



Strathmore
UNIVERSITY

Strathmore University
SU+ @ Strathmore
University Library

[Electronic Theses and Dissertations](#)

2019

Factors affecting food and beverage processing firms in adoption of Internet of Things technology in Nairobi, Kenya

Chetan Ratna
Strathmore Business School (SBS)
Strathmore University

Follow this and additional works at <https://su-plus.strathmore.edu/handle/11071/9515>

Recommended Citation

Ratna, C. (2019). *Factors affecting food and beverage processing firms in adoption of Internet of*

Things technology in Nairobi, Kenya [Thesis, Strathmore University].

<https://su-plus.strathmore.edu/handle/11071/9515>

This Thesis - Open Access is brought to you for free and open access by DSpace @Strathmore University. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of DSpace @Strathmore University. For more information, please contact librarian@strathmore.edu

**FACTORS AFFECTING FOOD AND BEVERAGE
PROCESSING FIRMS IN ADOPTION OF INTERNET OF
THINGS TECHNOLOGY IN NAIROBI, KENYA**

CHETAN RATNA

MASTERS IN BUSINESS ADMINISTRATION

2019

**Factors Affecting Food and Beverage Processing Firms in in the
Adoption of Internet of Things Technology in Nairobi, Kenya**



By

Chetan Ratna

**A Research Thesis Submitted in Partial Fulfillment of Requirements
for Degree of Masters in Business Administration at Strathmore
Business School**

**Strathmore Business School
Strathmore University
Nairobi, Kenya**

June, 2019

**© This thesis is available for library use on the understanding that it is copyright material and that no
quotation from the thesis may be published without proper acknowledgement**

DECLARATION

I declare that this work has not been previously submitted and approved for the award of degree by this or any other University. To the best of my knowledge and belief, the proposal contains no material previously published or written by another person except where due reference is made in the proposal itself.

Chetan Ratna

MBA/99214/2017

07/06/2019

Approval

The thesis of Chetan Ratna was reviewed and approved for examination by the following:

Name of Supervisor: Dr. Vincent Omwenga

Faculty Affiliation: Faculty of Information Technology

Institution: Strathmore University

Head of Strathmore Business School

Strathmore Business School

Dean, School of Graduate Studies

ABSTRACT

The study analyzed the factors affecting food and beverage processing firms in the adoption of internet of things technology in Nairobi, Kenya. The study was done as efforts by KAM and the global advancement in technology had led to the call for adoption of Internet of Things (IoT) however there has been a slow uptake. The study was guided by four specific objectives: to determine the effect of security of generated data; to investigate the effect of management of IoT devices; to establish the effect of business skills side in IoT; and to determine the effect of technical perspective of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya in Kenya. Sample size comprised of 69 firms with annual turnover of above 100 million Kenya shillings with CEOs/Operation managers as the participants. Data was analyzed through descriptive statistics and inferential statistics. The findings showed positive and significant relationship between influence of security of generated data, management of IoT devices, business skills side in IoT, technical perspective of IoT to adoption of IoT. The results further showed security of generated data were the most important in influencing adoption of IoT technology. The interviews established that fear of losing jobs and redundancy of employees made management to lack enthusiasm for IoT adoption. The study concluded that there exist significant effect of security of generated data as well as management of IoT devices on the adoption of IoT technology in food and beverage manufacturing firms in Kenya. The study recommends that managers of food and beverage manufacturing firms in Kenya should prioritize the security of the data and overall security of their organization in the process of adoption of IoT applications in their firms. Further, the management of food and beverage manufacturing firms should possess requisite techniques to enable the employees to create networks for the deployment of IoT applications automatically.

TABLE OF CONTENT

DECLARATION	I
ABSTRACT	II
TABLE OF CONTENT.....	III
LIST OF TABLES.....	V
LIST OF FIGURES	VI
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background to the Study	1
1.2 Statement of the Problem	5
1.3 Objective of the Study	6
1.4 Significance of the Study.....	7
1.5 Scope of the Study	8
CHAPTER TWO: LITERATURE REVIEW	9
2.1 Introduction	9
2.2 Theoretical Framework.....	9
2.4. Internet of Things	12
2.3 Factors Affecting Organizations in Adoption of IoT.....	13
2.4 Adoption of IoT in Enhancing Efficient Energy Utilization	24
2.5 Conceptual Framework.....	30
2.6 Operationalization of variables.....	31
CHAPTER THREE: RESEARCH METHODOLOGY	32
3.1 Introduction	32
3.2 Research Design.....	32
3.3 Population of the Study	32
3.4 Data Collection Instruments	34
3.5 Validity of Research Instruments.....	42
3.6 Data Analysis and Presentation	44
3.7 Research Quality	45
3.8 Ethical Considerations	46
CHAPTER FOUR: RESEARCH FINDINGS AND DISCUSSION	47
4.1 Introduction	47
4.2 Response rate	47
4.3 Demographic Characteristics	47
4.4 Factors inhibiting the adoption IoT energy devices.....	49
4.5 Descriptive Analysis of Study Variables	51
4.6 Inferential analysis for study variables	59
4.7 Optimal Model.....	63

CHAPTER FIVE SUMMARY AND DISCUSSION.....	64
5.1 Introduction	64
5.2 Summary of the Study	64
5.3 Discussions of Findings	65
CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS.....	74
6.1 Conclusions	74
6.2 Recommendations	75
6.3 Area for Further Research	76
REFERENCES.....	77
APPENDICES	86
APPENDIX A: INTRODUCTORY LETTER.....	86
APPENDIX B: QUESTIONNAIRE	87
APPENDIX C: INTERVIEW SCHEDULE.....	91
APPENDIX: LIST OF FOOD AND BEVERAGE PROCESSING FIRMS.....	93
APPENDIX E: WORK PLAN	95
APPENDIX F: BUDGET OF THE STUDY	96

LIST OF TABLES

Table 2. 1 Operationalization of variables	31
Table 3. 1 Target population	33
Table 3. 2 Item-total statistics for security of generated data.....	35
Table 3. 3 Item-total statistics for management of IoT.....	37
Table 3. 4 Item-total for business skills side in IoT.....	38
Table 3. 5 Item-total for technical perspective of IoT.....	39
Table 3. 6 Item-total for adoption of IoT.....	41
Table 3. 7 Measures of sampling adequacy	43
Table 3. 8 Reliability test results	44
Table 4. 1 Factors inhibiting adoption of IoT	50
Table 4. 2 Security of generated data	52
Table 4. 3 Management of IoT.....	53
Table 4. 4 Business skills side of IoT.....	55
Table 4. 5 Technical perspective of IoT.....	56
Table 4. 6 Adoption of IoT technology.....	58
Table 4. 7 Reliability analysis.....	59
Table 4. 8 Correlation analysis.....	60
Table 4. 9 Normality test.....	61
Table 4. 10 Model summary.....	61
Table 4. 11 ANOVA ^a	62
Table 4. 12 Regression coefficient	62

LIST OF FIGURES

Figure 2. 2 Conceptual Framework	30
Figure 4. 1 Gender of respondents	47
Figure 4. 2 Age of respondents	48
Figure 4. 3 Education level of respondents	48
Figure 4. 4 Position of respondents	49
Figure 4. 5 Length of service.....	49
Figure 4. 6 Level of efficiency	51

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Globally, the issue of efficient management of the scarce sources of energy is gaining a lot of attention in unprecedented levels due to the ever increasing and uncertainty of the future of energy prices. Major governments in the world are forced to relook at the issue of the ever increasing and unpredictable generation, transmission and wanton utilization of energy especially in the industrial sector. This is an issue at the heart of many government, industrial and society mandarins especially on the need to conserve and utilize the scarce energy resources (Ishak, 2016). Currently, organizations, both public and private, are expected to conform to the set standards set by International Energy Agency (ITA) and other global regulatory bodies on efficient utilization of energy during the entire period of performance.

One of the key requirements in efficient energy utilization is for organizations to continuously meet the laid down energy efficiency levels by adopting energy technologies that aim at enhancing and promoting global efficiency and sustainability of energy (World Economic Forum, 2016). A lot of input on the need for adopting the use of efficient energy technologies as well as the necessity for energy efficiency and sustainability is also an area where energy stakeholders all over the world have focused their attention (Kyusakov, Eliasson, Deventer, Delsing, & Cragie, 2012).

Kasae (2014) states that globally, adoption of efficient energy technologies like Internet of Things (IoT) has been accorded a lot of attention by scholars and stakeholders in the field of energy. The global forum for the advocacy for the need for adoption of IoT technology is viewed as an ideal platform to create awareness on the energy-related challenges, ranging from the need for a more efficiency use of energy in industries, the social and economic costs associated with the increasing energy prices and the growing worry originating from climate change. Research indicates that addressing the need for energy efficiency enhances industrial competitiveness and the general consumer welfare especially in conforming economies (International Energy Agency (ITA), 2014). A study conducted by CSIRO and Griffith University (2007) on energy efficiency opportunities revealed

that there is an increasing and unprecedented tendency of leading manufacturers to continuously invest in more energy efficient technologies like Internet of Things (IoT) for industrial goods and services. The concept of manufacturers designing new goods and services through IoT technologies is a great milestone to penetrate new markets and gain new customer base leading to an overall enhancement in brand recognition as well as customer loyalty.

1.1.1 Global Adoption of Internet of Things (IoT)

The term IoT was defined by the International Telecommunications Union (ITU), a major institution that enforces global technological standards as, “a global infrastructure enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies” (Renner & Krieger, 2015). Important objects in the architecture of the IoT are things. According to ITU, things are characterized as “objects of the physical world (physical things) or of the information world (virtual world), which are capable of being identified and integrated into communication networks” (Gubbi, Buyya, Marusic & Palaniswami, 2013).

Globally, the manufacturing sector in many countries is in a state of transition; growing in emerging economies, shrinking but becoming more productive in advanced economies. Some manufacturers compete on cost while others prefer to compete on adoption of energy efficient technology and innovation (Chartered Institute of Management Accountant, CIMA, 2010). Currently, the trend in the advancement and adoption of IoT technology has led to widespread connection of devices and machines translating to efficient use of energy (Onyalo, Kandie & Njuki, 2015).

The integration of machines and other machines and also human beings have created the concept of Internet of Things (IoT). This has enabled sensors and actuators integrating in a widespread network with the surrounding environment. It has also led to the concept of sharing of data originating from various nodes and applications and in the process creating a Shared Operating Environment (SOE) (Evans, 2011). Over the last few years adoption of IoT technology has become an omnipresent term (Brech, Jamison, Shao, & Wightwick, 2013).

The use of IoT technology enables organizations to acquire vastly improved energy efficiency (e.g., improved uptime, asset utilization) through predictive maintenance and remote management. The use of IoT technology enables organizations to scale down on energy costs by reducing the utilization levels by a large margin. Most IoT technologies comprise of devices that are battery powered and connected through a lower power wireless leading to low utilization of energy (Gartner, 2016). Additionally, most of the IoT technologies have devices with applications that allow energy saving modes while in use or standby leading to efficiency in energy use (Meraka, 2013).

1.1.2 Energy Efficiency in Manufacturing Sector in Kenya

The Kenya manufacturing sector is a leader in the growth of the economy constituting about 70 per cent of the industrial sector contribution to GDP. In this sector, the building, construction and quarrying collectively contribute the remaining 30% per cent. Additionally, the Vision 2030, which is the Kenyan blueprint for economic growth has stated that the manufacturing sector is among the most important contributors with a sustained annual GDP growth of 10 percent (Kasae, 2014). Adoption of IoT energy efficiency technology is a key enabler for the Kenyan manufacturing sector to leap ahead of others.

Organizations' such as the Kenya Association of Manufacturers (KAM) through its Centre for Energy Efficiency and Conservation (CEEC) have attempted to address the challenge of high cost of energy in the manufacturing sector by encouraging the development of energy efficiency technologies like IoT that manufacturers can adopt to lower their energy utilization. Energy Audit is one tool that is being used by the organization whereby the current utilization of a particular company is assessed, potential areas of energy saving identified and energy saving implementation strategies identified (Kariuki, 2016). The Energy Regulatory Commission (ERC) is committed to addressing the high energy costs by industries through encouraging adoption of energy efficiency measures such as IoT as demonstrated by The Energy Management Regulations, 2012 that require among other things that companies carry out energy audit once every three years and implement at least 50% of recommendations (Energy Regulatory Commission (ERC), 2013).

In Kenya, the manufacturing sector can leap from the good network of ICT infrastructure, coupled with a mobile penetration levels at 80% and is therefore capable of adoption of Internet of Things technologies for efficiency in energy uptake. The adoption of IoT technology in Kenya requires a foundation of innovative policy and regulation (Sint & Garba, 2016). Ishak (2016) argues that adopting various types of IoT technological devices in organizations in the manufacturing sector requires much effort, attention and expertise. This is due to the complexity in adoption as well as a lot of requirement. Thus, smart energy saving IoT devices will help a lot in management and adoption of efficient use of energy in organizations.

Food and beverage processing firms in Kenya are categorized under the manufacturing industry. The segment contributes about 10% of the Gross Domestic Product (GDP) to the economy (KIPPRA, 2018). The segment is a key prolific sector of the economy projected to contribute to the realization of Vision 2030 due to its immense potential in poverty reduction, job creation and wealth establishment. In Kenya, food and beverage processing segment is a relatively well-developed sector with products ranging from dairy products, canned vegetables, bakery products, sugar and confectionary, fish, oil and fats among many other products (Kariuki, 2016).

Food and beverage processing firms in Kenya range from small family-owned informal firms to large formal enterprises listed in the Nairobi Stock Exchange. Others include subsidiaries of foreign and multinational companies. Multinational food and beverage processing firms have established operations in Kenya either as foreign companies or as joint ventures (Muteshi, Awino, Kitiabi and Pokhariyal, 2017). Energy cost is a major challenge to food and beverage processing firms in Kenya. If these entities have to survive in the ever increasing competitive environment in Kenya they have to adopt energy efficient technologies that will enhance utilization of efficient energy such as IoT. Food and beverage processing firms may solve the problem of high cost of energy use through adoption of smart and energy efficient IoT technologies like use of battery powered devices and lower power wireless devices.

However, the adoption of IoT technology in Kenya's food and beverage processing sector faces a number of challenges ranging from governance, policy frameworks,

fear of organization security, technical inabilities and inadequate knowhow and access to efficient and smart IoT devices and infrastructures (Onyalo, Kandie & Njuki, 2015). It is paramount to note that even with these challenges there are also myriad opportunities for adoption of IoT technology in food and beverage processing firms in Kenya.. IoT technology can be applied in food and beverage processing firms in Kenya by development and use of smart IoT devices that are energy efficient and reduce the cost of energy in these organizations. In such, there is need to research in this area in order to balance between challenges and opportunities to gain total yields from IoT technology in Kenya.

1.2 Statement of the Problem

In Kenya, the food and beverage processing firms are grappling with the escalation of energy utilization and the subsequent elevated cost of production due to continued use of archaic technology. The Kenya Association of Manufacturers (KAM) through its Centre for Energy Efficiency and Conservation (CEEC) has indicated that players in the food and beverage processing industry are still using archaic and obsolete technology that have increased energy inefficiency and lowered the competitiveness of locally produced commodities (Meraka, 2013). The KAM has continuously encouraged its members to adopt efficient energy technology like IoT to cut on energy costs.

In addition, the Energy Regulatory Commission (ERC) has attempted to address the high energy costs faced by the food and beverage processing firms through adoption of IoT as energy efficient technology as demonstrated by the Energy Management Regulations, 2012 that require among other things that organizations carry out energy audit once every three years and implement at least 50% of recommendations (Energy Regulatory Commission (ERC), 2013). Few technological trends hold greater promise than adoption of IoT technology in injecting efficient energy use by food and beverage processing firms in Kenya (Onyalo, Kandie & Njuki, 2015).

Despite the efforts by KAM and the global advancement in efficient technology as demonstrated by call for adoption of Internet of Things (IoT), there is slow uptake and adoption of this technology (Kariuki, 2016). This has led to high levels of energy utilization and increased cost of production. Similarly, only 20% of organizational managers in food and beverage processing firms in Kenya have shown interest in

adoption of IoT with less than 10% of the players attempting at its adoption. Globally, the factors affecting adoption of IoT include governance issues, policy frameworks, fear of organization security, technical inabilities and inadequate knowhow. Other obstacles include inadequate knowledge by managers on the IoT opportunities and lack of commitment to implement technological changes to their organizations (Kariuki, 2016).

Kariuki (2016) has pointed that since IoT in food and beverage processing firms in Kenya is still in infancy, factors affecting its adoption have not been fully investigated with organizations struggling in terms of developing, deploying and adopting the IoT technology. The continued use of archaic technology and failure to adopt IoT in the food and beverage processing sector in Kenya due to the stated hindrances will deter the industry from effectively competing with other global competitors. The sector will continue to be unattractive for global players and the country will be unable to achieve the Vision 2030 goal of industrialization with the rapid growth of the manufacturing sector as a key component (Kasae, 2014). As noted by Gartner, use of IoT technology can reduce energy costs by up to 30 percent (Gartner, 2016). Despite this knowledge, few studies have been undertaken a research on factors affecting food and beverage processing firms in the adoption of internet of things technology in Kenya. This study attended to fill this gap.

1.3 Objective of the Study

1.3.1 General Objective of the Study

The purpose of the study is to analyze the factors affecting food and beverage processing firms in the adoption of internet of things technology in Nairobi, Kenya.

1.3.2 Specific Objectives of the Study

The specific objectives of the study are:

1. To determine the effect of security of generated data on the adoption of IoT technology in food and beverage processing firms in Kenya.
2. To investigate the effect of management of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya
3. To establish the effect of business skills side in IoT on the adoption of IoT technology in food and beverage processing firms in Kenya.

4. To determine the effect of technical perspective of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya in Kenya.

1.3.3 Research Questions

The research questions of the study were:

1. How does security of generated data affect the adoption of IoT technology in food and beverage processing firms in Kenya?
2. Does management of IoT devices affect the adoption of IoT technology in food and beverage processing firms in Kenya?
3. How does the business skills side in IoT affect the adoption of IoT technology in food and beverage processing firms in Kenya?
4. How does technical perspective of IoT devices affect the adoption of IoT technology in food and beverage processing firms in Kenya in Kenya?

1.4 Significance of the Study

Optimization of energy utilization levels for any organization is an essential driver of effectiveness and efficiency in performance. Organization should invest resources in endeavors to achieve the most efficient energy utilization levels. This study is therefore significant to the government of Kenya and other energy players since it creates awareness of the need to spearhead essential policies to address the factors affecting the adoption of IoT devices by food and beverage processing firms in order to enhance efficiency in utilization of energy. This may further advance the energy efficiency theory as a guiding principal for efficiency utilization of energy.

The study is significant to management of food and beverage processing firms in Kenya since the findings creates information on the need to adopt IoT devices to reduce on the cost of utilization of energy. The findings are significant since they may equip the management of these firms with realization of acquiring principles of energy efficiency theory as a guiding platform for understanding need for efficiency energy utilization. This is in terms of the perceive ease of use of IoT technology and its requisite perceived usefulness. Future scholars may benefit since this study acts as a foundation of further scholarly .works on importance of energy efficient theory and technology acceptance model as platform for adoption of IoT as efficiency energy utilization.

1.5 Scope of the Study

The study focused on the factors affecting food and beverage processing firms in the adoption of internet of things technology in Nairobi, Kenya. The study covered the period 2016-2018. The independent variables of the study were: the effect of security of generated data, the effect of management of IoT devices, the effect of business skills side and the effect of technical perspective. The dependent variable was adoption of IoT technology in food and beverage processing firms in Kenya. The study was conducted in a period of five months.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter introduces the concept of Internet of Things in organization context. A review of literature on the determinants of energy utilization, utilization model in manufacturing organizations as well as the relationship between IoT and energy utilization among food and beverage processing firms in Kenya. The chapter also highlights the theoretical and conceptual frameworks for the entire study.

2.2 Theoretical Framework

Theoretical foundation of this study involves the analysis as well as linkage of the theories. Two theories anchor the study; Energy Efficiency theory and Technology Acceptance model.

2.2.1 Energy Efficiency theory

Energy Efficiency theory is based on the neo-classical work of Decanio in 1993. It is a theory of the organization which represents organizations as well informed; rational actors that systematically maximize profits subject to the constraints imposed by technology, public policy and the prevailing market conditions. It forms a central framework in the economics of energy efficiency and attempt to adopt new technological energy (Decanio, 1993). In this perspective, organizations enjoy informational advantages concerning the new technological advancements and economic aspects of efficient energy use.

Hence, market-based policies that equate marginal costs and benefits of adoption of efficient energy like IoT may be used to implement specified levels of environmental quality at minimum social cost. Direct regulatory interventions by the government, in contrast, induce inefficiencies by failing to exploit organization's expertise and motivation to cut energy costs. Application of this theory in the manufacturing sector in advanced economies has led to significant innovations in policy formulation and adoption of efficiency use of energy.

However, the neo-classical theory of adoption of efficiency energy faces a major challenge from the outcome of sustained direct regulatory interventions. Success in adoption of energy efficiency improvements has been realized through the neo-

classical organization theory as well as through direct regulatory interventions. Business organizations have varying interests in adopting energy efficiency. This fact is illustrated by the importance almost every organization is now placing on adoption of efficient energy technologies through policy and direct regulatory interventions. According to Howarth, Haddad and Paton (2000), the role of policies to promote the adoption of energy efficient technologies are a matter of great importance given the links between energy use and global environmental change. It therefore follows that the argument from the neo classical theory of the organization in energy efficiency improvements does not hold true in all areas.

Calculated government regulation and technology are already yielding tangible results where they have been implemented in organizations that have adopted efficient energy technologies. Sutherland (2001) notes that the functioning of normal markets provides powerful incentives for consumers and organizations to exploit investments in efficient energy technologies that yield accompanying cost savings. Technology analysts are also accused of overstating the energy savings generated by energy efficient technologies, including a rebound effect that would offset the gains made through enhanced equipment energy efficiency like IoT.

A technology that yields time cost savings would stimulate the demand for efficient energy services, including a rebound effect that would partially offset the direct energy savings from enhanced energy efficient technologies (Khazzoom, 2010). Since the world population has kept on increasing, there will be sustained demand for more adoption of efficient energy. It does not matter whether energy efficient technologies like IoT are developed or not. Maintaining the business as usual approach for organizations will only assist in aggravating the energy deficit while worsening the performance levels. Some of the technologies like IoT have not been widely appreciated and exploited due to lack of awareness among potential users.

This theory is relevant in this study since through adoption of IoT devices, food and beverages processing firms may enjoy informational advantages arising from technological and economic side thus adopting efficient technologies like IoT. Additionally, food and beverages processing firms may gain significant innovations in policy formulation that will spur adoption of efficiency use of energy technologies like IoT. Awareness campaigns among food and beverage processing firms in Kenya

are likely to enhance the management of the firms to view adoption of IoT devices from the business angle in terms of the advantages gained from the organization point of view. The theory is finally important since adoption of IoT technologies may subsequently enhance the technical capacity of the human capital in the entire organization to effectively manage and use the new devices.

2.2.2 Technology Acceptance model

Technology Acceptance models aim at studying how individual perceptions affect the intentions to use information technology as well as the actual usage. The Technology Acceptance model was originally defined by Agrawal (1999), but it has subsequently been modified and augmented by other researchers. This Technology Acceptance Model (TAM) is a widely used and accepted model in the developing context that has been under-tested under different development conditions. Since the introduction of the TAM by Davis (1989), the empirical evidence and research across hundreds of studies strongly suggest that TAM is a valid framework and reliable predictor of IT adoption (Agrawal, 1999; Venkatesh, 2000).

With its underpinnings anchored in the social psychology theory of reasoned action (Ajzen & Fishbein 1980), TAM theorizes that a person's intention to adopt a particular IT is guided and determined by two distinct beliefs, perceived ease of use (PeoU) and perceived usefulness (PU). Perceived ease of use is defined as the extent to which a potential IT user perceives or believes that the use of that IT system will be free of effort (Thong et al., 2002). Perceived usefulness in turn is defined as the extent to which a potential IT user believes that the use of that IT system will enhance that user's job performance.

Further, TAM theorizes that perceived usefulness has a direct and positive effect on perceived intention to use, while perceived ease of use has an indirect and direct positive affect on a user's intent to adopt an IT, or perceived intention to use it. Perceived ease of use directly affects perceived usefulness and, therefore, perceived ease of use both indirectly and directly drives perceived intent to use (Thong et al., 2002).

TAM is relevant to this study since it explains how managers of organizations like food and beverages processing firms may adopt IoT technology in terms of their perceived usefulness and perceived intention to use IoT technology and devices..

Perceived usefulness in turn may bring out the aspect of security of the acquired IoT technology. It may also equip the management and employees in the organization with technical skills to effectively and efficiently manage the newly acquired IoT technology.

2.4. Internet of Things

Internet of Things (IoT) is a key component of innovation accelerators and it cannot be ignored in the journey of innovation today in the industrial world. IoT is defined as a network of uniquely identifiable end points (or things) that communicate without human interaction using IP connectivity: be it locally or globally. It is not an individual technology that can be implemented in isolation but it is an integral part of an "innovation platform" tying together multiple IT systems and teams within and sometimes outside an organization (Ramachandran, 2015).

IoT provides real-time and reliable digital feedback on a product performance, in a structured manner, to get closer to customers and understand their actual usage. This helps in product enhancement and design of new versions matching customer requirements, making IoT a vital piece in the industrial innovation platform. The integration of multiple IT applications by enabling seamless flow of information between them and handling the amount of data continues to be a challenge for enterprises and manufacturing organizations, and IoT adds one more source of data generation that should be integrated with appropriate IT systems for timely generation of valuable insights and their translation into meaningful actionable items (Kocher, 2014).

Like many evolving IT and networking technologies, the Internet of Things has encountered multiple barriers in its adoption. Traditional inertia, budget priorities, risk aversion and other factors still prevent some companies from adopting IoT in the near future. Expectations are that early adopters led by innovative business leaders will identify and pursue specific opportunities to better serve their customers, open new businesses reduce costs and provide new value that result in increased revenues (Mayer, 2009). In addition to the technical challenges around power, latency, integration and storage, there are a number of other issues critical to adoption of IoT technology. These challenges provide new business opportunities for technology-

oriented companies, middleware and tools developers, system integrators, device builders and cross-platform integration companies (Kocher, 2014).

2.3 Factors Affecting Organizations in Adoption of Internet of Thing (IoT) technology

Despite all the advancement of implementing IoT technologies into manufacturing firms, Zhang et al. (2015) explain that a number of factors affect the adoption of IoT technologies. They range from security of generated data, management of Internet of Thing (IoT) devices, Business skills side in Internet of Thing (IoT) devices and technical perspective of IoT.

2.3.1 Organizational security of data generated from IoT

A high level of security is a central requirement for software in the IoT. “In the IoT, every ‘thing’ is connected, which results in significant security threats towards confidentiality, authenticity and integrity of both data and services”. The more complex and pervasive technological systems become, the more vulnerable they will be to abuse. Thus, in order to convince users to participate in the Internet of Things, effective mechanisms for and data protection must be put into place” (Kelion, 2015). Security threats arise when an IoT application needs to be updated. While there is technology that supports updating nodes within a network, these technologies lack encryption layers and therefore might not prevent malicious software installations (Brown, 2015).

Security is also an important requirement for machines that compute data from sensor networks, offer shared storage to different customers, and implement appropriate security policies. All in all, a high level of trust and security are necessary for the IoT technology to be adopted by a critical mass. “Without sureness that safety of private information is assured and adequate security is provided, users will be unwilling to adopt this new technology that invisibly integrates into their environment and life” (Mayer, 2009).

IoT generates a vast amount of data. It is important for organizations to decide at the beginning of the implementation on who owns the raw data and makes use of it in whatever fashion to draw insights out of it. Sometimes, the cost of hardware required to implement IoT can become a security threat to the entire system if it is expensive equipment. The product should be designed in such a way that it is secured when

deployed on the field with necessary alarms and tracking systems in place if stolen or subjected to harsh weather conditions (Ramachandran, 2015).

As the IoT connects more devices together, it provides more decentralized entry points for malware. Less expensive devices that are in physically compromised locales are more subject to tampering. More layers of software, integration middleware, APIs, machine-to-machine communication, etc. create more complexity and new security risks. There is rise on many different techniques and vendors addressing these issues with policy-driven approaches to security and provisioning (Kelion, 2015).

With remote sensors and monitoring a core use case for the IoT, there is heightened sensitivity to controlling access and security of data. Compliance will continue to be a major issue in medical and assisted-living applications, which could have life and death ramifications. New compliance frameworks to address the IoT's unique issues need to evolve. Social and political concerns in this area may also hinder IoT adoption (Pütter, 2015).

In addition, with so many players involved with the IoT, there are bound to be ongoing turf wars as legacy companies seek to protect their proprietary systems advantages and open systems proponents try to set new standards. There may be multiple standards that evolve based on different requirements determined by device class, power requirements, capabilities and uses. This presents opportunities for platform vendors and open source advocates to contribute and influence future standards leading to development of unregulated devices (ITU, 2012).

Lack of clear use cases or strong ROI examples will slow down adoption of the IoT. Although technical specifications, theoretical uses and future concepts may suffice for some early adopters, mainstream adoption of IoT will require well-grounded, customer-oriented communications and messaging. Detailed explanations of a specific device or technical details of a component won't cut it when buyers are looking for a "whole solution" or complete value-added service. IoT providers will have to explain the key benefits of their services or face the queries of security (Pütter, 2015).

Hwang (2015) studied on IoT security and privacy as well as the threats and challenges in China. The study attempted to introduce approaches to solve the security and privacy issues in the industrial field. The study established that IoT has valuable benefits to organizational operations. The findings revealed that IoT exposes the organizational management to different types of security threats in the course of operations. Additionally, the findings revealed that unlike in the period prior to IoT where the management had only to grapple with informational leakages and loss of service, the IoT security threats are related to non-virtual operations of entities leading to physical security threats. The findings also established that demand for security solutions able to support multi-profile platforms and provide equivalent security levels is in preference for various IoT device interactions. Finally, the findings revealed that user privacy is becoming more important in the IoT environment since a lot of personal information is delivered and shared among connected IoT devices. The study is in China, a developed economy while the current study is in Kenya, a developing economy.

Vasilomanolakis, Daubert, Luthra, Gazis, Wiesmaier and Kikiras (2015) studied on the security and privacy of IoT architecture and systems in Greece. The main objective of the study was to identify and discuss the properties that constitute the uniqueness of the IoT in terms of the upcoming security and privacy challenges. The findings established that there is a mediocre coverage of security and privacy requirements in many organizations in Greece. The findings also identified that security of the generated IoT data in many organizations is not keenly monitored. This study is in Greece a developed economy compared to Kenya which is the focus of the current study.

Roman, Zhou and Lopez (2013) conducted a study on the features and challenges of security and privacy in distributed IoT devices in USA. The study established that the approach on the features and challenges of security and privacy in many firms have issues that need solutions. The study also revealed that it is necessary to understand the advantages and disadvantages of distribute IoT devices in order to understand the security and privacy features. The study is in USA, a developed economy compared to Kenya.

Patil and Seshadri (2014) study was on IoT big data security and privacy issues in healthcare in India. The study established that digitization of medical data has led to

an increase in sheer volume of data in terms of complexity, diversity and timeliness. The findings revealed that there is a paradigm shift where every opportunity is sought by healthcare leadership for lowering medical costs while improving the care process leading to the power of IoT big data. Finally, the findings revealed that the power of IoT big data has the potential of exposure to security and privacy issues on the generated medical data leading to emergency of threats and vulnerabilities of data. This study has focused on security of IoT generated data in healthcare in India with current study focusing on adoption of IoT in food and beverage processing firms in Kenya.

2.3.2 Management of Internet of Thing (IoT) devices

Due to the high number of IoT devices that are expected to come, capabilities offering management of IoT infrastructures have grown in importance. The number of devices that need to be managed and that communicate with each other will be at least an order of magnitude larger than the devices connected to the current Internet. Therefore, it is crucial to be able to deploy a fleet of devices in a fast and simple way. For instance, applications need to be easily deployable on several hundred devices in parallel (Kocher, 2014). Most of the IoT applications implemented so far are smaller in scale for selected products, geographies, or services. When scaled up across the entire portfolio of products or across the country and even between countries, new unforeseen challenges can be thrown up due to the high volume of data and unforeseen situations (Mayer, 2009).

Manageability is an additional important requirement in the IoT. This relates to semantics of data, as well as efficient data handling. ITU expects a paradigm shift in communication because communication triggered by humans will noticeably shift towards device-triggered communication. This implies that IoT applications usually work automatically without human participation, but their whole operation process should be manageable by the relevant parties (Hickey, 2017). The large number of devices requires a high level of automation, including “self-management, self-configuring, self-healing, self-optimizing and self-protecting techniques” in networks as well as for applications. These techniques can be applied in networks and for the deployment of applications using automation features offered by container technology (Ramachandran, 2015).

Furthermore, every device needs to carry an identifier to provide identification of other operating devices. IoT devices are loosely coupled entities in networks, some devices are even frequently changing locations and require the ability to be traced back to the owner in case of, e.g., legal infringements. An identifier also helps to establish communication connections. Investigations of this requirement will not be covered further in this work. It is assumed that borders between IT infrastructures in the IoT are seamless enough to render devices indistinguishable (Kelion, 2015).

Yan, Zhang and Vasilakos (2014) carried out a survey on trust management for IoT in Hong Kong. The objective of the study was to investigate the properties of trust, propose objectives of IoT trust management and finally provide a survey on the current literature advances towards trustworthy of IoT. The findings established that trust management for IoT plays a crucial role in IoT data fusion and mining and lead to enhanced user privacy and information security. In addition, the study established that trust in IoT assist organization managers to overcome perceptions of uncertainty and accrued risks of data generated. Finally, the study revealed that the current literature on IoT still lacks a comprehensive study on trust management in IoT. The study is on trust management of IoT in Hong Kong with current study focusing on adoption of IoT by firms in Kenya.

Bohli, Skarmeta, Moreno, Garcia and Langendorfer (2015) study was on secure IoT data management for smart cities in Netherlands. The objective of the study is to create an end-to-end security and trust in information delivery for decision making process as per the privacy requirements of data owner. The study applied a data centric paradigm in order to offer highly scalable and secure information for smart city. The study established that provision of advanced and secure information services is critical for enabling powerful higher-layer applications in the management of secure IoT data. The study was on secure IoT data management for smart cities in Netherlands while the current study is on adoption of IoT in food and beverage processing firms in Kenya.

Lee and Lee (2015) studied on applications, investments and challenges for management of IoT in enterprises in USA. The objective of the study was to present five IoT technologies that are crucial in the deployment of successful IoT-based products and services and also a presentation of three IoT categories for enterprise

applications used to enhance customer in enterprises. The study established that IoT is a technological paradigm envisioned as an important area for future technology in the industrial sector. Thus management of enterprises needs to have technical and cognitive skills of management of IoT data generated for the advancement of future enterprises. The study is on applications, investments and challenges for management of IoT in enterprises in USA and may not be generalized to the Kenyan context due to the differences in industrial development of the two countries.

Sanchez et al. (2014) conducted a study on the deployment and experimentation architecture of IoT in Santander city in Spain. The objective of the study was to assess the deployment and experimentation architecture of IoT in one of the projects of the Future Internet Research and Experimentation initiative of the European Commission. The study revealed that management of the data generated from such facilities is critical since it presents the reality of the situation and challenges that managers of firms adopting IoT technology must deal with. Since the objective of the study was on deployment and experimentation architecture of IoT in an experimental setup, the findings may not be generalized in food and beverage processing firms like the ones under the current study since the situation in Kenya and Spain are not similar.

2.3.3 Business Skills side in Internet of Thing (IoT) Devices

With any IOT implementation, there are several elements that need to be considered, the strategy to be used, the laid down infrastructure and the coinciding business processes. The requisite business abilities are crucial to merge the glaring disparities existing between the IT departments and the business side of an organization. There should also be focus on the ability of the management of an organization to source for the needed skills either within or outside the organization through recruitment or partnerships. Development of the newly recruited workforce is also very crucial to enhance the skill levels (Pahl, 2015). According to Hickey (2017), the ability to possess the requisite entrepreneurial skills enable the workers to be more committed and loyal to the business and in the process transforming the business to have an impact in both the local and global levels. For a business to scale the heights of consistent levels of competition, it must possess a strategic plan to enable it to understand and conceptualize of its future growth and development.

The slow implementation of most IOT projects can be attributed to several factors, such as time to complete, a lack of internal capabilities or appropriate skills, lack of business transformation, poor cost planning and the quality of data received. Any organization anticipating its functions integrating with the IoT platform need to have a base and foundation of understanding its strengths and weaknesses and especially so its line of expertise. For many businesses, the reality of IoT has introduced new dimensions in the operations and lifetime of the business that will shake its core foundation and in the process forcing them to change to remain relevant (Kocher, 2014).

An organization with the hope of adopting the concept of IoT should employ the services and management capabilities of an experienced leadership or management with the capabilities to take the organization to the next level of growth. Such a leader or manager should possess the visionary and strategic management capabilities to visualize the needs for an IoT adopting entity as well as have the ability to project the future requirements to project needs that is needed to lead to positive disruption of the organization undertakings. Such a leader should also be visionary enough to source for potential and able-bodied partnership with the intellect to expertly execute the IoT needs and vision in the organization lifetime. The potential leader should finally get into the organization to lead in the eventual realization of the IoT set targets and goals as well as lead in the process of managing of the organization change management process (Pütter, 2015).

De Cremer, Nguyen and Simkin (2017) studied on the integrity challenges of IoT and its challenges in business set up. The study aims at understanding the influence of marketing practices and tackling the challenges of adoption of IoT technology in marketing. The study established that the overlooked dark side in marketing practices under IoT includes trust, privacy and security of the generated marketing data both to the user and organization. The study revealed how different types of dark-side behaviours are linked to key strategic IoT processes and also outlines how the dark-side practices may be addressed by adopting a more strategic and integrity-oriented approach. The conclusion of the study is that through adoption of holistic approach to IoT, dark-side behaviours can be addressed and move in the direction of more effective market practices.

Hoberg, Krcmar, Oswald and Welz (2017) conducted a study on skills for digital transformation in IoT business set up in USA. The study further aimed at showing the application of various new technologies under IoT that may be adopted for digital transformation in digitally-enabled business opportunities. Cross-section research design was used with a sample size of 344 participants. The study established that 80% of the respondents indicated that they regarded IoT digital transformation as important for their company's business strategy. The study revealed that 76% of respondents indicated that companies had few recruitment and training programs in place dedicated for procuring and developing IoT digital skills. This study was on skills for digital transformation in IoT business set up in USA and generalization in the Kenyan context may not be feasible due to the nature of development in the two countries.

Li, Hou, Liu and Liu (2016) study attempted to provide a theoretical framework classifying IoT strategies into four archetypes from two dimensions of manager's strategic intent and industrial driving force in Taiwan. The study established that market-based exploratory capabilities play an important role for firms adopting IoT based strategy. The study also showed that market based exploitative capabilities play an important role for firms adopting catch-up strategy in marketing. In addition, IoT based exploratory capabilities play a more important role for firms adopting catch-up strategy like IoT technology. Finally, external industry IoT information sharing more efficiently contributes to the enhancement of both market-based and technology-based exploratory capabilities of firms. However, this study is on provision of a theoretical framework classifying IoT strategies into four archetypes from two dimensions of manager's strategic intent and industrial driving force in Taiwan.

Kiel, Arnold and Voigt (2017) studied on the influence of industrial IoT on business models of established manufacturing companies in Germany. The study aimed at analyzing the influence of IoT on the business models from a business level perspective. Its focus was on the interrelationships between business model component changes. For this purpose, an exploratory multiple case study approach was employed, which was based on relevant IoT-related experiences of 76 German manufacturing companies. By triangulating data from semi-structured expert

interviews and archival company material, the study provided in-depth insights and a better understanding of IoT-driven effects on manufacturing business models. It contributed to extant management literature by revealing the value proposition, internal infrastructure management, and customer relationships predominantly influenced by the IoT. Moreover, it established that IoT-triggered business model changes are offer-driven, particularly by production and process optimization within customers' production systems. These value proposition changes result in subsequent modifications of the remaining business model elements. This study was in Germany on manufacturing companies with current study focusing on food and beverage processing firms in Kenya.

2.3.4 Technical Perspective in Internet of Thing (IoT) Devices

To conceptualize the technical side of IoT, requisite skills are necessary to mid-wife the process of change management in the organization through the implementation, development of the necessities for articulating the related activities effectively and efficiently. This can only be efficiently articulated by an experienced and a thoughtful entrepreneur with the ability to visualize the need for use of fast data, the need for the scalability necessary to understand that it is vital for users possess the capability to make sound judgments (Kelion, 2015).

In terms of integrating third party components, skills and requisite ability to work are paramount for users especially around platform-to-platform integrations with the ability to create partnership while working in IoT related undertakings. IoT developers possessing necessary skills should be brought on board in decision making. The developers should possess the ability and understanding to effectively and efficiently participate in all the business undertakings with different applications or by different partners. The IoT developers should be able to solve the flexibly found in the requirements for every hardware and software solutions (ITU, 2012).

For the users of IoT the basic security skills are vital in the attempt to creating a secure environment in the entire organization. The need for security should be visualized at the concept stage of the life of an organization and should never be seen as an afterthought. The organization and also individual users of IoT should possess the highest level of understanding the necessity for partitioning and monitoring the entire security requirement in totality (Banerjee, 2015). According to Hickey (2017),

the explosion of IoT phenomenon has ushered in the era of monumental amount of data exchange at unprecedented levels and to get the benefit of this information, efficient and effective data processing and analysis is a crucial requirement. The widespread growth in information sharing arising from the explosion of data in motion and data streaming should be interpreted effectively. The benefits of IoT are specifically in provision of true-value in decision making (Pütter, 2015).

The requisite technical skills needed for an ideal IoT program include the presence of a qualified hardware developer, a knowledgeable senior organization ware developer, front end developer and senior back-end developer (Pahl, 2015). An organization also requires the services of an experienced system administrator with clear knowhow on hosted cloud environments as well as service provider relationships. In addition, skills and understanding for in-depth technical capability specifically in implementing a wireless networking solution is crucial. An organization finally requires the services of a skillful system administrator with management skills for network requirements from the field to the hosted environment, and with technical knowhow to manage the monstrous volume of information (Banerjee, 2015).

Ultimately, IoT projects are complex and challenging, and the need to specifically and effectively undertake the implementation of IoT in the organization is very costly, manageable only to the large businesses with monumental amount of financial resources. Any organization with the mindset of integrating IoT but without the requisite amount of finances resources accountable for the efficient projection and financing of that vision may not be able to fully undertake the implementation stage and may thus fail to achieve its business results (Kelion, 2015).

On the other hand, organization with the necessary financial resources to successfully mount the IoT cloud platform on board will successfully leap the benefits accruing the IoT. The successful visualizing, conceptualizing, and implementing the IoT platform is not an easy undertaking for any organization. It calls for successful collaboration, unity of purpose and determination from all the stakeholders in an organization. Finally, such an organization will acquire a cloud platform enabling it to access and convert the monstrous information generated by the IoT devices, leading to unprecedented growth levels and performance (Hickey, 2017).

Shin (2014) study was on a socio-technical framework for IoT design in Korea. The main objective of the study was to resolve and clear the understanding of evolution and stabilization of IoT in a smart environment. It also investigates the complex interaction between social and technical aspects of IoT. This is through highlighting the co-evolution, interaction and interface which constitutes the next generation network environment. Finally, the findings of this study provide insights into these challenges and opportunities, by offering a socio-technical analysis of IoT development. The insights help to conceptualize how the IoT can be designed and situated within human-centered contexts. The study on socio-technical framework for IoT design in Korea and may not be generalized in the current study which aims at studying adoption of IoT in Kenyan firms.

Soro, Ambe and Brereton (2017) study was on influence of technical perspective of IoT on healthy ageing of employees in firms in USA. The study established that there are two distinct bodies of literature on the Internet of Things, one that derives from a technical perspective, while the other comes from a human perspective. Findings show that from a technical perspective, sensors can automatically detect physical activity, thus enabling elderly people to live independently, while sensors in essence check that they are active; remind them to take their pills, and so on. In addition, the study revealed that from a human perspective, employees seek control over their lives, good health, social connection, and a sense of well-being that comes from having purpose and feeling competent in daily routines. This study is on influence of technical perspective of IoT on healthy ageing of employees in firms in USA. The current study is on adoption of IoT in food and beverage processing firms in Kenya.

Gao and Baj (2014) research aimed at developing and testing integrative model of factors determining consumer's acceptance of IoT technology in China. Based on technology acceptance model (TAM), the authors proposed an IoT acceptance model that consists of three technology factors (perceived usefulness, perceived ease of use, and trust); one social context factor (social influence); and two individual user characteristics (perceived enjoyment and perceived behavioral control). Data from 368 Chinese consumers were used to test the research model through the use of structural equation modeling. The results showed particularly strong support for the effects of perceived usefulness, perceived ease of use, social influence, perceived

enjoyment, and perceived behavioral control. However, trust played an insignificant role in predicting the intention. In addition, perceived ease of use and trust were found to affect perceived usefulness. Compared with the individual TAM model, the integrated model provides more explanation on user behavioral intention toward IoT usage. This study was based in China and may not be generalized in the Kenyan context as per the objectives of the current study.

Laudien and Daxböck (2016) studied on the influence of IoT on business model design in Turkey. The bases of the study were that IoT is recently a widely discussed phenomenon. However, business level effects of this phenomenon are by now under-researched. The research attempted to tackle this research gap by presenting an in-depth analysis of business model changes manufacturing firms employ to adequately react to this technological development. Against the background of a multiple-case study the study identified and characterized three archetypes of business models manufacturing firm implement in order to benefit from opportunities provided by the IoT. Furthermore, the study contributed to business model research and additionally bolstered up a strategic firm level perspective on the IoT. This study was on influence of IoT on business model design in Turkey while the current study is on adoption of IoT in food and beverage processing firms in Kenya.

2.4 Adoption of IoT in Enhancing Efficient Energy Utilization

According to Shrouf, Ordieres and Miragliotta (2014), the development and adoption of the Internet of Things (IoT) is a critical element of smarter manufacturing organizations globally. Though manufacturing firms have been implementing sensors and computerized automation for decades, these management systems are largely disconnected from IT and operational systems. These legacy structures differ from the open, highly connected IP network structures that play such a large role in the value propositions of IoT. At present, many manufacturing entities face common challenges which are basically related to efficiency in energy utilization; cost of production and timely, accurate and consistent inadequacies of manufacturing during manufacturing execution. Real-time data is required in production of manufacturing firms. Regarding data collection, adoption of IoT devices offers a fast and accurate way to collect real-time data from manufacturing processes. Therefore employing IoT devices in the production planning and control has significant benefits. For

maximum optimization, there should be a consistent dual-way connection between decision-making level and execution level (Zhang et al, 2015).

Zhang et al (2015) further suggested that the abilities of IoT technologies to impact production processes in manufacturing firms are categorized into four groups of: monitoring, control, optimization and autonomy. In monitoring, sensors and external data sources enable the thorough monitoring of product's operation and usage, product's condition and external environment. It also enables alerts and notifications of changes. The second group is control which happens through the software embedded in the product or in the product cloud. The software allows control of product functions and personalization of the user experience. The next group is optimization. The purpose of optimization is enhancing product performance and allowing predictive diagnostics, service and repair. To elaborate more, monitoring and control capabilities facilitate algorithms that optimize product operation and use. Autonomy is the last group. It is the combination of three previous groups. In other words, combining monitoring, control and optimization allows autonomous product operation, self-coordination of operation with other products and systems, autonomous product enhancement and personalization, and self-diagnosis and service.

Ghashghaee (2016) stated that manufacturers may use IoT connected sensors to provide an unprecedented level of visibility into the factory operations and supply chain flow in a much broader range of manufacturing than just the very high value processes currently enabled. IoT in manufacturing improve business by connecting people to the right information, over the right device at the point of need and cross company boundaries to include suppliers, maintenance partners, and distribution chains. Kenya manufacturers may also use the new mobile-ready software from IoT devices to have access to data such as equipment efficiency, line efficiency, data visualization tools and alerts from any location at much lower costs than previous custom systems. This will create efficiency in the manufacturing processes of these firms.

Babiceanu and Seker (2016) suggest that IoT, analytics and IP networks help manufacturers gain a better understanding of the supply chain information that can be delivered in real-time. By connecting the production line and balance of plant

equipment to suppliers, all parties can understand interdependencies, the flow of materials, and manufacturing cycle times. In Kenya manufacturers can use IoT enabled systems to configure location tracking, remote health monitoring of inventory, and reporting of parts and products as they move through the supply chain. They can also use IoT systems to collect and provide up-to-date information to accounting functions for billing. Real-time information access may help these manufacturers to identify issues before they happen, lower their inventory costs and potentially reduce capital and energy requirements.

Jabbar, Khan, Silva and Han (2016) argued that in many industries, energy is frequently the second largest operating cost. But many firms lack cost effective measurement systems and modeling tools and/or performance and management tools to optimize energy use in individual production operations, much less in real-time across multiple operations, facilities, or an entire supply chain. There are numerous ways that IoT and automation of environmental controls such as HVAC and electricity can create cost savings for manufacturers. Connected energy solutions can provide peak demand charge avoidance and enable economy model operations. Certain IoT-enabled HVAC systems also offer integrated weather data and prediction analysis to help manufacturers understand expenses and plan energy usage. Jabbar et al add that efficiency improvements of 5% in a small industrial power plant generating 15MW can save over \$200,000 on average per year. Kenyan manufacturers can also borrow from these global practices.

Globally, manufacturers have widely accepted the concept of preventative and condition-based monitoring but many are still in the process of implementing these programs. Lower cost sensors, wireless connectivity and big data processing tools make it cheaper and easier to collect actual performance data and monitor equipment health. If the manufacturer has equipment that's supposed to operate within a certain temperature range, the company can use sensors to actively monitor when it goes out of range and prevent malfunctions. Measuring vibrations to detect out of spec operations is another example. Businesses, particularly industrial businesses, lose money when equipment fails (Muhonen, 2015). With new sensor information, IoT can help Kenyan manufacturer improve overall equipment effectiveness (OEE), save

money by minimizing equipment failure and allow the company to perform planned maintenance.

Generally, adoption of IoT in manufacturing firms in Kenya may help in creating many opportunities by enhancing data collection, enabling real-time responses, increasing efficiency and productivity, and improving access and control of devices. Through IoT, frequent data collection is possible and then, these data can be used to optimize outcomes. The data can be collected instantly which makes the real-time decision making by management happen and afterwards necessary actions taken. This would have a positive impact on efficiency and minimizing on energy costs. By capturing real-time information, it is easier to make sure production line runs smoothly and efficiently and the lack of spare parts or raw material on the line is minimal. IoT is in enhancing productivity at a larger scale where coordination of numerous pieces is crucial. This is due to IoT's ability to provide better access and control over internet-connected devices.

However, Kenyan manufacturing firms should be privy of the fact that using Internet of Things technologies results in generating more data. This data requires ample storage and processing. This large amount of data raises concerns about privacy, data processing, data security, communication and standards. Kenyan manufacturers may therefore be forced to define and implement new set of standards in order to coordinate and make the devices to work together. Therefore, deploying different approaches such as data structures and communications, considering IoT is necessary for businesses.

As stated by Ghashghaee (2016) security of the collected data by IoT in different scenarios that involve multiple parties is a challenge. Typically, copyright agreements are signed to clarify the owner of the produced data by a machine. In case of an IoT object security, this object might be owned by a specific company, could be co-owned by several companies or it can be part of a public or private infrastructure. The concern for Kenya manufacturers then would be who has the authority to utilize the object and decide on how it is interacting with other IoT objects which requires modification in business model design.

For Kenyan manufacturing firms, cyber security may be a concern for the data or systems developed by IoT. The IoT cloud creates very sensitive data as well as supporting safety critical systems. It is vital that these systems be safe and secure from intrusion by an unauthorized user or any unintentional data breaches by authorized personnel to handle data. Jabbar et al (2016) commented that firms face many challenges while implementing IoT technologies. The first challenge is tracking the process products and materials in real-time.

Second challenge is nonsynchronous communication between inventory control department and manufacturing schedules which results in a backlog of orders and ultimately a time delay. Next one is not being able to forecast life spans, malfunctions which lead to managing systems manually and time delays. And finally, lack of appropriate real-time monitoring system and feedback channel are also big challenges for managers of these firms. Additionally, lack of monitoring system makes it hard to capture information about conditions and failures in the system. Therefore, repair time is delayed. Manufacturing firms in Kenya should therefore be aware of ways of maneuvering through these challenges.

Shrouf and Miragliotta (2015) studied on energy-efficient production management practices that are enhanced and enabled by the Internet of Things technology in Canada. In addition, the study focused on the benefits that can be obtained thanks to adopting such management practices. Eventually, a framework was presented to support the integration of gathered energy data into a company's information technology tools and platforms. The study established that operational and tactical decision-making processes could leverage on IoT data in order to improve energy efficiency, and therefore competitiveness, of manufacturing companies. The study revealed that with adoption of Internet of Things, there is a better focus on those energy management practices that are more aligned with company maturity, measurable data and available information systems and tools. The study is on energy-efficient production management practices that are enhanced and enabled by the Internet of Things technology in Canada and may not be generalized in the Kenyan context especially in the current study due to variation of study variables.

Rahimifard et al (2017) studied a number of key IoT research challenges facing modern food manufacturers in USA. The challenges include improved productivity

using fewer resources, valorization of food waste, improving the resilience of food supply chains, localization of food production, and utilization of new sustainable sources of nutrition for provision of customized food products. The findings were that one of the most prominent challenges commonly acknowledged by modern manufacturing industries is production of more volumes of products with fewer energy uses. The study also established that climate change has diminished the ability to produce food hence the need for adoption of new technologies like IoT to enhance utilization of energy. The study was on key IoT research challenges facing modern food manufacturers in USA while the current study is on adoption of IoT in Kenyan firms.

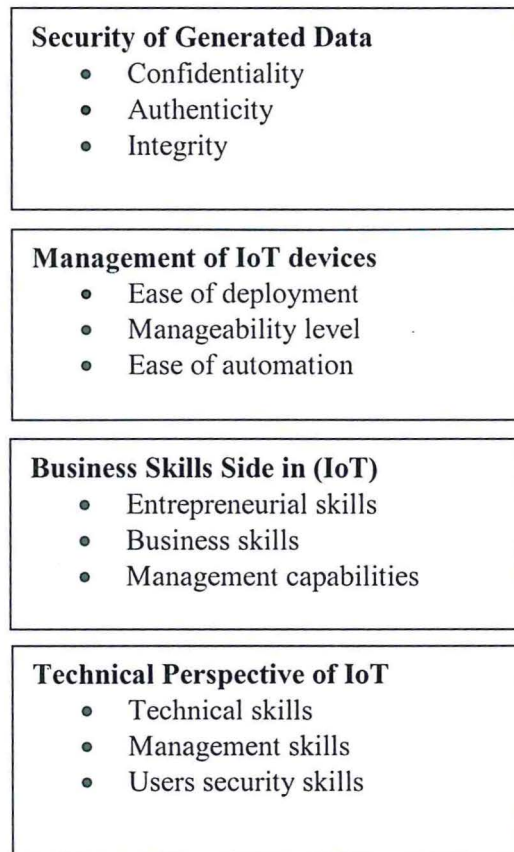
Fernando, Bee, Jabbour and Thome (2018) studied on IoT energy management practices on energy supply chains in emerging economies. Drawing from the resource based view (RBV), the study tested the effects of IoT energy management practices on supply chain initiatives in 151 certified (ISO 14001 and ISO 50001) manufacturing firms in Malaysia. The results showed three dimensions of energy management practices (EMP) – top management commitment, energy awareness, and energy auditing – which were positively associated with the development of IoT energy initiatives. The findings established that insufficient knowledge of energy efficiency means firms struggle to manage energy effectively, constraining opportunities such as converting waste into energy to support business' targets. This study is based in Malaysia and may not be generalized in the Kenyan context.

Tripoli and Schmidhuber (2018) researched on facilitating a better understanding of the opportunities, benefits and applications of IOTs in agri-foods in Germany. It also identified technical limits and possible institutional barriers to their adoption. The findings were that by utilizing digital records, cryptography and the disintermediation of transaction processing and data storage, IOTs can improve both agricultural supply chains and rural development interventions in a number of ways. First, the ability of the technology to trace a product's provenance, carry detailed attributes for the product in each transaction and ensure its authenticity brings vast improvements in traceability with positive impact on food safety, quality and sustainability. The findings established that the vast amount of data generated from transactions in agricultural supply chains provides more accurate market information and data for supply chain actors and the public sector, which can be used to inform

production and marketing decisions prove a farmer's track record to access credit and strengthen the enabling environment with better informed policies. The study was on facilitating a better understanding of the opportunities, benefits and applications of IOTs in agri-foods in Germany while the current study is on adoption of IoT in food and beverage processing firms in Kenya.

2.5 Conceptual Framework

Independent Variables



Dependent Variables



Figure 2. 1 Conceptual Framework

2.6 Operationalization of variables

Table 2. 1 Operationalization of variables

Objectives	Research Question	Indicators	Types of Analysis	Testing
To determine the effect of security of generated data on the adoption of IOT technology in food and beverage processing firms in Kenya.	How does security of generated data affect the adoption of IOT technology in food and beverage processing firms in Kenya?	Security of Generated Data <ul style="list-style-type: none"> • Confidentiality • Authenticity • Integrity 	Descriptive and inferential statistics applied. Regression analysis used to determine the effect of security of generated data and adoption of IOT	If p value < 0.05 reject null hypothesis if p value is > 0.05 fail to reject the null hypothesis.
To investigate the effect of management of IoT devices on the adoption of IOT technology in food and beverage processing firms in Kenya	Does management of IoT devices affect the adoption of IOT technology in food and beverage processing firms in Kenya?	Management of IoT devices <ul style="list-style-type: none"> • Ease of deployment • Manageability level • Ease of automation 	Descriptive and inferential statistics applied. Regression analysis used to determine the effect of management of IoT devices and adoption of IOT	If p value < 0.05 reject null hypothesis if p value is > 0.05 fail to reject the null hypothesis.
To establish the effect of business skills side in IoT on the adoption of IOT technology in food and beverage processing firms in Kenya.	How does the business skills side in IoT affect the adoption of IOT technology in food and beverage processing firms in Kenya?	Business Skills Side in (IoT) <ul style="list-style-type: none"> • Entrepreneurial skills • Business skills • Management capabilities 	Descriptive and inferential statistics applied. Regression analysis used to determine the effect of business skills side in IoT on adoption of IOT	If p value < 0.05 reject null hypothesis if p value is > 0.05 fail to reject the null hypothesis.
To determine the effect of technical perspective of IoT devices on the adoption of IOT technology in food and beverage processing firms in Kenya in Kenya.	How does technical perspective of IoT devices affect the adoption of IOT technology in food and beverage processing firms in Kenya in Kenya?	Technical Perspective of IoT <ul style="list-style-type: none"> • Technical skills • Management skills • Users security skills 	Descriptive and inferential statistics applied. Regression analysis used to determine the effect of technical perspective of IoT devices on the adoption of IOT	If p value < 0.05 reject null hypothesis if p value is > 0.05 fail to reject the null hypothesis.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This section gives a preamble to the methodology to be used in this study. It describes the study design, area of study, target population, sample size, sampling technique, data collection procedure, data collection instruments, ethical issues and data analysis method.

3.2 Research Design

Research design is the overall strategy for integrating the different components of the study in a coherent and logical way. Mathew and Thompson (2012) stated that research design comprises of a set of decision that makes up the master plan specifying the methods and procedures for collecting and analyzing the needed information. Cooper and Schindler (2014) further define research design as a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings. This study adopted a descriptive research design.

The research was both quantitative and qualitative in its approach and in the process generating quantitative and qualitative data. The design is appropriate for this research because it examined the situation the way it is, and no changes or modification of the situations under investigation may be done (Kothari, 2009). Quantitative and qualitative approaches were utilized aiming at quantifying the relationship between independent variables; factors affecting adoption of IoT by food and beverage processing firms.

3.3 Population of the Study

A population refers to an entire group of persons, events or elements of interest that a researcher wishes to investigate, have at least one thing in common and make inferences based on sample statistics (Cooper & Schindler, 2014). The population in this study was manufacturing firms in Kenya specialized in food and beverage processing. Target population refers to the aggregate or totality of all objects, subject or members that conform to set of specification (Creswell, 2014). The target population of this study constituted of 69 food and beverage manufacturing firms in

Nairobi, Kenya as stated in the website of Kenya Association of Manufacturers (2018) (See appendix 2).

For this study, either the CEOs/Operation managers of the targeted firms were the main participants. The CEOs/managers were targeted since they possessed the requisite knowledge and experience on the issues related to IoT adoption that affect these organizations. They are also in charge of the day to day operations in these organizations and as such are well equipped with the information on IoT adoption.

Table 3. 1 Target population

Managers	Total
Chief Executive offices/operation managers	69
Total	69

3.3.1 Sampling Frame

A sampling frame is the complete and correct list of population constituency of a given population. Sampling frame refers to a list of the items where representative samples of a given population are drawn for purpose of a study (Nachmias & Nachmias, 2008). A sampling frame is also defined by Welman, Kruger and Mitchell (2008) as a list of the source material or device from which a sample is drawn. Out of the 119 firms, the study sampled 69 firms with the annual turnover of above 100 million Kenya shillings. In this study, 69 Chief Executive Officers or Operation managers constituted the sampling frame.

3.3.2 Sampling Technique

Sampling is an element of data collection, and is defined by Bryman and Bell (2011) as the fragment or section of the population that is selected for the research process. Various sampling techniques were in use in this study. First, purposive sampling was used to select 69 firms with a turnover of over 100 million Kenya shillings annually. In addition, either the Chief Executive Officers (CEO's) or Operation managers of the 69 sampled firms were selected.

Additionally, Creswell (2014) defines purposive sampling as the technique that statistically select study samples by the way of certain set criteria. The Chief Executive Officers or Operation managers were purposively selected since they were rich sources of data on adoption of IoT technology. Simple random method was applied in selecting the 69 firms with CEOs/operation managers as the main respondents.

3.4 Data Collection Instruments

Two categories of data collection instruments were used in this study; a questionnaire and an interview schedule for the two tiers of managers. Creswell (2014) stated that a questionnaire is an accurate tool for measuring self-sufficiency and existing relationship. A questionnaire allows the collection of data in a quick and efficient manner making it possible for descriptive, correlation and inferential statistical analysis. The questionnaire also allowed the researcher to carry out the quantitative approach effectively with the use of statistics for data interpretation. The questionnaire comprised of open and closed ended questions to help in gathering in-depth information so that the study may acquire a complete and detailed understanding of the issue under research. Each question in the questionnaire was developed to address a specific objective or research question of the study. Questionnaires collected information as per all the independent and dependent variables.

Cooper and Schindler (2014) stated that interviews supplement the questionnaires through inducing in-depth responses from the participants. Both the CEOs and / or Operation managers were interviewed to supplement the questionnaires. This interview schedule was appropriate for this category of participants because they have a diverse knowledge on the area of study. This interview schedule was constructed as per the study objectives.

3.4.1 Data collection Procedures

Before commencing on the actual data collection procedure, the researcher sought for an introductory letter from Strathmore Business School. Data collection involved a face to face encounter with the respondents during the questionnaire distribution period. This method of data collection had the advantage of providing the respondents the opportunity for effective interaction with the researcher and sought clarification where necessary on the questionnaire. The researcher contacted the respondents prior to conducting the interview so as to establish a rapport and a friendly relationship and to prepare them for the exercise. The list of names and contacts in the sample frame facilitated the above process. Permission to carry out the research was also sought from the responsible authority in the premises of targeted firms.

3.4.2 Pilot Study

Welman, Kruger and Mitchell, (2008) outlines the need for conducting a pilot study that range from the need to detect possible flaws in the measurement procedures, checking for ambiguity in instructions or inadequate time limits and identifying lack of clarity or ambiguity in formulated items. In this study, the pilot study was carried out in Kenafric Bakeries. The sampled participants in the pilot study were excluded from the main study.

3.4.3 Descriptive Statistical Results

In addition to estimation of reliability and internal consistency of the items constituting each construct, scale refinement was assessed using item to total correlations analysis, with indicators with an item to total correlation threshold of 0.7 and higher being maintained for further analysis.

3.1.1. Security of Generated Data

The security of generated data scale achieved a Cronbach alpha 0.883 and item to total correlations of 0.612 to 0.793. The security of generated data subscale attained a Cronbach alpha value of 0.768 while the adoption of IoT subscale achieved a Cronbach alpha value of 0.770. The measure of Cronbach's alpha if item deleted for all the items was above 0.7 which means that no item should be deleted as they all meet the test of reliability. The results implies that all items of security of generated data construct were maintained for further analysis as they achieved the required thresholds for reliability as indicated in Table 3.2.

Table 3. 2 Item-total statistics for security of generated data

Security of generated data	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
The organization has faced significant security threats on confidentiality of IoT data.	16.13	8.442	.708	.870
The organization has significant confidentiality on the security of its IoT data.	15.74	8.415	.793	.855
The organization has effective mechanisms for IoT data protection.	15.39	9.056	.612	.885

The organization has enhanced systems for enhancing vulnerability of its IoT data.	15.87	9.523	.737	.869
Before adopting IoT, the organization has effective for data mechanism.	15.45	8.416	.744	.863
The organization often faces threats when updating its IoT applications.	15.50	9.068	.678	.874
The organization has technology that supports updating nodes of its IoT applications.	15.22	8.341	.712	.833
The organization has encryption layers that prevent malicious software installations.	15.81	9.522	.642	.802
The organization IoT applications have a high level of trust and security from customers.	15.40	8.413	.713	.845
The organization has secured IoT applications with necessary alarms and tracking systems.	15.14	9.553	.741	.843

3.1.2. Management of IoT

The management of IoT scale achieved a Cronbach's alpha 0.807 and item to total correlations of 0.771 to 0.838. The management of IoT subscale attained a Cronbach alpha value of 0.873 while the adoption of IoT subscale achieved a Cronbach alpha value of 0.865. The measure of Cronbach's alpha if item deleted for all the items was above 0.7 which means that no item should be deleted as they all meet the test of reliability. The results implies that all items of management of IoT construct were maintained for further analysis as they achieved the required thresholds for reliability as indicated in Table 3.3.

Table 3. 3 Item-total statistics for management of IoT

Management of IoT	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
The organization has deployed its fleet of IoT devices in a fast and simple way.	15.97	17.540	.787	.922
The organization has the capacity to effectively manage its IoT applications.	15.87	17.144	.819	.918
The organization has automated its IoT devices.	15.54	17.322	.752	.921
The organization IoT devices have identifiers to provide identification of other operating devices.	15.63	17.644	.812	.919
The organization has the capacity to track/trace its IoT devices	15.55	18.470	.771	.924
The organization has capability of locating its IoT devices when desired.	15.44	17.441	.753	.913
The organization is able to repair its IoT devices when needed.	15.92	18.345	.792	.922
The organization interconnected IoT devices are easily traceable.	15.34	17.534	.745	.933
The organization has managerial capability to track its IoT applications.	15.79	16.982	.838	.916

3.1.3. Business skills side in IoT

The business skills side in IoT scale achieved a Cronbach's alpha 0.906 and item to total correlations of 0.572 to 0.679. Business skills side in IoT subscale attained a Cronbach alpha value of 0.732 while the adoption of IoT subscale achieved a Cronbach alpha value of 0.706. The measure of Cronbach's alpha if item deleted for all the items was above 0.7 which means that no item should be deleted as they all meet the test of reliability. The results implies that all items of business skills side in

IoT construct were maintained for further analysis as they achieved the required thresholds for reliability as indicated in Table 3.4.

Table 3. 4 Item-total for business skills side in IoT

Modes of payment	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
The IT department is able to match the IoT business demands of the organization.	17.03	7.216	.556	.822
The organization has capacity to source for requisite IT skills of its personnel.	17.11	7.178	.632	.804
The organization develops the newly recruited workforce to enhance their skill levels in IoT devices.	16.95	7.186	.671	.796
The organization workforce has requisite entrepreneurial skills to handle its IoT devices business side.	16.66	8.069	.578	.817
The workforce is committed and loyal to the organization in handling IoT needs.	17.16	7.272	.679	.795
The organization possesses a strategic plan to enable it to understand and conceptualize of its future IoT growth and development.	16.82	7.344	.572	.817
The organization has employed the services of an IoT experienced leader	16.11	7.431	.612	.795
The management has IoT related capabilities to take the organization to the next level of growth.	17.13	7.533	.631	.813

The management possesses visionary and strategic management capabilities to visualize the needs for an IoT adopting.	16.91	7.221	.573	.811
The management has partnered with the intellect to expertly execute the IoT needs and vision in the organization lifetime.	16.73	7.322	.612	.814

3.1.4. Technical perspective of IoT

Technical perspective of IoT scale achieved a Cronbach's alpha 0.850 and item to total correlations of 0.573 to 0.672. Technical perspective of IoT subscale attained a Cronbach alpha value of 0.872. The measure of Cronbach's alpha if item deleted for all the items was above 0.7 which means that no item should be deleted as they all meet the test of reliability. The results implies that all items of technical perspective of IoT construct were maintained for further analysis as they achieved the required thresholds for reliability as indicated in Table 3.5.

Table 3. 5 Item-total for technical perspective of IoT

Technical perspective of IoT	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
The organization has workforce with requisite skills to conceptualize the technical side of IoT.	16.11	8.123	.663	.783
The organization has experienced entrepreneurs with the ability to visualize the need for IoT use.	16.10	7.322	.632	.834
The management has capability to make sound judgments on requisite IoT applications.	16.35	8.621	.651	.732
The organization has the ability to create partnership while working in IoT related undertakings.	17.63	8.002	.578	.833

The organization has IoT developers possessing necessary skills in decision making.	16.22	7.300	.639	.853
The organization has created basic security skills for a secure IoT environment.	16.32	7.344	.672	.783
The organization possesses the highest level of understanding the IoT security requirements.	16.43	7.231	.612	.794
The organization has the services of an experienced system administrator.	17.13	7.513	.631	.781
The organization has the financial capability for integrating IoT applications.	16.33	7.331	.573	.872
The organization has collaborated with stakeholders in integration of IoT applications.	17.42	7.442	.612	.822

Adoption of IoT technology

Adoption of IoT technology scale achieved a Cronbach's alpha 0.894 and item to total correlations of 0.533 to 0.683. The measure of Cronbach's alpha if item deleted for all the items was above 0.7 which means that no item should be deleted as they all meet the test of reliability. The results implies that all items of Adoption of IoT technology construct were maintained for further analysis as they achieved the required thresholds for reliability as indicated in Table 3.6.

Table 3. 6 Item-total for adoption of IoT

Adoption of IoT technology	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
The organization has workforce with requisite skills to conceptualize the technical side of IoT.	16.21	7.331	.662	.781
The organization has experienced entrepreneurs with the ability to visualize the need for IoT use.	16.10	7.322	.631	.822
The management has capability to make sound judgments on requisite IoT applications.	17.15	8.621	.631	.722
The organization has the ability to create partnership while working in IoT related undertakings.	17.63	8.002	.634	.821
The organization has IoT developers possessing necessary skills in decision making.	17.23	7.21	.639	.843
The organization has created basic security skills for a secure IoT environment.	16.32	7.344	.672	.783
The organization possesses the highest level of understanding the IoT security requirements.	16.43	7.231	.612	.722
The organization has the services of an experienced system administrator.	17.13	7.513	.631	.791
The organization has the financial capability for integrating IoT applications.	16.33	7.331	.533	.832
The organization has collaborated with stakeholders in integration of IoT applications.	17.42	7.442	.683	.832

3.5 Validity of Research Instruments

Validity checks are undertaken during questionnaire development with the aim of ensuring that the selected instruments measure what it is supposed to measure. Validity refers to the extent to which a construct measure what it is intended to measure (Hair, Money, Page & Samouel, 2007). Three approaches exist for measuring validity: content validity (also referred to as face validity), construct validity and criterion validity. This study applied the use of content and construct validities.

Content Validity

The foundation of content focuses on the extent to which a construct reflects the specific intended domain of content. Content validity represents the extent the content of the instrument is measured in terms of the statements, questions or indicators of the property being measured (Creswell, 2014). Validity is normally a qualitative measure and may not be quantified by statistical methods. For this study content validity involved discussions with supervisors and other experts at the university during the questionnaire formulation. This ensured that the tool was adequate and representative in terms of items relevant for the content.

Construct Validity

Construct validity constitutes the degree to which a given test measures an intended hypothetical construct. It assesses what is measured by understanding what a construct or scale is in measuring (Hair, Money, Page & Samouel, 2007). Construct validity was maintained through anchoring of the constructs to the theory from which it is derived. The researcher consulted the supervisors and peers to approve the content of the instruments. The experts were required to assess if the validity of the questionnaires. Measuring validity deals with the question of whether a measure can actually provide reality of a concept (Bryman & Bell, 2011). Besides, the use of a 5-point Likert measurement, the questionnaire removed the neutral opinions thereby increasing the measurements' accuracy. In addition, collected data was processed and analyzed by use of SPSS software to explore the independent and dependent variables.

Validity Results

The sample sufficiency index (KMO) by Kaiser-Meyer-Olkin and the Barlett's test of sphericity were the tests used to test for hypothesis validity. Table 3.8 shows the

KMO measure of sampling adequacy results. The KMO measure lies between zero and one. When a value is close to one indicates that each of the measured variables is closely predicting the other variables. Any measure below 0.5 is unsatisfactory. The results present a KMO statistic equal to 0.670, which is greater than 0.5 and it, indicates that 67 percent of the variance is likely to be explained by the variables.

The test for sphericity tests for significant correlations amongst the variables. If the significance value calculated is more than the significance value at 95 percent confidence level, 0.05, the data is not appropriate for factor analysis. For this study, the calculated significance value is $0.000 < 0.05$, hence decision to proceed with regression given results above.

Table 3. 7 Measures of sampling adequacy

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.670
	Approx. Chi-Square	619.636
Bartlett's Test of Sphericity	Df	210
	Sig.	.000

3.5.1 Reliability of Research Instruments

Reliability refers to the dependability or consistency of data as interpreted by the bridge between the construct and the data (Bryman & Bell, 2011). In research, the trustworthiness of the data collected is usually evaluated through analysis of reliability. In this study, data reliability was measured using Cronbach’s alpha method. The coefficient alpha is normally an appropriate measure of variance attributable to subjects and the variance attributable to the interaction between subjects and items. It includes a statistical summary that describes the consistency of a specific sample of respondents across a set of questions or variables that help in estimating the reliability of participant’s responses to the measurements (Helms, Henze, Sass & Mifsud, 2006). Cronbach’s alpha is a general form of the Kuder-Richardson (K-R) 20 formula.

The formula is as follows;

$$KR_{20} = \frac{(K)(S^2 - \sum S^2)}{(S^2)(K-1)}$$

KR_{20} = Reliability coefficient of internal consistency

K = Number of items used to measure concept

S_2 = Variance of all scores

S^2 = Variance of individual items

Bryman and Bell (2011) suggests that Cronbach's alpha should be at least 0.7 to make sure that the measurements are reliable. However, many statisticians believe that it can be acceptable if the Cronbach's alpha is over 0.6 (Shelby, 2011). Besides, statisticians recommend that it is necessary to consider the corrected item-total correlations when using the Cronbach's alpha index. In this study, the corrected item-total correlations, which reflect the correlation of variables or items designated with the total score for all other items, was at the acceptable score of 0.7 or higher.

In this study, reliability was measured by internal consistency tests through the use of Cronbach's alpha statistics. Cronbach alpha measures consistency within the instrument. Cronbach's alpha (α) is a coefficient (a number between 0 and 1) that is used to rate the internal consistency or homogeneity or the correlation of items in a test. It also assesses how well a set of item measures a given behavior or characteristics within the test. The Cronbach's alpha for study variables ranged from 0.702 and 0.933 therefore indicating acceptable reliability score. The overall questionnaire attained reliability Cronbach's score of 0.935 which was high as shown in table 3.8.

Table 3. 8 Reliability test results

Variables / constructs	Cronbach's Alpha	No of Items	Conclusion
Security of generated data	0.833	10	Reliable
Management of IoT devices	0.807	9	Reliable
Business skills side in IoT	0.906	10	Reliable
Technical perspective of IoT	0.850	10	Reliable
Adoption of IoT technology	0.894	14	Reliable
Combined variables of the study	0.858	53	Reliable

3.6 Data Analysis and Presentation

Quantitative and qualitative data was generated in this study. The researcher assessed the collected data in order to make inferences through editing the data to exclude inconsistencies and classifying the resultant results based on similarity and tabulating it to relate to the study variables. Quantitative data was analyzed through descriptive statistics and inferential statistics to enable meaningful distribution of scores or measurement using indices and statistics. Sushil and Verma (2010) stated that descriptive statistics use numerical and graphical methods to create patterns in a data set, to summarizing the information gained in a data set and to present the information in a convenient form.

The descriptive statistical analysis was done through the use of mean, percentages, standard deviation and frequencies. In analyzing qualitative data, qualitative techniques looked into account the feelings, suggestions and opinions of the respondents. Additionally, inferential statistics was used to analyze relationship between the independent and dependent variables, through correlation and regression analysis. Similarly, linear multiple regression analysis was used to explain the extent to which independent variables explained the variation in dependent variable.

3.6.1 Data Presentation

The analyzed data was interpreted and presented in frequency tables, graphs and pie charts. Responses from open ended questions were coded, interpreted and their frequencies determined through cross-tabulation on differences between respondents and the central tendencies of responses to each factor. Cooper and Schindler (2014) define cross-tabulation as a technique for comparing two classification variables using tables with rows and columns that correspond to the level or values of each variable's categories.

3.7 Research Quality

Yin (2017) stated that research quality is determined through four basic steps. They include understanding the application of internal validity, external validity, construct validity, reliability and objectivity. This study attested the internal validity, external validity, construct validity and construct validity through the pilot test and also through application of the advice of the supervisor and other experts from Strathmore Business School. Reliability was tested during the analysis of pilot test with all the variables exhibiting scores of Cronbach Alpha of above 0.7.

Objectivity was assessed through consideration of ethical issues during the data collection and analysis phase of the study. Due to the fact that the study used aspects of qualitative data, issues of credibility, dependability and transferability were also considered. To ensure credibility of the results interview schedules were used to complement the feedback provided by the participants in the questionnaires. Dependability was assessed through the pilot test where the results of the pilot test guided the enhancement of quality of the main data collection process. Finally, confirmability of the result was achieved by comparing the findings of the study with prior study conducted by both the local and international scholars.

3.8 Ethical Considerations

The following ethical considerations was observed before collection of data; research permit, approval from the government, letter of consent for the respondents, confidentiality of data, anonymity, privacy and safety of participants. After the approval of the research proposal, the researcher sought for a research permit from Strathmore Business School. Further, research approval was sought from the National Commission for Science Technology and (NACOSTI). The research permit enabled the researcher to proceed to the field for data collection. The researcher then presented a letter of consent to each participant in the study. In the letter, the researcher informed the research participants about the purpose and procedure of the study so that they understood the nature of the research and any likely impact it would have had on them.

In addition, participants signed consent forms upon acceptance for participation before they engaged in the research. They were further made fully aware of their rights to withdraw from the research without fear of consequence. Furthermore, participants were informed of the fact that their participation is voluntary, and they were coerced to participate in the study. In addition, consent was sought from the managers of each of the firms sampled.

The current study also ensured that the confidentiality of data, anonymity, privacy and safety of participants was observed and maintained. The research participants were assured that the data provided would remain confidential and not disclosed in any manner without their consent. The respondents were duly informed that they had been assigned pseudonyms. In addition, the raw interview data and recordings were kept secure and destroyed six months after submission of the dissertation. Throughout the study the principle of honesty, integrity and confidentiality was maintained. Participants were informed of the purpose of the study as a first step to conform to the principle of voluntary and informed consent.

CHAPTER FOUR: RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

The purpose of the study was to analyze the factors affecting food and beverage firms in the adoption of internet of things technology in Nairobi, Kenya. This chapter presents the data analysis results, interpretation and presentation. The data analysis is presented as per the study variables.

4.2 Response rate

Questionnaires were administered to 49 CEOs and / or operation managers of the food and beverage firms. Out of the total, 69 questionnaires 49 were received as complete. This represented 71% response rate which implied that the data was adequate for the study. The return rate surpassed the threshold of 50% advocated by Bryman and Bell (2011) for this kind of study.

4.3 Demographic Characteristics

This section discusses the results of the general information about the respondents including the gender, education level, position and age of the respondents.

4.3.1 Gender of Respondents

The study was interested in finding out the gender of the respondents. The findings are displayed on figure 4.1. As shown, most respondents were male represented by 96% as opposed to female respondents who were represented by 4%. From the results it is clear that majority of those that responded were male respondents. This implies that there are few CEOs/managers in the food and beverage firms.

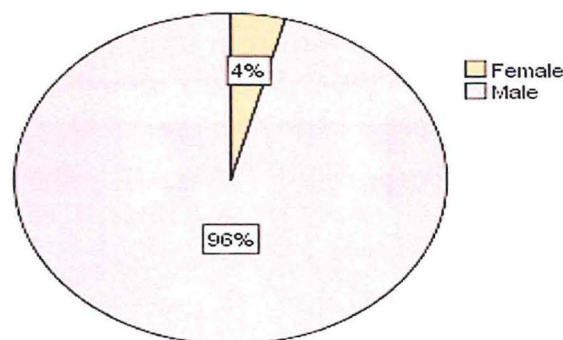


Figure 4. 1 Gender of respondents

4.3.2 Age of the respondents

The study sought to find out the age group of the respondents. The results in figure 4.2 indicates that most of the respondents (51%) were aged between 40 and 49 years, 31% were aged between 30 and 39 years, 8% were aged between 20 and 29 years and 10% were aged 50 years and above.

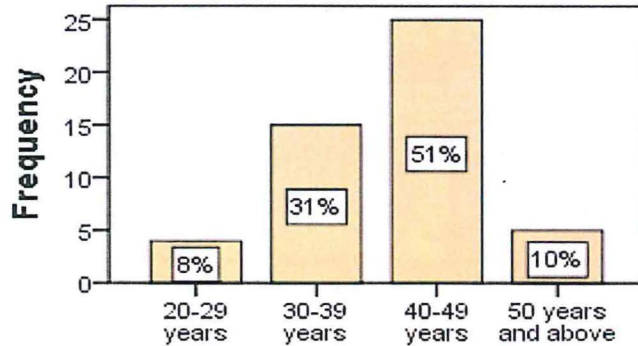


Figure 4. 2 Age of respondents

4.3.3 Education level

The study sought to establish the highest level of education achieved by the respondents, the results in figure 4.3 indicates that most of the respondents 57% had attained degrees, 29% had achieved masters degree and 15% had tertiary qualifications. This shows that the participants had requisite education to conceptualize the idea of adoption of IoT technology in the firms.

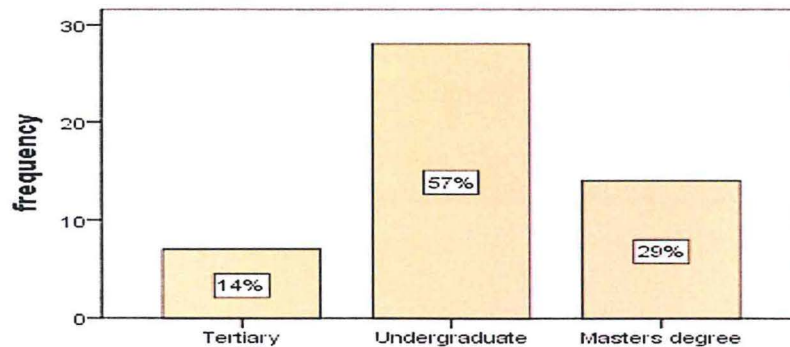


Figure 4. 3 Education level of respondents

4.3.4 Position of the respondents

The study sought to find out the position held by the respondents. The findings displayed on figure 4.4 indicate that most respondents 53% were in middle level management and 47% were in senior management. This implies that the participants were in positions of influencing adoption of IoT technology in the organization.

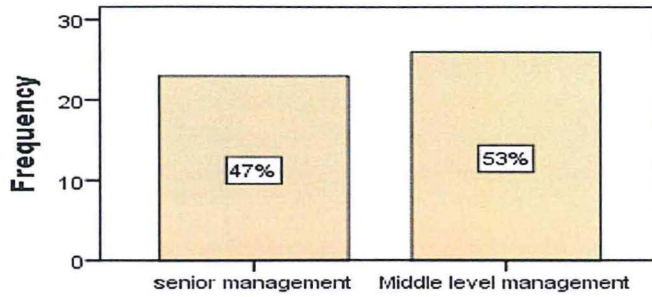


Figure 4. 4 Position of respondents

4.3.5 Length of service

The study sought to establish the length of service of each participant in the organization. The results indicate that majority of the participants 59%, had less than five years of stay. Similarly, 20% had 6-10 years of stay. 8% had 11-15 years and 12% had over 15 years of stay in the organizations. This implies that the respondents had adequate length of stay to understand and even undertake the process of adoption of IoT technology in the firms.

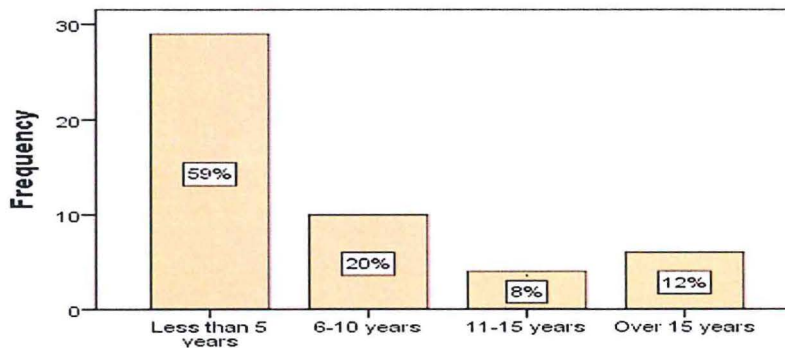


Figure 4. 5 Length of service

4.4 Factors inhibiting the adoption IoT energy devices

The respondents were requested to express their views on the factors inhibiting the adoption IoT energy devices in their organization. The results as shown in table 4.1 indicate that 66.3% of the respondents had the fear of losing their jobs while 62% had the fear of redundancy of the employees. In addition, 53% of the respondents blamed lack of capital to fund new IoT energy efficient projects as a barrier while 51.5% stated that lack of existing IoT cost-effective technologies in the market was a challenge. Similarly, 59% argued that prohibitive costs of adopting IoT devices was a barrier while 58% stated that managerial reluctance to adopt IoT technology was a barrier. Finally, 47% revealed that low level of awareness of the existence of IoT technology was a barrier.

The findings support the sentiments by Brown (2015) that fear of lay offs and redundancy among the workers was an eminent source of fear for management of organizations that leans towards the adoption of IoT technology. The managements always feels that introduction of IoT devices in the work palce will substitute the human input in organizations. The findings also concur with Kariuki (2016) that the factors affecting adoption of IoT include governance issues, policy frameworks, fear of organization security, technical inabilities and inadequate knowhow. Other obstacles include inadequate knowledge by managers on the IoT opportunities and lack of commitment to implement technological changes to their organizations. This means that management of food and beverage manufacturing firms in Kenya should overcome the fears inhibiting their readiness for adoption of IoT devices in order to improve performance in their organizations.

Table 4. 1 Factors inhibiting adoption of IoT

	Yes (%)	No (%)
Lack of capital to fund new IoT energy efficient projects	53.0	47.0
Fear of the management to lose jobs	66.3	33.7
Fear of redundancy of employees	62.0	38.0
Lack of existing IoT related cost-effective technologies	51.5	48.5
Prohibitive costs of adopting IoT energy efficient technologies	59.0	41.0
Managerial reluctance to adopt new IoT technologies	58.0	42.0
Low level of awareness on existing energy efficient devices like IoT	47.0	53.0

4.4.1 Level of efficiency

The respondents were asked to state their views on the level of efficiency in their organizations in the adoption of IoT technology. From the findings in figure 4.5, 61% of the respondents agreed that level of efficiency of their organization in terms of utilization of energy was moderate, 24% responded felt that utilization of energy was efficient , 10% indicated that quite efficient and 4% very efficient. The findings support Onyalo, Kandie and Njuki (2015) who opined that adoption of IoT technology to create efficiency in the utilization of energy in Kenya was at moderate and infancy levels. They added that it is paramount to note that even with the many challenges; there are also myriad opportunities for IoT in Kenya, including sustainability, economic growth and industry applications. Thus managers of food and beverages manufacturing firms should enhance efficiency of their firms in the adoption of IoT technology.

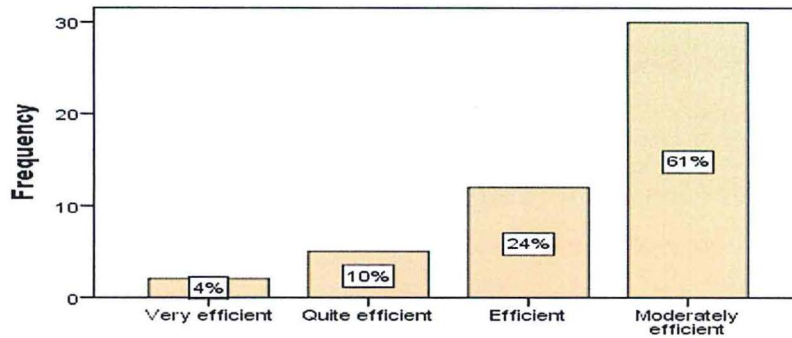


Figure 4. 6 Level of efficiency

4.5 Descriptive Analysis of Study Variables

This section describes the analysis of the study variables. The discussion is based on security of data generated, management of IoT devices, and business skills side in IoT devices, technical side of IoT devices and adoption of IoT technology.

4.5.1 Security of generated data and adoption of IoT Technology

The study sought to examine the respondent's level of agreement concerning security of generated data. The results in table 4.2 indicate that 70.0% of the respondents agreed that the organization had faced significant security threats on confidentiality of IoT data. Similarly, 84.0% agreed that the organization had significant confidentiality on the security of its IoT data. Moreover, 78.0% agreed that the organization had effective mechanisms for IoT data protection while 77.5% agreed that the organization had enhanced systems for enhancing vulnerability of its IoT data.

At the same time, 84.5% of the respondents agreed that the organization had effective data mechanism before adopting IoT. Again, 73.5% agreed that the organization often faced threats when updating its IoT applications while 73.5% agreed that the organization had technology that supports updating nodes of its IoT applications. Further, 75.0% agreed that the organization had encryption layers that prevent malicious software installations while 75.5% agreed that the organization IoT applications had a high level of trust and security from customers and 78.5% agreed that the organization had secured IoT applications with necessary alarms and tracking systems.

Table 4. 2 Security of generated data

Security of generated data	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
The organization has faced significant security threats on confidentiality of IoT data.	22.5	47.5	25.5	3.0	1.5
The organization has significant confidentiality on the security of its IoT data.	31.5	52.5	12.0	3.0	1.0
The organization has effective mechanisms for IoT data protection.	31.0	47.0	12.5	7.0	2.5
The organization has enhanced systems for enhancing vulnerability of its IoT data.	23.0	54.5	18.5	3.0	1.0
Before adopting IoT, the organization has effective for data mechanism.	44.0	40.5	12.0	2.5	1.0
The organization often faces threats when updating its IoT applications.	15.0	58.5	21.5	3.5	1.5
The organization has technology that supports updating nodes of its IoT applications.	25.0	48.5	17.0	7.0	2.5
The organization has encryption layers that prevent malicious software installations.	28.5	46.5	16.0	8.0	1.0
The organization IoT applications have a high level of trust and security from customers.	40.5	35.0	16.0	7.0	1.5
The organization has secured IoT applications with necessary alarms and tracking systems.	35.5	43.0	17.5	3.5	.5

4.5.2 Management of IoT devices and adoption of IoT Technology

The study sought to examine the respondent's level of extent concerning management of IoT devices. The results in table 4.3 indicate that 83.0% of the respondents agreed that the organization had deployed its fleet of IoT devices in a fast and simple way. Similarly, 81.5% of the respondents agreed that the organization had the capacity to effectively manage its IoT applications while 63.5% agreed that the organization had automated its IoT devices. The findings support Kocher (2014) suggestions that organizations have created the capacity to deploy IoT applications in an efficient and parallel manner.

In addition, 74.0% agreed that the organization IoT devices had identifiers to provide identification of other operating devices with 61.0% agreed that the organization had the capacity to track/trace its IoT devices. Further, 79.5% agreed that the organization had capability of locating its IoT devices when desired with 77.0% agreeing that the organization was able to repair its IoT devices when needed. Finally, 82.0 agreed that the organization interconnected IoT devices were easily traceable.

Table 4. 3 Management of IoT

Management of IoT devices	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
The organization has deployed its fleet of IoT devices in a fast and simple way.	40.0	43.0	9.0	6.0	2.0
The organization has the capacity to effectively manage its IoT applications.	26.0	55.5	9.0	8.0	1.5
The organization has automated its IoT devices.	21.0	42.5	24.5	7.5	4.5
The organization IoT devices have identifiers to provide identification of other operating devices.	25.0	49.0	16.0	6.0	4.0
The organization has the capacity to track/trace its IoT devices	16.0	45.0	31.5	7.0	.5
The organization has capability of locating its IoT devices when desired.	30.0	49.5	17.5	2.0	1.0
The organization is able to repair its IoT devices when needed.	25.0	52.0	19.0	3.5	.5
The organization interconnected IoT devices are easily traceable.	29.0	53.0	11.0	5.0	2.0
The organization has managerial capability to track its IoT applications.	10.0	23.5	39.0	20.5	7.0

4.5.3 Business Skills Side in (IoT) and adoption of IoT Technology

The study sought to examine the respondent's level of agreement concerning business skills side of IoT technology. The results in table 4.4 indicate that 76.0% of the respondents agreed that the IT department was able to match the IoT business demands of the organization. Similarly, 68.5% agreed that the organization had capacity to source for requisite IT skills of its personnel while 68.0% also agreed that

the organization developed the newly recruited workforce to enhance their skill levels in IoT devices.

Meanwhile, 54.5% agreed that the organization workforce had requisite entrepreneurial skills to handle its IoT devices business side while 70.5% agreed that the workforce was committed and loyal to the organization in handling IoT needs. In addition, 66.5% of the respondents agreed that the organization possessed a strategic plan to enable it to understand and conceptualize of its future IoT growth and development while 75.5% agreed that the organization had employed the services of an IoT experienced leader.

Moreover, 80.0% agreed that the management had IoT related capabilities to take the organization to the next level of growth with 58.5% agreeing that the management possessed visionary and strategic management capabilities to visualize the needs for an IoT adopting. Finally, 70.0% agreed that the management had partnered with the intellect to expertly execute the IoT needs and vision in the organization lifetime.

Table 4. 4 Business skills side of IoT

Business skills side in (IoT)	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
The IT department is able to match the IoT business demands of the organization.	24.5	51.5	11.5	7.0	5.5
The organization has capacity to source for requisite IT skills of its personnel.	18.5	50.0	20.5	9.0	2.0
The organization develops the newly recruited workforce to enhance their skill levels in IoT devices.	27.5	40.5	23.0	7.0	2.0
The organization workforce has requisite entrepreneurial skills to handle its IoT devices business side.	28.5	26.0	29.5	11.5	4.5
The workforce is committed and loyal to the organization in handling IoT needs.	33.5	37.0	20.5	6.5	2.5
The organization possesses a strategic plan to enable it to understand and conceptualize of its future IoT growth and development.	15.5	51.0	22.0	9.0	2.5
The organization has employed the services of an IoT experienced leader	24.0	51.5	16.5	5.5	2.5
The management has IoT related capabilities to take the organization to the next level of growth.	54.5	25.5	11.0	7.0	2.0
The management possesses visionary and strategic management capabilities to visualize the needs for an IoT adopting.	12.0	46.5	30.5	9.0	2.0
The management has partnered with the intellect to expertly execute the IoT needs and vision in the organization lifetime.	27.5	42.5	18.0	11.5	.5

4.5.4 Technical Perspective of IoT and adoption of IoT Technology

The study sought to examine the respondent's level of extent of agreement concerning technical side of IoT devices. The results in table 4.5 indicate that 65.0% of the respondents agreed that the organization had workforce with requisite skills to conceptualize the technical side of IoT. Additionally, 81.5% agreed that the organization had experienced entrepreneurs with the ability to visualize the need for IoT use while 65.5% agreed that the management had capability to make sound judgments on requisite IoT applications.

Furthermore, 82.0% agreed that the organization had the ability to create partnership while working in IoT related undertakings with 73.0% agreeing that the organization had IoT developers possessing necessary skills in decision making. Further, 77.0% agreed that the organization had created basic security skills for a secure IoT environment while 67.0% agreed that the organization possesses the highest level of understanding the IoT security requirements. Again, 85.0% agreed that the organization had the services of an experienced system administrator while 83.5% agreed that the organization had the financial capability for integrating IoT applications. Finally, 74.0% agreed that the organization had collaborated with stakeholders in integration of IoT applications.

Table 4. 5 Technical perspective of IoT

Technical perspective of IoT	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
The organization has workforce with requisite skills to conceptualize the technical side of IoT.	15.0	50.0	20.0	12.0	3.0
The organization has experienced entrepreneurs with the ability to visualize the need for IoT use.	34.5	47.0	12.0	4.5	2.0
The management has capability to make sound judgments on requisite IoT applications.	21.5	44.0	25.0	7.5	2.0
The organization has the ability to create partnership while working in IoT related undertakings.	36.0	46.0	12.5	2.5	3.0
The organization has IoT developers possessing necessary skills in decision making.	24.5	48.5	20.5	4.0	2.5
The organization has created basic security skills for a secure IoT environment.	23.0	54.0	15.0	4.5	3.5
The organization possesses the highest level of understanding the IoT security requirements.	20.0	47.0	15.0	7.5	10.5
The organization has the services of an experienced system administrator.	40.0	45.0	11.0	3.0	1.0
The organization has the financial capability for integrating IoT applications.	48.5	35.0	12.5	3.0	1.0
The organization has collaborated with stakeholders in integration of IoT applications.	29.0	45.0	12.0	11.5	2.5

4.5.5 Adoption of IoT Technology

The study sought to examine the respondent's agreement concerning adoption of IoT Technology. The results in table 4.6 indicate that 74.5% of the respondents agreed that the organization had adopted the use of IoT devices while 72.0% agreed that adoption of IoT applications had led to efficiency in energy utilization. Again, 70.0% agreed that adoption of IoT applications had led to reduced cost of production with 88.0% also agreeing that adoption of IoT devices had offered fast and accurate way to collect real-time data from manufacturing processes. Meanwhile, 67.5% agreed that adoption of IoT appliances had translated to better decision-making and execution of set plans. While 71.0% agreed that adoption of IoT applications had ushered in efficient monitoring of product's operation and usage.

Further, 74.5% agreed that adoption of IoT devices had enhanced coordination of operations of products and systems while 76.0% agreed that the use IoT connected sensors had provided unprecedented levels of visibility into the factory operations and supply chain flow. Also, 56.5% agreed that the adoption of IoT applications had improved the functions of the organization through connecting customers, suppliers and partners while 64.0% agreed that the adoption of IoT devices has enhanced cyber-security in the organization.

Further, 76.5% agreed that there was a regulatory framework on adoption of IoT technologies in Kenya. Moreover, 55.5% agreed that the government framework to support adoption of IoT devices in food and beverage processing firms. Finally, 64.0% agreed that the adoption of IoT applications had improved the functions of the organization through connecting customers, suppliers and partners and 64.5% agreed that the adoption of IoT devices had enhanced cyber-security in the organization.

Table 4. 6 Adoption of IoT technology

Adoption of IoT technology	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
The organization has adopted the use of IoT devices	18.0	56.5	13.0	9.5	3.0
Adoption of IoT applications has led to efficiency in energy utilization.	28.5	43.5	13.0	9.5	5.5
Adoption of IoT applications has led to reduced cost of production.	28.5	41.5	11.5	11.5	7.0
Adoption of IoT devices has offered fast and accurate way to collect real-time data from manufacturing processes.	50.0	38.0	7.0	4.0	1.0
Adoption of IoT appliances has translated to better decision-making and execution of set plans.	29.5	38.0	18.5	10.0	4.0
Adoption of IoT applications has ushered in efficient monitoring of product's operation and usage.	24.0	47.0	16.0	10.5	2.5
Adoption of IoT devices has enhanced coordination of operations of products and systems.	35.5	39.0	9.5	12.0	4.0
Use IoT connected sensors have provided unprecedented levels of visibility into the factory operations and supply chain flow.	36.0	40.0	7.0	9.5	7.5
Adoption of IoT applications has improved the functions of the organization through connecting customers, suppliers and partners.	24.5	32.0	20.0	14.5	9.0
Adoption of IoT devices has enhanced cyber-security in the organization.	22.5	41.5	19.0	8.0	9.0
There is a regulatory framework on adoption of IoT technologies in Kenya	32.0	44.5	15.5	5.5	2.5
The government framework support adoption of IoT devices in food and beverage processing firms	19.5	36.0	19.5	20.5	4.5
Adoption of IoT applications has improved the functions of the organization through connecting customers, suppliers and partners.	27.5	36.5	20.0	10.0	6.0
Adoption of IoT devices has enhanced cyber-security in the organization.	24.0	40.5	20.0	7.0	8.5

4.6 Inferential analysis for study variables

4.6.1 Reliability analysis

The internal consistency of the items of the variables was assessed using Cronbach's Alpha. The Cronbach's Alpha values for security of generated data, management of IoT devices, business skills side in (IoT), technical perspective of IoT and adoption of IoT technology were 0.833, 0.807, 0.906, 0.850 and 0.894 respectively. The findings complement the threshold established by Bryman and Bell (2011) by suggesting that Cronbach's alpha of at least 0.7 is an indicator that the measurements are reliable. The findings also support Shelby (2011) suggestion that the Cronbach's alpha of over 0.6 is acceptable. In this study, the corrected item-total correlations, which reflect the correlation of variables or items designated with the total score for all other items, was at the acceptable score of 0.7 or higher. This implies that reliability of the study indicators indicated good subscale reliability as indicated in table 4.7.

Table 4. 7 Reliability analysis

Variables	Number of items	Cronbach's Alpha
Security of generated data	10	0.833
Management of IoT devices	9	0.807
Business skills side in IoT	10	0.906
Technical perspective of IoT	10	0.850
Adoption of IoT technology	14	0.894

4.6.2 Correlation analysis

Correlation analysis of the study variables was calculated. The results indicated that security of generated data was found to be positive and significantly related to adoption of IoT technology ($r = 0.692$, $p\text{-value}=0.000<0.05$). Management of IoT devices was found to be positive and significantly related to adoption of IoT technology ($r = 0.694$, $p\text{-value}=0.000<0.05$). Business skills side in (IoT) was found to be positive and significantly related to adoption of IoT technology ($r = 0.707$, $p\text{-value}=0.000<0.05$). Technical perspective of IoT was found to be positive and significantly related to adoption of IoT technology ($r = 0.752$, $p\text{-value}=0.000<0.05$) as indicted in table 4.8. The findings shows that technical perspective of IoT had the highest positive and significant correlation ($r = 0.752$, $p\text{-value}=0.000<0.05$). The findings supports Kelion (2015) who stated that to fully conceptualize the adoption

of IoT in firms, the skills in technical side of IoT is necessary to mid-wife the process of change management in the organization through the implementation and development of the necessities of IoT for articulating the related activities effectively and efficiently. This implies that CEOs and managers of food and drink manufacturing firms in Nairobi, Kenya must have the requisite technical side of IoT in order to effectively guide the process of adoption of IoT devices in their firms.

Business skills side in (IoT) had the second highest positive and significantly correlation related to adoption of IoT technology ($r = 0.707$, $p\text{-value}=0.000<0.05$). The findings agreed with the sentiment by Hickey (2017) that ability of the management to possess the requisite entrepreneurial skills enables the employees to be more committed and loyal to the firm and in the process transforming it to adopt new technologies like IoT. This implies that the CEOs/managers of food and drink manufacturing firms should possess requisite business and entrepreneurial skills to effectively steer the organization to adopt IoT devices.

Table 4. 8 Correlation analysis

		Adoption of IOT	Security	Management	Business Skills	Technical Perspective
Adoption of IOT	Pearson Correlation	1	.692**	.694**	.707**	.752**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	49	49	49	49	49
Security	Pearson Correlation	.692**	1	.448**	.473**	.433**
	Sig. (2-tailed)	.000		.001	.001	.003
	N	49	49	49	49	49
Management	Pearson Correlation	.694**	.448**	1	.423**	.407**
	Sig. (2-tailed)	.000	.001		.002	.004
	N	49	49	49	49	49
Business Skills	Pearson Correlation	.707**	.473**	.423**	1	.417**
	Sig. (2-tailed)	.000	.001	.002		.003
	N	49	49	49	49	49
Technical Perspective	Pearson Correlation	.752**	.433**	.407**	.417**	1
	Sig. (2-tailed)	.000	.003	.004	.003	
	N	49	49	49	49	49

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

4.6.3 Normality test

Normality of response variable allows the application of statistical analyses such as ordinary least squares (OLS) estimation methods in this case multiple regression analysis. In this study, the normality is tested using skewness and kurtosis. All of these values of skewness and kurtosis indices for all the variables (adoption of IoT, security, management, business skills and technical perspective) did not exceed the absolute values of 1 and, therefore, the data set was considered to follow normal distribution and consequently the relationship would be tested using multiple linear regressions. The results are presented in Table 4.9.

Table 4. 9 Normality test

Constructs	N	Skewness		Kurtosis	
		Statistic	Std. Error	Statistic	Std. Error
Adoption of IOT	49	-.491	.172	-.240	.342
Security	49	-1.488	.172	2.949	.342
Management	49	.206	.172	1.935	.342
Business Skills	49	.048	.172	.260	.342
Technical Perspective	49	-.603	.172	.583	.342

4.6.4 Regression Analysis

Regression analysis was conducted to test the relationship between the independent (security, management, business skills and technical perspective) and dependent variables (adoption of IoT). The R square value in this case is 0.737 which clearly suggests that there is a strong relationship between and adoption of IOT as indicated technical perspective, management, business skills, security in table 4.10. This indicates that and adoption of IOT as indicated technical perspective, management, business skills, security share a variation of 73.7 % of adoption of IOT. The implication is that the independent variable explains a big percentage of the variation in the adoption of IoT in food and drink manufacturing firms in Nairobi, Kenya.

Table 4. 10 Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.859 ^a	.737	.732	.21665

a. Predictors: (Constant), Technical Perspective, Management, Business Skills, Security

4.6.5 Regression Analysis of Variance (ANOVA)

Regression ANOVA is a statistical measure for assisting in understanding the level and extent of variability of the regression model. Its findings are usually a basis for testing significance. A regression ANOVA test was conducted to test the goodness of fit of the data for the overall regression model. It also tested the level of variation of directive leadership. The ANOVA in table 4.11 indicates that the overall model was a good fit since (F-value=30.857 and p-value=0.000<0.05).

Table 4. 11 ANOVA^a

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25.676	4	6.419	30.857	.000 ^b
	Residual	9.153	44	.208		
	Total	34.829	48			

a. Dependent Variable: Adoption of IOT

b. Predictors: (Constant), Technical Perspective, Management, Business Skills, Security

4.6.6 Regression Coefficients

Regression coefficient refers to the slope as indicated by the linear relationship between the independent and the dependent variables. For regression coefficients (Table 4.12), the study found security influence coefficient value of $\beta = .215$, t (3.664), $p < .05$; management $\beta = .220$, t (5.294), $p < .05$; business skills $\beta = .215$, t (3.664), $p < .05$ and technical perspective $\beta = .238$, t (3.269), $p < .05$ which are all less than the critical p-value of 0.05. This implies that there is a positive and significant relationship between influence of security, management, business skills and technical perspective) and dependent variables (adoption of IoT).

Table 4. 12 Regression coefficient

Model		Unstandardized Coefficients		Standardized T Coefficients	Sig.
		B	Std. Error	Beta	
1	(Constant)	.116	.032		3.664 .001
	Security	.215	.040	.290	5.374 .000
	Management	.220	.042	.267	5.294 .000
	Business Skills	.277	.051	.276	5.432 .000
	Technical	.238	.073	.207	3.269 .002
	Perspective				

a. Dependent Variable: Adoption of IoT

4.7 Optimal Model

The model becomes as indicated in table 4.13.

$$\text{Adoption} = 0,116 + 0,215_{SD} + 0,220_{SM} + 0,277_{BS} + 0,238_{TP} + \varepsilon$$

Security of generated data was found to have a positive linearly significant influence on adoption of IoT technology. ($\beta=0.215$, T-value=5.374, $p=0.000<0.05$). Here one unit change in security of generated data results in 0.215 unit increase adoption of IoT technology. Management of IoT devices was found to have a positive linearly significant influence on adoption of IoT technology. ($\beta=0.220$, T-value=5.294, $p=0.000<0.05$). Here one unit change in management of IoT devices results in 0.220 unit increase adoption of IoT technology.

Business skills side in (IoT) was found to have a positive linearly significant influence on adoption of IoT technology. ($\beta=0.227$, T-value=5.432, $p=0.000<0.05$). Here one unit change in business skills side in (IoT) results in 0.227 unit increase adoption of IoT technology. Technical perspective of IoT was found to have a positive linearly significant influence on adoption of IoT technology. ($\beta=0.238$, T-value=3.269, $p=0.000<0.05$). Here one unit change in technical perspective of IoT results in 0.238 unit increase adoption of IoT technology.

The beta coefficients indicate the relative importance of each independent variable (technical perspective, management, business skills, security in influencing the dependent variable (adoption of IoT technology). Security of generated data is the most important in influencing adoption of IoT technology ($\beta=0.290$) followed by business skills side in (IoT) ($\beta=0.276$), then management of IoT devices ($\beta=0.267$), the least is technical perspective of IoT ($\beta=0.207$).

CHAPTER FIVE SUMMARY AND DISCUSSION

5.1 Introduction

This chapter presents the summary, discussion, conclusion as well as the recommendations of the findings of the study. The discussions and conclusions made are based on the specific objectives of the study. The recommendations provided are based on areas that require further improvements in terms of need for further research.

5.2 Summary of the Study

The purpose of the study is to analyze the factors affecting food and beverage processing firms in the adoption of internet of things technology in Nairobi, Kenya. The study was guided by four specific objectives: to determine the effect of security of generated data on the adoption of IoT technology in food and beverage processing firms in Kenya; to investigate the effect of management of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya; to establish the effect of business skills side in IoT on the adoption of IoT technology in food and beverage processing firms in Kenya; and to determine the effect of technical perspective of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya in Kenya. Two theories anchor the study; Energy Efficiency theory and Technology Acceptance model.

This study adopted a descriptive research design since the research was both quantitative and qualitative in its approach and in the process generating quantitative and qualitative data. The design was appropriate because it examined and quantified the hypothesized relationship between independent variables; factors affecting manufacturing firms and the dependent variable; adoption of IoT Technology for efficient energy utilization. The population in this study was manufacturing firms in Kenya specializing in food and beverage processing. The target population constituted of 119 food and beverage manufacturing firms in Nairobi, Kenya. The study sampled 69 firms with the annual turnover of above 100 million Kenya shillings. Either the CEOs/Operation managers of the targeted firms were the main participants. The CEOs/managers were targeted since they possessed the requisite knowledge and experience on the issues related to IoT adoption that affect these organizations. They are also in charge of the day to day operations in these organizations and as such are well equipped with the information on IoT adoption.

Various sampling techniques were in use in this study. First, purposive sampling was used to select 69 firms with a turnover of over 100 million Kenya shillings annually. In addition, either the Chief Executive Officers (CEO's) or Operation managers of the 69 sampled firms were selected. Simple random method was applied in selecting the 69 CEOs/operation managers as the main respondents. The pilot study was carried out in Kenafic Bakeries. The sampled participants in the pilot study were excluded from the main study. Out of the total, 69 questionnaires, 49 were received as complete. This represented 71% response rate which implied that the data was adequate for the study.

Data analysis involved the generation of quantitative and qualitative data. Quantitative data was analyzed through descriptive statistics and inferential statistics. The descriptive statistical analysis was done through the use of percentages and frequencies. Similarly, linear multiple regression analysis was used to explain the extent to which independent variables explained the variation in dependent variable. The analyzed data was interpreted and presented in frequency tables, graphs and pie charts. Responses from open ended questions were coded, interpreted and their frequencies determined through cross-tabulation on differences between respondents and the central tendencies of responses to each factor.

5.3 Discussions of Findings

In this section, discussion of the findings is undertaken. The study aimed at analyzing the factors affecting food and beverage processing firms in the adoption of internet of things technology in Nairobi, Kenya. The study was guided by four specific objectives: to determine the effect of security of generated data on the adoption of IoT technology in food and beverage processing firms in Kenya; to investigate the effect of management of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya; to establish the effect of business skills side in IoT on the adoption of IoT technology in food and beverage processing firms in Kenya; and to determine the effect of technical perspective of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya in Kenya.

5.3.1 Effect of Security of Generated Data and Adoption of IoT Technology

The study sought to determine the effect of security of generated data on the adoption of IoT technology in food and beverage processing firms in Kenya. The results show that 84.5% of the respondents agreed that the organization had effective data mechanism before adopting IoT. Again, 73.5% agreed that the organization often faced threats when updating its IoT applications while 73.5% agreed that the organization had technology that supports updating nodes of its IoT applications.

The results also indicated that 70.0% of the respondents agreed that the organization had faced significant security threats on confidentiality of IoT data. Similarly, 84.0% agreed that the organization had significant confidentiality on the security of its IoT data. Further, 75.0% agreed that the organization had encryption layers that prevent malicious software installations while 75.5% agreed that the organization IoT applications had a high level of trust and security from customers and 78.5% agreed that the organization had secured IoT applications with necessary alarms and tracking systems.

These findings support Brown (2015) and Mayer (2009) suggestions that security in adoption and use of IoT applications is paramount while convincing users to participate in the adoption of IoT technology. This means that managers of food and beverage manufacturing firms in Kenya should prioritize the security of the data and overall security of their organization while adopting the IoT technology. The findings further complements the recommendation by Mayer (2009) that security is an important requirement for machines that compute data from sensor networks, offer shared storage to different customers, and implement appropriate security policies. This implies that the CEOs/managers of food and beverage manufacturing firms in Kenya should effectively ensure security of data in the process of adoption of IoT applications in their firms.

The findings agreed with Kelion (2015) that as the IoT connects more devices together, it provides more decentralized entry points for malware. Less expensive devices that are in physically compromised locales are more subject to tampering. More layers of software, integration may create more complexity and new security risks. This means that CEOs and managers of food and beverage manufacturing

firms should guard at all cost the security of the organization and data during the entire process of adoption of IoT technology.

Findings on the reliability analysis of security of generated data revealed that the Cronbach's Alpha value was 0.833. The findings support Shelby (2011) suggestion that the Cronbach's alpha of over 0.6 is acceptable. Correlation analysis of security of generated data was found to be positive and significantly related to adoption of IoT technology ($r = 0.692$, $p\text{-value}=0.000<0.05$). Regression coefficient revealed that security had a coefficient value of $\beta = .215$, $t (3.664)$, $p<.05$.

This implies that there is a positive and significant relationship between influence of security of generated data and adoption of IoT. The implication is that one unit change in security of generated data results in 22% unit increase in adoption of IoT technology. This shows that security of generated data has a major contribution in the effectiveness of adoption of IoT technology in food and beverage manufacturing firms in Kenya.

5.3.2 Effect of Management of IoT devices and Adoption of IoT Technology

The study attempted to investigate the effect of management of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya. The results reflected that 83.0% of the respondents agreed that the organization had deployed its fleet of IoT devices in a fast and simple way. Similarly, 81.5% of the respondents agreed that the organization had the capacity to effectively manage its IoT applications while 63.5% agreed that the organization had automated its IoT devices. In addition, 74.0% agreed that the organization IoT devices had identifiers to provide identification of other operating devices with 61.0% agreed that the organization had the capacity to track/trace its IoT devices.

The findings support Kocher (2014) suggestions that organizations have created the capacity to deploy IoT applications in an efficient and parallel manner. The findings also complement Hickey (2017) sentiments that manageability is an additional important requirement in the adoption of IoT technology. This implies that managers of food and beverage manufacturing firms should possess the capacity to manage and efficiently deploy the adoption of IoT technology efficiently. The findings support Ramachandran (2015) who opined that large number of IoT devices requires a high level of automation in networks as well as for applications.

From the findings on the reliability analysis of management of IoT devices revealed that the Cronbach's Alpha value was 0.807. The findings support Bryman and Bell (2011) that Cronbach's alpha of at least 0.7 is an indicator that the measurements are reliable. Correlation analysis of management of IoT devices was found to be positive and significantly related to adoption of IoT technology ($r = 0.694$, $p\text{-value}=0.000<0.05$).

Regression coefficient revealed that management of IoT devices had a coefficient value of $\beta = 0.220$, $t (5.294)$, $p<.05$. This implies that there is a positive and significant relationship between influence of management of IoT devices and adoption of IoT. The implication is that one unit change in management of IoT devices results in 22% unit increase in adoption of IoT technology. This again shows that management of IoT devices by the management has a significant effect on the adoption of IoT technology in food and beverage manufacturing firms in Kenya.

5.3.3 Effect of Business Skills Side in IoT and Adoption of IoT Technology

The study aimed at establishing the effect of business skills side in IoT on the adoption of IoT technology in food and beverage processing firms in Kenya. The results showed that 76.0% of the respondents agreed that the IT department was able to match the IoT business demands of the organization. Similarly, 68.5% agreed that the organization had capacity to source for requisite IT skills of its personnel while 68.0% also agreed that the organization developed the newly recruited workforce to enhance their skill levels in IoT devices.

Meanwhile, 70.5% agreed that the workforce was committed and loyal to the organization in handling IoT needs. In addition, 66.5% of the respondents agreed that the organization possessed a strategic plan to enable it to understand and conceptualize of its future IoT growth and development while 75.5% agreed that the organization had employed the services of an IoT experienced leader. The findings support Pahl (2015) statement that organization adopting IoT technology should focus on the business demand of the use of the new technology. This is through the ability of the management to source for the needed skills either within or outside the organization through recruitment or partnerships. Development of the newly recruited workforce is also very crucial to enhance the skill levels. This implies that for the food and beverage manufacturing firms in Kenya, effective management of

the business skills of the employees in the firm is important. The intention is for the employees to effectively mid-wife the process of adoption of IoT technology.

The findings also support Hickey (2017) statement that the ability to possess the requisite entrepreneurial skills enable the workers to be more committed and loyal to the business and in the process transforming the business to have an impact in both the local and global levels. For a business to scale the heights of consistent levels of competition, it must possess a strategic plan to enable it to understand and conceptualize of its future growth and development.

The findings also show that reliability analysis of business skills side in IoT had the highest Cronbach's Alpha value of 0.906. The findings support Bryman and Bell (2011) that Cronbach's alpha of at least 0.7 is an indicator that the measurements are reliable. Correlation analysis of business skills side in IoT was found to be positive and significantly related to adoption of IoT technology ($r = 0.707$, $p\text{-value}=0.000<0.05$). Regression coefficient revealed that business skills side in IoT had a coefficient value of $\beta = 0.215$, $t (3.664)$, $p < .05$.

This implies that there is a positive and significant relationship between influence of business skills side in IoT and adoption of IoT. The implication is that one unit change in business skills side in IoT results in 22% unit increase in adoption of IoT technology. This is an indicator that possession of entrepreneurial and other business skills by management has a significant effect on enhancing the adoption of IoT technology in food and beverage manufacturing firms in Kenya.

5.3.4 Effect of Technical Perspective of IoT Devices on the Adoption of IoT Technology

The purpose of the study was to determine the effect of technical perspective of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya in Kenya. The results indicated that 81.5% agreed that the organization had experienced entrepreneurs with the ability to visualize the need for IoT use while 82.0% agreed that the organization had the ability to create partnership while working in IoT related undertakings with 73.0% agreeing that the organization had IoT developers possessing necessary skills in decision making. Further, 77.0% agreed that the organization had created basic security skills for a secure IoT environment while 85.0% agreed that the organization had the services of an

experienced system administrator. Finally, 83.5% agreed that the organization had the financial capability for integrating IoT applications while 74.0% agreed that the organization had collaborated with stakeholders in integration of IoT applications.

The findings support Kelion (2015) that conceptualization of the technical side of IoT requires requisite skills are necessary to mid-wife the process of change management in the organization through the implementation, development of the necessities for articulating the related activities effectively and efficiently. These findings also support ITU (2012) sentiments that for organizations to effectively integrate third party components, skills and requisite ability to work are paramount for users especially the ability to create partnership while working in the process of adopting IoT related devices. IoT developers possessing necessary skills should be brought on board in decision making.

Thus the management of food and beverages manufacturing firms in Kenya should have the ability and understanding to effectively and efficiently participate in all the business undertakings with different IoT applications. The findings finally support Kelion (2015) that since the implementation of IoT in the organization is very costly; organization with the mindset of integrating IoT requires adequate finances resources. This implies that management of food and beverage manufacturing firms in Kenya should set aside adequate resources for financing the process of adoption of IoT technology.

From the findings on the reliability analysis of technical perspective of IoT revealed that the Cronbach's Alpha value was 0.850. The findings support Bryman and Bell (2011) that Cronbach's alpha of at least 0.7 is an indicator that the measurements are reliable. The findings shows that technical perspective of IoT had the highest positive and significant correlation ($r = 0.752$, $p\text{-value}=0.000<0.05$). Regression coefficient revealed that technical perspective of IoT had a coefficient value of $\beta = 0.238$, $t(3.269)$, $p<.05$. This implies that there is a positive and significant relationship between influence of technical perspective of IoT and adoption of IoT. The implication is that one unit change in technical perspective of IoT results in 24% unit increase in adoption of IoT technology. This again shows that technical perspective of IoT by the management has a significant effect on the adoption of IoT technology in food and beverage manufacturing firms in Kenya.

5.3.5 Adoption of IoT Devices

The study sought to examine the respondent's agreement concerning adoption of IoT Technology. The respondents were requested to express their views on the factors inhibiting the adoption IoT energy devices in their organization. The results show that 66.3% of the respondents had the fear of losing their jobs while 62% had the fear of redundancy of the employees. Similarly, 59% argued that prohibitive costs of adopting IoT devices was a barrier while 58% stated that managerial reluctance to adopt IoT technology was a barrier. Finally, 47% revealed that low level of awareness of the existence of IoT technology was a barrier. The findings support the sentiments by Brown (2015) that fear of lay offs and redundancy among the workers was an eminent source of fear for management of organizations that leans towards the adoption of IoT technology. The findings also concur with Kariuki (2016) that the factors affecting adoption of IoT include governance issues, inadequate knowledge by managers on the IoT opportunities and lack of commitment to implement technological changes to their organizations.

The results also indicated that 74.5% of the respondents agreed that the organization had adopted the use of IoT devices while 72.0% agreed that adoption of IoT applications had led to efficiency in energy utilization. Again, 70.0% agreed that adoption of IoT applications had led to reduced cost of production with 88.0% also agreeing that adoption of IoT devices had offered fast and accurate way to collect real-time data from manufacturing processes. Meanwhile, 71.0% agreed that adoption of IoT applications had ushered in efficient monitoring of product's operation and usage. Further, 74.5% agreed that adoption of IoT devices had enhanced coordination of operations of products and systems while 76.0% agreed that the use IoT connected sensors had provided unprecedented levels of visibility into the factory operations and supply chain flow.

The findings correlate with Shrouf, Ordieres and Miragliotta (2014) argument that development and adoption of the Internet of Things (IoT) is a critical element of smarter manufacturing organizations globally. The findings are in line with Ghashghaee (2016) stated that adoption of IoT in manufacturing firms improve business by connecting people to the right information, over the right device at the point of need and cross company boundaries to include suppliers, maintenance

partners, and distribution chains. This implies that Kenya manufacturers in the food and beverage sector may also use the new mobile-ready software from IoT devices to have access to data such as equipment efficiency, line efficiency, data visualization tools and alerts from any location at much lower costs than previous custom systems. This will create efficiency in the manufacturing processes of these firms.

These findings supports Zhang et al. (2015) who suggested that adoption of IoT devices offers a fast and accurate way to collect real-time data from manufacturing processes. Therefore employing IoT devices in the production planning and control has significant benefits. For maximum optimization, there should be a consistent dual-way connection between decision-making level and execution level. This means that adoption of IoT technologies will enable the food and beverage manufacturing firms to efficiently coordinate the operation of the firms.

The findings further showed that the Cronbach's Alpha values for adoption of IoT technology was 0.894. The findings complement the threshold established by Bryman and Bell (2011) that Cronbach's alpha of at least 0.7 is an indicator that the measurements are reliable. From the regression analysis, the R square value in this case was 0.737 which clearly suggests that there is a strong relationship between and adoption of IOT as indicated through technical perspective, management, business skills, security of generated data. This indicates that adoption of IOT as indicated technical perspective; management, business skills, security share a variation of 73.7 % of adoption of IOT. The implication is that the independent variable explains a big percentage of the variation in the adoption of IoT in food and drink manufacturing firms in Nairobi, Kenya.

Regression ANOVA test for was conducted to show the goodness of fit of the data for the overall regression model. It also tested the level of variation of directive leadership. The ANOVA results for the overall model was a good fit since (F-value=30.857 and p-value=0.000<0.05). For the optimal model, the beta coefficients indicated the relative importance of each independent variable (technical perspective, management, business skills, security) in influencing the dependent variable (adoption of IoT technology). Security of generated data is the most important in influencing adoption of IoT technology ($\beta=0.290$) followed by business skills side

in (IoT) ($\beta=0.276$), then management of IoT devices ($\beta=0.267$), the least is technical perspective of IoT ($\beta=0.207$).

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study sought to analyze the factors affecting food and beverage processing firms in the adoption of internet of things technology in Nairobi, Kenya. This section provides conclusions based on the effects of security of generated data, management of IoT devices, business skills side in IoT and technical perspective of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya in Kenya.

6.1.1 Effect of Security of Generated Data and Adoption of IoT Technology

The study determined the effect of security of generated data on the adoption of IoT technology in food and beverage processing firms in Kenya. Regression coefficient revealed that security had a coefficient value of $\beta = .215$, $t (3.664)$, $p < .05$. This implies that there is a positive and significant relationship between influence of security and security of generated data and adoption of IoT. The study concludes that there exist significant effect of security of generated data on the adoption of IoT technology in food and beverage processing firms in Kenya.

6.1.2 Effect of Management of IoT devices and Adoption of IoT Technology

The study investigated the effect of management of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya. Regression coefficient revealed that management of IoT devices had a coefficient value of $\beta = 0.220$, $t (5.294)$, $p < .05$. This implies that there is a positive and significant relationship between influence of management of IoT devices and adoption of IoT. The conclusion is that management of IoT devices has a significant effect on the adoption of IoT technology in food and beverage manufacturing firms in Kenya.

6.1.3 Effect of Business Skills Side in IoT and Adoption of IoT Technology

The study established the effect of business skills side in IoT on the adoption of IoT technology in food and beverage processing firms in Kenya. Regression coefficient revealed that business skills side in IoT had a coefficient value of $\beta = 0.215$, $t (3.664)$, $p < .05$. This implies that there is a positive and significant relationship between influence of business skills side in IoT and adoption of IoT. The conclusion is that business skills side in IoT has a significant effect on enhancing the adoption of IoT technology in food and beverage manufacturing firms in Kenya.

6.1.4 Effect of Technical Perspective of IoT Devices on the Adoption of IoT Technology

The study determined the effect of technical perspective of IoT devices on the adoption of IoT technology in food and beverage processing firms in Kenya in Kenya. Regression coefficient revealed that technical perspective of IoT had a coefficient value of $\beta = 0.238$, $t (3.269)$, $p < .05$. This implies that there is a positive and significant relationship between influence of technical perspective of IoT and adoption of IoT. The study concludes that technical perspective of IoT has a significant effect on the adoption of IoT technology in food and beverage manufacturing firms in Kenya.

6.2 Recommendations

In this section, the recommendations based on the findings and conclusions are made. The recommendations are in two parts. They include recommendations for improvements and suggestions for further research.

6.2.1 Effect of Security of Generated Data and Adoption of IoT Technology

The study established that there exist significant effect of security of generated data on the adoption of IoT technology in food and beverage processing firms in Kenya. The study recommends that managers of food and beverage manufacturing firms in Kenya should prioritize the security of the data and overall security of their organization in the process of adoption of IoT applications in their firms.

6.2.2 Effect of Management of IoT devices and Adoption of IoT Technology

The study found that there is a positive and significant relationship between influence of management of IoT technology in food and beverage manufacturing firms in Kenya. The study recommends that management of food and beverage manufacturing firms should possess requisite techniques to enable the employees to create networks for the deployment of IoT applications automatically.

6.2.3 Effect of Business Skills Side in IoT and Adoption of IoT Technology

The study established the there is a positive and significant relationship between influence of business skills side in IoT and adoption of IoT technology in food and beverage manufacturing firms in Kenya. The study recommends that management of food and beverage manufacturing firms in Kenya should equip the employees with necessary entrepreneurial and business skills to effectively implement IoT

technology. Awareness should be created on managers to embrace and not fear adoption of IoT.

6.2.4 Effect of Technical Perspective of IoT Devices on the Adoption of IoT Technology

The study established that technical perspective of IoT has a significant effect on the adoption of IoT technology in food and beverage manufacturing firms in Kenya. The recommendation is that management of food and manufacturing firms in Kenya should possess adequate skills in the adoption process of IoT. This is in order to effectively visualize the need for use of fast data, the need for the scalability necessary to understand that it is vital for users possess the capability to make sound judgments on the adoption process.

6.3 Area for Further Research

The limitation of this study was that it focused on the food and beverage manufacturing firms in Nairobi, Kenya. Therefore:

1. A comparative study should be undertaken in other firms such as processing, telecommunication and financial firms to establish the factors affecting them in the adoption of internet of things technology.

REFERENCES

- Agrawal, S. A. (1999). A longitudinal investigation of personal computers in homes: adoption determinants and emerging challenges. *MIS quarterly*, 71-102.
- Ahmar, A., & Rahman, A. (2017). Development of teaching material using an Android. New York, USA: The Irwin/McGraw-Hill Series.
- Ahmar, M. (2017). Optimize renewable energy via Internet of Things (IoT) & Big Data.
- Asamoah, M. K., & Mackin, E. E. (2016). PhD year 1 students' experience with the Educational Technology and Innovation Course. *Africa Education Review*, 13(2), 31-47. doi:10.1080/18146627.2016.1224094
- Atikiya, R. (2015). *Effect of Competitive Strategies on the performance of Manufacturing Firms in Kenya* (Doctoral dissertation, JKUAT).
- Author index. (2016). *2016 IEEE 3rd World Forum on Internet of Things (WF-IoT)*. doi:10.1109/wf-iot.2016.7845519
- Babiceanu, R. F., & Seker, R. (2016). Big Data and virtualization for manufacturing cyber-physical systems: A survey of the current status and future outlook. *Computers in Industry*, 81, 128-137.
- Baumers, M. Tuck, C., Hague, R., Wildman, R. Ashcroft, I, (2010). A comparative study of metallic additive manufacturing power consumption. Proceedings of the Solid Freedom Fabrication Symposium, 2010, AUSTIN, USA.
- Bell, E., & Bryman, A. (2007). The Ethics of Management Research: An Exploratory Content Analysis. *British Journal of Management*, 18(1), 63-77. doi:10.1111/j.1467-8551.2006.00487.x
- Birol, F. (2010). World energy outlook 2010. *International Energy Agency*, 1(3).
- Bohli, J. M., Skarmeta, A., Moreno, M. V., García, D., & Langendörfer, P. (2015). SMARTIE project: Secure IoT data management for smart cities. In *2015 International Conference on Recent Advances in Internet of Things (RIoT)* (pp. 1-6). IEEE.
- Bradley, J., Barbier, J., & Handler, D. (2013). *Embracing the Internet of Everything*. San Jose, USA: Cisco Inc.
- Bradley, E. (2011). Business Models for the Internet of Things. *Architecting the Internet of Things*, 253-277. doi:10.1007/978-3-642-19157-2_10
- Brown, C. (2015). Price and Time. *Breakthroughs in Technical Analysis*, 83-113. doi:10.1002/9781119204749.ch5
- Bryman, A., & Bell, E. (2011). *Business Research Methods*, Third edition, Oxford University Press.
- Chakavarti, K.K. (2012). Promoting End – use Energy efficiency in India (Case Study).

- Chartered Institute of Management (CIMA), (2010). The expectation-performance gap in accounting education: An exploratory study. *Accounting Education: An International Journal*, 19(1-2), 23-50.
- CIMA, (2013). *Secure decentralized internet of things infrastructure*, Universidade de Aveiro.
- Cooper, D.R. & Schindler, P.S. (2016). *Business Research Methods (9th Ed.)*. New York, USA: The Irwin/McGraw-Hill Series.
- Creswell, J. W. (2014). *Research Design qualitative, quantitative and mixed approaches*. London: SAGE.
- Crosbie .T, & Keith, B. (2010). *Energy Efficiency Interventions in housing: Learning from the inhabitants: - Research paper*; Building Research & Information, 38(1), 70-79(UK).
- Crosbie, S., & Baker, J. (2013). Energy consumption behaviour: rational or habitual? *The Planning Review*, 50(3), 11-19.
- CSIRO, & Griffith, S. (2007). Internet of Things (IoT) and Dairy Farm Automation.
- Davis, S. M. (1989). From “future perfect”: Mass customizing. *Planning review*, 17(2), 16-21.
- De Cremer, D., Nguyen, B., & Simkin, L. (2017). The integrity challenge of the Internet-of-Things (IoT): on understanding its dark side. *Journal of Marketing Management*, 33(1-2), 145-158.
- Decanio (1993): Scenarios for a clean energy future: US Dept of Energy Inter laboratory working Group on Energy – Efficient and Clean Energy Technologies.
- Energy Regulatory Commission, (2013). Regulatory and Competition–Related Reforms in Kenya’s Power and Petroleum Sectors.
- Energy Regulatory Commission, (2015). *Pro-poor access to green electricity in Kenya* (No. IDS Evidence Report; 135). IDS.
- Evans, D. (2011). *The Internet of Things: How the Next Evolution of the Internet is Changing Everything*. San Jose, USA: Cisco Internet Business Solutions Group.
- Fernando, Y., Bee, P. S., Jabbour, C. J. C., & Thomé, A. M. T. (2018). Understanding the effects of IoT energy management practices on energy supply chains: Implications for energy policy in emerging economies. *Energy Policy*, 118, 418-428.
- Fishbein, M., & Ajzen, I. (1981). On construct validity: A critique of Miniard and Cohen's paper. *Journal of Experimental Social Psychology*, 17(3), 340-350.
- Gao, L., & Bai, X. (2014). A unified perspective on the factors influencing consumer acceptance of internet of things technology. *Asia Pacific Journal of Marketing and Logistics*, 26(2), 211-231.

- Gartner, R. (2016). Metadata. doi:10.1007/978-3-319-40893-4.
- Ghashghaee, P. (2016). *Smart manufacturing: role of Internet of Things in process optimization*. Tempere University of Technology Press.
- Gomm, R. (2008). Social Research Methodology. doi:10.1007/978-0-230-22911-2
- Goswami, R. S., Banerjee, S., Dutta, M. P., & Bhunia, C. T. (2015). Absolute key variation technique of automatic variable key in cryptography. *Proceedings of the 8th International Conference on Security of Information and Networks - SIN '15*. doi:10.1145/2799979.2800021
- Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. *Future Generation Computer Systems*, 29(7), 1645-1660.
- Hair, J. F., Money, A., Page, M., & Samouel, P. (2007). *Research methods for business*. England: Chichester, John Wiley & Sons Ltd.
- Han, Q., Setchi, R., & Evans, S. L. (2016). Synthesis and characterization of advanced ball-milled Al-Al₂O₃ Nano composites for selective laser melting. *Powder Technology*, 297, 183-192.
- Han, W., Liu, Y., Zhang, Y., Li, L., Wang, J., & Zheng, L. (2016). An Internet-of-Things solution for food safety and quality control: A pilot project in China. *Journal of Industrial Information Integration*, 3, 1-7.
- Helms, J. E., Henze K. T., Sass, T. L., & Mifsud, V. A. (2006). Treating Cronbach's Alpha Reliability Coefficients as Data in Counseling Research. *The counseling psychologist*, 34 (5): 630-660.
- Hickey, W. (2017). Energy and Human Resource Development in Developing Countries. doi:10.1057/978-1-137-57082-6.
- Hoberg, P., Kremer, H., Oswald, G., & Welz, B. (2017). Skills for digital transformation in IoT business set up. *IDT survey*.
- Howarth, A., & Curvelo, P. (2013). Agency in the Internet of Things. *Luxembourg: Publication office of the European Union*.
- Howarth, R. B., Haddad, B. M., & Paton, B. (2000). The economics of energy efficiency: insights from voluntary participation programs. *Energy Policy*, 28(6-7), 477-486.
- Hwang, Y. H. (2015). Iot security & privacy: threats and challenges. In *Proceedings of the 1st ACM Workshop on IoT Privacy, Trust, and Security* (pp. 1-1). ACM.
- Ines, J., Azevedo, I. L., Michalek, J., & de Bruin, W. B. (2010). Labeling energy cost on light bulbs lowers implicit discount rates. *Ecological Economics*, 97, 42-50.
- Ines, S., Oikonomou, G., Tryfonas, T., Chen, T. M., & Da Xu, L. (2010). A distributed consensus algorithm for decision making in service-oriented

- internet of things. *IEEE Transactions on Industrial Informatics*, 10(2), 1461-1468.
- International Energy Agency, (2014). World Energy Outlook 2014 – Executive Summary. www.iea.org/publications/freepublications/publication/English.pdf (accessed 15.05.2018).
- Ishak, M. (2016). Introductory Chapter: A Brief Introduction to Joining and Welding. *Joining Technologies*. doi:10.5772/64726.
- ITU, (2012). Financing off-grid sustainable energy access for the poor. *Energy policy*, 47, 87-93.
- Jabbar, S., Khan, M., Silva, B. N., & Han, K. (2016). A REST-based industrial web of things' framework for smart warehousing. *The Journal of Supercomputing*, 1-15.
- Kagermann, H., Helbig, J., Hellinger, A. & Wahlster, W. (2013). Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0: Securing the Future of German Manufacturing Industry; Final Report of the Industries 4.0 Working Group, Forschungsunion.
- Kariuki, S. (2016). Impact of IoT in Kenya. *International Journal of Science and Research (IJSR) ISSN (Online): 6. (14.) 6-9*
- Kariuki, A. M. (2010). SIU Scholarship: Dr. Anthony M. Kariuki. *Urology*, 76(4), 773-774. doi:10.1016/j.urology.2009.11.006.
- Kasae, P. (2014). Energy efficiency and operational performance of manufacturing organizations in Kenya. Unpublished Master of Business Administration thesis, University of Nairobi.
- Kasae, Y. (2014). Hosting a Server on a Browser Using Wemu Architecture. *Proceedings of the 16th International Conference on Information Integration and Web-based Applications & Services - iiWAS '14*. doi:10.1145/2684200.2684305.
- Kelion, A. D. (2015). Nuclear cardiology. *Medicine*, 34(4), 150-153. doi:10.1383/medc.2006.34.4.150.
- Kerlinger, F. N. (1983). Lee, HB (1983). Foundations of Behavioral Research.
- Kettunen, K., & Salmela, E. (2017). Internet of Things as a Digital Transformation Driver in the Finnish Manufacturing Technology Industry. *Journal of Innovation & Business Best Practice*, 1(1), 18.
- Khazzoom D.J (2010). Economic implications of mandated efficiency in standards for house hold applications. *Energy Journal* 1(4), 21-39.
- Kiel, D., Arnold, C., & Voigt, K. I. (2017). The influence of the Industrial Internet of Things on business models of established manufacturing companies—A business level perspective. *Technovation*, 68, 4-19.

- KIPPRA, (2018). Performance of food and beverage firms in Kenya. *International Journal of Supply Chain and Logistics*, 2(1), 1-25.
- Kocher, H. (2014). *Determinants of key success criteria in establishing and sustaining an Internet of Things (IOT) new technology venture (NTV) in South Africa* (Doctoral dissertation).
- Kocher, P. (2014). *Innovation Leadership*. doi:10.1007/978-3-658-06526-3.
- Kothari, C.R (2012). *Research Methodology: Methods and Techniques*, New Delhi: New Age Publications.
- Kothari, C.R. (2009). *Research Methods and Techniques*. New Delhi: New Age International Publishers.
- Kyusakov, R., Eliasson, J., van Deventer, J., Delsing, J., & Cragie, R. (2012). Emerging energy management standards and technologies—Challenges and application prospects. In *Emerging Technologies & Factory Automation (ETFA), 2012 IEEE 17th Conference on* (pp. 1-8). IEEE.
- Laudien, S. M., & Daxböck, B. (2016). The influence of the industrial internet of things on business model design: A qualitative-empirical analysis. *International Journal of Innovation Management*, 20(08), 1640014.
- Lee, I., & Lee, K. (2015). The Internet of Things (IoT): Applications, investments, and challenges for management of IoT in enterprises in USA. *Business Horizons*, 58(4), 431-440.
- Li, Y., Hou, M., Liu, H., & Liu, Y. (2016). Towards a theoretical framework of strategic decision, supporting capability and information sharing under the context of Internet of Things. *Information Technology and Management*, 13(4), 205-216.
- Luo, J., Chong, A. Y. L., Liu, M. J., & Keng-Boon, O. (2015). Predicting RFID adoption in healthcare supply chain from the perspectives of users. *International Journal of Production Economics*, 159, 66-75.
- Luo, X., Wang, J., Dooner, M., & Clarke, J. (2015). Overview of current development in electrical energy storage technologies and the application potential in power system operation. *Applied energy*, 137, 511-536.
- MacMillan, J.H. & Schumacher, S. (2010). *Research in Education-Evidence based inquiry International Edition*. Boston: Pearson Education incl.
- Madakam, R. Ramaswamy, S. Tripathi, (2015). Internet of Things (IoT): A literature review. *Journal of Computer and Communications* 3, 164.
- Mathew, J. J., & Thompson, D. (2012). Elementary Research Design, Elementary Version. *School Psychology Quarterly*, 27(2), 61.
- Mayer, C. P. (2009). Security and privacy challenges in the internet of things. *Electronic Communications of the EASST*, 17.

- Meraka, A. I. (2013). VHF Spectrum Monitoring Using Meraka Cognitive Radio Platform. *Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering*, 55-64. doi:10.1007/978-3-642-41178-6_6.
- Minelli, M., Chambers, M. & Dhiraj, A. (2013). Big data technology. *Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses*, 2, 61-88.
- Moreno, M., Úbeda, B., Skarmeta, A., & Zamora, M. (2014). How can We Tackle Energy Efficiency in IoT Based Smart Buildings? *Sensors*, 14(6), 9582-9614. doi:10.3390/s140609582.
- Muhonen, T. (2015). Standardization of industrial internet and iot (internet of things)–perspective on condition-based maintenance. *University of Oulu, Finland*.
- Muteshi, D. C., Awino, Z. B., Kitiabi, R. K., & Pokhariyal, G. P. (2017). Firm-Level Strategy and Performance of Food and Beverage Manufacturing Companies in Kenya. *DBA Africa Management Review*, 7(2).
- Nachmias, C.F., & Nachmias, D. (2008). *Research Methods in the social Science* (5th ed). London: St. Martin Press, Inc.
- Nicola, A. (2014). Internet of Things for Smart Cities. *IEEE Internet of Things Journal*, 1(1), 22-32. doi:10.1109/jiot.2014.2306328.
- Onyalo, N. Kandie, H. & Njuki, J. (2015). The Internet of Things, Progress Report for Africa: A Survey. *International Journal of Computer Science and Software Engineering (IJCSSE)*, 4 (9), 230-231.
- Orodho, J. (2008). *Techniques of Writing Research Proposals and Reports in Education and Social Sciences*. (3rd ed.). Nairobi: Kanezja HP Enterprises, Maseno.
- Pahl, K. (2015). What a Mess. *MLN*, 130(3), 528-553. doi:10.1353/mln.2015.0047
- Patil, H. K., & Seshadri, R. (2014). IoT Big data security and privacy issues in healthcare. In *2014 IEEE international congress on big data* (pp. 762-765). IEEE.
- Paul, E., & Fleisch, E. (2010). What is the internet of things? An economic perspective. *Economics, Management & Financial Markets*, 5(2).
- Pütter, J. M. (2015). Der Nachhaltigkeitsbericht. *Controlling*, 27(11), 646-649. doi:10.15358/0935-0381-2015-11-646.
- Radziwon, A., Bilberg, A., Bogers, M., & Madsen, E. S. (2014). The smart factory: exploring adaptive and flexible manufacturing solutions. *Procedia engineering*, 69, 1184-1190.
- Rahimifard, S., Woolley, E., Webb, D. P., Garcia-Garcia, G., Stone, J., Jellil, A., & Trollman, H. (2017). Forging new frontiers in sustainable food

- manufacturing. In *International Conference on Sustainable Design and Manufacturing* (pp. 13-24). Springer, Cham.
- Ramachandran, S. (2015). Optical Vortices in Fiber. *Frontiers in Optics 2015*. doi:10.1364/fio.2015.fw3f.4
- Renner, M., & Krieger, U. R. (2015). On a Fog Computing Platform Built on ARM Architectures by Docker Container Technology. *Innovations for Community Services*, 71-86. doi:10.1007/978-3-319-60447-3_6.
- Roman, R., Zhou, J., & Lopez, J. (2013). On the features and challenges of security and privacy in distributed internet of things. *Computer Networks*, 57(10), 2266-2279.
- Sahu, D., Santosh, K. & Narayanan, K. (2009). Determinants of Energy Intensity: A preliminary Investigation of Indian Manufacturing Industries. *Energy Journal* 1(1), 1-3.
- Saint, M., & Garba, A. (2016). Technology and Policy for the Internet of Things in Africa. In *Global Humanitarian Technology Conference (GHTC), 2017 IEEE* (pp. 1-10). IEEE.
- Sanchez, L., Muñoz, L., Galache, J. A., Sotres, P., Santana, J. R., Gutierrez, V., & Pfisterer, D. (2014). SmartSantander: IoT experimentation over a smart city testbed. *Computer Networks*, 61, 217-238.
- Saunders, M., Lewis, P. and Thornhill, A. (2009). *Research Methods for Business Students*. London: St. Martin Press, Inc.
- Schneider Electric wins lucrative UK infrastructure improvement project. (2015). *Renewable Energy Focus*, 16(3), 10. doi:10.1016/s1755-0084(15)30063-6
- Schulze, M., Nehler, H., Ottosson, M., & Thollander, P. (2016). Energy management in industry—a systematic review of previous findings and an integrative conceptual framework. *Journal of Cleaner Production*, 112, 3692-3708.
- Semenik, R, Russell Belk, and John Painter (1982). A study of Factors Influencing Energy Conservation Behaviour. *Journal of Advances in Consumer Research* Volume 09, Association for Consumer Research.
- Shelby, L. B. (2011). Beyond Cronbach's Alpha: Considering Confirmatory Factor Analysis and Segmentation. *Human Dimensions of Wildlife*, 16 (2): 142–148.
- Shin, D. (2014). A socio-technical framework for Internet-of-Things design: A human-centered design for the Internet of Things. *Telematics and Informatics*, 31(4), 519-531.
- Shrouf, F., & Miragliotta, G. (2015). Energy management based on Internet of Things: practices and framework for adoption in production management. *Journal of Cleaner Production*, 100, 235-246.
- Shrouf, F., Ordieres, J., & Miragliotta, G. (2014). Smart factories in Industry 4.0: A review of the concept and of energy management approached in production based on the Internet of Things paradigm. In *Industrial Engineering and*

Engineering Management (IEEM), 2014 IEEE International Conference on (pp. 697-701). IEEE.

- Sint, J., Bonnechère, B., Jansen, B., & Omelina, L. (2016). The use of commercial video games in rehabilitation: a systematic review. *International journal of rehabilitation research, 39*(4), 277-290.
- Sint, V. O., & Gabra, A. D. (2016). *Trustworthy Cloud Computing*. doi:10.1002/9781119114215.
- Soro, A., Ambe, A. H., & Brereton, M. (2017). Reconciling human and technical perspectives on the IoT for healthy ageing in USA. *Wireless Communications and Mobile Computing, 2017*.
- Stock, T., & Seliger, G. (2016). Opportunities of sustainable manufacturing in industry 4.0. *Procedia Cirp, 40*, 536-541.
- Sushil, S., & Verma, N. (2010). Questionnaire Validation Made Easy, *European Journal of Scientific Research, 46*(2):172-178.
- Sutherland R.J (2001). Market Barriers to energy efficiency investments, *Energy Journal 12*(3).
- Tholander, J., & Fernaeus, Y. (2007). Setting the stage—Embodied and spatial dimensions in emerging programming practices. *Interacting with computers, 21*(1-2), 117-124.
- Thong, J. Y., Hong, S. J., & Tam, K. Y. (2002). The effects of post-adoption beliefs on the expectation-confirmation model for information technology continuance. *International Journal of Human-Computer Studies, 64*(9), 799-810.
- Tripoli, M., & Schmidhuber, J. (2018). Emerging Opportunities for the Application of Blockchain in the Agri-food Industry. *FAO and ICTSD: Rome and Geneva. Licence: CC BY-NC-SA, 3*.
- Vasilomanolakis, E., Daubert, J., Luthra, M., Gazis, V., Wiesmaier, A., & Kikiras, P. (2015). On the security and privacy of Internet of Things architectures and systems. In *2015 International Workshop on Secure Internet of Things (SIoT)* (pp. 49-57). IEEE.
- Venkatesh, M. (2000). The usage of internet banking service among higher learning students in Malaysia. *American Journal of Economics, 2*(4), 105-108.
- Venkatesh, V. (2000). Where to go from here? Thoughts on future directions for research on individual-level technology adoption with a focus on decision making. *Decision Sciences, 37*(4), 497-518.
- Wang, G., Wang, Y., & Zhao, T. (2016). Analysis of interactions among the barriers to energy saving in China, *Energy Policy, 36*(6):1879-1889.
- Welman, J. C., Kruger, S. J., & Mitchell, B. (2008). *Research Methodology* (3 Ed.). Cape Town, South Africa; Oxford University Press.

- Wenbo, W., Haidong, Y., Yingfeng, Z. & Jianxue, X. (2017). IoT-enabled real-time energy efficiency optimization method for energy-intensive manufacturing enterprises, *International Journal of Computer Integrated Manufacturing*, 31,(4-5), 362-379.
- World Economic Forum, (2016). Industrial internet of things and cyber manufacturing systems. In *Industrial Internet of Things* (pp. 3-19). Springer, Cham.
- World Energy Outlook, (2010). Internet of Things in product life-cycle energy management. *Journal of Industrial Information Integration*, 1, 26-39.
- Yan, Z., Zhang, P., & Vasilakos, A. V. (2014). A survey on trust management for Internet of Things. *Journal of network and computer applications*, 42, 120-134.
- Yin, R. K. (2017). *Case study research and applications: Design and methods*. Sage publications.
- Zadehgo, A. (2016). Signal and power integrity of microelectronic networks through modelling and simulation of fields and devices. *International Journal of Numerical Modelling: Electronic Networks, Devices and Fields*, 29(3), 544-544. doi:10.1002/jnm.2168.
- Zhang, Y., Zhang, G., Wang, J., Sun, S., Si, S., & Yang, T. (2015). Real-time information capturing and integration framework of the internet of manufacturing things. *International Journal of Computer Integrated Manufacturing*, 28 (8), 811-822.
- Zink, R. C. (2012). Sampling Methodology: Implications for Drawing Conclusions from Clinical Research Findings. *Principles of Research Methodology*, 197-205. doi:10.1007/978-1-4614-3360-6_10.
- Zuehlke, D. (2010). Smart Factory-Towards a factory-of-things. *Annual Reviews in Control*, 34(1), 129-138.

APPENDICES

APPENDIX A: INTRODUCTORY LETTER

I am the undersigned, currently undertaking a Master's degree in Business administration at Strathmore Business School. I am conducting a study involving collecting data for writing and compiling the final thesis proposal as a partial requirement for the award of the degree. The research entails establishment of the **factors affecting food and beverage processing firms in the adoption of internet of things technology in Nairobi, Kenya**. The information collected will be used solely for academic purposes and will be handled with utmost confidentiality.

Please direct any enquiries to: **CHETAN RATNA**

APPENDIX B: QUESTIONNAIRE

This questionnaire aims at collecting information on **factors affecting food and beverage processing firms in the adoption of internet of things technology in Nairobi, Kenya**. You have been selected to form part of this study. Please answer the following questions. Information collected will be treated with due confidentiality and will be used for academic purposes only.

SECTION A: DEMOGRAPHIC INFORMATION

1. Name _____ of _____ company

.....

2. Gender: Male () Female ()

3. Age (please tick which bracket you fall)

Below 20 years	20 – 29 years	30 –39 years	40 – 50 years	51 years and above
----------------	---------------	--------------	---------------	--------------------

4. Please tick your highest education level

a) Primary ()

b) Secondary ()

c) Tertiary ()

d) Undergraduate ()

e) Master Degree ()

f) Doctorate ()

5. Name of department.....

6. Position.....

7. How long have you worked in the firm

SECTION B: DETERMINANTS OF ENERGY UTILIZATION IN MANUFACTURING ORGANIZATIONS

8. Which factors inhibit the adoption IoT energy devices in your organization?

Factors	Tick
Lack of capital to fund new IoT energy efficient projects	
Lack of existing IoT related cost-effective technologies in the market	
Prohibitive costs of adopting IoT energy efficient technologies and devices	
managerial reluctance to adopt new IoT technologies	

Low level of awareness on existing energy efficient devices like IoT	
--	--

9. Rate the level of efficiency of your organization in terms of utilization of energy.

Level of efficiency	Tick
Very efficient	
Quite efficient	
Efficient	
Moderately efficient	
Never efficient	

10. Please indicate the extent to which the following issues **affect organizations in adoption of Internet of Thing (IoT) technology** by indicating the extent of agreement or disagreement with the scale: Strongly Agree - S.A, Agree - A, Neutral - N, Disagree - DA and Strongly Disagree – SD.

1 A	Aspects of Security of Generated Data	S.A	A	N	DA	SD
a)	The organization has faced significant security threats on confidentiality of IoT data.					
b)	The organization has significant confidentiality on the security of its IoT data.					
c)	The organization has effective mechanisms for IoT data protection.					
d)	The organization has enhanced systems for enhancing vulnerability of its IoT data.					
e)	Before adopting IoT, the organization has effective for data mechanism.					
f)	The organization often faces threats when updating its IoT applications.					
g)	The organization has technology that supports updating nodes of its IoT applications.					
h)	The organization has encryption layers that prevent malicious software installations.					
i)	The organization IoT applications have a high level of trust and security from customers.					
j)	The organization has secured IoT applications with necessary alarms and tracking systems.					
1 B	Aspects of Management of IoT					
a)	The organization has deployed its fleet of IoT devices in a fast and simple way.					
b)	The organization has the capacity to effectively manage its IoT applications.					

c)	The organization has automated its IoT devices.					
d)	The organization IoT devices have identifiers to provide identification of other operating devices.					
e)	The organization has the capacity to track/trace its IoT devices					
f)	The organization has capability of locating its IoT devices when desired.					
g)	The organization is able to repair its IoT devices when needed.					
h)	The organization interconnected IoT devices are easily traceable.					
i)	The organization has managerial capability to track its IoT applications.					

1 C	Aspects of Business Skills Side in (IoT)	S.A	A	N	DA	SD
a)	The IT department is able to match the IoT business demands of the organization.					
b)	The organization has capacity to source for requisite IT skills of its personnel.					
c)	The organization develops the newly recruited workforce to enhance their skill levels in IoT devices.					
d)	The organization workforce has requisite entrepreneurial skills to handle its IoT devices business side.					
e)	The workforce is committed and loyal to the organization in handling IoT needs.					
f)	The organization possesses a strategic plan to enable it to understand and conceptualize of its future IoT growth and development.					
g)	The organization has employed the services of an IoT experienced leader					
h)	The management has IoT related capabilities to take the organization to the next level of growth.					
i)	The management possesses visionary and strategic management capabilities to visualize the needs for an IoT adopting.					
j)	The management has partnered with the intellect to expertly execute the IoT needs and vision in the organization lifetime.					
1 D	Influence of Technical Perspective of IoT					
a)	The organization has workforce with requisite skills to conceptualize the technical side of IoT.					
b)	The organization has experienced entrepreneurs with the ability to visualize the need for IoT use.					
c)	The management has capability to make sound judgments on requisite IoT applications.					
d)	The organization has the ability to create partnership					

	while working in IoT related undertakings.					
e)	The organization has IoT developers possessing necessary skills in decision making.					
f)	The organization has created basic security skills for a secure IoT environment.					
g)	The organization possesses the highest level of understanding the IoT security requirements.					
h)	The organization has the services of an experienced system administrator.					
i)	The organization has the financial capability for integrating IoT applications.					
j)	The organization has collaborated with stakeholders in integration of IoT applications.					

11. Please indicate the extent to which the following issues of IoT enhance efficient energy utilization in manufacturing firms by indicating the extent of agreement or disagreement with the scale: Strongly Agree - S.A, Agree - A, Neutral - N, Disagree - DA and Strongly Disagree – SD. in Kenya

Aspects of IoT adoption	S.A	A	N	DA	SD
The organization has adopted the use of IoT devices					
Adoption of IoT applications has led to efficiency in energy utilization.					
Adoption of IoT applications has led to reduced cost of production.					
Adoption of IoT devices has offered fast and accurate way to collect real-time data from manufacturing processes.					
Adoption of IoT appliances has translated to better decision-making and execution of set plans.					
Adoption of IoT applications has ushered in efficient monitoring of product's operation and usage.					
Adoption of IoT devices has enhanced coordination of operations of products and systems.					
Use IoT connected sensors have provided unprecedented levels of visibility into the factory operations and supply chain flow.					
Adoption of IoT applications has improved the functions of the organization through connecting customers, suppliers and partners.					
Adoption of IoT devices has enhanced cyber-security in the organization.					
There is a regulatory framework on adoption of IoT technologies in Kenya					
The government framework support adoption of IoT devices in food and beverage processing firms					
The government policy on adoption of IoT in Kenya is cascaded to individual firms					
The government policy positively contribute to					

adoption of IoT devices					
-------------------------	--	--	--	--	--

12. Explain the challenges that inhibit your firm in adoption of IoT

.....

.....

.....

.....

.....

APPENDIX C: INTERVIEW SCHEDULE

1. Mention the extent of adoption of IoT in your organization.
2. Which factors affect adoption of IoT energy devices in your organization?
3. Which factors affect awareness of importance of adoption of IoT devices in your organization?
4. Is your organization efficient in terms of utilization of IoT energy devices?
5. Which are the challenges faced by your organization on securing the confidentiality of IoT data?
6. Does the organization have the capacity to effectively manage its IoT applications?
7. Does the organization have workforce with requisite skills to conceptualize the technical side of IoT?
8. Which are the benefits of adoption of IoT in your organization?

APPENDIX: D
LIST OF FOOD AND BEVERAGE PROCESSING FIRMS IN NAIROBI,
KENYA

- | | |
|--|---|
| 1. Afribon (K) Limited | 28. Coca-Cola Juices (K) Ltd |
| 2. Africa Spirits Ltd | 29. Confini Limited |
| 3. Afrimac Nut Company | 30. Danone Baby Nutrition Africa and Overseas |
| 4. Agriner Agricultural Development | 31. DPL Festive Ltd |
| 5. Al-Mahra Industries Ltd | 32. East African Breweries Ltd |
| 6. Almasi Beverages Limited | 33. East African Sea Food Ltd |
| 7. Alpha Fine Foods Ltd | 34. East African Seed Co. Ltd |
| 8. Alpha Grain Millers Limited | 35. Eastern Produce Kenya Ltd (Kakuzi) |
| 9. Alpine Coolers Ltd | 36. Edible Oil Products |
| 10. Aquamist Ltd | 37. Elekea Limited |
| 11. Aviano East Africa | 38. Elle Kenya Limited |
| 12. Bakers Corner Ltd | 39. Erdemann Co. (K) Ltd |
| 13. Bdelo Ltd | 40. Europack Industries Limited |
| 14. Belfast Millers Ltd | 41. Excel Chemicals Ltd |
| 15. Bio Food Products Limited | 42. Farmers Choice Ltd |
| 16. Blueplastics and Water Co. Limited | 43. Frigoken Ltd |
| 17. Breakfast Cereal Company (K) Ltd
(Formerly Weetabix) | 44. Frutarom Kenya (Ltd) |
| 18. Britannia Foods Ltd (Formerly Jambo Biscuits) | 45. Giloil Company Limited |
| 19. British American Tobacco Kenya Plc
Formaly (British American Tobacco Ltd) | 46. Githunguri Dairy Farmers Co-operative Society |
| 20. Bulto Foods Ltd | 47. Glacier Products Ltd |
| 21. C. Dormans Ltd | 48. Global Fresh Ltd |
| 22. C.Czarnikow Sugar(EA) ltd | 49. Gonas Best Ltd |
| 23. Cadbury Kenya Ltd | 50. Green Forest Foods Ltd |
| 24. Candy Kenya Ltd | 51. Italian Gelati & Food Products Ltd |
| 25. Capel Food Ingredients | 52. Jambo East Africa Ltd |
| 26. Chirag Kenya Limited | 53. Kamili Packers Ltd |
| 27. Coca-Cola East Central and West Africa Ltd | 54. Kedsta Investment Limited |
| | 55. Kenafic Industries Limited |
| | 56. Kenchic Ltd |

APPENDIX E: WORK PLAN

ACTIVITY	SEP 2017 – APR 2018	AUG 2018	FEB 2019	MAR 2019	MAY 2019	JUN 2019
Chapter one						
Literature review						
Chapter three						
Pilot testing of instruments						
Analysis of pilot test						
Main data collection						
Data analysis						
Report compilation						
Report submission and presentation						

APPENDIX F: BUDGET OF THE STUDY

ACTIVITY	ITEM	COST IN KSHS
Consolidation of literature	<ul style="list-style-type: none"> • Travelling, library expenses 	20,000
Designing and developing research instruments	<ul style="list-style-type: none"> • Typing • Photocopies of research instruments 	30,000
Pilot survey	<ul style="list-style-type: none"> • 2 visits @ 10,000/- 	20,000
Main field data collection	<ul style="list-style-type: none"> • 20 days x 5,000/- per day 	150,000
Research assistant	<ul style="list-style-type: none"> • 20 days x 1000/- per day 	40,000
Data processing, analyzing and report writing	<ul style="list-style-type: none"> • 20 days x 1000/- per day 	40,000
Contingencies and institutional cost	<ul style="list-style-type: none"> • 25 % of total expenditure 	50,000
TOTAL COST		350,000