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AN ASSESMENT OF THE EFFECTS OF THE INTERNET OF THINGS ON EFFICIENT INTEGRATION AND PERFORMANCE OF SUPPLY CHAIN MANAGEMENT DURING COVID 19 IN ZIMBABWE: A CASE OF CIMAS MEDICAL LABORATORIES (2020- 2022)

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTERS SCIENCE DEGREE IN PURCHASING AND SUPPLY CHAIN MANAGEMENT OF BINDURA UNIVERSITY OF SCIENCE EDUCATION.

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DEDICATION

This project was done and specifically dedicated to my wife, siblings and two daughters for unwavering support during difficult times.

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I acknowledge the assistance and full support and patience that I got from my lecturer Mr S.P. Mandaza but not least I acknowledge the support I got from my wife Haziel Zvidzai who facilitated less concentration on family issues.

ABSTRACT

The aim of this study is to delve into the influence of the digital supply chain on the quality, productivity, and cost reduction aspects of supply chain performance. The target population of the study was 150 employees of Cimas Medical laboratories. The sample frame included the employees defined by their departments. Data collection instrument used was the questionnaire. It is notable that there exists strong positive relationship between the independent variables and dependent variable as shown by the high adjusted R squared (0.7133). It shows that the independent variables in the study were able to explain 0.7133variation in the Perfomance. The standard error is minimal with a value of 1.4195 meaning the model used in the study would have minimal effects of errors associated with supply chain service delivery. This shows that the model has a good fit since the value is 71%. the investigation reveals that the digital supply chain has significant effects on operational performance in terms of quality, productivity, and cost reduction performance. The research find out that digital technology in terms of big data technology has a positive effect on company performance, the implementation of digital supply chain practices in a company leads to an increase in the level of operational performance and the adoption of digital technology can create considerable value-added and monetary performance gain for companies, and it will soon become a standard throughout the industry.. It concludes that big data is widely recognized as a critical field of future technology and is rapidly gaining the attention of many industries due to the high value it can offer businesses. This study recommends that the understanding of supply chain management by addressing the knowledge gap associated with the digital supply chain. In particular, it has concentrated on the hitherto unresearched effect of operational performance in the context of the industry.

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CHAPTER ONE

INTRODUCTION

1.0. Introduction

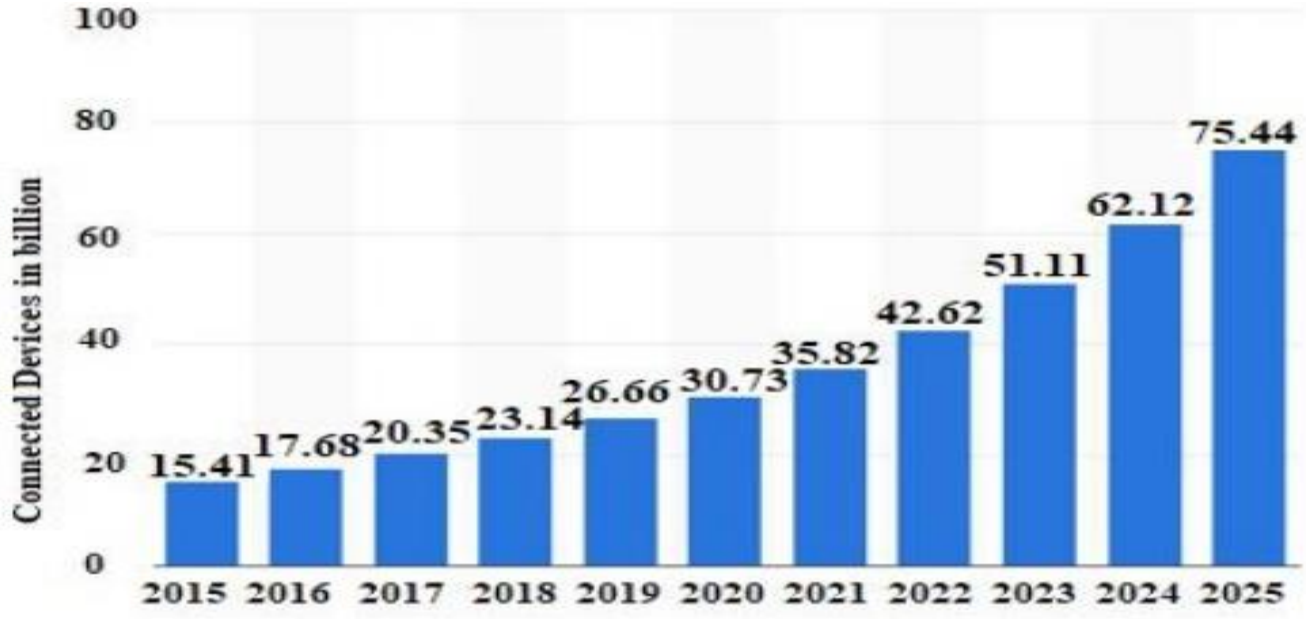
Given how it affects prevailing paradigms, business models, and industry borders, digitalization in the logistics and supply chain management sector is becoming more strategically significant for enterprises (Caches et al., 2020). Several businesses devote resources to utilizing digital opportunities that could revolutionize communities, economics, and organizations (Caches et al.2020). But digitalization appears to have two sides: on the one hand, companies like Amazon have fundamentally altered the landscape through digital goods and services (Cohen, 2018), embracing and promoting digitalization as a force for change not only between institutions and organizations but also between supply chains. This research will on how internet of things have affected supply chain management in Zimbabwe. The chapter hereunder shall present a brief background of study. The discussion also focuses on the statement of hypothesis, research objectives and questions to which this research attempts to address, justify and delimitations for this research shall also be discussed.

1.1. Background to the study

In recent years, significant paradigm shifts have occurred in the areas of supply chain integration and the internet of things (De Vass, et al 2018). Internet of things and supply chain integration are becoming increasingly popular due to pressure from the market, which has elevated them to a crucial position in organizational operations and strategy (Raheb, et al 2020). In order to maintain their competitive position in this more dynamic business environment, the organizational activities of supply chain integration and the internet of things have assumed more significant responsibilities (Tang, & Veelenturf, 2019). In order to deliver the right product to the right client at the right time, organizations must continuously improve their internet of things and supply chain integration (Raheb, et al 2020).

These days, wireless communication and mobility services are relied upon by the entire world. As wireless networking expands, the disadvantage of wireless communication is clearly obvious. The website Statistica (2020) estimates that by 2025, there will be up to 50 billion smart gadgets worldwide that are connected to one another. According to Siemens study, there will be around 26 billion connected physical objects online by 2020. (See figure 1). It won't be long before billions of physical objects are connected in real time.They can communicate each other and forwarding and process required data on the cloud. But there is a lack of technical standardization security perspective on the internet of smart thing. According to Statistica (2020) report, in 2025, the total number of connected devices in the world will be approximately 75.44 billion. See figure 1.1

Figure 1.1: Internet of things (IoT) connected devices



Source: P. Krishna, et al. (2014)

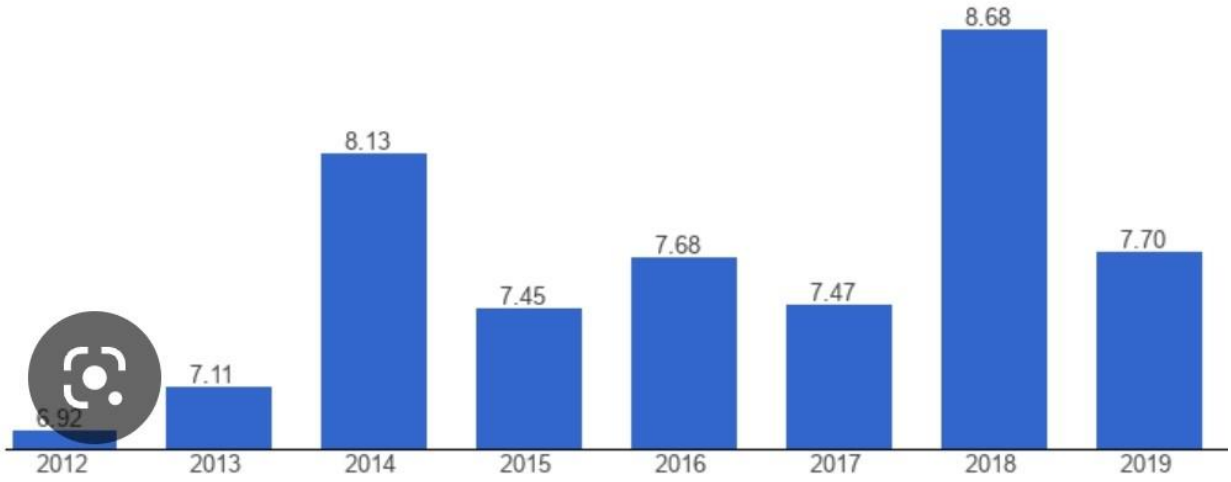
Smart devices, not global population, are the primary cause of this expansion. The use of integrated technologies is essential for connecting physical objects and facilitating information exchange. In this setting, both humans and machines can communicate with one another through machine-to-machine communication. The Internet of Things (IoT) is the interconnection of physical objects, intelligent devices, intelligent buildings, intelligent cars, and embedded objects with electronics,

software, sensors, actuators, and network connections. The wireless sensor network had a major role in the development of the Internet of Things (IoT) concept.

Internet of Things (IoT) is defined as a universal platform of internet-connected smart objects that allow things to connect anytime, anywhere using any network or service (De Vass, et al 2018). It is advancement in technological innovation connecting objects and devices through Internet (De Vass, et al 2018). The network of objects embedded with sensors and software has the potential to collect and communicate data over internet (Raheb, et al 2020). Internet of Things (IoT) and supply chain integration platform facilitate things to be identified, located, sensed and controlled via the global platform. It is viewed as progression of information and communication technology (ICT) applications that are helpful to capture and share data in a network of organizations on real-time basis (De Vass, et al 2018). This digitally upgrading of conventional objects via internet connectivity generates added capabilities to its functionality. Internet of Things may differ to previous information and communication technology capabilities due to their ubiquity, intelligence and autonomy (Mohanty and Mishra 2020).

Tanzanian businesses creating knowledge-based networks might vary in terms of size, sector, and organizational design. These variations cause inconsistencies in the outcomes that collaborating enterprises anticipate from the supply chain. A small supplier, for instance, whose main goal is operational excellence, may be more motivated to improve order-interface-related expertise than to amass product or customer knowledge. As a result, it is crucial that the supply chain's partners have strong organizational and technological foundations to support the utilization of its knowledge management capability. In order to conduct laboratory tests, the Zimbabwe Ministry of Health and Child Care has switched from utilizing its own equipment to equipment that is owned by vendors. According to the Ministry of Health and Child Care Report, this has been particularly true for chemistry testing, which accounts for 77 percent of all reportable laboratory tests (2017). In order to purchase laboratory equipment, the Ministry of Health and Child Care invested $8 million on capital projects between 2015 and 2022.

Figure 1.2: The Ministry of Health and Child Care capital expenditure



Source: Ministry of Health and Child Care report (2019)

The routes of equipment acquisition included purchases secured with the support of Global Fund. In all cases, Cimas Medical Laboratories were responsible for servicing, maintenance, disposal, and replacement, in addition to sourcing reagents and consumables.

Instead of being a nice bonus, enhancing clinical and public health laboratories ought to be one of the key objectives of strengthening health systems. In order to hasten national laboratory services' journey toward accreditation in the African region, numerous African nations, donors, the World Health Organization (WHO), and implementing partners met in Kigali, Rwanda, in July 2009 to start a program for enhancing laboratory management. The Maputo Declaration for Strengthening Laboratory Health Systems, the Lyon Statement on the Need for Developing Countries to Establish Practical Quality Management Systems, and the Yaoundé Resolution issued by the WHO Region VIII in September 2008 were all significant events that brought attention to the necessity of strengthening laboratory networks, systems, and services in developing countries prior to the 2009 meeting in Kigali. The recent emphasis on improving laboratory systems and health systems suggests that the time has come for the international community to take action.

In Zimbabwe, 83% of chief executives lack confidence in their company's ability to develop and implement the future operational models required to drive digital transformation, according to the 2019 KPMG Global CEO Outlook report. The head of the supply chain has a special chance to alter this viewpoint. Getting the supply chain right is one of the major value levers that firms can

pull, COVID-19 has demonstrated. Technology and talent are both essential for growth. Digital disruption affects every aspect of company, but the size, makeup, and skill set of the workforce will be particularly affected. Resilience requires that personnel be upskilled for the digital age. In a nutshell, individuals are the center of every organization, and their choices and deeds have a significant impact.

Over the past five years, Zimbabwean laboratories have dealt with their international suppliers through contracts for the purchase and upkeep of lab equipment. According to Hakansson (1983), the provision of laboratory services depends on the equipment being accessible and in good working order. The key reason for having contacts set up between laboratories and original equipment owners is to guarantee that equipment maintenance is completed on time despite the fact that they are in different geographic areas. Local salespeople are hired by international suppliers expressly to support their line of machinery. Every time a new piece of equipment enters the market, local engineers are dispatched to get training. As part of the laboratory quality management systems mandated by the Ministry of Health, local laboratories engage into agreements with local representatives for equipment maintenance.

Cimas acquired Medical Laboratories from Dr. M. E. Chitiyo and Dr. Barclays in 1985; this was in line with the Cimas Strategic Plan to provide its members with the best quality service in the health delivery system. Dr. S. Bopoto and Dr. D. Madziwa are the consulting pathologists with specialties in histology, while Dr. M. Chatambudza is the haematologist. The three pathologists interpret results and issue reports to their colleagues in the health profession. In order for pathology services to be accessible to the nation, Cimas Medical Laboratories has various satellite collection points in Harare and laboratories countrywide. Cimas acquired the assets and staff of the Medical Laboratories in October 1985 in order to ensure that private laboratory services would continue to be available for the medical profession and the public of Zimbabwe. The decision to take over the laboratories was made when the pathologists who owned the laboratories decided to retire. In 1988, Cimas also acquired the assets and staff of the Bulawayo Laboratory. These were combined as Cimas Medical Laboratories and formed the basis of the society's Medical Services Division. These laboratories account for over 60% of all pathology tests done in Zimbabwe, with an extensive network of branches and satellites throughout the country. The main laboratory in Harare is situated on the ground and second floors of Medical Chambers in Baines Avenue. A period from 1985 to present saw the Cimas Group continue with its profitable operations, which saw it purchase

the Radiology Services in Bulawayo and introduce the Travel Cover Scheme in 1986. Branches were opened in Gweru and in Mutare in the year 1997 and in 1998 respectively. In 1999, the Cimas Group opened a joint venture company with Gambro of Sweden for renal dialysis known as the Harare Hemodialysis Center.

Cimas Medical Laboratories is a truly independent pathology practice and takes pride in providing comprehensive, superior-quality pathology services to the medical profession, using the latest cutting-edge technology. Cimas Medical Laboratories is deeply committed to maintaining professional and technical excellence, personal service, and the highest ethical standards. Pathological test profiles have increased over the years and have also been supported by the fast-changing technology in laboratory equipment, which allows test results to be obtained in the shortest time possible, thereby enabling fast diagnosis for patients. More advanced systems have been introduced into the medical sector across all disciplines. As such, the local industry does not have the capability to make and support this equipment because of the huge capital outlays required and the lack of technology. Medical laboratories' equipment needs are being fulfilled by international suppliers through reagent rental and placement contracts, which do not require huge capital outlays to obtain the equipment. Issues of geographical locations require the international suppliers to subcontract local representatives responsible for the maintenance of equipment at Cimas Medical Laboratories on their behalf. The local representatives will in turn charge Cimas Medical Laboratories for rendering services for equipment maintenance. Despite having the subcontracts in place, Cimas Medical Laboratories is faced with issues of business continuity disruption because equipment down time is not controllable and there is not enough control over the local representatives' activities.

There are quite a number of suppliers that equip Cimas Medical Laboratories to operate efficiently, and these suppliers range from those that supply laboratory reagents and equipment, stocks, consumables such as stationery, and cleaning materials, among many others. Most of the reagents used in the lab are acquired from foreign suppliers, who include countries such as Germany, the United Kingdom, the United States of America, and South Africa. The suppliers are classified as follows: Suppliers of stationery and stationery consumables, Suppliers of laboratory reagents, repairs, and maintenance

Organizations use the growing internet of things paradigm to a great extent to manage supply networks in response to client needs (De Vass, et al 2018). Additionally, the supply chain literature on internet of things applications is still in its infancy and heavily focused on rhetoric, technology, and architecture (Mishra et al., 2016). The study of the internet of things in this context is topical because of the enthusiasm for technological adoption in data transparency and visibility to achieve supply chain process integration (Tu, 2018). Several new smart devices have recently joined the list under the recently coined internet of things umbrella of technologies, with the potential to address the information capture and exchange in supply chain functions such as purchasing, transportation, storage, distribution, sales, and returns. In addition to conventional technologies that help monitor supply chain functions such as these, real-time has multiplied (Vanpoucke, et al., 2017).

The next generation of internet-connected embedded information and communication technology (ICT) systems to integrate supply chain processes in a digital environment is known as the Internet of Things (IoT). The integration of the coming internet of things into the current information and communication technology systems can be exceptional due to its intelligent and widespread applications (Cruz, 2021). It is seen as a development of earlier information and communication technology systems that enable information sharing across people, groups, and sectors of the economy (Borgia, 2014). Regardless of an organization's ideology, culture, or religion, Internet of Things (IoT) performance has become a global standard.

Furthermore, it is true that supply chain integration with the Internet of Things (IoT) has a significant impact on how well a company performs. As a result, the platform makes it easier for "things" to be identified, located, sensed, and controlled through the global platform (Borgia, 2014). It is thought to be improving information and communication technology (ICT) applications that are helpful in gathering and exchanging data in real-time networks of enterprises (De Vass, et al 2018). The desire to increase living quality as evidenced by IoT, grow chances for improving business performance, and reduce time spent on production and commuting with customers, employees, and suppliers are the technical drivers behind the promotion of the supply chain.

1.2. Statement of the problem

By leveraging new digital supply chain business models and converting to a digital supply chain, a variety of technologies are altering the conventional method of functioning. Through connectivity, the Internet of Things promises benefits for the whole logistics value chain. In the

health sector, it is still in its early phases. Industrial executives have been given the opportunity for the past 15 years, but they have been hesitant to commit. Due to a lack of research, it is challenging for a corporation to determine which technologies or combinations of technologies are most suited for enhancing supply chain performance through enhancing visibility through its applications. The Internet of Things has a limited impact on supply chain integration and performance in the medical sector in poor countries like Zimbabwe.

1.3. Research objectives

a) To understand the impact of internet of things in improving customer services
b) To determine the role played by internet of things in improving supply chain management efficiency
c) To understand the role of internet of things in supply chain integration and inventory management

1.4. Research questions

a) What is the impact of internet of things in improving customer services on supply chain chains performance.?
b) What is the role played by internet of things in improving supply chain management efficiency?
c) What is the role of internet of things in supply chain integration and inventory management?

1.5. Significance of the study

a) **Cimas Medical Laboratories:** The study is crucial for Cimas Medical Laboratories because it has the potential to address many of the issues with their supply chain management, including the lack of essential medications, evidence of inefficiency and ineffectiveness, non-compliance with established policies, rules, and regulations, and subpar supply chain management. Cimas Medical Laboratories are a division of the Ministry of Health and Child Care in Zimbabwe. The remedies will be suggested by the research.
b) **Researcher.** The researcher will use it as a basis for training in research skills. After the study the researcher is going to publish the research on the internet so that it increases on the bases of knowledge in the area of study.

c) **Bindura University of Science Education**: The University will widen the scope of researched areas.

d) **Student**: Partial fulfilment of the requirements for the master's science degree in purchasing and supply chain management.

1.6 Assumptions of the Study

i. Selected respondents responded in time.

ii. Information collected from respondents is accurate, relevant and can be relied on.

iii. The methods used to collect information were the most appropriate for the research.

iv. Respondents provided bias free information and all of the respondents returned their questionnaires and data analysis did not lead to loss of information.

v. The methodology used is ethically accepted and the instruments are valid and reliable.

1.7 Scope of the study

1.7.1 Delimitations of the study

The scope of this research will be limited to Cimas Medical laboratories in Harare.

1.7.2 Limitations of the study

The following are the limitations which are likely to be faced during the study

i. The researcher is going to face time limitations. However, in order to solve this limitation, the researcher is going to schedule a time table for the interviews so that he can manage time effectively. The researcher used the Parkinson's Law time management strategy. The strategy works by reducing the time assigned to each task.

ii. Strict organizational policies on information management. The policies require that high standards of confidentiality be applied whereby information relating to budget operations and financial management and strategic plans is highly guarded by the entity and employees in particular. These might lead to respondent's refusal to respond to the research instruments or the information provided may lack a lot in details. However, the researcher assured the respondents that the information they provided was treated with utmost confidentiality and was used strictly for academic purposes only.

iii. The study adopted simple random sampling method in sample selection, some respondents might have information relevant to the study but they might end up not being picked in the

representative sample size. To mitigate this the researcher ensured that there was fair representation of the sample

1.8 Definition of terms

1.8.1 Supply chain Management

In order to create and maximize value for the customer in the form of goods and services that are specifically designed to meet customer demands, supply chain management integrates a network (or web) of upstream linkages (sources of supply) and downstream linkages (distribution and, ultimately, to customers) (Hugo et al. 2004).

1.8.2 Procurement

Procurement can be defined as the acquisition of suppliers or service, the hiring or letting of anything, the acquisition or granting of any right or the disposal of movable state property, resulting from the invitation and acceptance of price quotations and, or public tenders (RSA, 2003).

1.8.3 Performance of supply chain management

According to the RSA (2003) performance of supply chain management is concerned with the provision of a product or service, by a government body to a community which it was promised, or which is expected by that community.

1.9 Structure of the research

The research is composed of seven chapters sequentially organized and these are as follows:

Chapter 1: Introduction. This first chapter introduces the background of the research followed by statement of research problem and thereafter research aim, objectives, research questions, delimitations and limitations are presented.

Chapter 2: Literature review. The chapter critically evaluate and analyse key concepts, models and academic discussions contained in literature of health care performance of supply chain management in the context of supply chain management perspective

Chapter 3: Research Methodology. The third chapter describes the data collection methods and analysis is finally presented.

Chapter 4: Presentation and Analysis of findings This Chapter mainly presents the qualitative and quantitative findings. Detailed analysis is reserved for the next chapter.

Chapter 5: Conclusion and Recommendations Detailed analysis and discussions of findings presented in the previous chapter is done in this chapter. The last chapter of this research paper provides first the conclusion; highlighting also the linkage between published literature and findings. Thereafter, recommendations are proposed in light of the analysis and discussion of the findings.

CHAPTER TWO

RELATED LITERARURE REVIEW

2.0 Introduction

This chapter encompasses the literature relating to the topic. This will comprise both the theoretical, conceptual, and empirical literature for evaluating the effect of the internet of things on supply chain integration and performance

2.1 Theoretical literature

The two main theories underpinning this work are organizational capability theory and resource-based theory.

2.1.1 Organizational capability theory

Adoption of the internet of things can be seen as an additional capability that might enhance any organization's current configuration of ICT capability. It is crucial that studies make use of and consider the "internet of things" as a development of ICT capabilities that may enable more integrated intra- and interorganizational communication and information flows (Borgia, 2014). Process integration capabilities are represented by information sharing, communication, and linkages across firms that occur both within and across organizations (De Vass, 2018). IoT capacity is thought to facilitate communication and information exchange between and within organizations. According to resource-based perspective theory and organizational capability theory, a company must create its own resources and capabilities for performance improvement (Hue, 2012).

Integration is a higher-order process competence that has a direct impact on how well a company performs (Hue, 2012). According to organizational capacity theory, internal integration can have a direct impact on external integration since internal process integration serves as the foundation

for the growth of the company's external process integration (Hue, 2012). According to Verona (1999), internal capabilities refer to partner networks and internal communication, whereas external capabilities refer to external communication and process integration. Implementing ICT in isolation will not directly boost performance; rather, it must be combined with other organizational resources. So, just like ICT, IoT can enhance an organization's integration capabilities (De Vass, 2018).

2.1.2 Resource-based Theory

The resource-based theory's central tenet is that organizations' resources and capacities can vary widely from one another and that these variations are stable (Barney & Hesterly, 1996). When an organization's resources and competencies are combined and exploited effectively, they may give the organization a competitive edge. In order to determine which operations, need to be outsourced, this theory primarily relates to the preparation phase of the process. It also applies to the vendor selection phase, allowing for the choice of the vendor with the most suitable resources. Additionally, the organization's decisions during the Relationship Management and Reconsideration phases have been explained by the idea (Kutsikos & Mentzas, 2011).A study from 2010 (Alvarez-Suescun, 2010) suggests a model that combines the Resource-based Theory and TCE theory to explain how outsourcing activities are implemented in relation to IT operations. The Resource-based theory is suggested as the most suitable strategy for its interpretation by the model, which primarily concentrates on the Transition phase. In order to create a model that tries to identify the elements determining the success or failure of outsourcing during the Preparation phase, Roy and Aubert's (2001) research utilized the Resourced-based theory. (Barthelemy & Quelin, 2006) offered a model to describe the Preparation, Vendor Selection, Relationship Management, and Reconsideration phases that was mostly based on the Resource-based theory and, to a lesser extent, on the TCE.

.2.2. Empirical studies

2.2.1. The Internet of Things (IoT)

Internet of Things refers to an extension or a new version of generic ICT (Borgia, 2014), an evolution from internetworked computers to internetworked objects connecting previously unconnected "things" (De Vass, 2018). According to Ackermann et al. (2011), the Internet of Things is a virtual ICT world where physical objects are seamlessly interwoven. When the Auto-ID Center of MIT deployed radio frequency identification tags with a special electronic product code as a tool to identify and track supply chain commodities over the Internet platform in 1999, that is when the Internet of Things (IoT) fundamental concept was invented (Verdun et al. 2016). Radio frequency identification was the foundation of the Internet of Things, but it has since evolved into a key component with extensive capabilities (Borgia 2014). To realize its envisioned limitless potentials, the IoT concept has grown by integrating additional competencies including sensory, context awareness, intelligence, pervasiveness, learning ability, and automation (Kellert et al. 2017).

Internet of things is not a singular novel technology but rather a collection of several complementary technologies that provide extended capabilities (Lee & Lee 2015). The Internet of Things (IoT) has the potential to significantly alter our lives by making a number of hitherto impossibilities possible. IoT is therefore considered a disruptive technology because of the fundamental changes it is said to bring about. The Internet serves as a universal platform for IoT devices to interact, coordinate, compute, and communicate with one another (Miranda et al. 2012). By utilizing the Internet as a communication infrastructure, storage mechanism, and medium for data processing and information synthesis, it is hypothesized that IoT devices' capabilities and intelligence will surpass those of the device itself (De Vass, 2018).

2.2.2Supply Chain Integration (SCI)

In order to get insights into suppliers' processes, capabilities, and restrictions for the focal company, coordination and information sharing with suppliers are termed as "supplier integration." This improves planning and forecasting, product and process design, and transaction management (De Vass, 2018). It refers to the degree to which a company works with suppliers to set up internal

practices, behaviors, processes, and strategies into coordinated, workable, and cooperative processes to satisfy client demand (Hue 2012).

In order to manage both intra- and inter-organizational processes and to guarantee a smooth flow of activities, integration is done in the supply chain with the goal of working with other supply chain partners. A free movement of information, assets, funds, goods, and services is the goal of supply chain integration in order to provide clients with effective and efficient service.

This has an impact on quick organizational processes and lowers operating expenses (De Vass, 2018). Along with offering both operational and strategic advantages, it also promotes supply chain patterns for strategic collaboration. It promotes information sharing among supply chain participants, lowers supply chain risks, shortens contract duration, and fosters greater partner trust (Hue 2012). It emphasizes the significance and results of both intra- and inter-organizational processes. The goal is to improve organizational and operational performance. Integration of suppliers and customers refers to strategic cooperation, information exchange, and all-around cooperation between them (Yu et al., 2017). A system that connects all the information gathered along each supply chain step is required for successful supply chain integration.Supply chain integration is the last step of a successful IoT implementation. It is a cloud-based platform for business collaboration that is based on a common set of Internet technology (Verdun et al., 2014).

2.2.3 Performance

Agway (2018) claims that "performance is the overall health of an organization as evaluated by its outcomes compared to the resources allocated to accomplishing the established goals. The accomplishment of organizational strategic goals is what it is (Almatroshi et al., 2016). It involves evaluating an organization's profitability, market share, rise in return on investment, rise in customer happiness, rise in customer retention, and rise in sales (Battor & Battor, 2010). It is the organization's output-to-input ratio, the level of target accomplishment, and the happiness of team members with the organizational process. How well their companies perform in the marketplace is a key concern for most managers (Tseng et al., 2013). As a result, managers think it's a great management technique (Gupta & Wales, 2017).

In general, academics with differing views on the best technique to evaluate performance have taken note of the multidimensional aspect of performance (Gupta & Wales, 2017). Determining the discrepancy between actual and desired results as well as the process's efficiency and effectiveness are the key goals of performance evaluation. The company was guided by performance measurement to achieve a double improvement and an accurate assessment of the advantages realized. Sales and efficiency are taken into account by performance metrics. It enables the shareholder to understand the company's long-term success and how it caters to its own customers on the market. Understanding the factors will help a business be successful in producing high-quality goods that match customer expectations (Wisner et al., 2010).

2.2.4The relationship between Internet of Thing and supply chain integration

According to the literature, the internet of things is an extension of ICT and has the added capacity to support real-time information flow, allowing inter- and intra-firm communication and further integrating supply chains. (Borgia, 2014) Similar to how the Internet links computers, an internet of things platform has the potential to synchronize and connect products, machines, and people, coordinating and integrating an enterprise's internal and external activities (Li & Li 2017).

The beneficial connections between ICT and supplier integration have long been demonstrated by studies. Additionally, according to the organizational capability theory, ICT as a core capability can favorably affect supplier integration (Hue 2012). Additionally, studies have revealed that while ICT does not directly correlate with performance, it does so indirectly via improving SCI (Kim 2017). According to Vanpoucke et al. (2017) and Zhang et al. (2011), the IoT is a key facilitator for all three aspects of SCI—supplier, internal, and customer integration. They draw the conclusion that the internet of things can improve supplier, internal, and customer integration skills as a development of ICT. De Vass et al. (2018) investigated how the Internet of Things affects the efficiency and integration of the supply chain. They utilize the organizational capability theory for developing an empirical model considering the effect of IoT capabilities on multiple dimensions of supply chain process integration, which in turn improves supply chain performance as well as organizational performance.

Using structural equation modeling, cross-sectional survey data from 227 Australian retail businesses were examined (SEM). The findings show that the ability of the internet of things has a favorable and significant impact on internal, customer, and supplier-related process integration, which in turn has a good impact on the efficiency of the supply chain and organizational efficiency. The adoption of IoT in the supply chain environment and its impact on supply and business performance are examined by Naser, H. A. N. (2019). Finding study demonstrates IoT enhanced capacity that boosts information exchange, auto-capture, and supply chain transparency for improved SCI. The internet of things integration technology shows a good impact on the pricing, efficiency, distribution, and adaptability of the entire supply chain and improves the sustainability of retail organizations with performance, social, and environmental factors.

2.2.5The relationship between Internet of Thing and performance

The Internet of Things (IoT) is a new global information service architecture that improves performance by generating value for all stakeholders and facilitating the interchange of goods in global supply chain networks (Lee & Lee, 2015). IoT is increasingly used as an expanded ICT capacity to enhance performance (Borgia 2014). IoT can coordinate activities for greater performance by optimizing how people and systems interact. For higher performance throughout the entire IoT ecosystem in terms of operational efficiency, safety and security, and customer experience, analytics may be used to make improvements and encourage best practices (Ben Dayi et al. 2017). ICT capacity is also likely to have an impact on performance via quality enhancements, better production and utilization, decreased waste, and ultimately improved supply chain efficiency and effectiveness. Academic

2.2.6 The relationship between supply chain integration and performance

The integration capability of a firm is seen as a dynamic organizational capability that directly influences performance from the standpoint of organizational capability theory (Hue 2012). According to the theory, integration improves the ability to deal with environmental uncertainty by preventing opportunistic behaviors, reducing production and transaction costs, boosting resource accessibility, and promoting information sharing across supply chain partners (Hue 2012). Partner integration, according to the literature, can increase performance by lowering costs through waste elimination and asset utilization as well as by assisting supply chains in becoming

more adaptable, flexible, reactive, and responsive to deal with risks and market unpredictability (Ready et al. 2015). Additional research indicates that supply chain integration has a favorable effect on organizational performance (Vanpoucke et al., 2017).

The IoT provides precise and fast information to help firms respond to market changes by tracking supply chain activity from product design to end consumers (Mishra et al., 2016). Supply chain strategy aims to align with the firm's performance improvement goals in order to produce environmental, social, and economic advantages while yielding performance by concentrating on improving cost, quality, delivery, and flexibility (Owosso & Jana, 2022). De Vass et al. (2018) investigated how the Internet of Things affects supply chain performance and integration. Using structural equation modeling, cross-sectional survey data from 227 Australian retail businesses were examined (SEM). The findings show that supply chain integration significantly and favorably impacts organizational performance. results reveal that IoT capability is perceived to have a positive influence on internal and external process integration that, in turn, positively affects supply chains and firm performance. Further, IoT-enabled external integration was perceived to influence supply chain performance significantly more than IoT-enabled internal integration. The following studies also found a positive relationship between supply chain integration and performance (Owosso & Jana, 2022; Vanpoucke et al., 2017; Prajogo & Lager, 2012). From the empirical studies above, we hypothesize that:

2.2.7. Internet of thing in improving SCM operational efficiency

Information sharing throughout the supply chain is made simple by the IoT's improved interconnection of devices and supply chain participants. As the supply chain becomes increasingly intricate, enhancing product visibility along the chain will ease operational burdens and lower logistics expenses. By the year 2020, there will likely be 26 billion linked devices, up from an estimated estimate of roughly 7 billion in 2017. (Uusitalo, 2006). The advancements in radio frequency identification and cloud-based visibility, which comprise the IoT's foundation, have contributed to the rapid expansion (Melski, Muller, Zeier, & Schumann, 2008). Despite the IoT's enormous potential to link items and other supply chain management system participants, such as suppliers.

This is partly attributable to the dearth of frameworks that show how firms might combine IoT with different supply chain procedures to advance effective and efficient SCM systems and boost revenue (Michael & McCathie, 2005). In order to take advantage of the potential presented by this fast-developing smart technology, firms must improve their SCM procedures through the use of suitable frameworks. In large part because to technology, the supply chain's operational issues have been resolved. IoT devices like RFID have made it feasible to track and manage inventories more easily, requiring less resources and saving time (Man, Na, & Kit, 2015). Consequently, IoT devices raise the operational efficiency of various supply chain processes such as manufacturing, logistics services, and inventory management, reducing the cost and time to deliver a complete product to the client. Due to the availability of real-time information that is helpful in making important decisions, supply chains are becoming more flexible and quicker as technology develops. In order to improve the effectiveness of the supply chain, IoT devices are essential for identification, authentication, and automatic data collection. Technology will become more affordable as it develops, making it more practical in the supply chain, where some participants are hesitant to switch from traditional to new systems. The integration of various supply chain activities is one of the key advantages of this contemporary technical advancement in IoT. (Wang, Lai, He, & Wang, 2012).

2.2.8 Internet of thing in improving customer services on SCM

Along the supply chain, IoT has a favorable effect on supplier and customer relationships. This is accomplished through enhancing logistics throughout the supply chain systems. Among other logistical tasks, the data gathered by IOT systems can be utilized to prevent unforeseen downtimes, which will save both time and money (Gubbi, Buyya, Marusic, & Palaniswami, 2013). These systems now have the capacity to gather, analyze, and show data relevant to product supply and demand thanks to the IoT's recent advancement (Prinsloo & Malekian, 2016). In addition to allowing consumers and suppliers to track and share real-time information on the movement of their products along the supply chain, this has led to more streamlined, adaptable, and responsive logistics systems.

This is so that businesses can keep tabs on how their products are being used across the supply chain and can estimate demand and prepare accordingly, allocating enough resources to make sure the supply chain is not disrupted. Parthasarathi Ramakrishnan, Yongsheng Ma Additionally,

customers can offer product feedback using smart devices like smartphones and various applications, which are used by the manufacturer to make decisions to enhance customer service. As a result of these devices' ability to convey information about the product directly to the manufacturer, the business is able to offer effective customer services that are catered to the needs of the customer (Patrono, Brizzi, Gadh, Petracca, & Radi, 2016). However,technology is only beneficial to companies that have adopted it. This is because they have better visibility of their products along the supply chain, as well as more efficient supply chain management practices.

Therefore, this implies that some businesses have missed out on these opportunities because they are not aware of how IoT can improve their logistics systems and promote a good relationship with their customers. This demonstrates a need for more innovative frameworks that can help such companies leap on the huge benefits of modern technology to improve their supply chain systems.

2.2.9 Internet of thing in improving inventory management

One of the trickiest parts of supply chain management has been inventory management. But by offering real-time data on refilling and reordering inventories, IoT innovation has substantially enhanced how businesses manage their inventory (Yasumoto, Yamaguchi, & Shigeno, 2016). The IoT offered an effective inventory management method that has the added benefit of keeping costs down and operations under control. As a result of the ability to update inventory in real time in accordance with replenishment orders provided by IoT, effective inventory management procedures are encouraged (Rose, Eldridge, & Chapin, 2015). This suggests that businesses who have incorporated IoT technology and innovation in their supply chain systems are no longer challenged by the delay caused by the old inventory management procedures.

2.3 Research gap

Given how it affects prevailing paradigms, business models, and industry borders, digitalization in the logistics and supply chain management sector is becoming more strategically significant for enterprises. Several businesses devote resources to utilizing digital opportunities that could revolutionize communities, economics, and organizations But digitalization appears to have two sides: on the one hand, companies like Amazon have fundamentally altered the landscape through digital goods and services, embracing and promoting digitalization as a force for change not only between institutions and organizations but also between supply chains. This is so that businesses

can keep tabs on how their products are being used across the supply chain and can estimate demand and prepare accordingly, allocating enough resources to make sure the supply chain is not disrupted.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter goes hand in hand with the methods that were undertaken in conducting this research, which is often termed the research design. A research design is a master plan that specifies the methods and procedures for collecting and analyzing the needed information. In order to come up with valid and reliable data, the researcher used a qualitative research approach (interviews and questionnaires were used).

3.1. Research Design

The general plan of action, which relates the research problem with the apt practical research procedures, is referred to as the research design. The present research employs a concurrent research design. The researcher was enticed by the research design due to its numerous merits. Chief among the advantages of the concurrent research design is the elimination of the weaknesses of a single design.

3.2 Population and sample of the study

3.2.1 Population of the Study

Employees of Cimas Medical Laboratories in Harare were used for this study, which consisted of a total population of 150 people as shown in Table 3.1 below. That includes employees from the procurement, operations, and finance departments. A sample size of 70 was used for this study, as illustrated in Table 3.1 below, and included participants from the procurement department, the finance department, employees, laboratory, as well as senior procurement executives from finance. In this study, a systematic sampling technique will be used

3.2.2 Sample of the Study

The study used Yamane's formulae, n= N/ (1 + Ne2), to determine the sample size (Yamane 1967:25)

Where:

n =Sample size N =Target Population 50 e = error of 5% point

Therefore, sample size (n) is calculated below:

n = 150 / {1 + 150(0.00762)}

n = 150/ {1 +150(0.0076)}

n = 150 /2.143333

n = 70 respondents

3.2.3 Sample size justification

According to Saunders (2012:265) a sample size is the total number of elements to be used in the study. In this study, a sample size of 70 participants will be asked to participate in the study.

Table 3. 1. Population and sample size summary

Departments	**Population**	**Sample size**
Laboratory technicians	**46**	**15**
Nurses	**21**	**4**
Finance and procurement	**20**	**3**
Laboratory scientists	**76**	**49**
Total	**150**	**70**

Source: researcher (2022)

3.3. Research instruments

In the proposed study, the researcher collects both qualitative and quantitative data so as to overcome the shortcomings of using either quantitative or qualitative data alone. Owing to the generally dispersed population of the manufacturing companies in Harare, and also with a view to circumvent the threat of scanty responses, the researcher emailed the survey questionnaires to the respondents' individual email addresses and give them up to two weeks to complete and email back the completed questionnaires.

3.3.1. Questionnaires

In this study, the questionnaires were used to complement the interviews. The closed-ended questionnaires used involved questions provided by the researcher, and the respondent picked their responses from the answers already provided.

The advantages of using questionnaires are that the researcher is able to contact large numbers of people easily from different research sites. A questionnaire guarantees anonymity, which encourages some respondents to reveal details of their views that they may not have in an interview. Bhebhe (2009) posits that this affirms and shows that anonymity of the respondents has no fear of their information being linked to them and may be later used against them. A questionnaire is easy to create and interpret. A questionnaire is able to explore sensitive areas, some of which can be embarrassing and require privacy. Tuckman (2008) believes that questionnaires provide privacy where sensitive issues are being researched. The questionnaire has a consistent collection of data. The other advantage of using the questionnaire, according to Johnson (2012), is that the questions permit only certain responses that are in line with what the researcher is searching for. The researcher chose to use the questionnaire to collect data because it is quick to collect information and affordable in terms of cost and time. Questionnaires are also easy to administer, too. Despite the identified advantages, the questionnaire technique has its limitations. Through the use of questionnaires, it is hard to check whether the answers are genuine.

3.3.2 Pilot Interviews

A pilot interview is a preliminary small scale study conducted to decide the best way to conduct a large scale study. It helps the researcher to identify or refine a research question and figuring out the best method for pursuing it. It also helps on how much time and resources necessary to complete the project. Pilot interviews helps identifying and evaluating sample population, research field site and data set.

3.4 Data Collection Sources and Instruments

3.4.1 Qualitative phase

The researcher designed the research instruments while cognisant of Saunders, Lewis and Thornhill's (2016) goals for instrument design. According to Saunders, Lewis and Thornhill (2016), the goals of instrument design include augmenting the accuracy and significance of the data to be collected by the instrument, improving the respondents' contribution and cooperation, and also ensuring the ease of collecting, collating, and analyzing the data. In the present study, the researcher makes use of the questionnaire and interview guide for the purpose of data collection. The questionnaire contained both closed-ended and open-ended questions.

A 5-point Likert scale was employed to measure the ratings of various items by respondents in relation to various variables that are under study. The respondents were asked to rate on a scale of 1-5 how given statements apply to their respective areas of work/job environment. A Likert scale is preferred because it is considered more reliable as respondents are likely to answer all or most of the questions contained in the questionnaire. Moreover, the Likert scale ratings constitute interval scale attributes, so they can be easily evaluated using standard techniques (Barua, 2013).

3.4.2 Quantitative phase

The Pearson coefficient of correlation was used to find the correlation between the variables. Multiple regression analysis with the ANOVA technique was used to determine the effect of independent variables on the dependent variable. It was used to measure the relative influence of each independent variable based on its covariance with the dependent variable and was used in forecasting. Usually, it is most appropriate when both the independent and dependent variables are intervals, though some social scientists also use regression on ordinal data.

3.5 Data Presentation and Analysis

As postulated by Kennedy, Farrell, Paden, Hill, Joliet, Cooper, and Schindler (2011), the data analysis process is one which entails interpreting results emerging from the research, cognisant of the research objectives and questions, as well as checking how the findings fit into existing literature.

3.5.1. Quantitative phase

In this research, data from questionnaires was classified to ensure ease of analysis. The researcher further engages in data cleansing with a view to bringing order, structure, and value to the raw data. Data editing, ordering, coding, classification, tabulation, and summarisation were performed on the data. Editing is necessary so as to allow for error.

Using the Stata package, the researcher applied stepwise regression to build the regression model. Predictor variables will be added or removed using T-test and F-test from an original set of the variables, until only those variables that are significant are left. The correlation between the significant variables identified through the Stepwise Regression Analysis will be analysed using Pearson's correlation analysis. Following the correlational analysis, multiple regression analysis will be further employed with a view to establishing how the independent variables relate to the dependent variable (performance of supply chain management).

3.5.2. Qualitative stage

Thematic and content analysis were used in the analysis of the data in this research. The data gathered was analysed according to different themes from the research. Content analysis was employed to analyse data gathered from documentary research. According to Prasad (2010), content analysis is a research technique for examining content with regards to meaning, content, and intentions. Content analysis is a technique for examining information or content in written material (Neumann 1999).

3.6. Validity and Reliability of Results

Data validity, as described by Yin (2013), refers to the extent to which the research instrument is capable of measuring what the researcher intends to measureContent validity, on the other hand, is also pertinent, and the researcher intends to engage four experts in the field of procurement in discussions relating to the survey questions. The researcher asks the experts to rate the questions on a scale relating to the questions in the questionnaire. The experts will be asked to rate the questions on a scale of 1 to 4. This is done so as to find out if the questions are relevant to the research objectives.

3.7 Ethical and Legal Considerations

The participants were informed that while anonymity could not be completely ensured between the researcher and the participants as the interviews were conducted face-to-face, anonymity would be upheld at all times with the participant's identities in the written research report. No identifying information was included therefore safe guarding participant's anonymity through the use of pseudonyms. Regarding confidentiality, all the participant's responses were kept confidential; however, confidentiality was limited as the interview material was shared with the supervisor. The participants were informed that the interview material would be kept in a locked cupboard and would be safeguarded electronically under password protection.

3.8 Chapter Summary

This chapter covered a related literature review with the aim of identifying knowledge gaps. A pretested, self-administered questionnaire will be used to collect data. Participation in the study is voluntary. The research instrument is pretested to ensure that it collects valid and reliable data. The next chapter will present results and a discussion of the findings.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, INTERPRETATION AND DISCUSIONS

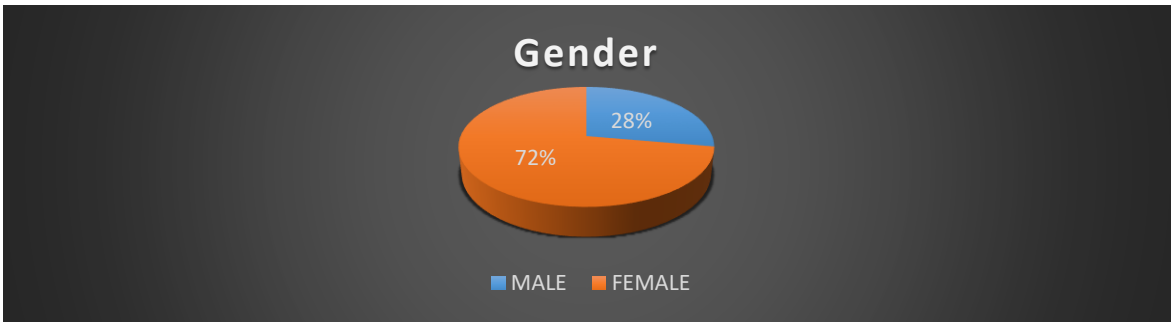
4.0 Introduction

This chapter discusses the findings. For this purpose, the various statistical analysis tools like Cronbach's alpha and multiple regression analysis were employed to establish the effects of internet of things on performance of supply chain management at Cimas Medical Laboratories in Zimbabwe. The chapter is divided into descriptive statistics and inferential statistic.

4.1. Presentation and analysis of socio-economic and demographic data

4.1.1 Gender of the Respondent

Figure 4.1 gender distribution



Source: primary data, Cimas HR (2022)

The study sought to find out the gender of the respondents. From the findings, 72% of the respondents were female while only 28% of the respondents were male. In addition, the findings show that both genders have been involved in the study and therefore there was no gender bias on the study though there was no equal distribution of the gender.

4.1.2. Age

Age of staff could be a factor contributing to the challenges of an institution. This is because older workers are less willing to learn and more likely to resist change. As stated by Wagner-Hartl et al. (2018), as employees get older, they develop age-related sensory, cognitive, and physical changes.

As such, they encounter increasing challenges in being productive in their workplaces. The table indicates that the highest age group of these research questionnaire respondents is between 31and 43. This age range constitutes around 48 percent of the respondents. The second highest age group is between 18 and 30. Correspondingly, among six people who were interviewed in the field, four of them were in the age range of 31 to 43 while the other two were in the age range of between 44 and 56. The table shows that most of staff in the institution are in the age range between 18 and 43. This implies that administration staff are in the active age group.

4.1.3. level of education

The institution has many young educated employees who can effectively contribute to the institution's operations only if they are well administered, have access to required facilities, and are motivated.

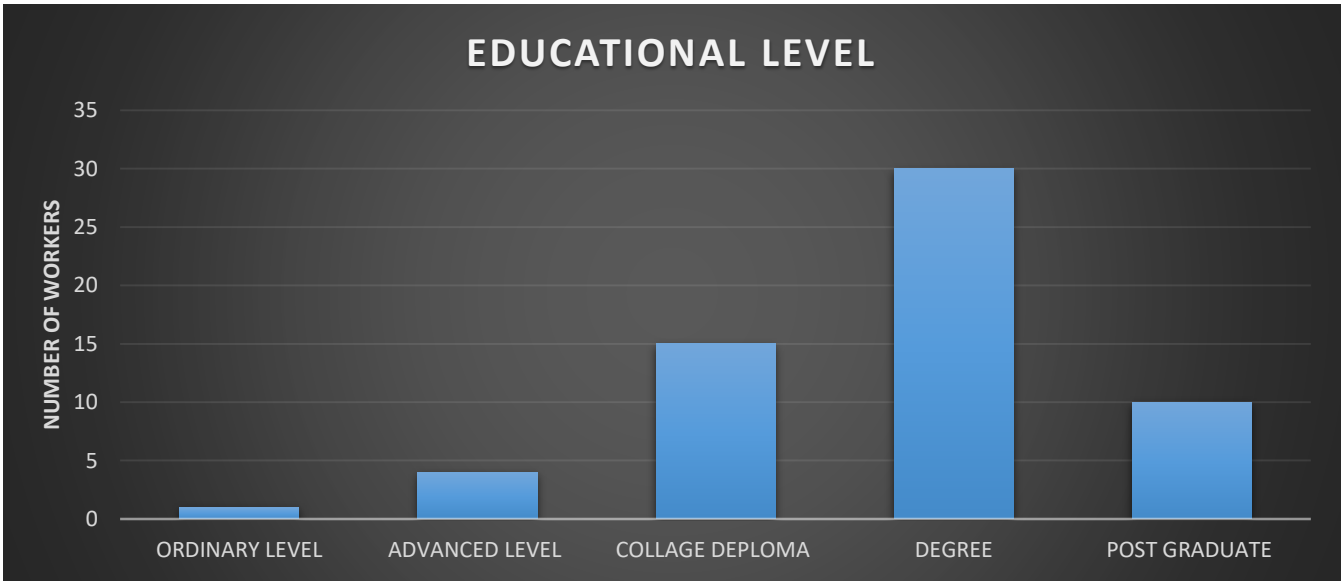


Figure 4.3 *Source*: primary data, Cimas HR (2022)

In addition, Figure 4.3 indicates the educational level of the research questionnaire respondents. The study reveals that a huge number of staff members have not been properly trained for the service they are rendering in the department. Those who have been trained indicated that they were not sufficiently trained in such a way as to perform with excellence. About (5%) of the respondents indicated that they received training whereas others indicated that the training was insufficient.

They further stated that they must be trained on how to apply rules, regulations, acts and policies governing supply chain management. This will help them to offer excellent services and to avoid corruption in supply chain management. The study found out that most of the managers had limited experience and to a certain extent they did not know anything about supply chain management as some of them are people who have been deployed to those positions by the Head of Department. As a result of this problem, the supply chain management directorate`s resources are seen to be greatly wasted. Forty three percent (43%) of the respondents claimed to have experience. These are mainly senior managers and managers who indicated that they have experience and knowledge of supply chain management.

4.2 Presentation, analysis and description of qualitative and quantitative findings

4.2.1. Reliability statistics

Table 4.1: 0 Reliability Statistics

Cronbach's Alpha	Number of Items
0.933	66

SOURCE: Primary data (2020)

The results of the Cronbach's Alpha test show that the data from the questionnaire is reliable and can be relied upon, this is shown by the Alpha test of 0.933 which is more than average of 0.70 used in most researches (Mohsen Tavakol 2011).

4.2.2. The impact of internet of things in improving customer service at Cimas Medical Laboratories.

This section will seek to understand the impact of internet of things in improving customer service at Cimas Medical Laboratories.

Table 4.2: customer service at Cimas Medical Laboratories statistics

Details	Mean	Std	95% conf.	interval
The company is able to produce consistent quality products with a low rate of defects.	2.58	0.23	2.12	3.05

The company operates regular customer satisfaction surveys to monitor our product quality	**2.89**	**0.18**	**2.52**	**3.26**
The company is able to maintain a low number of customer complaints concerning product quality	**3.92**	**0.21**	**3.50**	**4.34**
The company is able to supply products based on conformance quality (national and international standards).	**4.42**	**0.15**	**4.12**	**4.71**

Source: primary data (2022)

As tabulated, a majority of respondents noted the following mean and standard deviation on being able to produce consistent quality products with a low rate of defects. (2.58); the company operates regular customer satisfaction surveys to monitor its product quality (2.89); the company is able to maintain a low number of customer complaints concerning product quality (3.917); the company is able to supply products based on conformance quality (national and international standards). (4.417); The study findings are in agreement with literature review by Kiage (2013) notes that request for quotations does not allow for competition in the county's procurement department. Request for quotations involves the entity lending itself to irregularities because the procuring entity selects the suppliers, service providers or contractors that it wants to send a request for quotations.

4.2.3. The role played by internet of things in improving supply chain management efficiency

The study sought to determine the role played by internet of things in improving supply chain management efficiency.

Table 4.3: supply chain management efficiency Statistics

	Mean	**Std**	**95% conf.**	**interval**
Labour and machine productivity are performing better than in its intended function.	**1.78**	**0.18**	**1.41**	**2.15**
The company is able to optimize its production defect/waste to acceptable levels	**2.94**	**0.24**	**2.46**	**3.43**

The company is able to provide short delivery times acceptable to its customers.	**2.78**	**0.23**	**2.31**	**3.24**
THE company is able to increase capacity utilization in its production when demand requires it.	**2.63**	**2.90**	**2.05**	**3.23**

Source: primary data (2022)

According to the study results in Table 4.3 presents the study results tabulated, a majority of respondents were found to disagree with the statement that the company is able to optimize its production defect/waste to acceptable levels labor and machine productivity is performing better than in its intended function. (1.778). The company is able to provide short delivery times acceptable to its customers. (2.7778); The company is able to increase capacity utilization in its production when demand requires it. (2.6391);

4.2.4. Supply chain integration and inventory management

Table 4.4: supply chain integration and inventory management Statistics

	Mean	Std	95% conf.	Interval
Cloud technologies enhance process capability and local storage.	**1.78**	**0.18**	**1.41**	**2.15**
The company uses or plans to use robotics on a regular basis in the future.	**2.94**	**0.24**	**2.46**	**3.43**
Robotics is used to improve production capacity	**2.78**	**0.23**	**2.31**	**3.24**
IoT provides the linkage for all devices to the internet associated with production processes	**2.63**	**2.90**	**2.05**	**3.23**
IoT provides a link between customers and the company.	**2.5**	**1.78**	**0.18**	**1.78**
Exchange of information with customers and suppliers is easier through the application of blockchain.	**3.1**	**2.94**	**0.24**	**2.94**
Blockchain improves traceability of products in the supply chain.	**4.1**	**2.78**	**0.23**	**2.78**
The company is able to achieve information exchange with cloud computing.	**1.0**	**2.63**	**2.90**	**2.63**
The company is able to monitor customer interaction through real time data analysis.	**2.9**	**1.0**	**0.89**	**2.5**

Source: primary data (2022)

According to the study results in Table 4.4 presents the study results tabulated, a majority of respondents were found to disagree with the statement that Cloud technologies enhance process capability and local storage. (1.778 The company uses or plans to use robotics on a regular basis in the future. (2.7778); Robotics is used to improve production capacity 2.6391); IoT provides a link between customers and the company. (2.5), Exchange of information with customers and suppliers is easier through the application of blockchain. (3.1), Blockchain improves traceability of products in the supply chain. (4.1), The company is able to achieve information exchange with cloud computing. (1.0), The company is able to monitor customer interaction through real time data analysis. (2.9)

4.2.5. The effectiveness of the internet of things on efficient integration and performance of supply chain (multiple regression analysis model)

Descriptive statistics

Table 4.5 contains the main descriptive statistics for the dependent and independent variables of our study, for the entire sample of 70. The law standard deviations for all variables show a low level of heterogeneity which requires in interpreting the results. The existence of high differences in the mean values of the variables among samples. High levels of poor performance of supply chain management are political-driven, diseases and Zimbabwe have a high level of poor performance of supply chain management.

Table 4.5 Regression analysis model

	Mean	Std	95% conf.	interval
customer service at Cimas Medical Laboratories	2.58	0.23	2.12	3.05
supply chain management efficiency	2.89	0.18	2.52	3.26
supply chain integration and inventory management	3.92	0.21	3.50	4.34
performance of supply chain management	4.42	0.15	4.12	4.71

Table 4.5 Source: Primary Data (2022)

The relationship among the variables using contemporaneous decor relation. Although correlation matrix cannot give us the exact relationship among the variables of this study, contemporaneous correlation among all the variables has been calculated in the following table 4.6 in order to understand how the variables are moving and how these are correlated. It indicates that there are

many correlation coefficients have a value greater than 0.1. variable 1 this positively associate with performance of supply chain management which is 0.177, in variable 2 is 0.0.1447, variable 3 is –0.1597 as shown below;

Table 4.6

Variables	Performance of supply chain management	Supply chain management efficiency	Customer service at Cimas Medical Laboratories	Supply chain integration and inventory management
Performance of supply chain management	1.0000			
Supply chain management efficiency	0.1772*	1.0000		
Customer service at Cimas Medical Laboratories	0.1447*	-0.2182*	1.0000	
Supply chain integration and inventory management	-0.1597*	-0.1000*	-0.3070*	1.0000

* Means the correlation between the two variable is significant at 5% significance level.

Table 4.6 Source: Primary data (2022)

The study adopted a multiple regression analysis so as to establish the relationship of independent variables and dependent variables. The study applied STATA to compute the measurements of the multiple regression analysis. **KEY**

Dependent variable: performance of supply chain management

CUSTOMER SERVICE: customer service at Cimas Medical Laboratories

SCME: supply chain management efficiency

SCIIM: supply chain integration and inventory management

Table 4.7: Model Summary (Overall)

Classical Linear Regression Model: PERFORMANCE OF SUPPLY CHAIN MANAGEMENT

Dependent Variable: Perfomance Of supply
Method: Least Squares

Date: 26/11/22 Time: 2:03
Sample (adjusted): Q4
Included observations: 66 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Costomer service	0.177	0.226	0.78	0.441
SCM efficiency	0.081	0.206	0.39	0.698
SCIIM	-0.182	0.283	-0.63	0.534
C	3.090	2.326	1.33	0.194

R-squared	0.713	Mean dependent var	-0.009474
Adjusted R-squared	-0.4565	S.D. dependent var	2.604651
S.E. of regression	1.2395	Akaike info criterion	.275571
Sum squared resid	52.3430	Schwarz criterion	3.424693
Log likelihood	-37.617	Hannan-Quinn criter.	3.300809
Statistic	8.744	Durbin-Watson stat	2.001361
Prob(F-statistic)	0.713303		

Source: primary data (2022)

). The coefficient of determination is between zero and one (Robinson, 2010). The data showed that the high R square is 0.7132. It shows that the independent variables in the study were able to explain 0.7134 variation in the performance of supply chain management. The standard error is minimal with a value of 1.4195 meaning the model used in the study would have minimal effects of errors associated with performance of supply chain management. This shows that the model has a good fit since the value is 71%. This concurs with Graham (2012) that R-squared is always between 0 and 100%: 0% indicates that the model explains none of the variability of the response data around its mean and 100% indicates that the model explains the variability of the response data around its mean. In general, the higher the R-squared, the better the model fits the data. This indicates that tendering planning; tendering methods, supplier selection and contract management need to be well adopted to enhance performance of supply chain management

F-test was done to test the effect of independent variables on the dependent variable simultaneously. According to Bryan and Cramer (2011), F-statistic test basically shows whether all the independent variables included in the model jointly influence the dependent variable. Based on the study results of the ANOVA Test or F-test in Table 4.9, obtained F-count (calculated) value was 0.7133 less the F-critical (table) value 12.345 with significance of 0.000. Since the significance level of 0.000 < 0.05 we conclude that the set of independent variables (tendering planning, sustainable tendering policy and ethical professionalism) have significant influence on the implementation customer service practices in the county governments in Zimbabwe hence performance of supply chain management (Y-dependent variable) and this shows that the overall model was significant.

Analysis of Results

ANOVA was used to compare the means of two groups on the dependent variable (Green & Salkind, 2012). The main difference between t-test and ANOVA is that t test can only be used to compare two groups while ANOVA can be used to compare two or more groups. In the process of selecting the data analysis technique for this study, I considered ANOVA. The advantage ANOVA has over t-test is that the post-hoc tests of ANOVA allow to better controlling type 1 error (Hopkins, 2000. From the study findings on the regression equation established, taking all factors into account (independent variables) constant at zero performance of supply chain management would be 3.090. The data findings analysed also shows that taking all other

independent variables at zero, a unit increase would lead to a 0.17 increase in performance of supply chain management. Based at 5% level of significance, tendering planning was found to have a calculated t =0.78(less than the tabulated value of t < 1.96) and a significance level of 0.000.

A unit increase in customer service would lead to a 0.08increase in performance of supply chain management and showed a calculated t = 0.39 (less than the tabulated value of t < 1.96) and a significance level of 0.002 thus the value of less than 0.05. This indicates that sustainable customer service influence performance of supply chain management. This provides the supplier selection to focus on the activity, performance standards, and results achieved in respect to the work involved in the customer planning for, the establishment and subsequent management and use of supply arrangements in the public sector. It also ensures consistent and thorough market analysis, costing measures, and compliance methods are applied to each expenditure category (SDPC, 2009).

A unit increase in SCM efficiency would lead to 0.182 decreases in performance of supply chain management. The SCM efficiency was found to have a calculated t = -0.63 (less than the tabulated value of t < 1.96) and significance level of 0.015 thus the value of less than 0.05. This indicates that it influenced performance of supply chain management.

The findings indicate that the digital supply chain has a beneficial effect on quality performance. The finding is consistent with previous research. For example, Li and Wang (2010) recommended that companies in the industry investigate digital innovation opportunities derived from big data and develop appropriate data-driven strategies to enhance their product quality and market competitiveness. Furthermore, the finding also supports those by Fawcett et al. (2012) who showed how digital technology could be used to enhance supply chain performance and create the capability to share information. Companies that recognize the need for, and invest in, digital supply chains should achieve higher levels of performance such as product quality, inventory, and supply chain cost. The findings from the work presented here are consistent with the of previous studies carried out by Raguseo (2019). He found that digital technology in terms of big data technology has a positive effect on company performance. Big data is widely recognized as a critical field of future technology and is rapidly gaining the attention of many industries due to the high value it

can offer businesses. Additionally, the finding here is congruent with that of Brandyberry et al. (2016) who found that by using information technology, companies could manage the flow and impact of various supply chain dimensions, such as quality, flexibility, cost, and delivery, by leveraging information technology. In addition, the results indicate that the digital supply chain has a positive influence on productivity performance. This result is in line with previous research undertaken by Pilat and Criscuolo (2018) who discovered that emerging innovations have the potential to boost productivity by encouraging innovation and lowering the costs of a variety of business processes. Despite the rapid growth of digital technologies, they stated that industries also face particular challenges in the adoption and effective use of digital technologies, particularly in the case of productivity-enhancing applications.

Furthermore, digital technology creates new growth opportunities for businesses and aids them in making strategic decisions that increase their productivity. Similar findings have been discovered by Ellis et al. (2001), who pointed out that the digital technology such as IoT and cloud computing can capture vital data in analytics to drive end-to-end supply chain improvements. Therefore, investment, adoption, and usage of digital technologies in the supply chain alone are not enough to improve productivity performance without having optimum knowledge and information sharing systems in place. The results also show the positive influence that the digital supply chain has on cost reduction performance). The implementation of digital supply chain practices in a company leads to an increase in the level of operational performance. The adoption of digital technology can create considerable value-added and monetary performance gain for companies, and it will soon become a standard throughout the industry. Companies have to consider the importance of selecting digital technologies such as big data, cloud computing, blockchain, IoT, and robotics for their supply chain. The findings are also supported by previous research from Haddud and Khare (2010), who highlighted the importance of companies identifying possible areas for improvement and ensuring that all potential supply chain digitalization benefits are fully realized. Therefore, the adoption of digitalization in the supply chain might then be seen as being incremental rather than radical. On the other hand, since digital technology adoption is both complex and time-consuming, companies must possess specific implementation skills and an understanding of their objectives.

4.3 summary

This chapter presented results of the Study. The research used descriptive in nature which involves observing and describing the behavior of a subject without influencing it in any way to indicate that there is evidence that the impact of internet of things on supply chain performance is significant. The next chapter is going to outline the recommendations on the findings of the study.

CHAPTER FIVE

SUMMARY, FINDINGS, RECOMMANDATIONS AND CONCLUSION

5.0 Introduction

The general objective of the study was to examine the impact of the internet of things on supply chain performance. The research design that was used was descriptive in nature which involves observing and describing the behavior of a subject without influencing it in any way. This study relied on primary data which was collected through the use of structured questionnaires which were intended to capture quantitative data. Questionnaires had close- ended questions and data

was processed through Microsoft Excel and STATA. This chapter outlines the findings found in the research as well as making recommendations for the study

5.1. Summary of findings

5.1.1The impact of internet of things in improving customer services

Although we are confident that the institutional view is the right approach to better understand the emergence, adaption and manifestation of the digitalization in, other theories may provide a different view and a more nuanced understanding. We are aware that this topic, covering the developments of over 60 years, is quite complex, and the digitalization within the industry may have also other influences and is shaped by different actors. Choice of information technology for Organizational Learning in Supply Chains.

5.1.2. The role played by internet of things in improving supply chain management efficiency

Although digitalization can be considered as a competitive advantage in the near-, middle- and long term, certain branches within the industry have not caught up yet and sometimes show little interest or efforts to drive digitalization in their companies or in their industry branch. For managers, our study not only shows the importance to enforce digitalization in the industry but also provides insight into the different adoption mechanisms and the associated actors that enact field-level changes, which can help to gain a better understanding how to implement digital practices in their company.

5.1.3. The role of internet of things in supply chain integration and inventory management

Exploitation learning strategy characterized by slow individual learning and fast organizational learning, does not create high long-term firm knowledge, while an exploration learning strategy is better in generating long-term knowledge. The results suggest that the ability of supply chain firms to collectively manage knowledge resources is an important requirement of supply chain strategic performance. In addition, supply chains‟ information technology infrastructure capabilities facilitate supply chains in managing knowledge through the supply chains‟ relational capability.

5.2.**Conclusion**

The purpose of this study was to determine how the digital supply chain affects operational performance. A conceptual framework and a research methodology were developed to investigate the impact of the digital supply chain on operational performance. Then, a quantitative method of research was designed, and data were collected via questionnaires distributed to respondents. As a

result, extending the study to include countries with varying cultural traditions and different levels of new technology adoption may offer an opportunity for future research. The empirical evidence indicates that the digital supply chain results increased operational performance. These findings will help managers acquire a greater understanding of the factors that affect the output of digital supply chains, especially in developing countries with similar characteristics. Furthermore, digital supply chain investment necessitates in-depth research, and supply chain parameters may need to be reconfigured and redefined as a result.

5.3. Recommendations

The following recommendations were made

a) Creating integration or the systematic exchange of information develops can develop two levels of processes and data.
b) To exchange information at the data level, the data resources distributed across the supply chain need to be connected.
c) Improve information flow across sub – units, standardization and integration facilitate communication and better co-ordination.
d) Enabling centralization of administrative activities such as accounts and payroll.
e) Reduce information system maintenance cost and increase the ability to deploy new functionality.
f) Investment in information technology has resulted in significant effect on productive levels, growth and also the value of business organization. There are also other works which have proved that there are also positive results on internal performance such as inventory turnover.
g) Determining the requirements of a reliable capacity to fulfill market demands.

5.4. Areas of further study

On the other hand, developing the supply chain decision-making models categorized based on Supply-Chain Operations may be another path for future studies. The performance indices of supply chain can always be improved by the development of decision-making and optimization

models with more realistic assumptions. An in-depth research is needed to fill the gap to develop ERP systems to support multiple enterprises.

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APPENDIX A

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BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF COMMERCE
ECONOMICS DEPARTMENT

21 November 2022

To Whom It May Concern

Dear Sir/Madam,

RE: REQUEST FOR PERMISSION TO CARRY OUT RESEARCH AT YOUR ORGANISATION

This letter serves to inform you that I, Engelbert Tamuka Zvidzai, student number B213519B, am pursuing a Master of Science in Purchasing and Supply Chain Management degree with Bindura University of Science Education. I am carrying out academic research on "**An assessment of the effects of the internet of things on efficient integration and performance of supply chain management during COVID 19 in Zimbabwe: A case of Cimas Medical Laboratories (2020-2022).** Please assist me access to your organization so that I can use it as a case study. The research is for academic purposes only, and the findings will not be published anywhere.

Your privacy and confidentiality are guaranteed.

Thank you for your co-operation.

Yours sincerely,

Engelbert Tamuka Zvidzai

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Engelbert Tamuka Zvidzai
Bindura University Of Science Education
Faculty Of Commerce
Economics Department

22 November 2022

REF: REQUEST FOR PERMISSION TO CARRY OUT RESEARCH AT YOUR CIMAS MEDICAL LABORATORIES

Engelbert Tamuka Zvidzai (B213519B), a student studying for a Master of Science in Purchasing and Supply Chain Management degree with Bindura University of Science Education has been granted permission to carry out research at Cimas Medical Laboratories.

The academic research project seeks to assess the effects of the internet of things on efficient integration and performance of supply chain management in Zimbabwe, based on a case of Cimas Medical Laboratories during the Covid-19 era (2020-2022).

The data collection will run from the 23rd to the 30th of November 2022.

Conditions:

Compliance with the confidentiality oath which will be signed.
Materials to be used for research purposes only.
To present on area of research to the Cimas Medlabs team.

Yours sincerely,

Lydia Makarau

Technical Manager
Cimas Medlabs

APPENDIX B: QUESTIONNAIRE
Section A

This Section contains questions on personal and organizational information

PERSONAL DATA

1. **Number of years working in the current position**

1-5	
6-10	
11-15	
16-20	
20 and above	

2. **Sex**

Male	
Female	

3. **Educational Level**

Certificate	
Diploma	
Degree	
Post Graduate Diploma	
Other (Specify)	

4. **Work experience**

1-3 Years	
4-6 Years	
7-9 Years	
Over 10 Years	

Section B

1.This section will seek to understand the impact of internet of things in improving customer service at Cimas Medical Laboratories. This section presents findings to statements posed in this regard with responses given on a five-point Likert scale (where 1 = strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5= Strongly Agree).

	1	**2**	**3**	**4**	**5**
Our company is able to produce consistent quality products with a low rate of defects.					
Our company operates regular customer satisfaction surveys to monitor our product quality					
Our company is able to maintain a low number of customer complaints concerning product quality.					
Our company is able to supply products based on conformance quality (national and international standards).					

Any other? Please indicate

……
……
……

2.The study sought to determine the role played by internet of things in improving supply chain management efficiency This section presents findings to statements posed in this regard with responses given on a five-point Likert scale (where 1 = strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5= Strongly Agree).

Statement	1	2	3	4	5
Our labor and machine productivity is performing better than in its intended function.					
Our company is able to optimize our production defect/waste to acceptable levels					
Our company is able to provide short delivery times acceptable to our customers.					
Our company is able to increase capacity utilization in our production when demand requires it.					

Any other? Please indicate

……

……

3. To understand the role of internet of things in supply chain integration and inventory management

The scale below will be applicable: **1= very small extent 2= small extent 3= moderate extent 4= Large extent 5= to a very large extent.**

	1	2	3	4	5
Cloud technologies enhance process capability and local storage.					
Our company uses or plans to use robotics on a regular basis in the future.					
Robotics is used to improve production capacity					
IoT provides the linkage for all devices to the internet associated with production processes					
IoT provides a link between customers and the company.					
Exchange of information with customers and suppliers is easier through the application of blockchain.					
Blockchain improves traceability of products in the supply chain.					

Our company is able to achieve information exchange with cloud computing.					
Our company is able to monitor customer interaction through real time data analysis.					
Big data is used to improve our data quality.					

……

……

4. The effects of the internet of things on efficient integration and performance of supply chain management. The scale below will be applicable: 1= very small extent 2= small extent 3= moderate extent 4= Large extent 5= to a very large extent.

	1	**2**	**3**	**4**	**5**
customer service at Cimas Medical Laboratories					
supply chain management efficiency					
supply chain integration and inventory management					
performance of supply chain management					

Appendix C: Interview Guide

Personal Interview (semi-structured)

a) What is the impact of internet of things in improving customer services on supply chain chains performance.?
b) What is the role played by internet of things in improving supply chain management efficiency?
c) What is the role of internet of things in supply chain integration and inventory management?

Thank you