiency and organizational effectiveness have been positively affected by e-logistics implementation. According to the study's findings, logistics organizations can boost their overall performance by implementing this technology. According to the study that recommends these technologies, they should be implemented in other areas of logistics like clearing and forwarding and warehousing. There is a clear difference between the study's methodology and the hypotheses being tested in the present investigation.

Examining how much a company's logistical efficiency may be enhanced by incorporating mobile technologies was the primary goal of the study conducted by Abbas (2016). Two main areas that were examined were logistical organizations and mobile technology. Three specific goals were pursued by the research project in Kenya: first, to determine how much these companies are using this technology; second, to see how this technology affects the efficiency of logistics organizations; and third, to find out what makes businesses use this technology. Three theoretical frameworks—the task technology fit theory, the technology acceptance model, and the resource advantage theory of competition—formed the basis of the study. The inquiry was predicated on these three hypotheses. In order to gather qualitative data, the study used a research strategy called descriptive cross-sectional research. A total of 228 clearing and forwarding companies were considered for the sample size estimate. By applying regression models to the collected data, a descriptive statistical analysis was possible to measure the strength of the relationship between the variables. Mobile phone technology significantly improves business operations, according to the study's results. Why? Because it teaches you how to communicate quickly, which is essential for getting products from A to B in the supply chain. According to the study's results,

clearing and forwarding organizations' efficiency is significantly correlated with their implementation of this technology. This fact is disregarded, even though the report claims that there are more elements that affect logistics organizations' success. There has been no prior research that is comparable to this one in terms of approach or hypothesis.

In order to better understand how bottlers in Nairobi use information and communication technology (ICT) to improve their logistical performance, Gakuubi (2018) conducted study. A number of factors were considered, including information and communication technology, logistics system performance, and other related matters. A competitive advantage was the driving force behind the research that sought to understand the potential outcomes of logistics organizations utilizing information and communication technology (ICT) for competitive advantage. The purpose of this research was to identify and analyze the barriers to improvements in logistics performance that can be achieved via the integration of ICT. An examination of the relationship between logistics firms' performance and information and communication technologies can be approached from three different angles. In order to offer a precise description of the factors that were explored, the study utilized a descriptive research design. There were 325 employees total, and the 76 people who made up the study's sample represented 23% of that group. As a means of selecting study participants, the researchers employed a procedure called simple random sampling. This was done to make sure that any prejudice was reduced as much as possible. The data collected from the surveys was analyzed using a variety of statistical methods, including descriptive and inferential statistics. The data shows that logistics firms' performance is strongly correlated with the use of information and communication technology (ICT) at a value of 0.603. This link works well. Information and communication technology (ICT)

allows firms to get an edge in the market by streamlining data gathering and distribution, according to the study's results. A correlation exists between the use and abuse of information and communication technologies and the management maze. Based on the study's findings, the corporation should increase its use of ICT to reduce vehicle theft and the costs associated with tracking and localizing vehicle. Employees must be reminded of this in order for them to be open to change. It is only fair that the company put more resources into expanding its technological capacities.

2.2.4 Identification Technologies

Voice recognition, automatic identification systems, and radio frequency identification technologies are all parts of the identification technology. One of the several reasons why these technologies are advantageous is that they assist in providing clear identification of the things being transported. Improvements in identification technology have made a substantial dent in the growing need for tracking and monitoring throughout transportation. This development is a major factor. Radio frequency identification (RFID), voice recognition, and automatic identification systems are the three most common types of identifying technology. Several technologies have been developed to detect certain details of shipments using scanners; they include technologies described by Doan (2017), Kahyarara (2018), and Oduma & Shale (2019).

An examination of the use of automatic identification systems to collect data on maritime safety was the goal of the most current study, which took place in 2016. The factors that were considered in this research were marine safety and identifying systems. The purpose of this German study was to assess the usefulness of automatic identification systems in enhancing maritime safety regulations. This objective was the driving force behind the research. This study used experimental and case study

approaches to collect and analyze data. At its core, this inquiry sought to address concerns about marine safety and automated information systems. We responded to questionnaires and took part in interviews to gather data for the research. The data was analyzed using inferential statistics so that conclusions could be drawn. The study's results suggested that automated information systems might greatly improve maritime safety if put into practice and used. In order to prevent collisions, these systems can predict the paths of ships, show signs of uncertainty, and take action accordingly. The extent to which automatic identification technology is used correlates with the efficiency of the maritime business, according to this analysis. However, the research site and methods used in the study are different.

According to research by Dhar (2016), the impact of AI systems was examined in light of the challenges posed by handling massive data sets in maritime navigation. Marine performance and automated information systems were identified as the variables under examination. The goals of the US-based study were to develop methodologies for data gathering, storing, reducing, and administration; furthermore, to record vessel activities by means of automated information systems. The US was the site of the research. In order to accomplish this investigation's goals, extensive literature research was conducted, and the collected data was analyzed utilizing several methods. AIS is essential for improving marine security, according to the study's results, which indicated that using AIS might decrease the quantity of big data used for navigation. This study highlights a link between AIS and the improvement of marine operations' efficiency, and it does it by employing an impressive methodology.

Radio frequency identification (RFID) has an effect on logistics-related tasks to what degree? That was the goal of the study by Doan (2017). Radio frequency was one of the factors studied; researchers looked into how it affected logistics efficacy and efficiency.

China was the site of the investigation. It was feasible to determine the current deployment level of RFID technology through the inquiry. Two distinct approaches can be taken to investigate the advantages of FRID. In order to correctly identify the problems caused by the deployment of RFID technology, three separate approaches can be used. The research project aimed to collect data using both qualitative and quantitative methodologies. Questionnaires and interviews were the main tools for gathering information. One hundred individuals employed by the most prominent logistics firms would make up the estimated sample for the study. Part of the procedure included transcribing interview transcripts and evaluating them using descriptive statistics in addition to the quantitative data collected for the study. The results, presented in tabular style, were arranged in a logical manner. According to the study's findings, logistics providers were able to boost their performance by implementing RFID technology. This led to cost savings, real-time data acquisition, simplified identification, and reliable delivery. The study's findings showed a statistically significant correlation between using RFID technology and how well a company handles its logistics. The study's results suggest that RFID developers should concentrate on making their products better to fix the problems associated with this technology. This study focused solely on quantitative methodologies, in contrast to the previous one which used both qualitative and quantitative approaches.

Niraj (2019) set out to accomplish his research goal by investigating how automation technology affects logistics and supply chain management. In order to find out if the logistical process is more effective when automation technology is used, this study set out to examine the relationship between the two. The experiment was conducted in India with the intention of investigating the different automation technologies used for logistics and supply chain management. Finding out how much of an effect automation

technology has on logistics and supply chain management was the driving force for this study. There are three separate approaches that can be used to identify the challenges that arise while implementing automation technology. Participating in the study, which used a survey research approach, were a total of 192 managers from various departments across the company. The sample size accurately matched the overall number of responders, it was found. In order to analyze the study's questionnaire data, descriptive and inferential statistical approaches were employed. The study found that automated technologies significantly improve supply chain and logistics operations, with a positive effect that is statistically significant ($p < 0.05$). Resulting from this influence were improvements in inventory management efficiency, accuracy, and the decrease of expenses and time spent on them. After carrying out their investigation, the experts determined that the aforesaid technologies affect logistics and supply chain efficiency. The study's conclusions suggest that companies should investigate automation options carefully if they want to boost their company's productivity. The present study, in contrast to its predecessor, zeroes particularly on shipping lines—a subset of logistics that has received very less attention in the preceding research.

An investigation was carried out by U-Thong, Jaturat, and Kingsida (2020) with the aim of contributing to the advancement of research in this sector. Finding out how much of an effect RFID technology has on a business's bottom line was the driving force for this study. This research looked at the logistics industry's performance and Radio Frequency Identification (RFID). In the end, these were the factors that were considered. This study set out to answer the question, "What are the many factors that influence the use of RFID technology in Thailand's automotive industry?" by examining that very question. The study was place in Thailand. There are two possible approaches to assess the potential correlation between an organization's performance

and its use of RFID technology. Research known as survey research was employed throughout the investigation. People born in 1975 were the major focus of the investigation because of their importance to the automotive industry. The investigation was conducted with a sample size that included the 151 participants who participated in the survey. Using radio frequency identification has a direct and significant favorable effect on an organization's performance, according to the study's findings. Both the organization's decision-making and the rewards it reaps are directly affected by the use of RFID technology. The research concluded that radio frequency identification (RFID) may be used as a sensor to search products and store data in decision-making systems. The company can now track the whereabouts of its merchandise thanks to this step's execution. The study's results suggest that more investigation into this topic is warranted. Unlike its predecessor, which mostly examined the automotive business, this research will be concentrating on shipping lines.

Assuming, Kofi, and Chelbi (2011) investigated the use of radio frequency identification (RFID) technology to trace counterfeit goods. Examining that technology was the aim of this research. With respect to the study's factors, it was determined that RFID and logistics performance in monitoring counterfeit items would be the ones to be examined. Using RFID technology to detect and prevent the sale of counterfeit goods was the major objective of the research, which took place in Ghana and was funded by the pharmaceutical company Kama. To gather information on the participants, this study used a qualitative research technique and made use of interview guides and questionnaires. A total of twenty-five people were surveyed over the observational period. Members of this group comprised workers, supervisors, and the CEO. Two methods were utilized when analyzing the data. Analyzing documents and using descriptive statistics were the approaches used. In addition to reducing tracking

costs by 6 to 7 percent, the study found that the company was able to detect counterfeit pharmaceuticals after implementing RFID technology. The company's capacity to detect and track fake medications is the driving force behind this. Conclusions drawn from the study indicate that RFID technology, when used correctly, can aid in the detection and tracking of fake items. The research found that this technology should be used in many parts of logistics, such as inventory management, incoming and outgoing logistics, and more.

In order to identify areas for development and new prospects, Kahyarara (2018) studied the use of automatic identification systems in the marine transportation industry. This investigation followed the methodology of the previously mentioned study. Both the identifying systems and the performance of maritime transportation were examined in this specific investigation. Using Automatic Identification systems as a possible solution to port inefficiencies such process clearance delays was the major goal of the Tanzanian research project. Tanzania was the site of the research. Identification systems and the efficacy of maritime system operations were the variables investigated in this study. A growth diagnostic method was utilized throughout the research. Longer container dwell time and delays in cargo clearance are examples of port inefficiencies that could be alleviated with the help of AIS deployment. Despite the study's novel technique, it does link these systems to marine traffic.

Siror, Liang, and Pang (2010) set out to study how radio frequency technology affects the efficiency of export commodity logistics management. The purpose of the research was to identify the effects of this technology. It was determined that radio frequency identification and logistics performance would be the factors under investigation after much deliberation. An RFID-based in-transit system for export logistics was the intended outcome of the research that took place in Kenya. The research was conducted

in the Kenyan setting. According to the study's findings, which were based on a thorough literature review, the constructed system significantly improved overall efficiency, cut down on turnaround times, and reduced diversion time, all of which are beneficial to transporters and other stakeholders. Based on its novel methodology, the study concludes that RFID is the sole technology with logistics industry-relevant efficiency-boosting potential. Contrarily, RFID isn't the only technology that offers advantages; there are others that do something similar.

Kabui, Gakobo, and Mwaura (2019) set out to examine the efficacy of cargo clearing procedures in relation to the impact of single window system operations. A greater body of information is now available thanks to the results of this investigation. A number of factors were considered, including system identification and the prosperity of the maritime sector. Researchers in Kenya, more especially in the port of Mombasa, set out to determine how much of an effect the single window method may have on the speed and accuracy of cargo clearance. The question was the driving force behind the research. This study set out to examine the Mombasa port in particular, looking into the effects of pre-clearing permits, shipping processes, and customs goods reporting systems. The ideas of business process re-engineering, the technology acceptance model, and system theory formed the basis of the conducted research. This study used a quantitative research approach, with questionnaires serving as the primary data collection tool. The sample size was determined by tallying the number of replies received from the 155 persons that were part of the target group. The statistical analysis performed on the examined data includes both descriptive and inferential analyses. We can conclude from the research that the single window approach significantly and favorably affects the processes of customs declaration ($p = 0.950$), shipping procedures ($p = 0.952$), and pre-clearance permits ($p = 0.861$). The study's

results showed that the Mombasa terminal's cargo clearing process was more efficient after going to a single window system. We propose further investigation on the subject because there are many elements that affect how efficiently cargo clearance is done at the port of Mombasa. This recommendation is made by the study to encourage further research on the matter. In terms of the research approach, the study demonstrates a great deal of variety.

In order to find out how logistics automation affected the efficacy and efficiency of logistics operations, Oduma and Shale (2019) performed research. The fundamental motivation for the study was to ascertain whether or not the link between automation systems and logistics operational performance is significant. This research was conducted in Kenya with the intention of examining the effects of transportation management systems on the supply chain of the Kenya Electric Supply Authority (KEMSA). Two distinct techniques are at your disposal for assessing the impact that ERP has had on KEMSA's supply chain. Business process reengineering served as the overarching concept throughout the study, which used a descriptive research approach. Among the State Corporation employees that were a part of the study's sample were ninety-one individuals. Two sorts of statistics, descriptive and inferential, were used to analyze the data collected from the questionnaires. According to the study's results, the supply chain's performance was enhanced once automation was applied. The decrease in reliance on human labour was the driving force behind this progress. The study found a direct correlation between the use of logistics automation and improved performance. The extremely high strength of the link proved this to be true. The research found that if KEMSA implemented logistics automation, it could reach the necessary level of visibility in its operations. This verdict is grounded in the results of

the investigation. There is a fundamental gulf between the research project's central concept and the methods used to conduct it.

It was the goal of the study by Murugi (2022) to find out how new technology affect transportation operators' productivity. Finding out how transportation operators' efficiency is affected by the use of technology was the main motivation for the inquiry. Such an investigation took place in the Kenyan nation. The main objective of the research was to identify the effects of these technologies' use on the effectiveness of logistics processing. The resource-based perspective theory, the task-technology fit theory, and the instrumental theory provided the theoretical groundwork for this research. These concepts were the cornerstones of our inquiry. This study used an explanatory research strategy as its primary methodology. Seven hundred and eleven people, give or take, were involved in the study. The study found that when these technologies are used and implemented, transport operators' performance improves, and this improvement is statistically significant.

2.2.5 Shipping Lines Performance

The degree to which an organization achieves its goals and objectives is the primary factor that determines its performance. This is the most important factor in gauging a business's success. It is feasible to assess a company's performance along multiple dimensions; the criteria for doing so are defined by the particular aspect of the business under consideration. It is possible to do such an assessment. According to Prathap and Mittal (2010), determining how a firm's competency and achievements are evaluated heavily relies on measuring the company's success. While "performance" is the end result of an action and "measurement" is the process of quantifying that action, according to Tuttle and Heap (2008), the former is more accurately described as "performance measurement." In recent years, supply chain management software has

grown in popularity among logistics companies. Why? Because these businesses are masters at making the most of these technologies, which means they can improve their performance to the fullest extent possible. Multiple studies in this area have come to the conclusion that logistics businesses' performance indicators will change under different contextual circumstances. Based on the research findings, the key metrics for logistics performance are as follows: on-time delivery, reduced costs, increased security, excellent customer service, increased profitability, and expanded market share.

Karia and Wong (2013) set out to determine how much of an impact logistics resource availability has on the efficiency and effectiveness of Malaysian logistics service providers. These two factors—the influence of logistical resources on logistics providers and the resources themselves—were the major foci of the research. To what extent does the use of more sophisticated technology lead to improved performance? That was the driving force behind the research. Finding out whether increasing the use of physical resources improves logistics performance is a prerequisite to getting started. First things first: we need to determine if the logistics department's performance is impacted by the level of managerial skill. Research is required to determine the extent to which relational resources affect logistical efficiency. There has to be research into the efficacy and efficiency of logistical processes, as well as the impact of organizational resources on such operations. The resource-based view theory provided the groundwork for the investigation that led to the study's use of the survey research method. Some 289 people filled out the survey or were otherwise involved with it in some way. A combination of survey data collection and descriptive statistics allowed for the examination of the collected information. Results showed that logistics companies may boost their performance by better utilizing technology, especially to cut costs. Findings from the study showed that logistics businesses in Malaysia can

improve their overall performance by using technology. The study's conclusions suggest that further investigation into the myriad ways in which logistical resources can be integrated and utilized in tandem to boost logistics firms' performance is warranted.

Sadovaya and Thai, (2015) looked at how a technology-based marine security management model might impact the performance of shipping firms in Singapore. This study is comparable to others like it. There are a great deal of studies that are similar to this one. Specifically, this research looked at the technology-based paradigm and how it affected shipping businesses' performance. We thought about both of these things. In the first part of the study, we aimed to verify that shipping companies are really using the model. In the second part, we wanted to see how this model affects their performance. These two goals served as the study's compass. This analysis made use of survey research methodology, and data was gathered through the administration of a standardized questionnaire. The research study's participants were management staff from several shipping companies. Structural equation modelling was employed to assess the proposition under investigation. The study concluded that shipping companies' safety, the resilience of their operations, and client performance were all positively affected by the proper installation and exploitation of this model. It turned out that this was correct. Unlike the previous study, which used structural equation modelling to form its hypothesis, this one did not. The incompatibility of the two studies can be explained by this.

Port infrastructure affects logistics in different ways, according to research by Munim and Schramm (2018). Both the port's infrastructure and the efficiency of the logistics system are highlighted in this report. The research set out to determine how much of a moderating role marine trade has in the relationship under scrutiny. The purpose of this was to determine if the two criteria are related. The study endeavours largely relied on a

descriptive survey for its approach. Structural equation modelling allowed us to look at the relationship between the two independent variables. The research concluded that the relevant parameters are significantly and positively correlated with one another.

Onyemejor (2015) conducted a study to gather data on how marine logistics performance affects the competitiveness of international trade. This study aimed to examine the effectiveness of marine logistics as well as the competitiveness of international trade. It was thought that both of these factors may change. One of the goals of the study, which was conducted in Nigeria and guided by the following objectives, was to analyze the extent to which logistics performance influences trade facilitation and competitiveness. In Nigeria, researchers set out to accomplish the following goals. The project's secondary objective was to delve into how logistics efficiency affects the competitiveness of global trade. The third objective was to figure out how logistical factors like time, cost, and dependability affect the worldwide competitiveness of trade. The fourth objective of the project was to determine the current problems with Nigeria's logistical performance and to provide appropriate solutions. For this study, a mix of qualitative and quantitative methods was used to achieve the research goals. The research sample consisted of one hundred practitioners and stakeholders who took part in the study. Questionnaires were used to collect data for the study, which was then analyzed using quantitative and qualitative methods. Based on the study's results, international trade is significantly more competitive when logistics are able to operate well. This is because the time and money needed for delivery have both decreased. The study's findings point to a connection between logistical efficiency and the competitiveness of global trade. The study's findings proposed that the country in issue adopt a logistic approach to facilitate easier trading.

The purpose of the research study was to examine how well a company handled its logistical operations, according to Karibo (2019). The purpose of the investigation was to carry out the study. The study's conclusions were based on data obtained from both the logistics management and the company's performance. The study set out to answer the question, "What role does logistics play in driving up sales and ensuring on-time deliveries?" by conducting research in Nigeria. Using a questionnaire and the survey research method, the data needed for the study may be collected accordingly. One hundred twenty-two persons participated as respondents in the research study. Among these individuals were managers from different companies. Researchers found a strong positive association between logistics management and a company's performance in terms of enhanced sales and on-time delivery after analyzing the research data using descriptive and inferential statistics. The researchers arrived at this conclusion after analyzing the study data. The study found that logistics management significantly affects a company's performance. Businesses, according to the argument, can boost their efficiency by using technology to manage their logistics processes.

Ndonye (2014) set out to study how IT affects logistics efficiency. The two main variables that were examined in this study were logistics and information technology performance. The purpose of this study was to identify the relative weight of three variables that have an effect on logistics productivity in Kenya. Included in this group are logistics-related aspects like information flow, logistical integration, inventory management systems, and fleet management systems. Systemic theory, control theory, adaptive theory, and the supply chain operational model were used as a basis for the research that was conducted. Researchers used a descriptive methodology to compile data from questionnaires filled out by study participants. A total of 105 people representing 53 distinct airlines and transportation companies filled out the poll.

Quantitative and descriptive statistics were utilized throughout the data analysis procedure. The frequency distribution and standard deviation are two instances of these types of statistics. The results were then provided with in-depth explanations in the form of pie charts. With the use of a regression model, we looked at how strong the relationship is between the variables. After finishing their investigation, the researchers concluded that a firm's efficiency and effectiveness are significantly impacted by the usage of information technology. Furthermore, it was suggested that logistics companies engaged in freight transportation should implement these cutting-edge technology developments. The study's conclusions confirmed that logistics performance is considerably affected by IT usage. It is feasible to increase logistical performance through supplier integration, according to the study's conclusions. Both the hypothesis and the research methodology used in this study are distinct from those in the one that is now underway.

According to Gacuru and Kabare (2015), the study set out to examine the factors that affected the operational effectiveness of logistics enterprises near Jomo Kenyatta International Airport. For this reason, the research was carried out. Factors such as information technology, human competency, business-to-business collaborations, and logistics operation efficiency were considered throughout the investigation. Finding out how three variables affect logistics performance efficiency was the driving force for this research. To begin with, there are three aspects that affect logistics performance efficiency: first, the influence of IT; second, the influence of competent staff; and third, the influence of business-to-business relationships. The study's foundation was laid in logistics theory and the principles of supply chain management. A descriptive cross-sectional research strategy based on the presentation of an analytical model allowed for the collection of trustworthy data from a variety of primary and secondary sources.

Several sources of information were utilized to do this. The sample comprised 42 separate logistics service managers. For the purpose of analysis, descriptive statistics were applied to the collected data, which encompassed both frequency counts and percentages. To evaluate the hypothesis under investigation, analysis of variance (ANOVA) was employed. Logistics firms may save time and money while increasing the quality and competitiveness of their operations by utilizing technology, according to the report. Thanks to technological advancements, these feats were attainable. Logistics performance is significantly affected by the existence of information technology, according to the study's results. It should be noted that other logistics companies operating in other sections of the country do not accurately mirror the actions of this study. The present inquiry makes use of very different research methodologies and theoretical frameworks than the prior study.

Macharia, Iravo, Tirimba, and Ombui (2015) conducted research on how technology affected the productivity of Nairobi-based logistics firms. The performance of logistics management organizations and the adoption of technology were the variables examined in this study. The study set out to answer multiple questions about the impact of IT on logistics performance, including how it relates to security systems, cargo tracking, customer service, and information integration. Both the instrumental theory and the substantive theory provided the theoretical underpinnings for the study that the researchers carried out. Applying technological knowledge is central to each of these philosophies. This descriptive strategy was used to perform the survey. Thirty personnel from 10 different Nairobi-based logistics firms were selected to take part in the study. We used descriptive statistics and statistical methodologies to analyze the collected data, and we displayed the findings in pie charts. This showed that the association between the factors is significant, as the study found. It was determined

from the study's results that logistics businesses that have used IT have performed better in terms of efficiency and effectiveness. The investigation's results led to this conclusion. The situation for companies that have not implemented technological solutions is drastically different from this. Companies are advised to integrate their systems for enhanced overall performance, according to the study's findings. It is possible that the results do not apply to all of Kenya's counties due to the study's focus on Nairobi County. The reason behind this is that the study took place in Nairobi County. Following up on the study's recommendations, more research on the benefits of IT for logistical service providers should be undertaken. The present inquiry makes use of very different research methodologies and theoretical frameworks than the prior study.

Ojwang (2016) set out to assess how humanitarian aid groups use IT to assist with logistics. Technology adoption and success in logistics were the two main factors evaluated. The following goals inspired the study's initial objective, which was to investigate how much these businesses rely on IT. The research took place in Kenya. Step two is figuring out how these non-profits' use of IT has changed their operations. The research study that was carried out to carry out the assessment was based on both the social network theory and the relief coordination theory. The research employed a cross-sectional survey to aid in data description and demographic characteristic identification. Researchers in Kenya surveyed 53 people working as IT and logistics administrators for non-profits' that help the poor. Inside the organizations, this group occupied various positions of employment. Analysis of the collected data included the use of both descriptive statistics and content analysis. Organizations that offer humanitarian relief use IT in the following ways, according to the study's findings: response relationship, automation, adaptability, and resource planning. Cooperation,

feedback, lead time, cost savings, and service quality were some of the ways in which these firms' logistics were positively affected by the exploitation of IT. The results of the investigation led to these inferences. There is a positive association between the use of IT by these humanitarian groups and their effectiveness. The study found that humanitarian assistance groups were able to attain higher levels of efficacy by utilizing information technology in their logistics. In order to ensure efficacy whenever this technology is used, it is urged that relief organizations' management emphasize the advancement of their information technology. The study's results (which are available here) formed the basis for this suggestion.

Njagi, Namusonge, and Mugambi (2016) sought to identify the elements that contribute to strategic management's effectiveness in the administration of Kenyan organizations involved in the shipping sector. This study set out to answer the question, "What makes strategic management effective?" by investigating that very question. The variables that were investigated in this study included strategic management aspects and shipping sector performance. The impact of differentiation strategy on the shipping industry was the primary focus of this study's several aims. Secondly, it was important to examine how the shipping sector has been impacted by the adoption of global corporate strategies. As a third step, we looked into how company leadership's actions have impacted the shipping industry throughout the years. This research was grounded in three separate theories. Strategic consistency, the balance score theory, and resource-based management are the names of these theories. This study used a mixed methodology of descriptive and exploratory research techniques. One hundred fifty-five people made up the sample size for the survey. The people in issue were employees of various shipping businesses, KMA, and KPA. The data collection process made use of both questionnaires and interview guides at different stages. A

combination of qualitative and quantitative techniques were used to analyze the data. Based on the findings, it appears that the factors impacting strategic management have a direct bearing on the profitability of shipping industry company performance. We discovered this to be true. In comparison to the previous study, this one makes use of various ideas, techniques, and approaches to data collecting and analysis. Although the focus of this study is narrowly on shipping lines, a far broader view of the shipping business is being employed.

Maina (2017) investigated how several factors impact the efficiency of Kenyan shipping lines. The variables that were examined in this study included worries about costs and the efficiency of delivery companies. We set out to investigate the impact of fuel costs, charter fees, insurance premiums, and container management fees on shipping vehicle performance in order to quantify their relative importance. As far as we can tell from the data collected, 77 people filled out the survey. The personnel of the shipping businesses that use the Mombasa port were the ones accountable for these persons. Data was also culled from secondary sources, such as the Kenya Maritime Authority's documents and bulletins. This study used a descriptive research approach and relied on a questionnaire to glean more information. Inferential and descriptive statistics were used to examine the collected data. Both statistical methods were utilized. It is possible to draw from the study's results that each of the four variables influences shipping lines' efficiency. The data allows us to draw this conclusion. Both the technique and the utilization of secondary data set this study apart from others.

2.2.6 International maritime regulations

The shipping industry uses up a lot of marine resources because it handles 90% of the world's trade. International marine transport bodies like the International marine Organization (IMO) regulate it because it is inherently a global activity. The fact that it

takes place all over the world explains this. As per Kenton's research (2020), the International Maritime Organization (IMO) is an arm of the UN charged with developing policies to enhance maritime security, prevent ship-related pollution, and ensure the safety of international shipping. There are 170 member nations of the International Maritime Organization (IMO), and it is the duty of every member nation to enforce these standards inside its own borders. The Kenya Maritime Authority is responsible for enforcing laws set down by the International Maritime Organization (IMO) in Kenya. Following the lead of the International Chamber of Shipping, the International Maritime Organization (IMO) establishes rules through a number of agreements. A separate function is served by each of these conventions. Ships must be built to meet certain criteria for safety, and essential safety equipment like fire extinguishers, radios, and navigational aids must be installed. These rules were laid forth in 1974 by the International Convention for the Safety of Life at Sea (SOLAS). Ships must be built according to these standards to guarantee their safety and security. The 2020 report on International Maritime and Transport Law produced by the United Nations Conference on Trade and Development (UNCTAD) is the applicable source.

A license is required for shipping enterprises to commence operations according the 1993 International Safety Management Code (ISM). They can't launch their business unless this condition is satisfied. Regular audits of companies and the ships they operate are necessary to verify the presence of a safety management system. Implementing well-established protocols and efficient channels of communication between the ships and their onshore administration is a prerequisite for this system to be considered complete. International maritime and transport legislation is expected to provide useful insights into the maritime economy in 2022, according to the United

Nations Conference on Trade and Development (UNCTAD) in 2020. The Multiannual Convention on the Prevention of Pollution from Ships (MARPOL) is a set of laws enacted to protect the environment from pollution caused by ships and their usual operations. MARTOL was established in 1973 and its regulations were revised in 1978. The prevention of pollution is one of MARPOL's main objectives. This includes pollution produced by oil, hazardous products, bulk chemicals, sewage, trash, and air pollution. In order to meet the specifications laid out in this document, certain oil tankers are required by rule to have double hulls. Publication on International Maritime and Transport Law prepared for the 2020 UN Conference on Trade and Development

When driving, one must adhere to certain basic concepts known as the "rules of the road," which outline who has the right of way and what one must do to prevent accidents. The Convention on the International Regulations for Preventing Collisions at Sea (COLREG) was inked in 1972. The organization was the one that had to come up with these guidelines. Ships' minimum freeboard is determined by multiple factors, including the time of year and the trading route they are sailing. The 1966 International Convention on Load Lines dictates this procedure.

According to (UNCTAD 2020; international transport and maritime laws), In order to make sure that ships and port facilities are safe while traveling, the 2002 International Ship and Port Facility Security Code (ISPS) established certain processes that must be followed. All parties involved, including the ships and the port infrastructure, are the target of these precautions. The research cited in this article provides proof that these international maritime regulations have affected the efficiency and productivity of shipping companies.

The factors that lead to the non-implementation of maritime legislation in Kenya was one of the examinations carried out by Mwashigadi,(2014) as part of his research. To better comprehend the current regulations governing Kenya's maritime trading industry, this research study set out to collect relevant data. In the second stage, we analyzed the several factors that affect how well these policies are put into action. The study used the descriptive survey research method as its main research approach and was based on theories concerning trade regulation. The study's respondents were the department heads within the state entities responsible for carrying out these regulations' execution. Both descriptive and inferential statistical methods were employed in the analysis of the data received from a semi-structured questionnaire. According to the study's results, bureaucracy, political interference, poor integration of harmonized regulation, and an inadequate infrastructure for information and communication technology all play a major role in making it difficult for businesses to comply with maritime trade regulations. The researchers came at this conclusion. Because of this, shipping line performance is affected.

Studying coastal areas with a focus on Kenya, Kombo (2018) looked into how maritime policy may make areas safer. The goals of the study were to assess the vulnerability of the marine environment as it is now, to look into how maritime security affects merchant shipping, to learn about the international treaties that address maritime security, and lastly, to assess potential strategies for making the ocean safer. This study employed a descriptive research strategy based on the administration of questionnaires to elicit the desired data. The Kenya ports authority, the Kenya maritime authority, and the Kenya navy were among the several marine-related bodies that provided responses. The study's results indicate a strong relationship between maritime strategy and the

improvement of coastal zone security. The efficiency of the shipping companies is adversely affected by this.

In order to learn how the rules set out by the International Maritime Organization (IMO) have affected the structure of the oil and gas industry's market, Anna (2018) conducted research. This Korean study examined the relationship between the market structure of liners and the regulations set forth by the International Maritime Organization (IMO). Qualitative and quantitative approaches were also used in the research design for this project. Ship liners' market share will be affected by the IMO 2020 standard's implementation and enforcement, according to the study's conclusions. Market share, which is dependent on the shipping line's profitability, is an important performance metric for shipping lines. This highlights the significance of market share as a measure. The methodology and the location of the study were both approached differently.

International maritime rules impact marine fuel oil, which is why Van, Ramirez, Rainey, and Ristovski (2019) investigated this impact on Queens land. The land in Queens was the site of the research. This study investigated the effects of maritime restrictions on shipping. Maritime rules and regulations were the study's independent variables. We set out to find out what may happen if we restricted the shipping industry's use of low-sulphur marine fuel oil, therefore we ran this study. Throughout the project, a comprehensive review of the existing literature was conducted. The study states that ship owners are forced to employ alternative fuels, which leads to higher business expenditures. This phenomena will lead to a decline in operating efficiency for shipping companies. The methodology and the location of the study were both approached differently.

Njiru (2020) looked into a variety of topics, one of which was the impact of maritime security on the utilization of blue economy market resources. The investigation was conducted in Mombasa County, which is located in Kenya. Two primary goals guided the research: first, to assess the impact of maritime safety on blue economy resource use; and second, to identify the function of marine governance in this process. It was hoped that both of these goals would be achieved. This study used a descriptive research approach and was based on the securitization theory developed by the Copenhagen school. Utilizing questionnaires, data was collected from 384 respondents who, at the time of the study, represented a variety of stakeholders linked with the blue economy. Despite several precautions being put in place to guarantee the safety of the players involved, the study's results show that the expectations of those involved have not been met. Researchers concluded that using blue resources does not significantly contribute to protecting marine habitats based on the study's findings.

In North America, Brewer (2021) set out to find out how international marine standards affect pollution reporting and monitoring in the marine transportation industry. In order to learn how these rules work, researchers conducted this study. Monitoring and reporting of marine pollution and the implementation of international maritime legislation were among the elements investigated in this study. The purpose of the research was to examine how international maritime legislation is involved in keeping an eye on ocean pollution levels. As part of the research process, a thorough literature review was conducted. Examining ships at the port to determine if they have complied with these regulations causes additional delays, according to the study's findings. This is the current state of affairs, even though ship owners have seen a rise in the cost of doing business due to the adoption of new technologies. In fact, this is the exact reason behind the introduction of these technologies, which shorten the duration of

inspections. The entire performance takes a major hit because of this. In terms of both approach and the location in question, it differs from the one that is currently underway.

Table 2.1 *Summary of related studies*

Author(s) & Year	Research Focus	Research major findings	Research gaps	Current Research
Localization Technologies Global Studies				
Michaelides *et al* 2010	Use of Localization technologies to optimize logistics operation in United Kingdom	The results indicated that there is a significant positive association between use of localization technologies and logistics performance	-The study used case study method instead of explanatory research method _ Data was gathered using interview and observation -	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Musa et al 2017	Utilization of localization technologies by logistics service providers in Malaysia	The results indicated that there is a significant positive association between use of localization technologies and performance of logistics service providers	-The study used descriptive survey method instead of explanatory research method -The sample size was 450 participants while the current study had 438	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Bolte & Goll 2020	Utilization of localization systems for outbound	The results indicated that there is a significant	The study used both primary and secondary data instead of primary	The current study uses multiple variables,

	logistics	positive association between use of localization systems and performance of logistics service providers	data alone -Explanatory and qualitative approach were used as opposed to explanatory approach alone	employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Shamsuzzoha *et al* 2021	Impact of positioning technologies in logistics in Finland	The results showed that there is a significant positive association between use of positioning technologies and performance of logistics	The study made use of secondary data instead of primary data as is the case in the current study	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Regional Studies Jonker 2016	Effects of localization systems on logistics in South Africa	The findings of the study were that a positive significant effect of use of these technologies and logistics performance	-The study did not make use of any theory as opposed to the current study which had three theories -interview schedule was used instead of questionnaires	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Oyebamiji 2018	Localization technologies and logistics performance improvement in Nigeria	The findings of the study were that a positive significant effect of use of these	-The study did not make use of any theory as opposed to the current study which had three theories	The current study uses multiple variables, employs inferential

		technologies and logistics performance	- descriptive survey was utilized instead of explanatory research design	statistics in testing hypotheses, a moderating variable and explanatory research method
Local studies Lukhoba 2014	Use of cargo locating systems by logistics firms to gain competitive advantage in Kenya	The findings of the study were that a positive significant effect of use of these technologies and logistics performance	-The study made use resource based view theory the current study used technology acceptance model, technology task fit and institutional theory -interview schedule was used instead of questionnaires	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Kabiru 2016	Impact of ECTS on logistics companies in Kenya	The findings of the study were that a positive significant effect of use of these technologies and logistics performance	-The study made use institutions theory and constraints theory; the current study used technology acceptance model, technology task fit and institutional theory -exploratory research design was utilized instead of explanatory	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Njeru 2017	Development of a vessel locating model in Kenya	The findings of the study were that a positive significant effect of use of these technologies and logistics	-The study did not make use of any theory as opposed to the current study which had technology acceptance model, technology task fit	The current study uses multiple variables, employs inferential statistics in testing

		performance	and institutional theory - both qualitative and quantitative methods were utilized instead of explanatory research design	hypotheses, a moderating variable and explanatory research method
Kilonzi & Kanai 2020	Effect of use localization technologies by logistics service providers in Kenya	The findings of the study were that a positive significant relationship between of use of these technologies and logistics service providers performance	-The study made use transaction cost theory and institutional theory the current study used technology acceptance model, technology task fit and institutional theory	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Sensor technologies Global Studies Skorna, Bode & Weiss 2011	Use of sensor technologies to prevent risk and loss in logistics in the united states	These technologies have the potential to prevent risk and loss in logistics	-The study made use of secondary data instead of primary data. -The study did not make use of any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -Data was analyzed using variance analysis instead of inferential statistics	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Himanka 2016	Use of IOT (sensors) in logistics in Finland	IOT is beneficial to logistics providers	-The study did not make use of any theory as opposed to the current study which had technology	The current study uses multiple variables, employs inferential

			acceptance model, technology task fit and institutional theory _ The study employed case study method instead of explanatory	statistics in testing hypotheses, a moderating variable and explanatory research method
Hiekata *et al* 2020	Use of sensor technology in maritime industry in Japan	Use of sensor technology has a positive impact on maritime logistics providers	_ The study employed case study method instead of explanatory. -The study did not make use of any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Shaik *et al* 2021	Development of technology in shipping lines Mumbai (India)	Use of developed sensor technologies improves security in maritime industry	-The study did not make use of any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory The study made use of secondary data instead of primary data	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Regional studies Kuma 2015	Use of vessel tracking systems in maritime traffic management in Ghana	Vessel tracking systems are effective in managing maritime traffic	-The study did not make use of any theory as opposed to the current study which had technology acceptance model, technology task fit	The current study uses multiple variables, employs inferential statistics in testing

			and institutional theory The study made use of secondary data instead of primary data	hypotheses, a moderating variable and explanatory research method
Agrifoglio 2017	Effects of digital technologies on maritime operations management in Nigeria	Digital technologies gave a positive effect on maritime operations management	-The study did not make use of any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory The study made use of case study method	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Khan & Adediji 2017	Effects of RADAR system to manage maritime traffic in Congo	RADAR systems are effective in managing maritime traffic	-both primary and secondary data were used instead of primary data alone. Data was analyzed using variance technique instead of inferential statistics --The study did not make use of any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Local Studies Mugambi 2017	Effects of ECTS on logistics in	Use of sensor technology embedded in	-The study used both descriptive and inferential	The current study uses multiple

	Kenya	ECTs has appositive effect on logistics	statistics instead of inferential alone -The sample size was 30 respondents while the current study had 438 respondents	variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Sakhasia 2017	Effects of E-customs and service delivery in logistics in Kenya	E-customs positively affects logistics service delivery	--The study employed capability approach theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 198 respondents and the current study had 438 respondents -The study used descriptive research design instead of explanatory design	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Nyongesa 2018	Impacts of RECTS on logistics in Kenya	Use of these systems positively affects logistics	-The study used descriptive research design instead of explanatory design -The study had a sample size of 60 respondents while the current had 438nrespondents	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and

				explanatory research method
Communication technologies Muhammad 2013	Role of ICT in logistics industry in Malaysia	ICT are effective in logistics industry operations	-The stud made use of convenient sampling technique instead of random sampling - The study had a sample size of 950 respondents while the current had 438nrespondents -The study did not make use of any theory as opposed to the current study which had three theories	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Bauk *et al* 2017	ICT intelligent usage in maritime organizations in Croatia	There is a significant relationship between ICT usage and maritime organizations performance	-The study did not make use of any theory as opposed to the current study which had three theories -The study employed focus group method. - purposive sampling was used instead random sampling	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Tharaka 2018	Use of internet of things to enhance performance in supply chain	There is a significant positive relationship between the use of internet of things and improved performance	-The study did not make use of any theory as opposed to the current study which had three theories -The sample size was 554 respondents while the current study had 438 respondents -Data was collected using	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and

			interviews instead of questionnaires	explanatory research method
Regional Studies Ayantoyinbo 2015	Effects of ICT in freight distribution logistics in Nigeria	Use of ICT positive affects freight distribution logistics	-The study did not make use of any theory as opposed to the current study which had three theories -The sample size was77respondents while the current study had 438 respondents -The study used descriptive research design instead of explanatory	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Mlimbila & Mbamba 2018	Impact of ICT on port logistics in Tanzania	Port logistics are positively affected by use of ICT	-The study did not make use of any theory as opposed to the current study which had three theories - purposive sampling was used instead random	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Kyomo 2019	Impacts of ICT on logistics	ICT implementation and proper use positively affects logistics operations	--The study employed systems approach theory and resource based view theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and

			-The sample size was 105 respondents and the current study had 438 respondents -The data was analyzed using both qualitative and quantitative techniques instead of quantitative	explanatory research method
Onwuegbuchunam *et al* 2021	Adoption of ICT in port logistics	Port logistics are positive impacted on by ICT adoption	-The study made use of survey method while the current study used explanatory method ---The study did not employ any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 85 respondents and the current study had 438 respondents	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Local studies Atieno 2014	Influence of ICT on logistics in Kenya	ICT usage positively affects logistics	-The study made use of descriptive research design while the current study used explanatory research design ---The study did not employ any theory as opposed to the current study which had technology acceptance model, technology task fit	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research

			and institutional theory -The sample size was 60 respondents and the current study had 438 respondents	method
Kithia 2015	Effects of e-logistics on logistics firms	Logistics firms that use e-logistics have improved their operational performance	-The study made use of survey method while the current study used explanatory method ---The study employed transaction cost and resource based view theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 75 respondents and the current study had 438 respondents - The study made use of a case study method	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Abbas 2016	Influence of mobile technology on logistics firms operation	Mobile technology usage by logistics firm influences their operational efficiency	-The study made use of descriptive cross sectional design while the current study used explanatory method ---The study employed resource advantage theory of competition, TAM and task fit	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and

			theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 228 respondents and the current study had 438 respondents	explanatory research method
Gakuubi 2018	Impact of ICT in logistics	ICT use positively influences logistics operations	-The study made use of descriptive research design while the current study used explanatory research design ---The study did not employ any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 76respondents and the current study had 438 respondents	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Identification technologies Global Studies Last 2016	Use of Automatic Identification systems for marine safety	Automatic identification systems are effective in improving marine safety	-The study employed experimental and case study methods while the current study used explanatory method ---The study did not employ any theory as opposed	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating

			to the current study which had technology acceptance model, technology task fit and institutional theory -Research data was collected using questionnaires and interviews whereas the current research made use of questionnaires only	variable and explanatory research method
Dhar 2016	Impact of Automatic Information Systems on marine navigation data	These systems are effective in reducing and managing maritime navigation data	-The research made use of secondary data while the current research made use of primary data -Data was analyzed using mixed methods while the current one used inferential statistics	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Doan 2017	Influence of Radio Frequency Identification technology in logistics activities	Radio frequency identification technology use has a positive impact on logistics activities	-The study made use of both quantitative and qualitative methods -The study did not employ any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method

			was 110 respondents and the current study had 438 respondents	
Niraj 2019	Impact of automation technology in logistics	Automation technology use has led to logistics efficiency	-The study made use of survey method while the current study used explanatory method -The study did not employ any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 192 respondents and the current study had 438 respondents	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Regional studies Kofi & Chelbi 2011	Impact of Radio frequency identification technology in tracking counterfeit goods in logistics	Use of Radio identification technology has the potential to identify counterfeit goods in logistics	-The study made adopted qualitative research design while the current study used explanatory method ---The study did not employ any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 25 respondents and	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method

			the current study had 438 respondents -Data was gathered using interviews and questionnaires while the current study used questionnaires only	
Kahyarara 2018	Automatic identification systems as an opportunity and growth diagnostic for maritime transport	Use of automatic identification systems has a positive effect on maritime transport efficiency	-The study made use of growth diagnostic methodology while the current study used explanatory method ---The study did not employ any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 90 respondents and the current study had 438 respondents	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Local Studies Siror et al 2010	Impact of Radio Frequency identification on export logistics	Radio frequency identification use allow efficiency of export logistics	-The study made use of secondary data while the current study used primary data ---The study did not employ any theory as opposed to the current study which had technology acceptance model, technology task fit and institutional	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory

			theory	research method
Kabui et al 2019	Impact of single widow system on cargo efficiency	Use of this systems improves cargo clearance efficiency	-The study made use of survey method while the current study used explanatory method ---The study employed systems theory, technology acceptance model and business process re-engineering theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory -The sample size was 112 respondents and the current study had 438 respondents	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method
Oduma & Shale 2019	Impact of automation on logistics	Automation technologies have a positive influence on logistics	-The study employed descriptive research design while the current study used explanatory method -The study used business reengineering theory as opposed to the current study which had technology acceptance model, technology task fit and institutional theory	The current study uses multiple variables, employs inferential statistics in testing hypotheses, a moderating variable and explanatory research method

	-The sample size was 91 respondents and the current study had 438 respondents

2.3 Summary of Research Gaps

A review of the relevant literature revealed that the implementation of supply chain management technologies results in enhanced operational efficiency for shipping lines. The lack of comprehensive studies on supply chain management technologies and the performance of shipping lines in Kenya is a significant gap that has emerged as a result of the review of the relevant literature. Despite the fact that studies have been conducted on the performance of shipping lines from various regions of the world, none of these studies have concentrated on the logistics of Kenya as a whole. Most of the studies that have been conducted in this field have been carried out in western countries, and the approaches and ideas that they use are different from those that are currently being studied. These circumstances call for an increase in the amount of research that is conducted in developing nations such as Kenya. In light of this, this constitutes the foundation of this study.

Studies that have been reviewed indicate that technologies for supply chain management have the potential to be both drivers and enablers of the performance of shipping lines. On the other hand, there are fewer empirical studies that have attempted to investigate how the performance of these companies can be affected by a combination of supply chain management technologies. In terms of theories, methodologies, data analysis, and the research variables, the ones that were conducted are different from the one that is currently being conducted. The introduction of a moderating variable is particularly noteworthy. It is therefore possible to identify a gap in the existing corpus of information that is empirical in nature. In order to fill this

void, the primary argument of this study was designed to focus on. It is the purpose of this study to fill the void left by insufficient research in the field of supply chain management technologies, the performance of these shipping lines in Kenya, and the moderating influence of international maritime regulations, as demonstrated by the literature survey. The study tried to address on the relative lack of robust empirical studies on supply chain management technologies, performance of shipping lines in Kenya and moderating effect of international maritime regulations.

2.4 Conceptual framework

Independent variables

Supply Chain Management Technologies

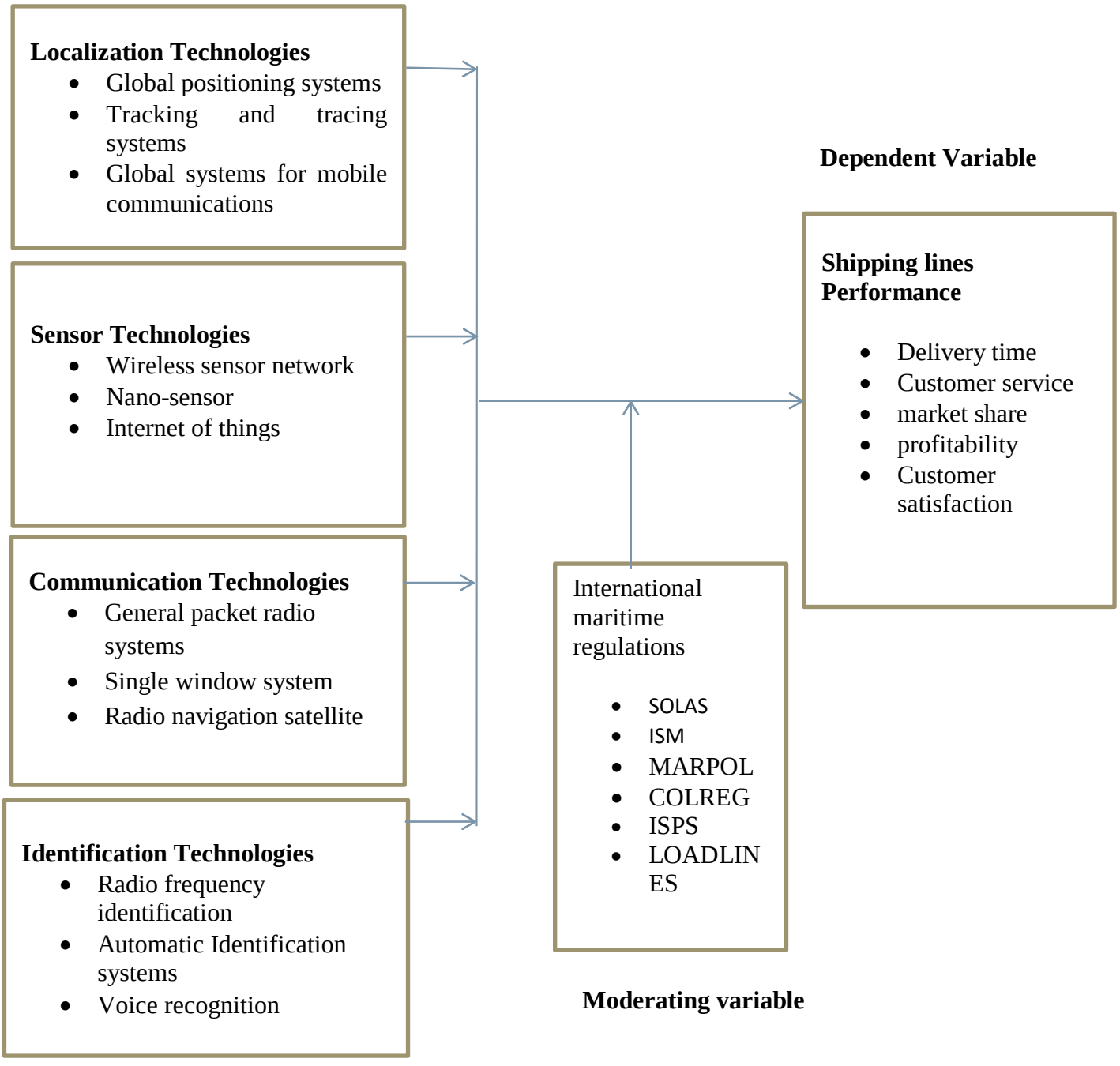


Fig 2.1 Conceptual framework
Source: Researcher (2021)

A conceptual framework provides a detailed explanation of the topic under investigation, presented through visual or spatial representations (Mugenda, 2008). The conceptual framework represented in figure 2.1was adopted from the literature review and used in this study. The conceptual framework had three variables. The independent variable was the supply chain management technologies which had four sub- variables namely; localization technologies, sensor technologies, communication technologies and identification technologies. These supply chain management technologies when well implemented and utilised by the shipping lines are supposed to offer benefits such as: timely delivery, quality customer service, improved market share, increased profitability and customer satisfaction which in this study are the key performance indicators of these firms

International maritime regulations were used as a moderator in the relationship between supply chain management technologies and the performance of shipping lines.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Philosophy

Practical implications influence the selection of a certain philosophical framework for study (Saunders, Lewis & Thornhill, 2012). Philosophical views, they maintained, provide light on the research problems at hand and reveal the best method to address them. Every researcher has their own set of core beliefs that shape their worldview, and these make up their research philosophy. The assumptions made will determine the research strategy and methodology that will be used. There are three primary subfields within research philosophy: ontology, epistemology, and axiology.

a) Ontology

When it comes to ontology, the bedrock is the very nature of being. Both objectivism and subjectivism serve as criteria for categorization. According to objectivists, social objects exist in the world outside of any particular social actor. Social events, according to subjectivists (Saunders, Lewis & Thornhill, 2012), stem from the thoughts and deeds of self-aware persons.

b) Epistemology

"Epistemic domain" means the generally accepted body of knowledge in a certain academic discipline. There are three schools of thought within research philosophy that approach questions of knowledge: positivism, realism, and Interpretivism.

As Lewis (1988) explains, positivism is a school of thought in research that holds that there is no change in the nature of reality. He argues that one can examine reality

objectively and provide an explanation without influencing the thing being studied. The positivist position holds that the measurement of actual social realities may be used to assess hypotheses derived from preexisting ideas. Consequently, the foundations of positivism can be found in the laws and theories of nature. Predictions can be made according to positivist research philosophy by looking at previous observations, clarifying current realities, and comprehending how they are all related.

Hatch and Cunliffe (2006) distinguish positivism from Interpretivism by defining Interpretivism as a perspective commonly referred to as post-positivism. As this theory sees it, people's expectations, past experiences, and memories shape how they understand and make sense of the world. Meaning is thus constructed via one's own unique set of experiences. According to Remenyi et al. (1998), different people have different experiences, hence there can be more than one way of looking at things.

An objective reality separate from human awareness is the premise upon which realism rests. Societal objects and events that do not depend on or exist independently of individuals impact their perception of their surroundings, according to realists (Saunders et al., 2007). Truth, according to realists, can exist independently of evidence since it is subjective and open to interpretation. Realist research posits the possibility of an objective world apart from scientific inquiry and empirical observation. Therefore, it is essential to fully understand the social processes that influence people's viewpoints and behaviors in order to comprehend their socially created meanings and interpretations (Saunders et al., 2007). Taking into account these three research philosophies, the researcher's intended hypothesis will dictate the research philosophy that is chosen. For this study, interpretivism (also called post-positivism) is the best research theory to follow.

c) Axiology

Aesthetics and ethics are the primary foci of this branch of philosophy. This method incorporates the complex procedure of social inquiry. Both the research topic and its implementation are evaluated using the researcher's axiological abilities. For example, the philosopher's guiding principles and the researcher's actual study practices, especially the procedures for gathering and analyzing data, reveal the researcher's philosophical orientation. Still, studies in the social sciences are greatly impacted by this method.

The current study was grounded in positivism, the philosophy of research. As stated by William (2006) and Robert (2008), positivism posits that the objective of knowledge is to merely describe the phenomena that individuals encounter. Methods based on quantitative data are central to the positivist paradigm. Moreover, in order to gauge improvement, pre- and post-tests are administered. In this case, the researcher is not physically present at the site of the investigation but acts as its controller (Taylor and Milton, 2013).

The positivist worldview holds that scientific inquiry provides the best means of discovering and mastering the truth about the universe. Eric (1998) argues that positivism seeks to understand the whole by studying its elements. In order to comprehend and foretell the social environment, positivists seek for regularities and casual correlations. Positive analysis helped bring attention to how international maritime rules moderated the relationship between supply chain management technologies and the performance of Kenyan shipping lines, according to the study.

3.2 Research design

A research design is the backbone of any study, say Roller and Lavrakas (2015). According to Creswell (2005), researchers use an explanatory research design to predict how various study components would interact. In order to reduce the possibility of incorrectly inferring causal correlations from the data, the research approach seeks to examine the types of inquiries that are performed. Using an explanatory research strategy, the study looked at how supply chain management tools affected the efficiency of Kenyan shipping companies. To achieve this, the study estimated the correlations between several facets of SCM tools and the efficiency of shipping companies. According to Kothari (2004), the most effective way to maximize efficiency and knowledge creation in research is with an explanatory research design.

3.3 Study Area

Nairobi and Mombasa were the precise places of the research in Kenya. The locations selected for the study were all within the 53 shipping lines that make calls at the port of Mombasa. Both Mombasa and Nairobi are home to these shipping lines. The majority of international trade is facilitated by shipping lines, which constitute an integral aspect of marine logistics (UNCTAD 2020).

3.4 Target population

It refers to that population that the researcher wants to generalise the results of the study. The target population of this study was made up of the logistic staff, IT staff, sales and marketing staff and finance staff of the shipping lines in Kenya. The decision on the departments to be included in the study was made on the basis of the research study shipping lines' performance which is influenced by supply chain management technologies. The reason behind choosing these staff was that they have crucial

information needed in this research study of establishing required relations. There are 53 shipping lines in Kenya (Kenya Business List Directory, 2021) as shown in appendix IV. The target population of this study is 2835 employees segmented into for department as shown in table 3.1 below

Table 3.1: *Target population*

Department	No. of staff
Logistics	706
Finance	666
Information technology	623
Sales and marketing	840
Total	2835

Source: Kenya Business List Directory 2021

3.5 Sample and sampling procedure

3.5.1 Sample size

For the purpose of obtaining a sample that was considered optimum and needed to make generalisations about the whole population (Table3.1: targeted staff from shipping lines), the sample size was determined using the Yamane (1976) formula. The sample size will be calculated as follows

$$n = N \div 1 + Ne^{(2)}$$

Where n=number of samples

N=total population

e= error tolerance

$n=2835 \div 1+ (2835*0.05^2) = 350$

n=350

In similar studies response rates have ranged between 68% - 80%. (Atieno, 2014 - 68.3%; Abbas, 2016 - 78%: Kilonzi & Kanai, 2020 - 75%). The study provided for non-response in line Sivo et al (2006) who argue that in social sciences that gather data through self-administered questionnaire the response rate is normally 80%. In this study therefore the expected nonresponse rate will be 20% hence the final sample size will be 350/ 0.8 = 437.5

=438

Table 3.2: *Sample size*

Department	No. of staff	n.Xi/N	sample size
Logistics	706	706 ÷ 2835 × 438	109
Finance	666	666 ÷ 2835 × 438	103
Information technology	623	623 ÷ 2835 × 438	96
Sales and marketing	840	840 ÷ 2835 × 438	130
Total	2835		438

Source: Kenya Business List Directory 2021

3.5.2 Sampling frame

This is a list or other device used to determine a researcher's population of interest (Saunders *et al* 2009). The sample frame for this study was shipping lines in Kenya that

totalled to 53 based on business directory (2021). The sampling units are the following four departments: logistics, Information Technology, sales and marketing and finance in these port based logistics firms (shipping lines).

3.5.3 Sampling procedure

Using a basic random sampling technique, 438 respondents were chosen from four strata representing the four departments. Information technology, finance, logistics, and sales and marketing departments of the shipping lines that made up the sample group were surveyed. This method of sampling made guaranteed that every single member of the target population had an equal opportunity to be chosen (Mugenda & Mugenda, 2013).

3.6 Data collection

Data gathered directly from shipping companies was used in the study. The purpose of the questionnaire was to collect information from primary sources alone. The National Council for Science, Technology, and Innovation gave their stamp of approval for this study. In order to undertake research within their businesses, the shipping lines' management had to give their permission.

Both the content of the data gathering instrument and the research needs in general were covered in the training that two research assistants received. During the pilot experiment, researchers followed the assistants so that they could practice administering questionnaires more effectively. A schedule for meeting with study participants was developed by the researcher during the primary investigation. Specific information about the date, time, and place of the survey's administration was supplied in the schedule. Researchers then sent their research assistants to various locations to interview the varied shipping line respondents. The purpose of this research was to analyze the relationship between shipping line performance and supply chain

management technology, with the impact of international maritime norms considered as a moderating variable.

3.6.1 Instrumentation

The information gathered through literature review provided background information on evaluation of supply chain technologies and performance of shipping lines items that enabled the researcher to design a structured questionnaire for the purpose of assessing the shipping lines performance. The questionnaire was designed to gather the information on the various staff perspectives on supply chain management technologies and performance of shipping lines. The questionnaire was made up of seven sections in line with the information required for the study variables as explained below Section A: respondents' background information. i.e. gender, age, department, academic qualifications, professional qualifications and length of stay in shipping lines. Sections B, C, D and E: supply chain management technologies contained questions pertaining to the perception of respondents on their several agreements on various statements representing different aspects use of various supply chain management technologies. Section F: Shipping lines' performance and section G: international maritime regulations.

3.6.1.1 Test of Validity

According to Bashir (2008), validity is the extent to which a test is truthful, accurate, legitimate, genuine, or sound in measuring the constructs it claims to measure. The questionnaire was validated using two forms of validity: content and face validity. To ensure content validity, the researcher asked supervisors to evaluate each construct's elements to see if the entire topic was covered and if the information was supported by the literature that was evaluated. Using factor analysis, we checked if the data was legitimate. Furthermore, two tests were conducted to ensure the data was suitable:

Bartlett's test of sphericity and the Kaiser-Meyer-Olkin test, which estimates the sampling sufficiency. To find out how much each variable explains the other, researchers use the Kaiser-Meyer-Olkin test to estimate the partial correlation. A Kaiser-Meyer-Olkin value greater than 0.5 is required to initiate a good analysis. You can safely disregard any variable with a value lower than 0.5. In accordance with the suggestion made by Chakraborty (2010) Trent et al. (2009), the Kaiser-Meyer-Olkin for each of the variables was more than 0.5.

3.6.1.2 Test of reliability

Heale and Twycross (2016) state that dependability is the extent to which a research instrument measures a phenomenon consistently producing the same results when analyzed again. Furthermore, according to Taherdoost (2016), a reliability test can determine the consistency of a study questionnaire's measurements. Pretesting the questionnaire with a randomly chosen subset of the population allowed us to determine its reliability in this study. The variables' reliability and consistency were assessed using Cronbach's alpha test, a statistical tool. The four independent variables were evaluated for reliability using Cronbach's alpha, a reliability coefficient developed for use in this study. According to Forero (2014), an appropriate coefficient was 0.7 or above. The data were then tabulated. The study findings revealed that all the independent variables exhibited a Cronbach's alpha value of 0.7 or higher, as evidenced in appendix IV. Consequently, the study instrument was deemed to be reliable. The results are recorded in table 3.3.

Table 3.3: *Reliability Test Results*

Variables	Number of items	Cronbach's Alpha
Localization Technology	6	.824
Sensor Technology	6	.710
Communication Technology	6	.757
identification Technology	6	.817
Shipping lines' performance	5	.816

Source: Field Data 2022

As shown in table 3.3 above, all the variables had an internal consistency of more than 0.7. All the variables met the reliability threshold Cronbach's Alpha of 0.7 and this there indicates that the instruments are reliable.

3.6.1.3 Pilot study

In order to determine how reliable the questionnaire was, a pilot study was conducted. The purpose of the pilot study was to ensure that the investigational instruments were reliable. Saunders *et al*. (2009) states that 10% of the sample size is the best amount to use when doing a pilot study. The suggested minimum sample size for the pilot study is 10% of the whole sample size (Monnete, Sullivan and Dejong, 2002). The Mombasa pilot project included six different shipping lines. The majority of shipping lines are located in the Mombasa region, which is why this is the case. For the main study, we did not include any of the companies who participated in the pilot. This helped alleviate maturation-related anxieties about internal validity. In the pilot study, a total of 44 questionnaires were handed out to determine the reliability and validity of the data.

3.6.2 Data Collection Procedure

Through NACOSTI, the researcher was able to secure study approval, and through Kisii University, a letter of introduction was desired. Research assistants helped the researcher deliver questionnaires to study participants. After agreeing upon a date for their collection, the questionnaires were distributed to the respondents. After assuring

respondents that their information would be utilized exclusively for the study, the researcher ensured that the data would be kept confidential.

3.7 Data analysis

Data analysis is defined by Patton (2006) as the methodical procedure of arranging and organizing collected data for the purpose of deriving useful insights from it. Data for the study questionnaire was collected, organized, edited, and analyzed. We used SPSS version 20 to compile and analyze the data using descriptive and inferential statistics. As part of the data analysis procedure, variables were transformed to get computed values. These values were subsequently utilized for regression analysis.

3.7.1 Descriptive data analysis

Quantitative data was collected and analysed using descriptive statistics that was the mean, standard deviation, minimum and maximum. The research data results were presented in tables.

3.7.2 Inferential data analysis

The data was then screened for missing values and outliers. Linear regression was used in testing the formulated hypothesis in order to establish influence of supply chain management technologies on performance of shipping lines and to determine the appropriate model relating shipping lines performance to supply chain management technologies. To test the moderating effect of international maritime regulations on the relationship between technologies and shipping lines' performance hierarchical regression model was used as it had the potential to test moderating influence of international maritime regulations (Tabachnick and Fidell, 2013). Before regression analysis supply chain management technologies were correlated with shipping lines' performance to ascertain whether relationship exists. In the objectives (1-4), multiple

linear regression model was used to determine the effect of localization technologies, sensor technologies, communication technologies and identification technologies on the performance of shipping lines. In the fifth objective, both simple and multiple linear regression models, following the three steps of testing moderation as described by Baron and Kenny (1986) was used. The three steps tested the moderating effect international maritime regulations on relationship between supply chain management technologies and performance of shipping lines. This is an extension to the ordinary multiple regression. Bisbe and Otley (2014) argue that this method is an attempt to improve the standard regression estimates by introducing a third variable to the ordinary regression equation.

3.7.3 Regression Analysis

The general empirical model is

$$\Upsilon = \beta_o + \beta X + \varepsilon$$

In the equation Υ is performance of shipping lines; X in equation represented a vector of the independent variables that were studied,β were the coefficients to be estimated, and β_o was a constant term and ε stood for the composite error term.

In the first four objectives, simple linear regression model was conducted to test for the direct relationship between individual predictors (supply chain management technologies) and the dependent variables (performance of shipping lines in Kenya). This was guided by the specific objectives of the study:

Objective 1: To examine the relationship between localization technologies and performance of shipping lines in Kenya

$\Upsilon = \beta_o + \beta_1 LT + \varepsilon$

Where, Υ= Shipping lines' Performance

β_o = Constant

β_1 = Regression Coefficients

LT = the localization technologies

ε= error term

Objective 2: To examine the relationship between sensor technologies and performance of shipping lines in Kenya

$\Upsilon = \beta_o + \beta_2 ST + \varepsilon$

Where, Υ= Shipping lines' Performance

β_o = Constant

β_2 = Regression Coefficients

ST = the sensor technologies

ε= error term

Objective 3: To examine the relationship between Communication technologies and performance of shipping lines in Kenya

$\Upsilon = \beta_o + \beta_3 CT + \varepsilon$

Where, Υ= Shipping lines' Performance

β_o = Constant

β_3 = Regression Coefficients

CT=communication technologies

ε= error term

Objective 4: To examine the relationship between identification technologies and performance of shipping lines in Kenya

$\Upsilon = \beta_o + \beta_4 IT + \varepsilon$

Where, Υ= Shipping lines' Performance

β_o = Constant

β_4 = Regression Coefficients

IT= the identification technology

ε= error term

Direct model

$\Upsilon=\beta_o+\beta_1 LT+\beta_2 ST+\beta_3 CT+\beta_4 IT+\varepsilon$

Where Υ= performance of shipping lines

B_o= Constant

LT, ST, CT, IT= Independent variables (Localization Technologies, Sensor Technologies, Communication Technologies and Identification technologies)

B_4= Regression coefficients

ε= error term

The extension of the ordinary multiple regression model to estimate international maritime regulations moderating effect on supply chain management technologies and performance of shipping lines followed baron and Kenny (1986) three steps. This gave the set of the following models. The first step estimates the regression model to measure the direct relationship between supply chain management technologies and performance of shipping lines given as

Objective 5: To examine international maritime regulations moderating effect on the relationship between supply chain management technologies and performance of shipping lines in Kenya.

a. To examine the moderating effect of international maritime regulations on the relationship between Localization technologies and performance of shipping lines in Kenya.

   $Y=\beta_o+\beta_1 LT+\beta_1 LTM+\varepsilon$

   Where Υ= performance of shipping lines

   LT= localization technologies is the independent variable

   β_o = Constant(Y intercepts

   β_1= coefficient of the regression

   M= International maritime regulations

   ε= error term

b. To examine the moderating effect of international maritime regulations on the relationship between Sensor technologies and performance of shipping lines in Kenya.

$Y=\beta_o+\beta_2ST+\beta_2STM+\varepsilon$

Where Υ= performance of shipping lines

ST= sensor technologies is the independent variable

β_o = Constant(Y intercepts

β_2= coefficient of the regression

M= International maritime regulations

ε= error term

c. To examine the moderating effect of international maritime regulations on the relationship between communication technologies and performance of shipping lines in Kenya.

$Y=\beta_o+\beta_3CT+\beta_3CTM+\varepsilon$

Where Υ= performance of shipping lines

$_{CT}$= Communication technologies is the independent variable

β_o = Constant(Y intercepts

β_3= coefficient of the regression

M= International maritime regulations

ε= error term

d. To examine the moderating effect of international maritime regulations on the relationship between Identification technologies and performance of shipping lines in Kenya.

$Y=\beta_o+\beta_4IT+\beta_4ITM+\varepsilon$

Where Υ= performance of shipping lines

IT= identification technologies is the independent variable

β_o = Constant(Y intercepts

β_4= coefficient of the regression

M= International maritime regulations

ε= error term

Overall model

$$Y = \beta_o + \beta_1 LT + \beta_2 ST + \beta_3 CT + \beta_4 IT + \beta_1 LTM + \beta_2 STM + \beta_3 CTM + \beta_4 ITM + e$$

Y= Shipping line's performance

β_o = Constant

β_{1-4} =Regression coefficient of the independent variables

LT, ST, CT, IT = Independent variables (Localization, Sensor, Communication and identification technologies

e = margin of error

M = International maritime regulations

e = margin of error

3.7.4 Assumptions of the Regression Model

There are certain assumptions that must be met by a regression model in order to justify its use in assessing the association among study variables. The model was assumed to have met the following conditions: Linearity between dependant and independent variables, normality of the population data, multicollinearity, heteroscedasticity of the errors and autocorrelation. Violating any these conditions would have affected use of robust parametric scores and would have implied use of non-parametric tests that are less robust in providing valid and reliable results.

3.7.4.1 Test for normality

This was conducted on independent variables (the supply chain management technologies) and dependent variable (shipping lines performance). Normality of variables was checked using histogram and Q-Q plots. Q-Q test is one method used to check for normality. The resulting plot should show an approximately straight line with a positive slope of normality, if the data is normally distributed. This was used to test the normality of the various variables of study.

3.7.4.2 Test for multicollinearity

According to Grewal, Cote and Baumgartner (2004) multi collinearity occurs in a situation whereby at least two predicators that are independent variables ate too correlated to provide redundant information about the response. In addition Grewal, Cote and Baumgartner (2004) argue that the more the variable correlate (overlap) the more the inability of the researcher to identify separate effects of the variables. According to Daoud (2020) this may result in some significant variables in a research study appearing to be statistically insignificant. Multicollinearity presence in a research data makes it difficult to tell the influence of one variable from the other variable. Hence it is important to carry out a multi-collinearity test on predicator variables (Localization technologies, Sensor technologies, Communication technologies and Identification technologies) prior to conducting any regression analysis. In this research the Tolerance and Variance Inflation Factors (VIF) statistics were used to carry out this regression analysis assumption. Shrestha (2020) recommends use of variance` inflator factor (VIF) method to test multicollinearity. Using this method if VIF=1, indicated no correlation,1<VIF< 5 indicated moderate correlation and VIF> 5 to 10 indicated high correlation. If there were two variable`s` with VIF of around 5or greater one such variable would have been removed as that indicated presence of multicollinearity.

A variance Inflation Factors (VIF) of less than 10 and a tolerance of more than 0.1 was acceptable. If the Variance Inflation Factors are below 10 and the tolerance scores are above 0.1, it implied that the test had met the minimum threshold for regression analysis to be carried out.

3.7.4.3 Test for heteroscedasticity

According to Green, 2003 and Gujarat, 2003 heteroscedasticity refers to differing variance. Prior to carrying out regression analysis the data was tested for heteroscedasticity (ensuring that data set had constant error variance). When the error variance is not constant then there is heteroscedasticity in the data. Heteroscedasticity hence implies that the variable of errors was not the same across all levels of the independent variable. Heteroscedasticity can lead to serious distortion of findings and can therefore weaken the analysis, thus increasing the possibility of type1 error. In this research study heteroscedasticity had been checked for using Breusch-Pagan/ Cook-Weisberg test.

3.7.4.4 Test for linearity

Linear regression analysis and correlation can only be done when independent and dependent variable relate linearly. According to Owen (2012) this is the reason a linearity test is basic before such an analysis. Osborne and Waters (2002) argued that multiple regressions can correctly examine the relationship between the dependent and independent variables when it has been ascertained that the relationship between the two was linear in nature. If this assumption was violated it would have threatened the significance of parameters measured in the analysis (Keith, 2006). In this research study the test for linearity was done using ANOVA and the p-p plot. When using ANOVA, the measure for linearity was done using the p –value. When p-value is less

than 0.05, the relationship between the dependent and independent variable was taken to be linear. On the other hand if value of p was greater than 0.05 the relationship between the dependent and independent variables was assumed to have deviated from linearity and was not suitable for carrying out regression analysis.

Table 3.4 *Summary of Analytical methods*

Objective	Hypothesis	Analytical Method	Interpretation
i.To examine the relationship between localization technology and performance of shipping lines in Kenya	$H_0$1There is no statistically significant relationship between localization technology and performance of shipping lines in Kenya	$Y=\beta_o+\beta_1 LT+\varepsilon$ Where Y=SLP LT= Localization technologies B_o= Constant(Y intercepts) β_1= coefficient of the regression ε= error term	calculated t values are higher than the critical values at significance ($p<0.05$), then there is significant relationship
ii.To assess the relationship between sensor technology and performance of shipping lines in Kenya	$H_0$2There is no statistically significant relationship between sensor technology and performance of shipping lines in Kenya	$Y=\beta_o+\beta_2 ST+\varepsilon$ Where Y=SLP ST= sensor Technologies B_o= Constant(Y intercepts B_2= coefficient of the regression ε= error term	calculated t values are higher than the critical values at significance ($p<0.05$), then there is significant relationship
iii.To examine the relationship between communication technology and performance of shipping lines in Kenya	$H_0$3There is no statistically significant relationship between communication technology and performance of shipping lines in Kenya	$Y=\beta_o+\beta_3 CT+\varepsilon$ Where Y=SLP CT= Communication Technologies B_o= Constant(Y intercepts B_3= coefficient of the regression ε= error term	calculated t values are higher than the critical values at significance ($p<0.05$), then there is significant relationship

iv.To assess the relationship between identification technology and performance of shipping lines in Kenya	$H_0$4There is no statistically significant relationship between identification technology and performance of shipping lines in Kenya	$Y = \beta_o + \beta_4 IT + \varepsilon$ Where Υ= SLP IT= Identification technologies B_o= Constant(Y intercepts B_4= coefficient of the regression ε= error term	Calculated t values are higher than the critical values at significance ($p<0.05$), then there is significant relationship
v.To examine the moderating effect of International maritime regulations on the relationship between SCMT and performance of shipping lines in Kenya	$H_0$5There is no statistically significant moderating effect of IRMs on the relationship between SCMT and performance of shipping lines in Kenya	$Y = \beta_o + \beta_1 LT + \beta_2 ST + \beta_3 CT + \beta_4 IT + \beta_1 LTM + \beta_2 STM + \beta_3 CTM + \beta_4 ITM + e$ Where Y = Firm's performance β_o = Constant (Y intercepts) β_{1-4} =Regression coefficient LT, ST, CT, IT = SCMT M = IMRs e = margin of error LT,ST,CT, IT*M= Interaction between IMRs and SCMT	calculated t values are higher than the critical values at significance ($p<0.05$), then IMRs have a significant moderating effect
Va) To examine the moderating effect of IMRs on the relationship between LT and performance of shipping lines in Kenya	$H_0$5a International maritime regulations have no statistically significant moderating effect on the relationship between LT and performance of shipping lines in Kenya	$Y = \beta_o + \beta 1 LT + \beta 1 LT * M + \varepsilon$ Where Υ= SLP LT= Localization technologies B_o= coefficient of the constant B_1=Regression coefficient or change induced in	calculated t values are higher than the critical values at significance ($p<0.05$), then IMRs have a significant moderating effect

		LT*M M=IMRs LTM= interaction between LT and IMRs ε= error term	
Vb) To examine the moderating effect of IMRs on the relationship between ST and performance of shipping lines in Kenya	$H_0$5b International maritime regulations have no statistically significant moderating effect on the relationship between ST and performance of shipping lines in Kenya	$Y = \beta_o + \beta 2ST_+ \beta 2ST_*M + \varepsilon$ Where Υ= SLP ST= Sensor technologies B_o= coefficient of the constant B_1=Regression coefficient or change induced in STM M=IMRs ST*M= interaction between ST and IMRs ε= error term	Calculated t values are higher than the critical values at significance ($p<0.05$), then IMRs have a significant moderating effect
Vc) To examine the moderating effect of IMRs on the relationship between CT and performance of shipping lines in Kenya	$H_0$5c International maritime regulations have no statistically significant moderating effect on the relationship between CT and performance of shipping lines in Kenya	$Y = \beta_o + \beta 3CT \beta 3CT_*M + \varepsilon$ Where Υ= SLP Communication Technologies B_o= coefficient of the constant B_1=Regression coefficient or change induced in X_3M M=IMRs CT*M= interaction between CT and IMRs	calculated t values are higher than the critical values at significance ($p<0.05$), then IMRs have a significant moderating effect

		ε= error term	
Vd) To examine the moderating effect of IMRs on the relationship between IT and performance of shipping lines in Kenya	$H_0$5d International maritime regulations have no statistically significant moderating effect on the relationship between IT and performance of shipping lines in Kenya	$Y = \beta_o + \beta IT_{4+} \beta 1 IT * M + \varepsilon$ Where ϒ= SLP IT= Identification technologies B_o= coefficient of the constant B_4=Regression coefficient or change induced in ITM M=IMRs IT*M= interaction between IT and IMRs ε= error term	calculated t values are higher than the critical values at significance ($p<0.05$), then IMRs have a significant moderating effect

Source: researcher 2022

3.8 Ethical Considerations

Confidentiality, anonymity, and the importance of willing involvement were all factors taken into account while discussing ethical concerns.

The participants' identities were not used in any way throughout data collection, and their actual ages were withheld to maintain the confidentiality of the research. The researcher analyzed the data independently, and the results were utilized only for this study, in accordance with the guidelines set forth by the Research Ethics board (2015). There was training for the research assistants on how to keep the information they collected private. In order to protect participants' identity, the data was evaluated collectively rather than at the level of each individual participant. Additionally, the participant's organization's name was withheld. Finally, the research questionnaire items were prepared in a way that would not pressure participants into answering,

ensuring their voluntary involvement. Financial incentives or preferential treatment were not offered or promised by the researcher either.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Response Rate

The total number of respondents that were targeted for this study was 438. Only 385 of the 438 questionnaires that were issued were both filled out and returned, while 53 of the questionnaires were not returned. The study results were as presented in table 4.1.

Table 4.1: *Response Rate*

Sample size	Number	Percentage
Questionnaires Distributed	438	100
Questionnaires returned	385	87.89
Questionnaires not returned	53	12.11

Source: Field data 2022

Sivo *et al.* (2006) advocated for a response rate of at least 80 percent, and the data indicate that this number was far higher than that. Due to the sensitive nature of the information that was sought from these organizations, the response rate might also be considered high. This is because the information could reveal the secret topics that were being handled by the organization. It is possible that the high response rate can be linked to the assurance that was provided in the introduction letter that the data that was being collected would only be utilized for academic purposes and that confidentiality would be protected.

4.2 Data screening and Preparation

4.2.1Analysis of Data entry Errors

The data from the questionnaires that were answered was entered into SPSS software Version 20 for further analysis. Twenty-five (25) questionnaires that could not be used were classified as data entry areas.

4.2.2 Analysis of outliers

Tabachnick and Fidel (2013) define outliers as very abnormal values in a study, resulting from either inaccurate data entry or significant variations in measurements. Anomalies can also be described as observations that deviate significantly from the other values in a random sample taken from a research population. According to Garson (2012), outliers should not be applied to the entire population and can result in erroneous findings and conclusions regarding a study population. No outliers were detected in the collected data.

4.2.3 Analysis of missing data

Masconi, Matsha, EchonffoTchengui, Rajit and Kengue (2015) contend that social research is often marked by these values, which might result in a decrease in statistical power and subsequently lead to inappropriate references. Tabachnick and Fidel (2013) assert that missing data greatly impact the conclusions that can be derived from the collected data. As shown in table 4.2 section B had 2missing values, C had 1 missing value, E had 3 missing values and G had 4

Table 4.2: *missing values*

Section with missing values	No. of values missing	Percentage
B	2	0.6
C	1	0.3
E	3	0.8
G	4	1.1
Total	10	2.8

Source: Field data 2022

Hair et al (2013) asserted that if the proportion of missing data is less than 5% of the sample size, it is possible to include those missing values in the analysis by using the mean of the available data. The research study had a minor amount of missing values, specifically 2.8%, which was below the threshold of 5% in each area. The missing values were replaced with means, as recommended by Hair et al (2013) and Tabachnick and Fidel (2013). Following the completion of data screening on the 385 questionnaires received, a total of 360 respondents were retained and used for the analysis.

4.3 Demographic characteristics of the respondents

Respondents' demographic characteristics in this study included gender, age, department worked in the institution, academic qualification, professional qualification and period of time worked in the organization. Demographic data offers information about respondents as well as defining the participants who are in the study and are a representative of target population with an intention to generalize the outcome of the research. This information was important in explaining the degree to which personal factors may influence the use of supply chain management technologies and the subsequent performance of shipping lines.

4.3.1 Gender of Respondents

The researcher sought to find out the gender distribution of employees in the shipping lines industry. This was included in the questions that were posed to the respondents in the questionnaire. The findings are presented in table 4.3

Table 4.3: *Respondents' Gender*

Characteristics	Description	Frequency	Percentage
Gender	Male	224	62.2
	Female	136	37.8
	Total	360	100

Source: Field Data 2022

The data presented in Table 4.3 indicates that out of the 360 respondents in this study, 224 were male, representing 62.2% of the total, while 136 were female, accounting for 37.8%. It is crucial to determine the degree to which the gender makeup can impact the adoption of supply chain management technology by shipping lines and their subsequent performance.

4.3.2 Age of respondents

The researcher aimed to find out the composition of respondents in terms of age. Results are presented in table 4.4

Table 4.4: *Age of respondents*

Characteristics	Description	Frequency	Percentage
Age in years	Below 25	30	8.3
	25-34	141	39.2
	35-44	148	41.1
	45-54	37	10.3
	55 & above	4	1.1
	Total	360	100

Source: Field Data 2022

Question two on demographic characteristics was requesting the research respondents to indicate their age brackets. The researcher's aimed at analysing the composition of employees working for shipping lines in terms of age. The findings showed that majority of the employees in the four departments in the shipping lines were aged between 35-44 years which translates to 41.1 %. That was closely followed by those aged between 25-34 years accounting for 39.2 %. The third group were those aged between 45-54 years at 10'3%; the second last group of employees were those aged below 25 years and the last group were employees aged 55 years and above at 1.1 %.. The findings showed that most of the employees in the four departments of the shipping lines were youthful below the age of 45 accounting for 88.6 % of the respondents. The findings of the study therefore suggest that the logistics, IT, finance, sale and marketing departments of shipping lines in Kenya were made up of the most active group of employees in the population.

4.3.3 Department of the Respondents

In question 3 of the research questionnaire, the researcher asked the respondent to specify the department in which they are employed at their shipping companies. This

guaranteed that the researcher obtained the pertinent information from the qualified personnel required for the study.

Table 4.5: *Respondents' Department*

Characteristics	Description	Frequency	Percentage
Department	Logistics	123	34.2
	IT	80	22.2
	Finance	70	19.4
	Sales & Marketing	87	24.2
	Total	360	100

Source: Field Data 2022

The findings showed that the majority of the respondents were from the logistics department who were 123 out of 360 respondents accounting for 34.2 %, sales and marketing department was second with 87 respondents at 24.2 %, third was the IT department with 80 respondents at 22.2 % and forth was the finance department accounting for 70 at19.4 %. This indicated that the individuals who completed the research questionnaires were knowledgeable about the information needed for the study.

4.3.4 Respondents' Academic Qualifications

In question 4 the research targeted to find out the academic qualifications of the respondents. Academic qualifications were divided into four (Diploma, Degree, Masters and PHD). This was meant to assist the researcher to determine the quality of information she expected to collect from the respondents

Table 4.6: *Respondents' Academic Qualifications*

Characteristics	Description	Frequency	Percentage
Academic qualifications	Diploma	110	30.6
	Degree	215	59.7
	Masters	35	9.7
	PHD	0	0
	Total	360	100

Source: Field Data 2022

The findings showed that the majority of the employees in the four departments of shipping lines 215 out of a sample of 360 at 59.7 % had degrees, The second category were diploma holders 110 accounting for 30.6% of the respondents. Masters holders were 35 at 9.7 % whereas none of the respondents had PHD. Employees in those four departments in shipping lines in Kenya had degrees and above at 69.4 %. This showed that the employees were knowledgeable enough to comprehend various technologies utilised in their companies' operations.

4.3.5 Respondents' professional Qualifications

Question 5 was used to assess the professional qualifications of the respondents. The professional qualifications were divided into four based on the departments (KISM, CISCO, CLEARING & FORWARDING, CPA). This was meant to assist the researcher to determine the quality of information expected to be collected from the respondents.

Table 4.7: *Respondents' professional Qualifications*

Characteristics	Description	Frequency	Percentage
Professional Qualifications	KISM	17	4.722
	CPA	36	10
	Clearing & Forwarding	21	5.833
	CISCO	30	8.333
	None	256	71.112
	Total	360	100

Source: Field Data 2022

The findings indicated that the majority of the respondents 256 out of 360 at 71.1 % did not have professional qualifications. 36 respondents who accounted for 10% had done CPA, 30 respondents at 8.3 % had done CISCO, 21respondents at 5.8 % had done clearing and forwarding and 17 respondents at 4.7% had done professional courses at KISM. The low number of professional qualifications among the employees could be resulting to the utilization of supply chain management technologies and the subsequent pe3rformance.

4.3.6 Respondents' Length of stay

The researcher in question 6 aimed to examine period of time in terms of years that respondents had been working for the shipping lines. This information was relevant in determining their level of understanding of the operations taking place in the shipping lines.

Table 4.8: *Respondents' Length of stay*

Characteristics	Description	Frequency	Percentage
Length of stay in years	Below 5	111	30.8
	5-10	180	50.0
	Over 10	69	19.2
	Total	360	100

Source: Field Data 2022

The findings in table 4.8 showed periods of time employees had been working for the shipping lines companies. Results showed that majority of them 180 which account for 50% had worked between 5-10 years. Those were followed by 111 at 30.8% who had worked in the shipping lines for less than 5 years. Those who had worked in the shipping lines for over10 years were 69 at 19.2 %. This showed that majority of the respondents 249 at 69.2 % had been in the shipping lines long enough to understand the activities going on in these shipping lines and hence were able to provide useful information regarding supply chain management technologies utilized by the shipping lines

4.4 Descriptive Statistics

The descriptive statistics entailed the use of minimum, maximum, mean, standard deviation, skewness and kurtosis to explain results of the study. The aim of the research was to examine the relationship between supply chain management technologies and performance of shipping lines in Kenya; the moderating effect of international maritime regulations. The information on supply chain management technologies, shipping lines performance and international maritime regulations was collected from the respondents by use of questionnaire.

The study's results were displayed through tables that offered the minimum, maximum, mean, standard deviation, skewness, and kurtosis. The minimum value represents the lowest score, while the maximum value represents the highest score. The mean values were utilized to indicate the direction of the average responses, while the standard deviation was employed to provide an indicator of the average distance from the mean. A low standard deviation indicates that the majority of the observations are closely clustered around the observed mean. Skewness measures the degree to which the distribution of values deviates from symmetry around the average, while kurtosis measures the flatness or peakedness of the distribution. This further demonstrated that the responses to a particular question were largely consistent among all of the respondents.

4.4.1 Supply Chain management Technologies

4. 4. 1.1 Localization Technologies

The technologies classified as localization include Global Systems for Mobile Communication (GSM), tracking and tracing systems, and Global Positioning Systems (GPS). Their primary function is to minimize delays, provide real-time tracking of shipment location throughout transit, precisely anticipate lead time, monitor vessel movements, and chart the route (Bolte & Goll, 2020) and (Lukhoba, 2014). The research aimed to assess the adequacy and utilization these technologies among the shipping lines in Kenya. Table 4.9 presented an analysis of answers given by the research respondents on various aspects

Table 4.9: *LT descriptive statistics results*

Statement	N	Min	Max	Mean	Std. dev	Skewness	Kurtosis
GPS are widely used in your firm operations as localization technology	360	1	5	2.92	1.224	-.069	-.920
GPS are sufficient for shipment positioning and lead time forecast	360	1	5	3.11	1.061	-.494	-.418
TTS are widely used in your firm operations as a localization technology	360	1	5	3.01	1.310	-.170	-1.134
TTS are sufficient to track vessel and notify route deviation by the vessel operator	360	1	5	3.02	1.436	-.172	-1.358
There is use of GSM as localization technologies in your firm in operation	360	1	5	3.07	1.394	-.216	-1.304
GSM are adequate technologies in planning and scheduling route	360	1	5	3.23	1.560	-.237	-1.492
Overall Score	360			3.06	1.331	-0.2263	-1.1043

Source: field data 2022

Results showed that several of the respondents who answered agreed GPS are widely used in their firms operations as localization technologies (M= 2.92 SD=1.224). Many more respondents agreed GPS are sufficient for shipment positioning (M=3.11 SD=1.06). Many of those who responded agreed TTS are widely used in firms operations as localization technologies (M=3.01 SD=1.310). Majority agreed TTS are sufficient to track vessels and notify route change (M= 3.02 SD=1.436). Similarly

results indicated GSM are widely used as a localization technologies in your firm in operation (M=3.07 SD=1.394). In addition results showed that GSM are adequate localization technology for route mapping (M= 3.23 SD=1.560). These findings are supported by Michaelides *et al* (2010), Tesfaye (2014) and Muchaendepi *et al* (2018) who in their study contended that use of these technologies enable cargo positioning, vessel tracking as well as route planning and scheduling

The skewness values obtained from table 4.9 did not exhibit any outliers or excessive values. Instead, they fell within the range of -2 and +1, indicating that the data followed a normal distribution. The results also revealed a negative skewness, with an overall score value of -0.2263, indicating that the distribution had a somewhat longer tail on the left side compared to the right side. As a result, there were fewer responses leaning towards one compared to those leaning towards five. Thus, the observations had a nearly symmetrical distribution. The results also indicated that the Kurtosis value did not have any outliers and were not too high or low. The values were within the range of -2 and +1, suggesting that the data was fairly symmetrical. The Kurtosis score of -1.1043 indicates that the data has a platykurtic shape, meaning it is right-tailed and has a lower peak than a normal distribution. Consequently, the data had a normal distribution. The results also showed a standard deviation of 1.331 for the overall score, indicating that the sub variables of localization technology were not spread apart. This indicated a strong level of internal consistency in measuring the same notion, namely Localization Technology. The overall results of the study on localization technology indicate an average score of 3.06 and a standard deviation of 1.331. The standard deviation of 1.331 suggests that there were variations in the respondents' answers regarding the extent to which localization technology affected the performance of

shipping lines. The average score of 3.06 indicated that shipping companies in Kenya are using localization technology to enhance their performance.

4.4.1.2 Sensor technologies

Sensor technology includes wireless sensor networks, nano sensors, and the internet of things. These technologies can be utilized for the surveillance of many environmental parameters, including temperature, humidity, shocks, and gases in shipping containers and vessels. They are capable of recording and storing such information (Skorna *et al*, 2011 and Diallo and Sene, 2012). The study aimed to assess application of these technologies in the organization and their effectiveness in cargo tampering, notifying cargo diversion, detect fault in goods and contributing to performance of shipping lines. Table4.10 presented an analysis of the answers given by research respondents on various aspects

Table 4.10 *Descriptive statistics results on Sensor technologies*

Statement	N	Min	Max	Mean	Std. Dev	Skewness	Kurtosis
The WSN are highly utilized by your company as a sensor technology in its operations	360	1	5	3.55	1.025	-1.002	.531
WSN are adequate sensor technology for monitoring environmental conditions that are risky to goods during transportation	360	1	5	3.70	.765	1.304	2.473
There is high utilization of Nano sensors by your organization in its operations	360	1	5	3.87	.835	-.103	-.758
Nano sensors are adequate technology for avoiding cargo tampering during transportation	360	1	5	3.82	.962	-.540	.033
IOT as a sensor technology is utilized by your firm in its operation	360	1	5	4.15	.857	-1.333	2.364
IOT is adequate technology for detecting fault in goods	360	1	5	4.31	.760	-1.132	1.482
Overall score	360			3.9	0.8673	-0.9023	1.0208

Source: field Data 2022

Table 4.10 showed that those who responded agreed that the WSN (wireless sensor network) are highly utilized by your company as a sensor technology in its operations (M=3.55 SD=1.025).Further the results indicated that majority of the respondents agreed that WSN are adequate sensor technology for monitoring environmental conditions that are risky to goods during transportation (M= 3.70 SD=0.765).

Similarly the results indicated that there is high utilization of Nano sensors by your organization in its operations (M=3.87 SD=.835). In addition results showed that Nano sensors are adequate technology for avoiding cargo tampering during transportation (M= 3.82 SD= .962). Several on the respondents who answered agreed that IOT as a sensor technology is utilized by your firm in its operation (M= 4.15 SD= .857). Many more respondents agreed that IOT is adequate technology for detecting fault in goods (M= 4.31 SD= .760).

The skewness values obtained from table 4.10 did not exhibit any outliers or excessive values. Instead, they fell within the range of -2 and +1, indicating that the data followed a normal distribution. The data also revealed skewness, with an overall score of -0.9023, indicating that the distribution had a somewhat longer tail on the left side compared to the right side. This resulted in a lower frequency of replies leaning towards one compared to those leaning towards five. Thus, the observations had a nearly symmetrical distribution. The results also indicated that the Kurtosis value did not have any outliers and were not too high or low. The values fell within the range of -2 and +2, suggesting that the data was fairly symmetrical. The Kurtosis value of +1.0208 indicates that the data has a platykurtic form, meaning it is right-tailed. This value is below 3, which is the threshold for determining the shape of the data. Therefore, the data followed a normal distribution. The results also demonstrated a standard deviation of 0.8673 for the total score, suggesting that the sub variables of sensor technology were not widely spread. This indicated a strong level of internal consistency in measuring the same notion, specifically sensor technology. Overall, the different study items on sensor technology had an average score of 3.9 and a standard deviation of 0.8673. The presence of a standard deviation of 0.8673 suggests that there were variations in the responses of the participants on the extent to which sensor

technology impacted the performance of shipping lines. The average score of 3.9 indicates that shipping companies in Kenya are using sensor technologies to enhance their performance.

The findings align with the research conducted by Shaik, Kamble & Siddharath (2021), which suggests that the utilization of sensor technology has a beneficial impact on both shipping efficiency and safety.

Evidence from studies conducted by Agrifoglio, Cannavale, Laurenza and Metallo (2017) and Hiekata, Wanaka, Mitsuyuki and Ueno (2020) suggests that this technology can greatly improve the profitability and overall performance of the maritime business. The findings are in line with those of Skorna, Bode, and Weiss (2011), who found that shipping companies can improve their overall performance by using this technology to detect cases of cargo tampering during transportation. This is in accordance with the findings of Himanka (2016), Kuma (2016), and Mugambi (2017), who all stated that these technologies improved shipping lines' operations. In particular, these methods were discovered to enhance security while simultaneously decreasing inspection time.

4.4.1.3 Communication technologies

Communication technologies encompass General Packet Radio System, Single Window System and Radio Navigation Satellite. These technologies are effective in relaying real time information that is required during cargo transportation process to the parties involved. The researcher purposed to assess the application of these technologies in the organization and their effectiveness in relaying real time information, connecting virtual and physical flow of goods and keeping customers

informed. The sampled responses in relation to communication technologies have been assessed and presented in table4.11

Table 4.11: *Descriptive statistics Results on Communication Technologies*

Statement	N	Min	Max	Mean	Std. Dev	Skewness	Kurtosis
There is use GPRS by your firm in its Operations	360	1	5	3.63	.956	-.811	.425
GPRS are adequate in relying real time information in your firm	360	1	5	3.72	.836	-1.065	1.773
There is utilization of SWS is as a communication technology by your firm in its operation	360	1	5	3.70	.949	-.900	.797
SWS are adequate for connecting virtual and physical flow of goods	360	2	5	3.93	.695	-.207	-.166
There is use of RNS as a communication technology in your organization	360	2	5	4.34	.741	-.891	.219
RNS are adequate in sharing of information and keeping customers informed	360	2	5	4.39	.700	-.860	.064
Overall score	360			3.951	0.8128	-0.789	0.5187

Source: field Data 2022

Table 4.11 showed that those who responded agreed that there is use GPRS by your firm in its Operations (M=3.63 SD= .956).Further many agreed that GPRS are adequate in relying real time information in your firm (M= 3.72 SD=0.836). Similarly the results indicated that there is utilization of SWS is as a communication technology by your

firm in its operation (M=3.70 SD=.949). In addition results showed that SWS are adequate for connecting virtual and physical flow of goods (M= 3.93 SD= .695). Several who answered agreed that there is utilization of RNS as a communication technology in your organization (M= 4.34 SD= .741). Many more respondents agreed that RNS are adequate in sharing of information and keeping customers informed (M= 4.39 SD= .700).

The skewness values obtained from table 4.11 did not exhibit any outliers or excessive values. Instead, they fell within the range of -2 and +1, indicating that the data followed a normal distribution. The results also revealed a negative skewness with an overall score of -0.789, indicating that the distribution had a somewhat longer tail on the left side compared to the right side. This implies that there were fewer responses leaning towards one compared to those leaning towards five. Thus, the observations exhibited a near-perfect symmetry. The results also indicated that the Kurtosis value did not have any outliers and were not too high or low. The values fell within the range of -2 and +2, suggesting that the data was fairly symmetrical. The Kurtosis score of 0.5187 indicates that the data has a platykurtic shape, meaning it is right-tailed and has a flatter distribution compared to a normal distribution. Therefore, the data followed a normal distribution. The results also demonstrated a standard deviation of 0.8128 for the total score, suggesting that the sub variables of communication technology were not widely spread. This analysis demonstrated a strong level of internal consistency in measuring the idea of communication technology. Overall, the different survey items on communication technology had an average score of 3.951 and a standard deviation of 0.8128. The presence of a standard deviation of 0.8128 suggests that there were variations in the responses of the participants on the extent to which communication technology affected the

performance of shipping lines. The average score of 3.951 indicates that shipping companies in Kenya are effectively using communication technologies to enhance their performance.

Consistent with this finding is the work of Bauk, Kapidani, and Schmeink (2017), who postulated that communication technology improves shipping performance by facilitating the transmission of real-time data. Consistent with previous studies, these results show that the maritime industry's operational efficiency has improved thanks to the use of communication technologies (Ayantoyinbo, 2015; Mlimbila and Mbamba, 2018). This is in line with the findings of Kyomo (2019), Atieno (2014), and Kithia (2015), who all stated that shipping line performance is positively correlated with the use of communication technology. This is accomplished by properly notifying clients ahead of time. This agrees with the findings of the studies conducted by Abbas (2016) and Gakuubi (2018), which showed that shipping lines' performance improved when they used communication technologies.

4.4.1.4 Identification technologies

Identification technologies include Radio Frequency Identification technology, Automatic Identification Systems and voice Recognition. These technologies are important in helping to clearly identify the goods being transported. The development of identification technology contributes to fulfilling the growing demands of identifying and inspecting cargo being transported. The researcher purposed to examine application of these technologies in the organization and their effectiveness in cargo identification, inspection and clearance contributing to shipping line performance. The sampled responses in relation to identification technology have been assessed and presented in table4.12

Table 4.12: *Descriptive statistics Results on Identification Technologies*

Statement	N	Min	Max	Mean	Std. Dev	Skewness	Kurtosis
RFID is highly utilized by your firm as an identification technology in its operations	360	1	5	3.95	.952	-1.027	.684
Radio Frequency Identification is adequate for identifying goods being transported	360	1	5	3.73	.741	-1.137	2.341
AIS are highly utilized by your firm as an identification technology in its operations	360	1	5	3.82	.916	-.277	-.515
Automatic identification systems are adequate in carrying out inspection of shipment	360	1	5	3.91	.964	-.456	-.580
VR is highly utilized by your firm as an identification technology in its operations	360	2	5	4.09	.674	-.437	.365
VR is adequate identification technology for your firm's performance	360	2	5	4.40	.677	-.861	.249
Overall score	360			3.923	0.8208	-0.6985	0.424

Source: field Data 2022

Table 4.12 indicated that those who responded agreed that RFID is highly utilized by your firm as an identification technology in its operations (M=3.95 SD= .952).Further

results indicated that majority of the respondents agreed that Radio Frequency Identification is adequate for identifying goods being transported (M= 3.73 SD=0.741). Similarly the results indicated that AIS are highly utilized by your firm as an identification technology in its operations (M=3.82 SD=.916). In addition results showed that Automatic identification systems are adequate in carrying out inspection of shipment (M= 3.91 SD= .964). Several of the respondents who answered agreed that VR is highly utilized by your firm as an identification technology in its operations (M= 4.09 SD= .674). Many more respondents agreed that VR is adequate identification technology for your firm's performance (M= 4.40 SD= .677).

The skewness values obtained from table 4.12 did not exhibit any outliers or excessive values. Instead, they fell within the range of -2 and +1, indicating that the data followed a normal distribution. The results also revealed a negative skewness with an overall score value of -0.6985, indicating that the distribution had a somewhat longer tail on the left side compared to the right side. This resulted in a lower frequency of replies leaning towards one compared to those leaning towards five. Therefore, the observations had a nearly symmetrical distribution. The results also indicated that the Kurtosis value did not have any outliers and were not too high or low. The values were within the range of -2 and +1, suggesting that the data was fairly symmetrical. The Kurtosis score of 0.424 indicates that the data has a platykurtic shape, meaning it is right-tailed and has a lower peak than a normal distribution. Consequently, the data had a normal distribution. The results also showed that the overall score had a standard deviation value of 0.8208, indicating that the sub variables of identification technology were not spread apart. This indicated a strong level of internal consistency in measuring the same idea, specifically identifying technology. Overall, the different study items on identifying technologies had an average score of 3.923 and a standard deviation of

0.8128. The presence of a standard deviation of 0.8208 suggests that there were variations in the responses of the participants on the extent to which identifying technology impacted the performance of shipping lines. The average score of 3.923 indicates that shipping lines in Kenya are utilizing identifying technologies to enhance their performance.

This is in line with the findings of Niraj (2019), who found that shipping performance is improved by using identifying technologies, which save time. These results are in agreement with those of Siror, Liang, and Pang (2010) and U-Thong, Jaturat, and Kingsida (2020), who both found that shipping line performance is positively affected by Radio Frequency Identification technology to the tune of 0.001. Dhar (2016), Kahyarara (2018), and Oduma & Shale (2019) all agree that logistics companies can benefit from using automated identification system technology to boost their performance. Minimizing delays in cargo clearance and reducing container dwell time accomplish this. Consistent with this finding is the work of Last (2016), who posited that shipping line performance is positively correlated with communication technology usage. Predicting vessel movements, visualizing uncertainty, and preventing collisions all contribute to this goal.

4.4.2 Performance of shipping lines

Metrics used to evaluate the performance of shipping lines encompass the reduction of operational costs, decreased delivery time, enhanced customer service, heightened profitability, expanded market share, and greater customer satisfaction (Sadovaya, 2015 and Karibo, 2019). Table 4.13 presented the various respondents' views

Table 4.13: *SLP results for descriptive statistics*

Statement	N	Min.	Max.	Mean	Std. Dev	Skewness	Kurtosis
Increased market share is a suitable key performance indicator	360	1	5	4.29	.625	-.513	.402
Your firm uses profitability as a critical success factor	360	1	5	4.31	.707	-.675	-.213
Improved customer service is an adequate key performance indicator	360	2	5	4.27	.679	-.720	.660
Customer satisfaction has improved in your firm	360	3	5	4.45	.571	-.424	-.760
Reduced delivery time has been witnessed in your firm	360	1	5	4.05	.750	-.803	.922
Overall score	360			4.274	0.6664	-0.627	0.2004

Source: field data 2022

In line with table 4.13 respondents agreed increased market share is a key performance indicator (M= 4.29 SD=0.625). Results showed improved profitability was adequate critical success factor for the organization (M= 4.27 SD= .679).Similarly findings revealed that use of these technologies has made your Firm to improved customer service (M=4.31 SD=.707). Several of the respondents who answered agreed that Customer satisfaction has been improved (M= 4.45 SD= .571). Those who responded agreed reduced delivery time has been witnessed in the firm (M= 4.05 SD= .750).

The skewness values derived from table 4.13 did not exhibit any outliers or excessive values. Instead, they fell within the range of -2 and +1, indicating that the data followed a normal distribution. The results also revealed a negative skewness with an overall score of -0.627, indicating that the distribution had a somewhat longer tail on the left side compared to the right side. This resulted in a lower frequency of replies leaning towards one compared to those leaning towards five. Thus, the observations exhibited a near-perfect symmetry. The results also indicated that the Kurtosis value did not have any outliers and were not too high or low. The values were within the range of -2 and +1, suggesting that the data was fairly symmetrical. The Kurtosis value of 0.0.2004 was less than 3, indicating that the data had a right-tailed distribution and a platykurtic shape. Therefore, the data followed a normal distribution. The results also suggested a standard deviation, with an overall score standard deviation value of 0.6664, which suggests that the performance sub variables of all the shipping lines were not widely spread. This indicated a strong level of internal consistency in measuring the same idea, specifically the performance of shipping lines. Overall, the many study measures of shipping lines performance indicated a collective average of 4.274 and a standard deviation of 0.8128. The presence of a standard deviation of 0.6664 suggests that there were variations in the responses of the participants on the extent to which the performance of shipping lines has changed after the implementation of these technologies. The average score of 4.274 indicates that shipping lines in Kenya are enhancing their performance.

The study conducted by Karibo (2019) found that the use of supply chain management technology greatly improved shipping performance. Specifically, there was a favorable impact of 0.982 on timely delivery and 0.964 on greater sales.

This is in accordance with the findings of Ojwang's study, which indicated that shipping lines may make better use of technology to improve their efficiency. This is because technology can reduce shipment arrival times, improve service quality, and provide timely feedback. Njagi, Namusonge, and Mugambi (2016) state that shipping businesses' success, particularly their profitability, is directly related to how they use technology.

4.4.3 International Maritime Regulations

These encompass the various convention that govern the maritime industry more soi the shipping industry. These convention are stipulated by international maritime organization to regulate this industry. Each of these conventions has got a specific function which the ship charterer must adhere to. The respondents' views are presented in table 4.14

Table 4.14: *IRMs results for descriptive statistics*

Statement	N	Min	Max	Mean	Std. Dev	Skewness	Kurtosis
Your firm adheres to SOLAS convention	360	1	5	4.15	.938	-1.380	1.743
ISM convention is adhered to by your firm during operations	360	1	5	4.23	.705	-.987	2.227
Your organization adheres to MARPOL convention in its operations	360	1	5	4.29	.837	-1.697	4.024
Your company adheres to COLREG convention in its operations	360	1	5	4.38	.812	-1.805	4.478
Your organization adheres to LOADLINES convention during its operations	360	1	5	4.34	.815	-1.310	1.737
ISPS is adhered to by your firm in its operations	360	1	5	4.40	.753	-1.810	5.101
Overall score	360			4.298	0.810	-1.4981	3.2183

Source: field Data 2022

Table 4.14 indicated that those who responded agreed that your organization adheres to SOLAS convention in its operations (M=4.15 SD= .938). Additionally. respondents agreed that ISM adherence affects your operations and consequently affects performance (M= 4.23 SD=0.705). Similarly the results indicated that MARPOL convention is adhered to by your company in its operations (M=4.29 SD=.837). In addition results showed that your organization strictly observes COLREG convention (M= 4.38 SD= .837). Several of the respondents who answered agreed that your organization adheres to LOADLINES convention during its operations (M= 4.34 SD= .815). Many more respondents agreed that your organization adheres to ISPS convention in its operations (M= 4.40 SD= .753).

The skewness values derived from table 4.14 did not exhibit any outliers or excessive values. Instead, they fell within the range of -2 and +1, indicating that the data followed a normal distribution. The data also revealed skewness, with an overall score of -1.4981, indicating that the distribution had a somewhat longer tail on the left side compared to the right side. Consequently, there were fewer responses leaning towards one compared to those leaning towards five. Thus, the observations had a nearly symmetrical distribution. The results also indicated that the Kurtosis value did not have any outliers and were not excessively high, falling within the range of -2 and +1. This suggests that the data was essentially symmetrical. The Kurtosis score of 3.2183 indicates that the data has a platykurtic shape, meaning it is right-tailed and has a lower peak compared to a normal distribution. Consequently, the data had a normal distribution. The results also suggested a standard deviation of 0.810 for the overall score, suggesting that the sub variables of international maritime norms were not widely scattered. This analysis demonstrated a strong level of internal consistency in measuring the idea of international maritime norms. Overall, the different study items on identifying technology had an average score of 4.298 and a standard deviation of 0.810. The presence of a standard deviation of 0.810 suggests that there were variations in the responses of the participants on the extent to which international maritime regulations influenced the relationship between the two variables being studied. The average score of 4.298 indicates that shipping lines in Kenya are complying with international maritime standards.

This aligns with the researchers conducted by Van et al (2019) and Brewer (2021) which suggested that these conventions play a substantial role in modulating the interaction between the two entities.

4.5 Correlation Analysis

This phenomenon was employed in the study to assess the magnitude of the linear association between the variables. It ranges from positive one to negative one, with positive one representing a significant positive relation, negative one representing a significant negative relation, and 0 indicating no link between the variables being studied. Values approaching 0 imply a weak correlation. Outcome is as shown in table 4.15

Table 4.15: *Correlation Analysis*

		LT	ST	CT	IT	SLP	.
	Pearson Correlation	1					
LT	Sig. (2-tailed)						
	N	360					
ST	Pearson Correlation	.280**	1				
	Sig. (2-tailed)	.000					
	N	360	360				
CT	Pearson Correlation	.192**	.508**	1			
	Sig. (2-tailed)	.000	.000				.
	N	360	360	360			
IT	Pearson Correlation	.333**	.446**	.473**		1	.
	Sig. (2-tailed)	.000	.000	.000			.
	N	360	360	360		360	
SLP	Pearson Correlation	.186**	.321**	.382**		.464**	1
	Sig. (2-tailed)	.000	.000	.000		.000	
	N	360	360	360		360	360

**. Correlation is significant at the 0.01 level (2-tailed).

Source: field Data 2022

Table 4.15 showed that GPS, TTS and GSM positively correlated with shipping lines performance at 0.186 at significance level of 5%. The p-value of the association was .000, which indicated that the correlation was significant as it conformed to p-value<0.05. These results showed that a significant variation in shipping lines performance was explained by localization technologies use. This is in agreement with

Michaelides *et al* (2010) and Muchaendepi (2018) who contended that use of positioning and tracking technologies are essential in enhancing a firm's efficiency.

The research also showed that Sensor technologies positively correlated with shipping lines performance at 0.321 at significance level of 5%. The p-value of the relationship was .000, which indicated that the correlation was significant since it conformed to p-value<0.05. These results showed that a significant variation in shipping lines performance was explained by sensor technology use. This is in line with the study of Sakhasia (2017) which contended that use of sensor technologies led to performance of shipping lines.

The research again showed that communication technologies positively correlated with shipping lines performance at 0.382 at significance level of 5%. The p-value of the relationship was .000, which indicated that the correlation was significant since it met the required threshold p-value<0.05. These results showed that a significant variation in shipping lines performance was explained by communication technologies use. These results are in agreement with Abbas (2016) and Mlimbila and Mbamba (2018) which showed use of communication technologies and performance of shipping lines correlated positively.

The research also showed that there was a positive correlation between identification technology and shipping lines performance by a coefficient of 0.484 at a significance level of 5%. The relationship p-value of .000, indicated that the correlation was significant since it conformed to p-value <0.05. These results showed that a significant change in shipping lines performance was explained by identification technology use. This is in line with the study of Kahyarara (2018) which contended that use of identification technology led to performance of shipping lines.

4.6 Assumptions of Regression

4.6.1Test for normality

Analysis of normality in this research was done first by use of histogram and Q-Q plots.

Normality analysis in this research was supported by use of visual check of histogram as shown in figure 4.1

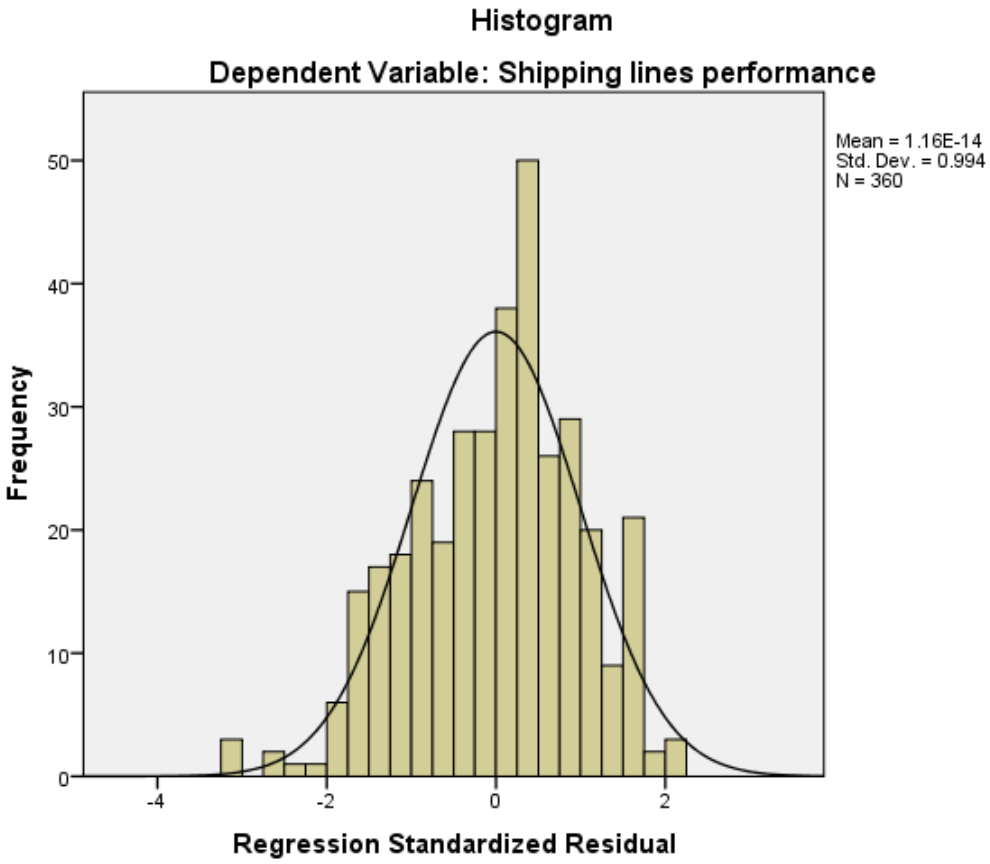


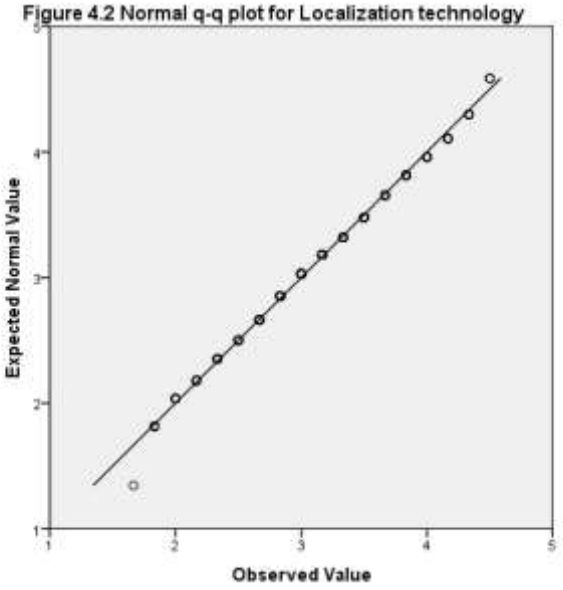
Figure 4.1

Source: Field data 2022

Figure 4.1 shows a bell shaped as well as symmetrical histogram. This indicates data was normally distributed.

Normality of variables was checked using p-p plots. Results presented in figure 4.2 to 4.6 showed that values of independent and dependent variables were close to the diagonal line implying they were normally distributed.

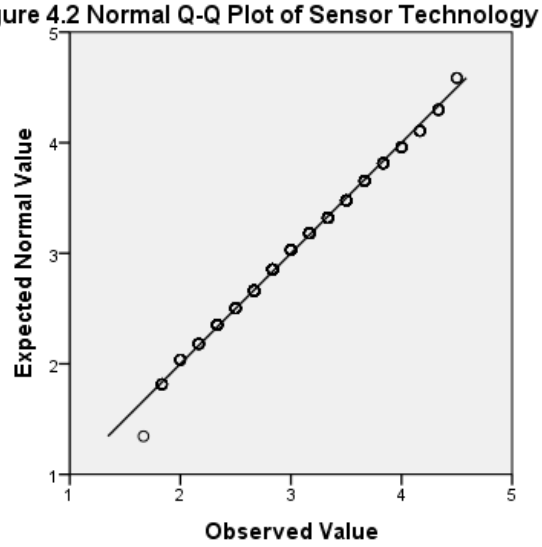
Figure 4.2 Normal q-q plot for Localization technology



Source: Field Data 2022

Localization technologies comprised the first variable that was used to measure supply chain management technologies. Figure 4.2 showed the closeness of plotted points to diagonal line on either side; confirming that the distribution of Localization technologies data was normal**.**

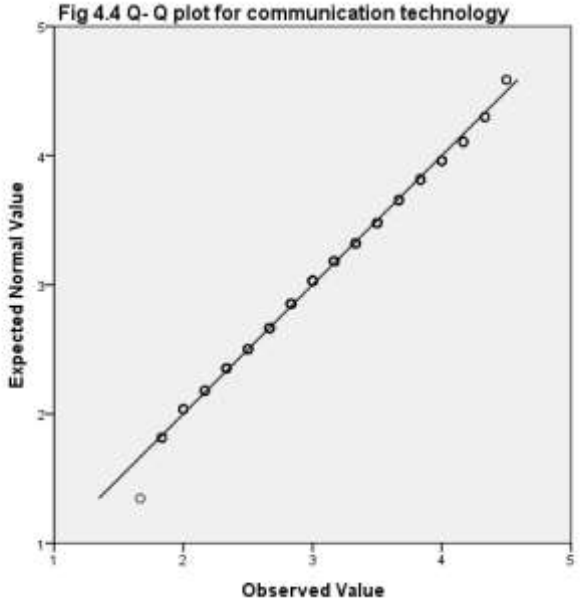
figure 4.2 Normal Q-Q Plot of Sensor Technology



Source: Field Data 2022

Sensor technologies composed the second variable that was utilized to measure supply chain management technologies. Figure 4.3 showed closeness of plotted points the diagonal line on either side. This confirmed that the distribution of sensor technologies data was normal.

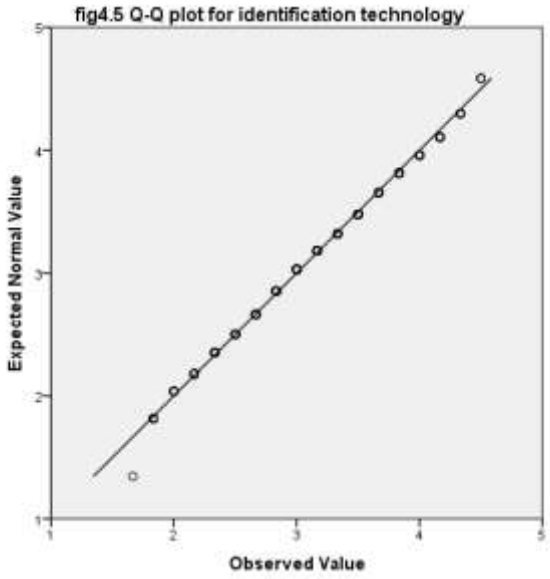
Fig 4.4 Q- Q plot for communication technology



Source: Field Data 2022

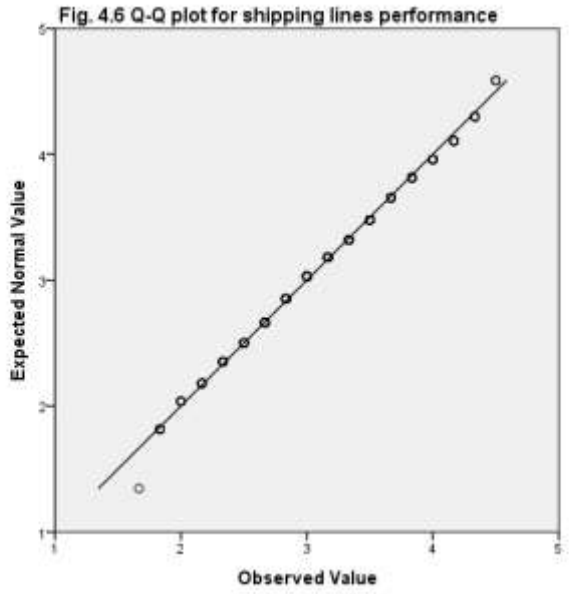
Communication technologies formed third variable that was used to measure supply chain management technologies. Figure 4.4 showed closeness of plotted points to the

diagonal line on either side. This confirmed normal distribution of communication technologies data.



Source: Field Data 2022

Identification technologies was the fourth variable used to measure supply chain management technologies. Figure 4.5 showed closeness of plotted points to the diagonal line on either side. This confirmed that the distribution of Identification technologies data was normal



Source: field data 2022

Shipping lines performance was the dependent variable in this research. Figure 4.6 indicated plotted points were close to the diagonal line on either side. This confirmed that the distribution of shipping lines performance data was normal.

4.6.2 Test for multicollinearity

The test results showed that the level of multi-collinearity was low. The results are as shown in table 4.16

Table 4.16: *test for multicollinearity*

	Tolerance	VIF
(Constant)		.
Localization Technology	.866	1.154
Sensor Technology	.668	1.497
Communication Technology	.662	1.511
Identification Technology	.677	1.477

Source: field data 2022

Table 4.16 showed that all the variables had a variance Inflation factors (VIF) below 10 and tolerance of above 0.1. The results showed the composite value for Localization technology had a variance Inflation Factors of 1.154 and a tolerance of 0.866, composite value for sensor technology had a variance Inflation Factors of 1.497 and a tolerance of 0.668, composite value for communication technology had a variance Inflation Factors of 1.511 and a tolerance of 0.662 and composite value for identification technology had a variance Inflation Factors of 1.477 and a tolerance of 0.677. This therefore indicated that there was no multi-collinearity and that the data was suitable for performing regression analysis.

4.6.3 Heteroscedasticity test

The test was carried out using the Breusch- Pagan test/ Cook Weisberg test. The test assumed that if P-value was below 0.05 threshold value, it would have depicted heteroscedasticity of data. A p-value of above 0.05 would have depicted lack of heteroscedasticity. Figure 4.7 showed the results for heteroscedasticity test.

Breusch- Pagan test/ Cook Weisberg test for heteroscedasticity

Ho: Constant variance

Variables: fitted values of SLP

Chi2 (1) = 0.57

Prob > Chi2 = 0.364

Source: field data 2022

The results in above had a Chi2 of 0.364 which is higher than 0.05. This therefore showed that there was absence of heteroscedasticity and hence the research data was suitable for regression analysis.

4.6.4 Linearity test

This research study utilized both ANOVA and p-p plot to test the linearity. The results for the test are presented in table 4.17

Table 4.17: *linearity Test*

Table 4.17: *linearity Test*

	F	Sig.	R
Localization Technologies	3.544	0.003	0.186
Sensor Technologies	6.149	0.002	0.321
Communication Technologies	10.778	0.004	0.382
Identification Technologies	12.952	0.001	0.311
Supply Chain Management Technologies	3.66	0.234	0.476

Source: field Data 2022

Table 4.17 showed the results for the linearity test using ANOVA. The F values were used as determinants of whether supply chain management technologies were significant in explaining the performance of shipping lines. R values indicated the strength of relationship between the independent and dependent variable. The results showed existence of a linear relationship of (F=3.544, p-value =0.003 and R=0.186), (F=6.149, p-value =0.002 and R=0.321), (F=10.778, p-value =0.004 and R=0.311) and (F=12.952, p-value =0.001 and R=0.476) between localization technologies, sensor technologies, communication technologies, identification technologies and shipping lines performance respectively

The other approach that was used to check linearity in the association between study variables was use of residual plots (Keith, 2006). In this research study the residual plots showed that the standardized residuals and the predicted values were used to determine linearity and checked the regression equation's significance. The residual plots for the results significance is shown in figure 4.7,

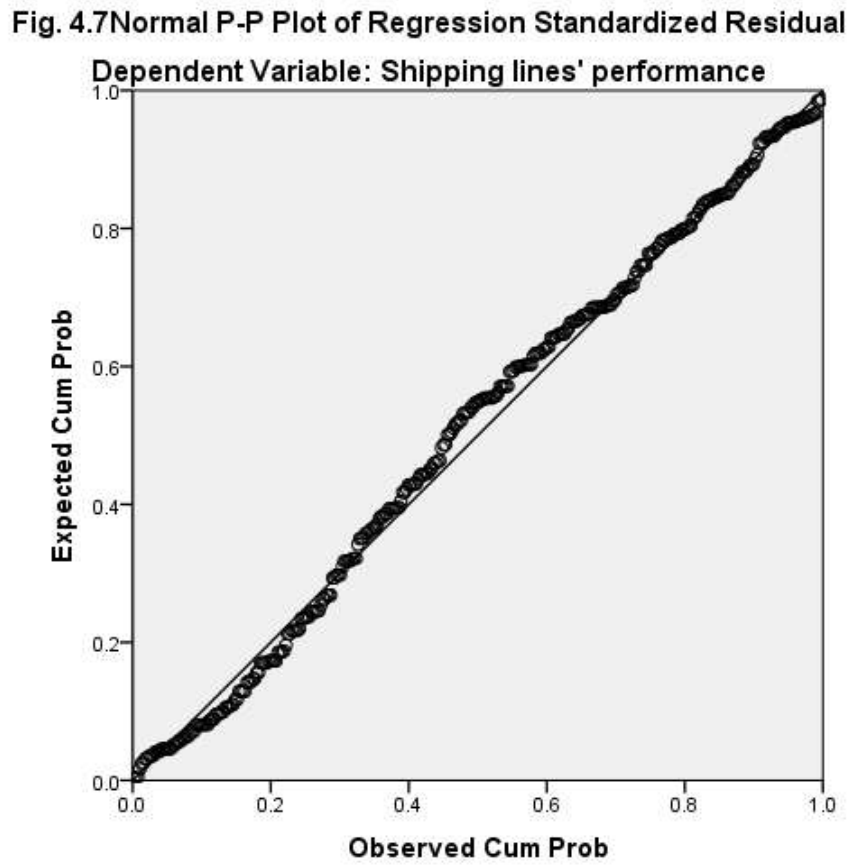


Figure 4.7 Normal P-P plot of regression standardized residual
Source: field Data 2022

Figure 4.7 showed the points fall along the line of best fit. This therefore showed that the relationship between the dependent and independent variable was linear and therefore the data was suitable for regression analysis.

4.7 Regression Analysis

The outcome of the hypothesis testing, numerical examination as well as interpretation of connections amongst numerous constructs being investigated are presented including, to examine the relationship between localization technologies and shipping lines performance, to assess the relationship between sensor technologies and shipping lines performance, to examine the relationship between communication technologies and shipping lines performance, to assess the relationship between identification technologies and shipping lines performance, to examine the moderating effect of

international maritime regulations on relationship between localization technologies and shipping lines performance, to examine relationship between these technologies (localization, technologies, sensor technologies, communication technologies, identification technologies) and shipping lines performance as moderated by international maritime regulations.

The outcome from the multiple linear regression examination was used to interpret the results. The $p<0.05$ meant a statistically significant association while $p>0.05$ showed a non-significant relationship. F-value showed the statistical significance level of the overall model while the t-values showed the significance level of individual variables. The R-value showed the power of the correlation between the research variables. The R^2 values disclosed the extent to which parameters are explained by explanatory variables. The Beta values indicated a positive or negative influence of the explanatory variable on the response variable. The results could be significant if the calculated F value is greater than the critical F value. The regression equation models were formulated from the beta values in the coefficient tables.

4.7.1 Localization Technologies and shipping lines performance

The researcher aimed at analyzing association among localization technologies and these firms' performance. This objective was realized by testing the hypothesis: **Ho**$_1$ Localization technologies and firms' performance do not have statistically significant association. A model $Y = \beta_o + \beta_1 LT + \varepsilon$, was formulated Regression analysis of the variables was carried out to achieve objective one and test hypothesis

4.7.1.1 Model Summary on Localization Technologies and Shipping lines performance

The model presented in table 4.18 (a) indicated various R values in addition to standard error of the estimates values that were utilized in determining regression model fitness for data. The results are presented in table 4.18 (a)

Table4.18 (a): *Model summary of Localization Technologies and Shipping lines performance*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the estimate	R Square Change	Change Statis
1	.174[a]	.030	.028	.32624	.030	

a. Predictors: (constant) Localization technologies
b. Dependent variable: shipping lines performance

Source: Field data 2022

Results in table 4.18 (a) showed 0.030 or 3% as R^2 value, meaning Global positioning systems, tracking and tracing systems and global systems for mobile communication use by these firms enabled them to improve their performance by3 % whereas the remaining 97 % of their performance was pegged on other factors.

.4.7.1.2 ANOVA on Localization Technologies and Shipping lines performance

This was used to test hypothesis and ascertain how fit the model was in predicting association between the two variables as presented in table 4.18 (b)

Table 4.18 (b): *Analysis of Variance on LT and SLP*

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.193	1	1.193	11.210	.000[b]
	Residual	38.102	358	.106		
	Total	39.295	359			

a. Dependent variable: shipping lines' performance

b. Predictors; Constant), Localization Technologies

Source; Field data 2022

Table4. 18(b) showed calculated value of F (1, 358) = 11.210 and a p-value of 0.000. based on these values the model developed was quite adequate to explain association between these technologies and firm's efficiency. The model was additionally proved to be adequate using the F values because the calculated F value of 11.210 at (1,358) was higher than the critical F value3.8676 at that point.

Results proved an existence of positive and significant association between GPS, TTS, GSM and firms' efficiency. Consequently the null hypothesis **Ho**$_1$, Localization technologies and shipping lines performance do not have statistically significant association was rejected based on the F values.

4.7.1.3 Coefficients on Localization Technologies and Shipping lines performance

A regression was carried out so as to ascertain the average shift in firms performance arising to localization technologies unit change .The model enabled to forecast the influence on dependent variable arising from the on independent variable. outcomes are presented in table 4.18 (c)

Table 4.18 (c):*LT and SLP coefficients of regression*

Coefficients[a]

Model		Unstandardized coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.261	.092		35.565	.000
	LT	.099	.029	.174	3.348	.001

a. DV:: SLP

Source: Field Data 2022

Table4. 18 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems. Based on the outcome 0.099 of variation in these firms efficiency is brought about by localization technologies unit change. The deduced equation of linear regression was

$Y = 3.261 + 0.099LT$

Research outcomes concur with those of studies of Michaelides *et al* (2010), and Muchaendepi (2018) who contended that utilization od global positioning systems, Tracking systems global systems for mobile communication were very beneficial to these firms and consequently enable them to improve their performance.

4.7.2 Sensor Technologies and shipping lines performance

The researcher aimed at analyzing association among sensor technologies and these firms' performance. This objective was realized by testing the hypothesis: **Ho**$_2$ sensor technologies and firms' performance do not have statistically significant association. A

model $Y = \beta_o + \beta_1 ST + \varepsilon$, was formulated Regression analysis of the variables was carried out to achieve objective one and test hypothesis

4.7.2.1 Model Summary on Sensor Technologies and Shipping lines performance

The model presented in table 4.19 (a) indicated various R values in addition to standard error of the estimates values that were utilized in determining regression model fitness for data. The results are presented in table 4.19 (a)

Table4.19 (a): *Model summary for Sensor Technologies and Shipping lines performance*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statis
1	.333[a]	.111	.108	.31245	.111	

a. Predictors: , ST
b. DV: SLP

Source: Field data 2022

Results in table 4.19 (a) showed 0.111or 11.1% as R^2 value, meaning internet of things ,wireless sensors and nano sensors use by these firms enabled them to improve their performance by11.1 % whereas the remaining 89.9 % of their performance was pegged on other factors.

4.7.2.2 ANOVA on Sensor Technologies and Shipping lines performance

This was used to test hypothesis and ascertain how fit the model was in predicting association between the two variables as presented in table 4.19 (b)

Table 4.19 (b): *ANOVA on ST and SLP*

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.346	1	4.346	44.517	.000[b]
	Residual	34.949	358	.098		
	Total	39.295	359			

a. dependent variable: Shipping lines performance
b.Predictors: sensor technologies impact
Source: field Data 2022

Table4. 19(b) showed calculated value of F (1, 358) = 44.517 and a p-value of 0.000. based on these values the model developed was quite adequate to explain association between these technologies and firm's efficiency. The model was additionally proved to be adequate using the F values because the calculated F value of 44.517 at (1,358) was higher than the critical F value3.8676 at that point.

Results proved an existence of positive and significant association between wireless sensor technology, nano sensors and internet of things and firms' efficiency. Consequently the null hypothesis **Ho**$_{2,}$ sensor technologies and shipping lines performance do not have statistically significant association was rejected based on the F values.

4.7.2.3 Coefficient on Sensor Technologies and Shipping lines performance

A regression was carried out so as to ascertain the average shift in firms' performance arising to sensor technologies unit change .The model enabled to forecast the influence on dependent variable arising from the on independent variable. outcomes are presented in table 4.19 (c)

Table 4,19 (c): *ST and SLP coefficients*

Model		Unstandardized coefficients		Standardized Coefficients	T	Sig.
		B	Std. error	Beta		
1	(Constant)	2.630	.141		18.682	.000
	ST	.239	.036	.333	6.672	.000

a. DV: SLP

Source: field data 2022

Table4. 19 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems. Based on the outcome 0.239 of variation in these firms efficiency is brought about by sensor technologies unit change. The deduced equation of linear regression was

$Y = 2.630 + .239ST$

The study concurs with findings concur with Kuma (2015) and Agrifoglio, Cannavale, Laurenza and Metallo (2017) who showed that utilization of sensor technologies have an influence on shipping lines efficiency. The findings further agreed with Sakhasia (2017), Mugambi (2017) and Nyongesa (2018) who showed that a significant positive association does exist between sensor technologies and shipping lines performance.

4.7.3 Communication Technologies and shipping lines performance

The researcher aimed at analyzing association among communication technologies and these firms' performance. This objective was realized by testing the hypothesis: **Ho**$_3$

communication technologies and firms' performance do not have statistically significant association. A model $Y = \beta_o + \beta_1 CT + \varepsilon$, was formulated Regression analysis of the variables was carried out to achieve objective one and test hypothesis

4.7.3.1 Model Summary on Communication Technologies and Shipping lines performance

The model presented in table 4.20 (a) indicated various R values in addition to standard error of the estimates values that were utilized in determining regression model fitness for data. The results are presented in table 4.20 (a)

Table 4.20 (a): *Model summary for CT and SLP*

Model Summary

Model	R	R Square	Adjusted R Square	Std. error of the Estimate	R square change
1	.364[a]	.132	.130	.30859	.132

a. Predictors: communication technologies impact
b. DV: SLP

Source: Field Data (2022)

Results in table 4.20 (a) showed 0.132or 13.2% as R^2 value, meaning general radio packets, single window systems and radio navigation satellite use by these firms enabled them to improve their performance by13.2 % whereas the remaining 86.8 % of their performance was pegged on other factors.

4.7.3.2 ANOVA on Communication Technologies and Shipping lines performance

This was used to test hypothesis and ascertain how fit the model was in predicting association between the two variables as presented in table 4.20 (b)

Table 4.20 (b): *ANOVA on CT and SLP*

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.202	1	5.202	54.630	.000[b]
	Residual	34.093	358	.095		
	Total	39.295	359			

a. DV: SLP

b. Predictors: Communication Technologies impact

Source: field data 2022

Table4. 20(b) showed calculated value of F (1, 358) = 54.630 and a p-value of 0.000. based on these values the model developed was quite adequate to explain association between these technologies and firm's efficiency. The model was additionally proved to be adequate using the F values because the calculated F value of 54.630 at (1,358) was higher than the critical F value3.8676 at that point.

Results proved an existence of positive and significant association between General Radio Packets, Single window systems and radio navigation satellite and firms' efficiency. Consequently the null hypothesis **Ho**$_3$, communication technologies and shipping lines performance do not have statistically significant association was rejected based on the F values.

4.7.3.3 Coefficient on Communication Technology and Shipping lines performance

A regression was carried out so as to ascertain the average shift in firms performance arising to communication technologies unit change .The model enabled to forecast the influence on dependent variable arising from the on independent variable. outcomes are presented in table 4.20 (c)

Table4. 20 (c): *Regression coefficients on Communication Technologies and shipping lines performance*

Coefficients[a]

Model		Unstandardized coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.516	.143		17.640	.000
	CT	.265	.036	.364	7.391	.000

a. DV: SLP

Source: field data 2022

Table4. 20 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems. Based on the outcome 0.265 of variation in these firms efficiency is brought about by communication technologies unit change.

A simple linear regression equation was formed from the results on communication technologies and performance of shipping lines.

$Y = 2.516 + .265CT$

The study findings concur with Kithia (2015), Abbas (2016) and Gakuubi (2018) Kyomo (2019), Onwuegbuchunam, Aponjolosun & Ogunsakin (2021) contended that a significant positive relationship between communication technology and performance of shipping lines.

4.7.4 Identification Technologies and shipping lines performance

The researcher aimed at analyzing association among identification technologies and these firms' performance. This objective was realized by testing the hypothesis: **Ho**$_4$ identification technologies and firms' performance do not have statistically significant association. A model $Y = \beta_o + \beta_1 IT + \varepsilon$, was formulated Regression analysis of the variables was carried out to achieve objective one and test hypothesis

4.7.4.1 Model Summary on Identification Technology and Shipping lines performance

The model presented in table 4.21 (a) indicated various R values in addition to standard error of the estimates values that were utilized in determining regression model fitness for data. The results are presented in table 4.21 (a)

Table 4,21 (a): *Model Summary on Identification Technologies and shipping lines performance*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square change
1	.448[a]	.201	.199	.29618	.201

a. predictors: (Constant),identification technologies
b. dv: SLP

Source: field data 2022

Results in table 4.21 (a) showed 0.201 or 20.1% as R^2 value, meaning Radio frequency identification, automatic identification systems and voice recognition use by these firms enabled them to improve their performance by320.1% whereas the remaining 79.9 % of their performance was pegged on other factors.

4.7.4.2 ANOVA on Identification Technologies and Shipping lines performance

This was used to test hypothesis and ascertain how fit the model was in predicting association between the two variables as presented in table 4.21 (b)

Table 4.21 (b): *ANOVA on IT and SLP*

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	7.891	1	7.891	89.961	.000[b]
	Residual	31.404	358	.088		
	Total	39.295	359			

a. DV: SLP

b. Predictors: identification technologies impact

Source: field data 2022

Table4. 21(b) showed calculated value of F (1, 358) = 89.961 and a p-value of 0.000. based on these values the model developed was quite adequate to explain association between these technologies and firm's efficiency. The model was additionally proved to be adequate using the F values because the calculated F value of 89.961 at (1,358) was higher than the critical F value3.8676 at that point.

Results proved an existence of positive and significant association between radio frequency identification, automatic identification systems and voice recognition and firms' efficiency. Consequently the null hypothesis **Ho**$_4$, identification technologies and shipping lines performance do not have statistically significant association was rejected based on the F values.

4.7.4.3 Coefficient on Identification Technology and Shipping lines performance

A regression was carried out so as to ascertain the average shift in firms performance arising to identification technologies unit change .The model enabled to forecast the

influence on dependent variable arising from the on independent variable. outcomes are presented in table 4.21 (c)

Table 4 21 (c): *regression coefficients for Identification Technologies and shipping lines performance*

Coefficients[a]

Model		Unstandardized coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.308	.133		17.323	.000
	IT	.320	.034	.448	9.485	.000

a. DV: SLP

Source: field data 2022

Table4. 21 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems. Based on the outcome 0.320 of variation in these firms efficiency is brought about by identification technologies unit change.

A simple linear regression equation was developed from the results on sensor technologies on shipping lines performance.

Y = 2.308 + .320IT

The study findings concur with Oduma & Shale (2019) and Kabui, Gakobo and Mwaura (2019) who showed that there is a significant positive relationship between adoption of identification technologies and shipping lines efficiency. The findings

further agreed with and u- Thong, Jaturat and Kingsida (2020) who found that implementation and usage of identification technologies such as Radio Frequency Identification has a positive impact on a firm's performance.

These findings further concur with Last (2016), Kahyarara (2018) and Niraj (2019), who found that proper implementation and use of automatic identification systems positively and significantly affected performance of shipping lines.

4.7.5 Supply Chain Management Technologies and Shipping Lines' Performance

The research endeavored to analyze the influence of technologies and operational efficiency of these organizations in Kenya. Multiple linear regression examination was conducted to determine the relation between supply chain management technologies (explanatory variable) and shipping lines' performance (response variable). Below is the multiple regression models that was utilized for testing the association between explanatory variable and explained variable.

$$\Upsilon = \beta_o + \beta_1 LT + \beta_2 ST + \beta_3 CT + \beta_4 IT + \varepsilon$$

Where, Υ= Shipping lines' Performance

β_o = Constant

$\beta_{1\text{-}4}$ = Regression Coefficients

LT = the localization technologies

ST = the sensor technologies

CT=communication technology

IT= the identification technology

ε= error term

Table 4.22(a) presented summary model results of R, R^2, and adjusted R^2 in addition to estimate of the Std, error which was used to find out how well the model represents the information needed in research. Further table 4.22(a) displays the model outcome of the relationship between SCMT and performance of these firms.

Table4.22 (a): *Model Summary for supply chain management technologies*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1	.489[a]	.239	.230	.29026	.239

a. Predictors: (Constant), IT,LT, ST,CT

Source : field data 2022

According to results shown in table 4.22(a) R square (R^2) had a value of 0.239. These findings revealed that 23.9% of alterations in organization operational effectiveness (Response variable) can be attributed to SCMT of while other factors explained 76.1% of the change in performance.

Table 4.22 (b) indicated the results for ANOVA, which was employed to determine the appropriateness of the model in defining the relationship between the two variables being investigated. The ANOVA outcome was also used to test the research hypothesis

Table 4.22 (b): *ANOVA on SCMTs and SLP*

Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**sig.**
1	Regression	9.386	4	2.346	27.850	.000[b]
	Residual	29.909	355	.084		
	Total	39.295	359			

a.DV: SLP

b. predicators: LT, ST, CT, IT

Source: field data 2022

Table4. 22 (b) presented ANOVA results which showed how fit model was to explain effect of SCM technologies on firm's performance. The findings indicated existence of a direct statistically significant association (F=27.850, P=0.000). It was further supported by fact that Computed F= 27.850 being greater than critical F =3.8676 (1, 358). In addition p= 0.000 was less than the stipulated 0.05 threshold. From ANOVA outcome there was enough evidence that SCM technologies are statistically significant.

Table 4.22 (c): *coefficients on SCMTs and SLP*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.895	.166		11.445	.000
	LT	.003	.028	.006	.124	.902
	ST	.077	.041	.107	1.902	.058
	CT	.113	.041	.155	2.731	.007
	IT	.232	.040	.325	5.791	.000

a. DV: performance

Source: field Data 2022

The outcome in table 4.22(c) of the coefficient estimates indicated that identification technologies had the greatest positive relationship and shipping lines performance with β_4=.232. Communication technologies had the second greatest positive significant relationship on shipping lines performance with β_3=0.113. It was followed by sensor technologies which had an influence of β_2 0.077. The variable which had the least influence on firm performance was localization technologies with β_1=0.003. The above results were used to formulate the multiple linear regression model that follows

$Y = 1.895 + 0.003LT + 0.077ST + 0.113CT + 0.232IT + \varepsilon$

4.7.6 Role of International maritime regulations on the relationship between supply Chain management technologies and shipping lines performance

This step involved the introduction of the moderator (International maritime regulations) into the multiple regression equation. This was aimed at measuring the effect of International maritime regulations on the relationship between supply chain management technology and performance of shipping lines in Kenya.

4.7.6.1 International maritime regulations, Localization technologies and performance of shipping lines

Objective 5a of the research study was to assess the influence localization technologies on shipping lines efficiency as moderated by International maritime regulations

4.8.1.1 Model summary of International maritime regulations on Localization technologies and performance of shipping lines

The researcher aimed at analyzing association among localization technologies and these firms' performance as moderated maritime regulations This objective was realized by testing the hypothesis: **H_o 5a** relationship between localization technologies and firms' performance are not statistically significantly moderated by international maritime regulations. A model $Y = \beta_o + \beta_1 IT + LTM + \varepsilon$, was formulated Regression analysis of the variables was carried out to achieve objective one and test hypothesis

Table 4.23(a): *Model summary of International maritime regulations, Localization technologies and performance of shipping lines*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1	.174[a]	.030	.028	.32624	.030
2	.261[b]	.068	.063	.32030	.038

a. Predictors (Constant), IMR, Localization technologies

b. Dependent variable: Shipping Lines' performance
Source: field data 2022

Table 4.23 (a), showed that $R^2$for the relationship between localization technologies and shipping lines performance was 0.030 0r 3.0 % before the introduction of the moderator. After the introduction of the moderator (international maritime regulations in the relationship, the R^2 increased to 0.068 or 6.8 %, this showed that international maritime regulations accounted for 3.8% of the increase in the shipping lines performance.

4.8.1.2 ANOVA on International maritime regulations, Localization technologies and performance of shipping lines

The Analysis of Variance was utilized to check how fit the model was to forecast the association between moderator, the dependent and independent variables as moderated by International maritime regulations as presented presented in table 4.23 (b)

Table 4.23 (b): *ANOVA on International maritime regulations, Localization technologies and performance of shipping lines*

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1.193	1	1.193	11.210	.001[b]
	Residual	38.102	358	.106		
	Total	39.295	359			
2	Regression	2.670	2	1.335	13.012	.000[c]
	Residual	36.625	357	.103		
	Total	39.295	359			

a. Dependent Variable: Shipping Lines' performance
b. Predictors (constant), IMR, Localization Technologies
Source: field data 2022

Table 4.23 (b) model 1 and 2 and their computed values for F and p. Model 1 calculated value (before the introduction of the moderator) for was 11.210 and a p

value of 0.000. Whereas model 2 calculated values (after the introduction of the moderator), was13.012. utilizing the p-value in ascertaining the suitability of the model in establishing moderating effect, showed that the model was suitable since the p-value obtained 0.000 is less than 0.05. The same results were found when using the F value in ascertaining fitness of the model. Calculated value of F (2,357), where 2 was the numerator and 357 was the denominator showed that the calculated F value = 13.012 was higher than the critical F value = 3.02101 at 5% significance level. Consequently the null hypothesis was rejected

4.8.1.3 Coefficients of International maritime regulations, Localization technologies and performance of shipping lines

A regression was carried out so as to ascertain the average shift in association between localization technologies and firms performance arising from the introduction of the moderating variable

Table 4.23 (c): *regression coefficients of international maritime regulations, localization technologies and performance of shipping lines*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.261	.092		35.565	.000
	LT	.099	.029	.174	3.348	.001
2	(Constant)	2.801	.151		18.537	.000
	LT	.080	.029	.141	2.730	.003
	LT*M	.120	.032	.197	3.794	.000

a. Dependent variable:: Shipping lines Performance

Source: Field data 2022

Table 4.23 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems. Based on the outcome 0.0.053 of variation in these firms efficiency is brought about by IRMs.

. Table 4.23 (c) showed the unstandardized constant coefficient β_0 3.261 while unstandardized coefficient $\beta_1 = 0.080$ while $\beta_5 = 0.120$

Consequently, a linear regression equation was derived

$Y = 2.801 + 0.080LT + 0.120LT*M + \varepsilon$

4.8.2 International maritime regulations, Sensor technologies and performance of shipping lines

Objective 5b of the research study was to assess relationship between sensor technologies and performance of shipping lines in Kenya as moderated by international maritime conventions

4.8.2.1 Model summary of International maritime regulations, Sensor technologies and performance of shipping lines

The researcher aimed at analyzing association among sensor technologies and these firms' performance as moderated maritime regulations This objective was realized by testing the hypothesis: **H_o 5b** relationship between sensor technologies and firms' performance are not statistically significantly moderated by international maritime regulations. A model $Y = \beta_o + \beta_1 ST + STM + \varepsilon$, was formulated Regression analysis of the variables was carried out to achieve objective one and test hypothesis

Table4.24 (a): *Model summary of International maritime regulations, Sensor technologies and performance of shipping lines*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statis
1	.333[a]	.111	.108	.31245	.111	
2	.342[b]	.117	.112	.31182	.006	

a. Predictors (constant), IMR, effect of sensor technologies
b. Dependent variable: Shipping Lines' performance

Source: field data 2022

Table 4.24 (a) results showed that R^2 for the relationship between sensor technologies and shipping lines performance was 0.111 0r 11.1 % before the introduction of the moderator. After the introduction of the moderator (international maritime regulations) in the relationship, the R^2 increased to 0.117 or 11.7 %, this showed that international maritime regulations accounted for 0.006 or 0.6% of the increase in shipping lines performance.

4.8.2.2 ANOVA on International maritime regulations, Sensor technologies and performance of shipping lines

The Analysis of Variance was utilized to check how fit the model was to forecast the association between, the dependent and independent variables as moderated by International maritime regulations as presented in table 4.24 (b)

Table 4.24 (b): ANOVA on International maritime regulations, Sensor technologies and performance of shipping lines

Table 4.24 (b): *ANOVA on International maritime regulations, Sensor technologies and performance of shipping lines*

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4.346	1	4.346	44.517	.000[b]
	Residual	34.949	358	.098		
	Total	39.295	359			
2	Regression	4.584	2	2.292	23.572	.000[c]
	Residual	34.711	357	.097		
	Total	39.295	359			

a. dependent variable: Shipping lines' performance
b. predictors: (constant), IMR, composite effect of Sensor Technologies

4Source: Field data 2022

Table 4.23 (b) model 1 and 2 and their computed values for F and p. Model 1 calculated value (before the introduction of the moderator) for was 44.517 and a p value of 0.000. Whereas model 2 calculated values (after the introduction of the moderator), was 23.572. utilizing the p-value in ascertaining the suitability of the model in establishing moderating effect, showed that the model was suitable since the p-value obtained 0.000 is less than 0.05. The same results were found when using the F value in ascertaining fitness of the model. Calculated value of F (2,357), where 2 was the numerator and 357 was the denominator showed that the calculated F value = 23.572 was higher than the critical F value = 3.02101 at 5% significance level. Consequently the null hypothesis was rejected

4.8.2.3 Coefficients of International maritime regulations, Sensor technologies and performance of shipping lines

A regression was carried out so as to ascertain the average shift in association between sensor technologies and firms performance arising from the introduction of the moderating variable

Table 4.24 (c): *Coefficients of International maritime regulations, Sensor technologies and performance of shipping lines*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.630	.141		18.682	.000
	ST	.239	.036	.333	6.672	.000
2	(Constant)	2.512	.160		15.733	.000
	ST	.211	.040	.293	5.249	.000
	ST*M	.053	.034	.087	1.564	.119

a. Dependent variable:: Shipping lines Performance

Source: field data 2022

Table 4.24 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems. Based on the outcome 0.053 of variation in these firms efficiency is brought about by IRMs

Table 4.26 (c) showed the unstandardized constant coefficient β_0 2.630 while unstandardized coefficient β_2 = .211 while β_6 =0.053

A linear regression equation was derived

$Y = 2.512 + .211ST + 0.053ST*M + \varepsilon$

4.8.3 International maritime regulations, communication technologies and performance of shipping lines

Objective 5c of the research study was to assess relationship between communication technologies and performance of shipping lines efficiency in Kenya as moderated by international maritime regulations

4.8.3.1 Model summary of International maritime regulations, Communication technologies and performance of shipping lines

The researcher aimed at analyzing association among communication technologies and these firms' performance as moderated maritime regulations This objective was realized by testing the hypothesis: **H_o 5c** relationship between communication technologies and firms' performance are not statistically significantly moderated by international maritime regulations. A model $Y = \beta_o + \beta_1 CT + CTM + \varepsilon$, was formulated Regression analysis of the variables was carried out to achieve objective one and test hypothesis

Table4.25 (a): *Model summary of International maritime regulations, Communication technologies and performance of shipping lines*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statis
1	.364[a]	.132	.130	.30859	.132	
2	.372[b]	.139	.134	.30792	.007	

a. Predictors: (Constant), IMR, composite effect of CT
b. Dependent Variable: Shipping Lines' Performance

Source: Field data 2022

The results shown in table 4.25 (a) above showed that the $R^2$for the relationship between communication technologies and shipping lines performance was 0.132 0r 13.2 % before the introduction of the moderator. After the introduction of the moderator (international maritime regulations in the relationship, the R^2 increased to 0.139 or 13.9 %, this showed that international maritime regulations accounted for 0.7% of the increase in shipping lines performance.

4.8.3.2 ANOVA on International maritime regulations, Communication technologies and performance of shipping lines

The Analysis of Variance was utilized to check how fit the model was to forecast the association between moderator, the dependent and independent variables as moderated by International maritime regulations as presented in table 4.25 (b)

Table 4.25 (b): *ANOVA on International maritime regulations, Communication technologies and performance of shipping lines*

ANOVA[a]

Model		Sumo Squares	Df	Mean Square	F	Sig.
1	Regression	5.202	1	5.202	54.630	.000[b]
	Residual	34.093	358	.095		
	Total	39.295	359			
2	Regression	5.445	2	2.723	28.716	.000[c]
	Residual	33.850	357	.095		
	Total	39.295	359			

a. Dependent variable: Shipping Lines' performance
b. Predictors: (constant) IMR, Communication Technologies

Source; Field data 2022

Table 4.25 (b) model 1 and 2 and their computed values for F and p. Model 1 calculated value (before the introduction of the moderator) for was 54.630 and a p value of 0.000. Whereas model 2 calculated values (after the introduction of the moderator), was 28.716. utilizing the p-value in ascertaining the suitability of the model in establishing moderating effect, showed that the model was suitable since the p-value obtained 0.000 is less than 0.05. The same results were found when using the F value in ascertaining fitness of the model. Calculated value of F (2,357), where 2 was the numerator and 357 was the denominator showed that the calculated F value = 28.716

was higher than the critical F value = 3.02101 at 5% significance level. Consequently the null hypothesis was rejected

4.8.3.3 Coefficients of International maritime regulations, Communication technologies and performance of shipping lines

A regression was carried out so as to ascertain the average shift in association between communicationn technologies and firms performance arising from the introduction of the moderating variable

Table 4.27 (c): *Coefficients of IMRs on Communication technologies and performance of shipping lines*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.516	.143		17.640	.000
	CT	.265	.036	.364	7.391	.000
2	(Constant)	2.390	.162		14.714	.000
	CT	.239	.039	.329	6.111	.000
	CT*M	.053	.033	.086	1.601	.110

a. Dependent variable: Shipping lines' performance

Source: field data 2022

Table 4.25 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems. Based on the outcome 0.320 of variation in these firms efficiency is brought about by IRS.

A linear regression equation was derived

$Y = 2.390 + .239CT + 0.053CT*M + \varepsilon$

4.7.6.4 International maritime regulations on identification technologies and performance of shipping lines

Objective 5d of the research study was to assess association between identification technologies and shipping lines efficiency as moderated by International maritime regulations

4.7.6.4.1 Model summary of International maritime regulations on identification technologies and performance of shipping lines

The researcher aimed at analyzing association among identification technologies and these firms' performance as moderated maritime regulations This objective was realized by testing the hypothesis: **H_o 5d** relationship between communication technologies and firms' performance are not statistically significantly moderated by international maritime regulations. A model $Y = \beta_o + \beta_1 IT + ITM_{+} \varepsilon$, was formulated Regression analysis of the variables was carried out to achieve objective one and test hypothesis

Table4.26 (a): *Model summary of International maritime regulations on identification technologies and performance of shipping lines*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change

1	.448[a]	.201	.199	.29618	.201
2	.453[b]	.206	.201	.29571	.005

a. Predictors: (Constant), IMR, effect of IT

b. Dependent Variable: SLP

Source: Field data 2022

The results shown in table 4.26 (a) above showed that the $R^2$for the relationship between identification technologies and shipping lines performance was 0.201 0r 20.1 % before the introduction of the moderator. After the introduction of the moderator (international maritime regulations in the relationship, the R^2 increased to 0.206 or 20.6 %, this showed that international maritime regulations accounted for 0.5% of the increase in the relationship between the identification technologies (independent variable) and shipping lines performance(dependent variable).

4.7.6.4.2 ANOVA on International maritime regulations on Identification technologies and performance of shipping lines

The Analysis of Variance was utilized to check how fit the model was to forecast the association between moderator, the dependent and independent variables as moderated by International maritime regulations as presented in table 4.26 (b)

Table 4.26 (b): *ANOVA on International maritime regulations on identification technologies and performance of shipping lines*

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	7.891	1	7.891	89.961	.000[b]
	Residual	31.404	358	.088		

	Total	39.295	359			
2	Regression	8.078	2	4.039	46.192	.000[c]
	Residual	31.217	357	.087		
	Total	39.295	359			

a. Dependent Variable: Shipping lines' performance
b. Predictors: (Constant), IMR, Composite effect of IT

Source: Field data 2022

Table 4.26 (b) model 1 and 2 and their computed values for F and p. Model 1 calculated value (before the introduction of the moderator) for was 89.961 and a p value of 0.000. Whereas model 2 calculated values (after the introduction of the moderator), was 46.192. utilizing the p-value in ascertaining the suitability of the model in establishing moderating effect, showed that the model was suitable since the p-value obtained 0.000 is less than 0.05. The same results were found when using the F value in ascertaining fitness of the model. Calculated value of F (2,357), where 2 was the numerator and 357 was the denominator showed that the calculated F value = 46.192 was higher than the critical F value = 3.02101 at 5% significance level. Consequently the null hypothesis was rejected

4.7.6.4.3Coefficients of International maritime regulations on identification technologies and performance of shipping lines

A regression was carried out so as to ascertain the average shift in association between identification technologies and firms performance arising from the introduction of the moderating variable

Table 4.26 (c): *Coefficients of International maritime regulations on identification technologies and performance of shipping lines*

Coefficients[a]

Model	Unstandardized	Standardize	T	Sig.

		Coefficients		d Coefficients		
		B	Std. Error	Beta		
1	(Constant)	2.308	.133		17.323	.000
	IT	.320	.034	.448	9.485	.000
2	(Constant)	2.186	.157		13.923	.000
	IT	.301	.036	.423	8.402	.000
	IT*M	.060	.035	.074	1.862	.004

a. Dependent Variable: Shipping Lines' performance

Source: Field data 2022

Table 4.26 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies as moderated by international maritime regulations according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems . Based on the outcome 0.601 of variation in these firms efficiency is brought about by IRMs.

A linear regression equation was derived

$Y = 2.186 + 301IT + 0.060IT*M + \varepsilon$

4.7.6.5 Model summary of International maritime regulations on supply chain management technologies and performance of shipping lines

The researcher aimed at analyzing association among technologies and these firms' performance as moderated maritime regulations This objective was realized by testing the hypothesis: relationship between technologies and firms' performance are not statistically significantly moderated by international maritime regulations.

Table 4.27 (a): *Model summary of International maritime regulations on supply chain management technologies and performance of shipping lines*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1	.489[a]	.239	.230	.29026	.239
2	.560[b]	.314	.298	.27718	.075

a. Predictors: (Constant), LT, ST, CT, IT

b. Predictors: (Constant), LT, ST, CT, IT, LT*M, ST*M,CT*M, IT*M

Source: Field data 2022

The findings from analysis in table 4.27(a) created two models one and two. The most significant of the two models was the multiple linear regression model 2 because it combined all the supply chain management technologies and international maritime regulations. Model 2 indicated a significant association between said technologies, international maritime regulations and firm's efficiency.

Results also indicated that supply chain management technologies accounted for 23.9% of the variations in shipping lines performance. When supply chain management technologies are combined with international maritime regulations, it also accounted for 31.4% of the change in shipping lines performance. The extent of moderation was 7.5% (31.4% - 23.9%).

4.7.6.5.2 ANOVA on Moderating effect of International maritime regulations on the relationship between supply chain management technologies and performance of shipping lines

The Analysis of Variance was utilized to check how fit the model was to forecast the association, the dependent and independent variables as moderated by International maritime regulations as presented in

table 4.27 (b)

Table 4.27 (b): *ANOVA on International maritime regulations on supply chain management technologies and performance of shipping lines*

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	9.386	4	2.346	27.850	.000[b]
	Residual	29.909	355	.084		
	Total	39.295	359			
2	Regression	12.328	8	1.541	20.057	.000[c]
	Residual	26.967	351	.077		
	Total	39.295	359			

a. Dependent Variable: SLP
b. Predictors: (Constant), Identification Technologies, Localization Technologies, Sensor Technologies, Communication Technologies
c. Predictors: (Constant), Identification Technologies, Localization Technologies, Sensor Technologies, Communication Technologies, LTM, STM, CTM, ITM

Source: Field data 2022

Table 4.27 (b) showed F and p-value for model 1 and 2.The calculated value for model 1(before the introduction of the moderator) for F (4, 355) = 27.850. While the calculated one for 2(after the introduction of the moderator), for F (8,351) = 20.057 Using the p-value to ascertain model suitability in assessing the moderating effect, showed that the model was fit since the p-value 0btained 0.000 is less than 0.05. The same results were found when using the F value to test the fitness of the model. The calculated value of F (8,351), where 8 was the numerator and 351 was the denominator showed that the calculated F value = 20.057 was higher than the critical F value = 1.9648.

4.7.6.5.3 Coefficients of International maritime regulations on supply chain management technologies and performance of shipping lines

Table 4.27 (c) indicated point that line of regression came into contact with the y-axis was positive in the graph because most of these companies had reported return on investment as being positive after utilization of these technologies as moderated by international maritime regulations according to the outcome. The line slope equally was positive indicating variation in performance arising from continuous usage of these systems as moderated by these regulations .

Table 4.27 (c): *Coefficients of International maritime regulations on supply chain management technologies and performance of shipping lines*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.895	.166		11.445	.000
	LT	.003	.028	.006	.124	.902
	ST	.077	.041	.107	1.902	.058
	CT	.113	.041	.155	2.731	.007
	IT	.232	.040	.325	5.791	.000
2	(Constant)	1.800	.173		10.419	.000
	LT	-.766	.202	-1.353	-3.796	.000
	ST	-.173	.213	-.240	-.811	.418
	CT	.117	.234	.160	.497	.619
	IT	1.136	.172	1.593	6.609	.000
	LT*M	.176	.046	1.683	3.858	.000
	ST*M	.065	.050	.627	1.304	.193
	CT*M	.003	.055	.025	.046	.963
	IT*M	-.213	.040	-2.060	-5.358	.000

a. Dependent Variable: SLP

Source: Field data 2022

Table 4.27 (c) showed the coefficients estimates on the introduction of interaction term between the moderator, predicator and dependent variable. Model 2 showed regression coefficients resulting from the interaction of the moderator, supply chain management technologies, shipping lines performance and the interaction term. As per the above outcome an equation was derived portraying association between localization, sensor, communication, identification technologies and these firms' efficiency as moderated by the said regulations.

$$Y=1.800-0.766LT.-0.173ST_{+}0.117CT+1.186IT+0.176LT*M + 0.65ST*M+0.003CT*M+ 0.213IT_{*}M +\varepsilon$$

Table 4.28: *Summary of hypothesis testing Results*

Hypothesis formulated main effects	p-Values	Calculated F value	Critical F value @= 0.05	Decision taken
H_o1 GPS, TTS, GSM and shipping companies in Kenya have no significant relationship $Y = \beta_o + \beta_1 Lt_{+} \varepsilon$	0.000	11.012	Df (1,358) 3.8676	Null hypothesis was rejected
H_o2 WSN, NS , IOT and shipping	0.000	44.517	Df	Null

companies in Kenya have no significant relationship $Y = \beta_o + \beta_2 ST_+ \varepsilon$			(1,358) 3.8676	hypothesis was rejected
H_o3 GPRS, SWS, RNS and shipping companies in Kenya have no significant relationship $Y = \beta_o + \beta_3 CT_+ \varepsilon$	0.000	54.630	Df (1,358) 3.8676	Null hypothesis was rejected
H_o4 RFI, AIS,VR and shipping companies in Kenya have no significant relationship $Y = \beta_o + \beta_4 IT_+ \varepsilon$	0.000	89.961	Df (1,358) 3.8676	Null hypothesis rejected
GPS, TTS and GSM and shipping companies in Kenya have no significant relationship as moderated by international maritime regulations $Y= \beta_o+\beta_1 LT_+ \beta_{1LT*} M+ \varepsilon$	0.000	13.012	Df (2,357) 3.021	Null hypothesis rejected
WSN, NS, IOT and shipping companies in Kenya have no significant relationship as moderated by international maritime regulations $Y= \beta_o+\beta_2 ST_+ \beta_{2ST*} M+ \varepsilon$	0.000	23.572	Df (2,357) 3.021	Null hypothesis rejected
GPRS, SWS, RNS and shipping companies in Kenya have no significant relationship as moderated international maritime regulations $Y= \beta_o+\beta_3 CT_+ \beta_{3CT*} M+ \varepsilon$	0.000	28.716	Df (2,357) 3.021	Null hypothesis was rejected
RFI, AIS,VR and shipping companies in Kenya have no significant relationship as moderated by international maritime regulations $Y= \beta_o+\beta_4 IT_+ \beta_4 IT*M+ \varepsilon$	0.000	46.192	Df (2,357) 3.021	Null hypothesis rejected

Source: Field Data 2022

F test was used to test the hypothesis the hypothesis and consequently, all the null hypothesis were rejected because the calculated F value is higher than the F critical value.

4.8 Comparison of the direct model and indirect model on the basis of regression outputs

The research assessed association of explanatory variable (SCMTs) with operating efficiency (explained variable); moderating effect. Existing literature and empirical data from earlier studies served as the foundation for the conceptual framework for the investigation. By including localization technologies, sensor technologies, communication technologies and identification technologies as independent variables in the model, the study diverged from earlier studies. The impact of these four factors was responsible for up to 23.9% of the shipping lines performance.

A strong correlation was proved to exist between SCM technologies, international maritime regulations and the companies' operational efficiency. Supply chain management technologies and international maritime regulations attributed for 31.4 % of alterations in these firms attaining efficiency. According to the outcome, international maritime regulations have a greater effect of 7.5% (31.4%-23.9%). Model 2 (indirect model) is more significant than model 1 since it increased shipping lines performance by 7.5 %.

The results indicated localization technology accounted for 3.0% of the variations in firms' efficiency. When localization technologies are combined with international maritime regulations, it accounted for 6.8%of the change in shipping lines performance. The extent of moderation was 3.8% (6.8% - 3.0%).

The findings further indicated sensor technology accounted for 11.1% of the variations in shipping lines performance. When sensor technologies are combined with international maritime regulations, it accounted for 11.7%of the change in shipping lines performance. The extent of moderation was 0.6% (11.7% - 11.1%).

The results indicated communication technologies accounted for 13.2% of the variations in shipping lines performance. When communication technologies are

combined with international maritime regulations, it accounted for 13.9%of the change in shipping lines performance. The extent of moderation was 0.7% (13.9% - 13.2%).

The research findings indicated that identification technologies accounted for 20.1% of the variations in shipping lines performance. When identification technologies are combined with international maritime regulations, it accounted for 20.6%of the change in shipping lines performance. The extent of moderation was 0.5% (20.6% - 20.1%).

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of findings

This research sought to examine the relationship between supply chain management technologies and performance of shipping lines in Kenya. The moderating effect of

international maritime regulations The research was geared towards tackling four study questions that included association between GPS, TTS, GSM and efficiency of Kenya's shipping companies, relationship between sensor technologies and performance of shipping lines in Kenya, relationship between communication technologies and performance of shipping lines in Kenya, relationship between identification technologies and performance of shipping lines in Kenya.

The research utilized positivist philosophy so as to bridge the identified gaps in the analysis of literature review as it recognized that supply chain management technologies and international maritime regulations were relevant in enabling the shipping lines to achieve performance. Explanatory research design used to investigate relationship between the study variables using data gathered using questionnaires; it facilitated research to be as efficient as possible yielding maximum information.

Different indicators were made use of to quantify supply chain management technologies and international maritime regulations, hierarchical multiple regression were carried out to test the accuracy of the hypothesis correlations. Positive associations were ascertained when five main hypotheses were explored. The four sub hypotheses were also investigated.

5.1.1 Localization Technologies and performance of shipping lines

Objective one was to analyze association between GPS, TTS, GSM and efficiency of Kenya's shipping companies. The research findings showed that respondents agreed that shipping lines make utilization of localization technologies such as Global positioning systems (GPS), TTS and GSM in their operations. The respondents were of the view that the localization technologies were used in their firms are adequate in positioning shipment among other important roles. The respondents also agreed ability of the shipping lines to use this technology contributed to their performance.

Correlation analysis indicated existence of an association between GPS, TTS, GSM and efficiency of Kenya's shipping companies. Results from regression proved existence of a significant positive relationship of R2 0.030 between the two variables. Results further indicated that localization technologies are adequate in explaining the operational; efficiency of the companies. Hypothesis one of the study (H_o1) was rejected and the conclusion made was that there is a significant positive relationship between Localization technologies and performance of shipping lines in Kenya.

5.1.2 Sensor Technologies and performance of shipping lines

The second objective analyzed association between WSN, NS, IOT and efficiency of Kenya's shipping companies. Research outcomes indicated respondents agreed that shipping lines utilize sensor technologies such as Wireless sensor networks, Nano sensors and internet of things (IOT) in their operations. The respondents were of the view that the Sensor technology was being used in their firms are adequate in monitoring a wide range of environmental conditions, avoid cargo tampering, notify cargo diversion, detect fault in goods and enhance transportation of environmental sensitive goods. The respondents also agreed on ability of the shipping lines to use sensor technology contributed to their improved performance.

From results of correlation analysis an association between sensor technologies and efficiency of Kenya's shipping companies proved to exist. In addition regression analysis showed Sensor technologies and performance of shipping lines have a significant positive relationship of R^2 0.111. These results indicated that Sensor technologies are adequate in explaining the performance of shipping lines in Kenya. The second hypothesis of the study (H_o2) that there is no statistically relationship between Sensor technologies and performance of shipping lines was rejected and the conclusion was a positive association between the two variables.

5.1.3 Communication Technologies and performance of shipping lines

The third objective was to assess association between GPRS. SWS, RNS and efficiency of Kenya's shipping companies. Research findings showed that the respondents agreed that shipping lines make utilization of Communication technology such as General Packet Radio Systems (GPRS), Single window system and Radio Navigation Satellite in their operations. The respondents were of the view that the communication technology being used in their firms were adequate in connecting physical and virtual flow of goods, relay real time information, sharing of information and keeping customers informed . The respondents also agreed on ability of the shipping lines using this technology contributed to their performance.

Analysis of correlation indicated existence of a significant association between Communication technologies and performance of shipping lines. Results from regression in addition showed that Communication technologies and performance of shipping lines have a significant positive relationship. These results indicated that communication technology is adequate in explaining the performance of shipping lines in Kenya. Hypothesis three of the study (H_o3) that there is no statistically relationship between communication technologies and performance of shipping lines in Kenya was hence rejected and the conclusion reached is that there is a significant positive association between communication technologies and performance of shipping lines in Kenya.

5.1.4 Identification Technologies and performance of shipping lines

The forth objective was to assess association between RFI, AIS, VR and efficiency of Kenya's shipping companies. Research outcomes showed the respondents agreed that shipping lines make utilization of Identification technology such as Radio Frequency Identification (RFID), Automatic identification Systems and voice recognition in their

operations. The respondents were of the view that the Identification technology being used in their firms is adequate in identifying the details of goods being transport, their status and even their country of origin. The respondents also agreed on ability of the shipping lines to use this technology contributed to their performance.

Correlation findings indicated existence of a association between RFI, AIS,VR and efficiency of shipping companies significant positive relationship between identification technologies and performance of shipping lines. Regression results in addition showed that Identification technologies and performance of shipping lines have a significant positive relationship. These results indicated that Identification technologies are adequate in explaining shipping companies' efficiency. The forth hypothesis (H_o4) was hence rejected and the conclusion reached is that there is a significant positive relationship between Identification technology and performance of shipping lines in Kenya.

5.1.5 Relationship between supply chain management technologies and performance of shipping lines in Kenya

This objective set to examine the relationship between supply chain management technologies and performance of shipping lines in Kenya. The hypothesis generated from general objective was that there was no statistically significant relationship between supply chain management technologies and performance of shipping lines in Kenya. The results showed that the joint prediction of all supply chain management technologies was statistically significant. The study discovered that Identification technology was the variable which increased shipping lines performance by biggest unit index figure, followed by communication technology, sensor technology and lo9calization technology in that order. The research findings further established that the

these technologies statistically and significantly affected shipping lines' efficiency. Therefore the null hypotheses were rejected.

5.1.6 Moderating effect of international maritime regulations on the relationship between supply chain management technologies and performance of shipping lines in Kenya

The fifth objective of the study was to examine Moderating effect of international maritime regulations on the Relationship between supply chain management Technologies and performance of shipping lines in Kenya. The study found that international maritime regulations had a moderating effect on the relationship between supply chain management technologies and performance of shipping lines. The relationship between supply chain management technologies and performance of shipping lines was 0.239 0r 23.9% before testing the moderation effect. After the test the combined effect of IRM and SCMT on shipping lines performance was 0.314 or 31.4%.

The calculated value for model 1(before the introduction of the moderator) for F (4, 355) = 27.850. While the calculated value for model 2(after the introduction of the moderator), for F (8,351) = 20.057. Using the p-value t showed that the moderator had a statistically significant effect on the relationship since the p-value obtained 0.000 is less than 0.05.

5.2 Conclusions

Following research findings it was concluded that there is a relationship between supply chain management technologies and performance of shipping lines in Kenya. The results concluded there was a significant and positive relationship on all the supply chain management technologies tested and performance of shipping lines. The study further concluded association between supply chain technologies and shipping

companies as moderated by international maritime regulation was positive and significant. The dependent variable was measured using efficiency and effectiveness. On these measures the research study concluded that when supply chain management technologies were utilized by shipping lines their performance improves. In addition international maritime regulations were measured using various conventions this showed that with the adherence of these conventions the supply chain management technologies increased shipping lines performance. This led to the conclusion that association between these technologies and efficiency of Kenya's shipping companies as moderated by international maritime regulations was significantly positive

Objective one aimed at analyzing the linkage that exists between Localization Technologies and shipping lines operational efficiency. A conclusion was arrived at hat a direct statistically and significant association does exist among these technologies and firms' attaining efficiency. It was also concluded that these companies make use of these technologies. to enable them in locating shipment in the course of being transported, predicting the lead time more accurately, route mapping to increase transport efficiency, and tracking vessels.

The research objective number two aimed to assess association between sensor systems and efficiency of Kenya's shipping companies. Conclusion reached was made that a direct statistically and significant association does exist between sensor technologies and shipping companies efficiency. It was also concluded that these firms utilized sensor technology to help them in notify cargo diversion monitoring a wide range of environmental conditions, detect fault in goods avoid cargo tampering, and enhance transportation of environmental sensitive goods.

Objective number three of the research aimed to analyze linkage between communication technologies and efficiency of these firms. It was concluded a statistically significant positive relationship between communication technologies and performance of these firm. Hence a conclusion was derived that shipping lines in Kenya made use of communication technology to assist them in connecting virtual and physical flow of goods, sharing of information and keeping the customers informed.

The research study forth objective sought to assess the association between identification Technologies and shipping lines operating efficiency. It was concluded that s a direct statistically and significant linkage existed between the two variables being investigated. It was also concluded that these firms made use of this technology to help them in identifying type and source of the goods being transported.

5.3 Implication on Theory

The study contributes to the available literature in procurement and logistics by providing empirical verification of association between supply chain management technologies and shipping companies efficiency as moderated by international maritime regulations.

The study also contributes towards Technology Acceptance Model (TAM) (Davis, 1986) and Task Technology Fit Theory (Good hue & Thompson, 1995) in supply chain management technologies, by examining the various supply chain management technologies that are applied by these shipping lines to perform various activities which in turn leads to improved performance. The elements of TAM which the research the study applied were ease of use and perceived usefulness. The study supported these elements as they diminish resistant to change towards using a new technology. On the

task Technology Fit Theory the research applied ability of technology to perform a certain task which an employee does. The study supported this element of the theory.

The logistics environment in which these shipping lines operate demands that the companies remain ahead with the latest technology in use in certain areas of their operations for them to perform and remain competitive.

The study supported the institutional theory in its elements of necessitating the shipping lines to comply with the various conventions governing this industry in shipping lines. Adherence to set regulations will enable them to stay ahead in their market of operation achieve improved performance.

5.4 Recommendations of the study

5.4. 1 Implication on managerial policy and practice

The managers of shipping lines will benefit from the insight derived from the research findings on importance of adopting and utilizing proper supply chain management technologies so as to enhance their firms' performance. The study therefore sheds more light on the critical supply chain management technologies that can be implemented in their various operations to improve their performance. The study further brought to the fore the importance of moderator among the study variables.

5.4.2 Implication for Methodology

The study used a questionnaire to collect data from the respondents drawn from staff in Logistics, IT, Finance and sales and marketing departments from shipping firms. This therefore necessitated use of a cross sectional research design as opposed to time series (Panel data). The study targeted the 53 shipping lines in Kenya. However six of them were used for piloting and were omitted during main research. Prior research studies have used multiple linear regressions in analyzing cross sectional data.

The study made use of hierarchical regression models using Kenny & baron (1986) to analyze the data. Grounded on the appropriateness of the results obtained from the use of the above instruments and data analysis; the methodology used was appropriate for the current study that aimed at assessing the relationship between supply chain management technologies and performance of shipping lines in Kenya. The implication of this was that instruments used for this study can be relied upon for similar studies in the future.

5.4.3 Contribution to Knowledge

From the study conclusions, the study findings make contributions to the existing literature by indicating that all the supply chain management technologies when studied combination, have got a significant positive relationship on shipping lines performance since they assist in curbing inefficiencies resulting for lack of technology use. The study findings helped in concluding that these technologies had a significant positive relationship on shipping lines performance. The study further contributed to existing literature by indicating that the various supply chain management technologies have an effect on improving shipping lines performance. Further the study makes contribution to the existing literature by pointing out that the introduction of the international maritime regulations in the relationship between research variables has positive effect .

The study has contributed to supply chain management by providing the evidence of various supply chain management technologies impact on performance of shipping lines in Kenya. The study also contributed to the existing literature by adding the moderating effect of international maritime regulations in the relationship between supply chain management technologies and shipping lines performance. The study revealed that international maritime regulation has significant positive effect on the relationship though very little. The study variables and their joint effects add to the

existing literature by opening new ways of enquiry and a wider scope of business research and establishing a strong basis for analyzing the effect of supply chain management technologies on shipping lines performance.

5.4.4 Suggestions for future studies

This study only focused on the relationship between supply chain management technologies and performance of shipping lines in Kenya: the moderating effect of international maritime regulations. The study while establishing the relationship between these technologies and shipping lines performance as moderated by international maritime regulations was able to identify gaps in the field of study that can be filled by future researchers. The study recommends that further studies can be done to establish moderating role firm size in the relationship between supply chain management technologies and performance of shipping lines in Kenya.

For this research the data was gathered through the use of the questionnaires that were distributed to staff of various departments of the shipping lines, Future research should considered using other instruments of data collection such as interview schedules with the employees of these companies.

Further the research used the international maritime regulations as the moderator which governs several countries; future research should focus on using a moderator such as local government such Kenya maritime Authority regulations.

REFERENCES

Abbas, W. A., (2016) the effects of mobile phone technology on logistics performance

Of clearing and forwarding firms in Mombasa County, Kenya accessed from

e-repository. uonbi.ac.ke.

Adisa, V. K. (2017 transport management technologies and performance of Third party

Logistics providers in Kenya erepository.uonbi.ac.ke.

Agrifoglio, R., Cannavale, C., Laurenza, E. & Metallo, C.(2017), How emerging digital technologies affect operations through co-creation. Empirical evidence from maritime industry *The management of operations* 28:1298-1306

Aikaruwa, P. M. (2019) The effects of information communication technology on supply chain management practices in Tanzania. A case of Tanzania electricity supply company (TANESCO) unpublished thesis college of business education

Anna, S. (2018) An analysis of the possible impact of the IMO 2020 regulation, in the market structure of the liner industry unpublished thesis Erasmus university of Rotterdam

Antwi, S. K. & Hamza, K.(2015) Qualitative and quantitative research paradigms in business research. A philosophical reflection *European journal of business and management*, 7(3), 217-225

Asuming, P. O., Kofi, A. A. & Chelbi, A. (2011) Adoption of radio frequency identification (RFID) to track counterfeit drugs in a supply chain: Case of Kama pharmaceutical company, Ghana, Unpublished thesis university of Education Winneba, Ghana

Ayantoyinbo, B. B. (2015) Assessing the impact of information communication Technology on performance of freight distribution *European Journal of logistics , purchasing and supply chain management* 3 (4) 18-29.

Bashange, L. (2015) Assessment of the risk awareness for mobile banking users in Tanzania, a case of CRDB Mbagala branch Temeke Municipality Dar Es salaam. The open university of Tanzania

Bashir *et al* (2008). Reliability and validity of qualitative and operational research paradigm: behaviour? *Journal of Economic Issues,* 31(1), 59-78.

Bauk, S., Kapidani, N. & Schmeink, A. (2017) on intelligent use of ICT in some maritime business organizations *Montenegrin journal of economics* 13(2):162-173

Ben-Daya, M., Hassini, E. Bahroun, Z. (2017) internet of things and supply chain management: a literature review *international journal of production research* 57:4919-4742

Begashaw, M. & Busha, T. (2018) The effect of fleet management on fleet efficiency from the perspective of employee (The case of World Health organization Ethiopia). Unpublished thesis Addis Ababa university

Bowley, A. L. (1926) Measurement of precision attained by sampling. Bull. Int. sta.inst. Amsterdam 22 1-62

Brewer, L. T. (2021) Regulating international maritime shipping's air polluting emissions monitoring, reporting, verifying and enforcing regulatory compliance *journal of international safety, environmental affairs and shipping* 5 (4)

Choi, H., Baek, Y. & Lee, B. (2014) Design and implementation of practical asset tracking systems in container terminals. *International Journal of precision engineering and manufacturing,* 13(11).

Coase R. H. (1937), the nature of the firm *Economica* 4(16) 386-403

Collins, H. (2010)‘ Creative Research The theory & practice of Research for creative industries’ AVA Publications P 38.

Creswell, J. W.(2015) A concise introduction to mixed method. Thousand oaks, CA Sage

Crowther, D. & Lancaster, G. (2008) ‘Research methods: A Concise Introduction to research in Management & business Consultancy’ Butterworth Heinemann.

David, F. R.(2010 2nd edition) Introduction to supply chain management technology (Resource management) CRC Press.

Davis, F. D. (1989), ‘’perceived usefulness, perceived ease of use, and user acceptance of information technology”, MIS Quarterly, 13 (3): 319-340.

Davis, F. D.; Bagozzi, R. P.: Warshaw, P. R. (1992), “User acceptance of computer technology: A comparison of two theoretical models “, Management Science, 35; 982-1003

Doan, B. (2017) radio frequency Identification (RFID) and its impact on logistics activities unpublished thesis

Elango, M., S., G. (2018), the impact of information communication technology on supply chain management in South Indian Small-scale grocery sector. Unpublished thesis national college of Ireland.

Gizem, E. (2020) the impact of industry 4.0 on supply chain integration and performance: An empirical investigation in an emerging market.

Hameed, U. W., Nadeem, S., Azeem, M., Aljumah, I. A. & Adeyemi, A. R. (2018)

Determinants of E-logistics customer satisfaction: A mediating role of

information and communication technology *International journal of supply chain management*

Hiekata, K., Wanaka, S., Mitsuyuki, T. & Ueno, R. (2020) Systems analysis for Deployment of internet of things (IOT) in maritime industry *Journal of marine Science and technology* 26(15)

Kabui, B. N., Gakobo, T. & Mwaura, P. (2019) Effect of single window system procedures on cargo efficiency in Kenya: A case for Mombasa port, *European journal of business and management* 11(24)

Kahyarara, G.(2018) maritime transport in Africa: challenges, opportunities and an Agenda for future research UNCTAD Ad Hoc Expert meeting

Khan, U. H. & Adediji, A. O (2017) Need for Radar system utilisation for maritime traffic management: a case of Congo River Basin. *International journal of computational systems Engineering* 3 (3), 163-174

Khan, N. R., Haq, M. A., Ghouri, A. M., Raziq, A. & Moiz, S. M.(2017)Adaptation of RFID technology in business supply chain success: Empirical findings from a developing country logistic industry. *Journal of quality management* 10 (160)

Kenya business list directory 2021

Khalil, G., Doss, R. & Chowdhury, U. M. (2019) A comparison survey study on RFID based anti-counterfeiting systems *journal of sensor and actuators* 8(8)

Kithia, A. K. (2015) Effects of electronic logistics on the logistical performance of Logistics firms in Kenya. A case study of Maersk Kenya limited, the International journal of business and management, 3(12), 68-92

Kothari, C. R,(2009 2nd ed) Research methodology : Methods and techniques new age international publishers New Delhi.

Kyomo, T.(2019), the impact of information and communication technology on logistics performance. A case of cargo transportation companies in Dar-es-salaam region, Tanzania. Unpublished thesis Mzumbe University

Last, P. (2016) Analysis of automatic identification system data for maritime safety *unpublished thesis Jacobs university* German

Lu, J. & Bowles, M. (2013) how will Nano sensor technology affect logistics management .*Journal of convergence information technology* 8(2) 820- 828.

Lui, K. H. (2015) the impact of disruptive information technology innovations on firm performance: The case of RFID adoption and its implication in fashion and textile industries. Unpublished thesis Hong Kong polytechnic university.

Maliss, V. (2018) IBM and Maersk developing cargo tracker, *research gate*

Marijan, S. M. (2020) the use of block chain technology in the supply chain. A case study from Austria unpublished thesis Modul Vienna University.

Maxwell, A. J. (2013), Qualitative research design: An interactive approach (applied social research methods. Thousand Oaks, CA: sage

Michaelides, R., Michaelides, Z & Nicolaou, D. (2010) Optimisation of logistics operations using GPS technology solutions: A case study. *POM 21st Annual conference Vancouver, Canada*

Mingers, J.(2000) the contribution of Critical Realism as an Underpinning philosophy for OR/MS and Systems. *The Journal of operational Research society,* 51(11)

Mlimbila, J. & Mbamba, U. O. L. (2018) the role of information system usage in enhancing port logistics performance: evidence from the Dar Es Salaam port Tanzania. *Journal of shipping and trade*, 3 (10) 1-23

Muhammad, M. Saahar, S. Hasan, H., Fiah, M. F. & Nor, M. A. (2013) Effective communication systems for Malaysian logistics industry. *Science direct*

Moh'd, A.(2016) Enhancing trade , facilitation system and supply *chain* security for local, Regional and international corridor. *International Journal of Industrial and manufacturing engineering* 10(10)

Mugambi, N.(2017)Effects of Cargo tracking systems on cross border trade between Kenya and Uganda erepository.uonbi.ac.ke.

Njeru, S. K. (2017) Radio Frequency Identification based model for tracking vehicles. thesis Strathmore University. Retrieved from https: // su-plus-Strathmore. edu/ handle 11071/ 568.

Njiru, S. N.(2020) Influence of maritime security on exploitation of blue economy resources along Kenya coastal region. Unpublished thesis of Africa's Nazarene university

Niraj, C. (2019) Impact of automation technology on logistics and supply chain management. American journal of theoretical and applied business 5(3) 53-58

Nomasu, N. D. (2017)The potential use of Internet Of Things (IOT) in South African Retail Businesses, Unpublished thesis by the University of Cape Town.

Oduma, R. O. & Shale, N (2019), effects of logistics automation on supply chain performance in Kenya Medical Supplies Authority. *International journal of social sciences and information technology*

Ojwang, J. S. (2016), Information technology usage on humanitarian logistics of relief organizations in Kenya. Unpublished thesis university of Nairobi

Onwuegbuchunam, D. E., Aponjolosun, M. O. and Ogunsakin, A. W. (2021)Information and communication technology (ICT) Adoption in Nigerian ports Terminals operations, *journal of transportation technologies*, 11, 311-324

Opiyo, M. M. (2017) Impacts of information Communication Technology in logistics management *journal of advanced research*

Okafor, D. J., Nico, M. & Azman, B. B. (2016) The influence of perceived ease of ease and perceived usefulness on the intention to use a suggested online advertising workflow. Canadian *Journal of Science and Technology*, 6 (14), 162-174

Pham, H.(2018) the impact of blockchain technology in the improvement of international food supply chain: transparency and traceability. Unpublished thesis, Seinajoki University

Pulka, B. Ramli, A. & Mohamad, A. (2018) The impact of information communication technology resources on SMEs performance. A conceptual framework r*esearch gate*

Ramkumar, A. & Jenamani, M. (2015) organizational buyers' acceptance of electronic procurement services – an empirical investigation in Indian firms services

Reynolds, J., Kizito, J., Ezumah, N., Mangesho, P., Allen, E., & Chandler, C.(2011) Quality assurance of qualitative research: *A review of the discourse, Health Research policy and Systems*, 9(1), 43

Rodrigue, P & Notteboom, T. (2017), reassessing port-hinterland relationships in the context of commodity global chains. *Taylorfrancis.com*

Ruto, W. & Datche, E.(2015) logistical factors influencing port performance a case of Kenya ports authority (KPA) *international journal Cur Res Rev* 7 (12)

Sakhasia, E. S. (2017) Influenced of electronic customs management systems on service delivery at the Eldoret Kenya Revenue Authority station, *Unpublished Thesis University of Nairobi.*

Shaikh, N. I., Kamble, P. P. & Siddharath, M. T.(2021) Advancement in sensor technology in shipping International journal of recent technologies and engineering 10 (1).

Skorna, A. C. H., Bode, C. & Weiss, M. (2011) Risk and loss prevention within transport chain, *20th international conference on management of Technology Florida*

Tajfar, H. A. & Gheysari, M. (2016) Analysis on the effects of internet of things technology in managing supply chain, *International journal of information and communication technology research* 8 (3) 15-25

Tannady, H., Resdiansyah, s., Andry, J. & Farady, R (2020) exploring the role of information communication technology readiness and information sharing on

supply chain performance in coronavirus disruptions *technology reports of Kansai university* 65 (5) 2581-2588

Tharaka, De-v., Himanshu, S. & Shah, J. M. (2018),the effect of internet of things on supply chain integration and performance of organizational capability perspective. *Australian journal of information systems* 22

Trochim, W.(2006 2nd ed) The research methods knowledge base, Atomic Dog Publishing. Cincinnati, OH.

Tsang, Y. P., Choy, K., Wu, C,. & Ho, G. T. S.(2017) An IOT-based cargo monitoring system for enhancing operational effectiveness under a cold chain environment. *International journal of engineering business management*

UNCTAD review on maritime transport (2020)

Urban, B. & Darlington, C. C. (2011) Adoption of automatic identification system by grocery retailers in Johannesburg's area *journal of transport and supply chain management* (1) 88-107

U-Thong, N., Jaturat, N. & Kingsida, S. (2020) The impact of RFID utilization on firms performance through decision making of automotive manufacturers industry. Science and technology RMUTT journal 207-214

Yamane, T. (1976)statistics; An Introductory Analysis 2nd edition, Harper and Row, New York.

Yan, J., Xin, S., Liu, Q., Xu, W., Yang, L., Fan, L., Chen, B. & Wang, Q. (2014) intelligent supply chain integration and management based on cloud of things *international journal of distributed sensor networks* 10 (3)

Yang, D., Wu, L., Wang, S., Jia, H.& X-li, K. (2019) how big data enriches maritime research- a critical review of automatic identification systems (AIS) data applications transport reviews 39 (6) 755-773.

Yelamarthi, K. (2014) An autonomous passive RFID assisted mobile robot system for indoor positioning *research gate*

Waiyaki, E. C. (2013) Levering technology for business fleet applications: A case study of fleet management system implemented in Kenya power and lighting company. Unpublished thesis university of South Africa.

Wang, J., Chi, H. – L., Shou, W., Chong, H. –P. & Wang, X. (2018) A coordinated approach to supply chain tracking in the liquefied natural gas industry *Sustainability* 10, 4822

Wil, T.; Kirti, C.; Christopher, M.; & Robins, G.(2018)An accurate real-time RFID-based location system. *International Journal of Radio Frequency Identification technology and applications.*5 (1):48

Wilson, J. (2010) "Essentials of Business Research: A Guide to Doing Your Research Project" SAGE Publications

World Bank (2018) International Logistics performance index ranking

Yan *et a*l (2016) intelligent supply chain integration and management based on cloud of things. *International journal of distributed sensor networks*

Zahid, M. J. A., M (2013) Information Communication Technology (ICT) for disabled persons in Bangladesh; preliminary study of impact/ outcome .International working conference on transfer and diffusion of IT, springer

Zikomo, M. (2016) Analysis on the effects of cargo handling factors to port performance in Tanzania: A case of Dar Es Salam port. Unpublished thesis of the open university of Tanzania

APPENDICES

Appendix I: Letter from University

KISII UNIVERSITY

P. O. Box 408-40200
KISII, KENYA

SCHOOL OF BUSINESS AND ECONOMICS

OFFICE OF THE COORDINATOR, POST-GRADUATE PROGRAMMES

Ref: KSU/SBE/DCB/10349/15

Tuesday , 22nd February, 2022

The Director,
National Commission for Science, Technology &
Innovation (NACOSTI)
NAIROBI.

Dear Sir,

REF: APPLICATION FOR A RESEARCH PERMIT FOR
NANCY MUTHONI NJERI REG. NO. DCB/10349/15

The above named is a PhD student in our institution who intends to carry out a Research. The intended study is titled: **"Relationship between Supply Chain Management Technologies and Performance of Shipping Lines in Kenya: The Moderating effect of International Maritime Regulations".**

The purpose of this letter is to request you to give her a research permit to enable her conduct the research.

Thank you.

22 FEB 2022

Dr. Joshua Watula, PhD
COORDINATOR, POST-GRADUATE PROGRAMMES

W.JC / pa

KISII UNIVERSITY IS ISO 9001:2008 CERTIFIED

Appendix II: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **811563**

Date of Issue: **01/March/2022**

RESEARCH LICENSE

This is to Certify that Ms.. NANCY MUTHONI NJERI of Kisii University, has been licensed to conduct research in Mombasa, Nairobi on the topic: Relationship between supply Chain Management Technologies and Performance of Shipping Lines in Kenya: The Moderating Effect of international Maritime Regulations for the period ending : 01/March/2023.

License No: **NACOSTI/P/22/16010**

811563

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY &
INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix III

Introductory letter to the respondents

From: Nancy Muthoni Njeri

P.O Box 1223-40200 Kisii

Kenya

Tel: 0721582608

Dear sir/ Madam,

SUBJECT: RESEARCH DATA COLLECTION QUESTIONNAIRE

Am **Nancy Muthoni Njeri,** a PhD student at Kisii University and I am currently doing research for my thesis on **RELATIONSHIP BETWEEN SUPPLY CHAIN MANAGEMENT TECHNOLOGIES AND PERFORMANCE OF SHIPPING LINES IN KENYA: THE MODERATING EFFECT INTERNATIONAL MARITIME REGULATIONS** for fulfilment of requirements for award of **PHD IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT**.

I am kindly requesting for your collaboration in filling in questionnaire in data gathering process.

Your assistance is highly appreciated, equally you response is of immense value for my thesis I would really appreciate your help. I would also like to request you to take time in completing it. In case of any query kindly contact me. Your response will be handled with confidentiality as they will used specifically for study

Thank you in advance for you attention, time and response.

Yours faithfully,

Nancy Muthoni Njeri

Appendix IV

RESEARCH QUESTIONNAIRE

Section A: Demographic Data

(**Instructions-Kindly please tick appropriately**)

1.What is your gender?

Male

Female

Others

2. Your age?

Below 25 years ( )

25- 34 years ( )

35-44 years ( )

45- 54 years ( )

55 years and above ( )

3. Which is your department in the firm?

Logistics ( )

IT ( )

Finance ( )

Sales and marketing ( )

4. Kindly indicate your highest academic qualification by ticking appropriately?

Diploma ( )

Degree ( )

Masters ( )

PhD ( )

5. . Kindly indicate your professional qualification by ticking appropriately?

KISM ( )

CPA ( )

Clearing and forwarding ( )

CISCO ( )

None ( )

6. Please indicate the period you have worked for the firm?

Below 5 years ( )

5-10 years ( )

Over 10 years ( )

Section B: Localization technologies

7. Kindly indicate by ticking from the list below the extent of your agreement with statements that follow relating to localization technologies within shipping lines. The scale for indicating is as follow; 1-Strongly Disagree, 2-Disagree, 3 – Undecided, 4-Agree, 5-Strongly Agree

Statements	**1**	**2**	**3**	**4**	**5**
There is high utilization of Global positioning technology as localization technologies in your firm's operation					
The of use of Global positioning systems are adequate localization technologies for indicating position of shipment and forecasting lead					

time					
TTS are widely used by your firm operations as a localization technologies					
TTS are adequate localization technologies for tracking vessels and checking route deviation					
Global systems for mobile communication are used by your firm in its operation as localization technologies					
The Global systems for mobile communication are adequate localization technologies in route mapping					

SECTION C: **Sensor technologies**

7. Kindly indicate by ticking from the list below to what extent you agree with the statements that follow relating to sensor technologies within shipping lines. The scale for indicating is as follow; 1-Strongly Disagree, 2-Disagree, 3- Undecided, 4-Agree, 5-Strongly Agree

Statements	**1**	**2**	**3**	**4**	**5**
The Wireless sensor networks are highly utilised by your company as sensor technology in its operations					
Wireless sensor networks are adequate sensor technology for monitoring environmental conditions that may be risky during transportation					
There is high utilization of Nano sensors in your organization operations					
The Nano sensors are adequate technology for avoiding cargo tampering during transportation					

The Internet of things as a sensor technology is utilised by your firm in its operations					
The Internet of things is adequate technology for detect in fault in goods					

SECTION D: **Communication technologies**

8. Kindly indicate by ticking from the list below the extent to which you agree with the following statements relating to communication technologies within shipping lines. The scale for indicating is as follow; 1-Strongly Disagree, 2-Disagree, 3- Undecided, 4-Agree, 5-Strongly Agree

Statements	**1**	**2**	**3**	**4**	**5**
There is use of general radio packets by you firm in it's operations					
The general packets radio are adequate in relaying real time information in your firm's operations					
There is utilization of Single window systems as a communication technology in it's operations					
The single Window systems has proved adequate in connecting virtual and physical flow of goods					
There is use of radio navigation satellite as a communication technology in your organization					
The radio navigation satellite is adequate in sharing of information and keeping customers informed					

SECTION E: **Identification technologies**

9. Kindly indicate by ticking from the list below your degree of agreement to these statements relating to identification technologies within shipping lines. The scale for indicating is as follow; 1-Strongly Disagree, 2-Disagree, 3-Undecided, 4-Agree, 5-Strongly Agree

Statements	**1**	**2**	**3**	**4**	**5**
Radio Frequency Identification is highly utilised by your firm as an identification technology in its operations					
Radio Frequency Identification is adequate for identifying goods being transported					
Automatic identification systems are highly utilised by your firm as an identification technology in its operations					
Automatic identification systems are adequate in carrying out inspection of shipment					
Voice recognition is highly utilised by your firm as an identification technology in its operations					
Voice recognition is adequate identification technology for your firm's performance					

SECTION F: **shipping lines performance**

10. Kindly indicate by ticking from the list below the extent to which you agree with the following performance indicators as observed in your firm. The scale for indicating is as follow; 1-Strongly Disagree, 2-Disagree, 3 - Undecided, 4-Agree, 5-Strongly Agree

Statements	1	2	3	4	5
Reduced delivery time is a key performance indicator in your firm					
Customers service is a key performance indicator in your firm					
Increased market share is a key performance indicator in your firm					
Profitability is a key performance indicator in your firm					
Customer satisfaction is a key performance indicator in your firm					

SECTION G: **International maritime regulations**

11. Kindly indicate by ticking from the list below to what extent you are in agreement with these statements on international tracking systems within shipping lines. The scale for indicating is as follow; SD-Strongly Disagree, D-Disagree, UD-Undecided, A-Agree, SA-Strongly Agree

Statements	1	2	3	4	5
Your organization adheres to SOLAS convention during its operations					
Your organization adheres to ISM convention during its operations					
Your organization adheres to MARPOL convention during its operations					
Your organization adheres to COLREG convention during its operations					
Your organization adheres to LOADLINES convention during its operations					
Your organization adheres to ISPS convention during its operations					

Source: Kenya Business Directory 2021

Appendix V

List of shipping lines in Kenya

Source: Kenya Business Directory, 2021

Shipping line	Logistics staff	Finance staff	IT staff	Sales & marketing staff	Target population
Africa liner agencies ltd	12	10	9	11	42
Africa shipping line	15	13	7	26	61
Agen pacific line(K) ltd	11	14	11	9	45
Alternative freight logistics ltd	13	10	12	14	49
Ampees shipping and general agencies	15	13	10	15	53
Breakbulk enterprises	10	15	11	20	56
CMA CGN Kenya ltd	12	14	18	21	65
Diamond shipping services ltd (Mombasa)	20	15	10	13	58
Diamond shipping services ltd (Nairobi)	17	10	13	20	60
East Africa commercial and shipping company ltd(Mombasa)	15	13	11	25	63
East Africa commercial and shipping company ltd(Nairobi)	22	14	10	26	72
East Africa commercial consolidation services ltd (Nairobi)	13	18	11	16	58

East Africa commercial and shipping company ltd	11	10	15	18	54
ECU line (K) ltd (Nairobi)	17	11	10	9	47
ECU line (K) ltd (Mombasa)	9	15	12	14	40
Export consolidation services (K) ltd (Nairobi)	13	17	10	15	55
Express shipping and logistics ltd (Mombasa)	18	12	20	16	66
GAC-seaforth shipping (K) ltd (Mombasa)	11	13	9	13	56
Global express international (Mombasa)	23	17	25	36	101
Ima (K) ltd (Mombasa)	13	12	15	10	50
Inchcape shipping services (Mombasa)	19	13	10	16	58
Kenya national shipping line ltd (Mombasa)	15	21	18	27	81
Kihanya ship's contractors ltd (Mombasa)	9	14	11	8	42
Macedonian maritime ships services (Mombasa)	13	19	17	11	60
Mackenzie maritime (K) ltd (Nairobi)	9	14	11	16	50
Mackenzie (K) ltd (Nairobi)	15	10	12	20	57

Makedonia maritime (K) ltd (Mombasa)	13	17	8	12	50
Messina (K) ltd (Mombasa)	8	14	10	22	54
Mitchell Cotts freight Kenya Ltd (Mombasa)	10	15	7	13	45
Multiport international ltd (Mombasa)	23	17	11	29	70
Murri ship management ltd (Mombasa)	7	4	8	10	39
Murtaza shipping agency ltd (Mombasa)	15	9	13	11	48
Oak shipping agencies ltd (Mombasa)	5	8	4	7	24
Oceanfreight (EA) ltd (Nairobi)	19	10	12	21	62
Omlion Enterprises (Nairobi)	8	14	9	11	42
Panalpina Kenya ltd (Mombasa)	19	16	13	21	69
PIL (K) (Nairobi)	12	17	8	15	52
PIL (K) ltd (Mombasa)	10	14	11	9	44
Rais shipping Services (K) ltd (Mombasa)	8	11	13	7	39
Safmarine Kenya ltd (Nairobi)	9	13	5	16	43
Mearsk (K) ltd (Nairobi)	24	16	13	27	80
Safco (K) ltd (Mombasa)	10	6	8	5	29
Safmarine Kenya ltd (Mombasa)	21	11	10	19	61
Sea bulk shipping	23	11	20	30	74

serves ltd (Mombasa)					
Seaforth shipping (K) ltd (Nairobi)	17	10	13	20	60
Sentrans maritime ltd (Mombasa)	7	8	10	12	37
Sinataco (K) ltd (Mombasa)	11	9	14	18	52
Star East Africa company ltd (Nairobi)	10	13	12	7	42
Stejan Freight forwarders (K) ltd (Mombasa)	8	10	15	17	52
Three ways shipping services (Nairobi)	11	9	7	13	40
Track freight express lines ltd (Mombasa)	18	12	22	10	62
W. E. C lines (K)ltd (Nairobi)	13	17	8	14	50
Zim Kenya (Mombasa)	7	5	11	9	32
Total	**706**	**666**	**623**	**840**	**2835**

Appendix VI

Plagiarism Report

NJERI MUTHONI THESIS

ORIGINALITY REPORT

19%	18%	6%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	ir.jkuat.ac.ke Internet Source	3%
2	www.irjp.org Internet Source	2%
3	ir.mu.ac.ke:8080 Internet Source	1%
4	ir-library.ku.ac.ke Internet Source	1%
5	test.egerton.ac.ke Internet Source	1%
6	ikesra.kra.go.ke Internet Source	1%
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8	dvc-ril.mksu.ac.ke Internet Source	1%
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