

**INDUSTRY 4.0 TECHNOLOGIES AND OPERATIONAL PERFORMANCE
OF FAST MOVING CONSUMER GOODS MANUFACTURERS IN
KENYA: A CASE STUDY OF UNILEVER KENYA AND L'OREAL EAST
AFRICA.**

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**A Research Project Submitted In Partial Fulfillment Of The Requirement For
The Award Of The Degree Of Master Of Business Administration In
Operations Management, School Of Business, University Of Nairobi.**

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DECLARATION

This Research Project is my original work and has not been presented in any other university for a degree.

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D61/8566/2017

SUPERVISOR:

This research project has been submitted for examination with my approval as university supervisor.

ONSERIO NYAMWANGE

Signed _____ **Date** _____

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DEDICATION

This research work is dedicated to my beloved son Adriel Mochama for your understanding perseverance and support throughout this period, my life couch Mr. Benedict Juma; I owe it all to you dad! Thank you so much for supporting, mentoring and instilling in me the spirit of hard work and the importance of education. I can never pay you back for the unconditional love and affection. A big thank you to my siblings and friends for your immense support that has brought me this far.

ABSTRACT

The purpose of the study was to investigate the impact of Industry 4.0 technologies and applications on FMCGs manufacturers in Kenya, with specific reference to L'Oréal East Africa and Unilever. The two companies were selected for the study because they are among the largest FMCGs manufacturers in Kenya, thus the size of their operations is almost equal. Therefore, the study was conducted through a case-study design. Data was collected using an interview guide and the information interpreted through descriptive statistics. The study established that Industry 4.0 technologies improve operational performance in various ways. Types of Industry 4.0 in the organizations are autonomous robots, big data and analytics, augmented reality, cloud computing, and operations. The industry 4.0 technologies help FMCGs to predict demand, understand consumer behavioral patterns, minimize errors and enhance flexibility for effective decision making. The adoption of these technologies improve operational performance by positively impacting product quality, delivery lead-time, volume flexibility, delivery dependability, production lead time, and productivity levels. The study findings show that Industry 4.0 helps in enhancing operational performance in FMCGs.

TABLE OF CONTENTS

DECLARATION	ii
ACKNOWLEDGEMENT	iii
DEDICATION	iv
ABSTRACT	v
LIST OF ABBREVIATIONS	ix
CHAPTER ONE: INTRODUCTION	1
1.1 Background of the Study	1
1.1.1 Industry 4.0 Technologies	2
1.1.3 FMCGs Manufacturers in Kenya	2
1.2 Research Problem	3
1.3 Research Objectives.....	5
1.4 Value of the Study	5
CHAPTER TWO: LITERATURE REVIEW	6
2.1 Introduction.....	6
2.2 Theoretical Literature Review	6
2.2.1 Technology Acceptance Model.....	6
2.2.2 Diffusion of Innovation Theory	7
2.3 Industry 4.0 Technologies and Applications	7
2.3.1 Autonomous Robots.....	7
2.3.2 Big Data and Analytics	8
2.3.3 Augmented Reality.....	8
2.3.4 Horizontal and Vertical System Integration.....	9
2.3.5 Cloud Computing	9
2.3.6 Simulations.....	9

2.3.7 Radio Frequency Identification and Barcode Scanners	10
2.3.8 Internet of Things	10
2.4 Operational Performance	11
CHAPTER THREE: RESEARCH METHODOLOGY	14
3.1 Introduction.....	14
3.2 Research Design.....	14
3.3 The Population and Sample.....	14
3.4 Data Collection	14
3.5 Data Analysis Method.....	14
CHAPTER FOUR: DATA ANALYSIS, FINDING AND DISUSSION	16
4.1 Introduction.....	16
4.2 Extent of Industry 4.0 adoption by Unilever and L’Oréal East Africa.....	16
4.3 Type of Industry 4.0 technologies used by L’Oréal East Africa and Unilever.....	17
4.4 Impact of Industry 4.0 on operational performance of Unilever and L’Oréal	19
4.4.1Product quality	19
4.4.2 Delivery Lead-Time	20
4.4.3 Volume Flexibility	20
4.4.4 Delivery Dependability	21
4.4.5 Production Lead Time.....	22
4.4.6 ProductivityLevels	23
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS	24
5.1 Introduction.....	24
5.2 Summary findings.....	24
5.3 Conclusion	25
5.4 Recommendations.....	25

5.5 Limitation of the study	25
5.5 Suggestions for further studies.....	26
REFERENCES	27
APPENDICES	32

LIST OF ABBREVIATIONS

FMCGs - Organizations in the Fast Moving Consumer Goods

IT - Information technology

DOI - Diffusion of Innovation Theory

IoT - Internet of Things

IIoT - Industrial Internet of Things

ERP - Enterprise Resource Planning

AIMS - Automated Inventory Tracking Systems

DRP - Distribution Requirement Planning

EDI - Electronic Data Interchange

RFI - Radio Frequency Identification

TAM - Technology Acceptance Model

AR - Augmented Reality

CPS - Cyber-Physical Systems

CC - Cloud Computing

PaaS - Platform as a Service

SaaS - Software as a Service

WSN - Wireless Sensor Networks

JIT - Just-in Time

TQM - Total Quality Management

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Organizations in the Fast Moving Consumer Goods (FMCGs) industry operate in a highly competitive and complex marketplace. FMCGs manufacturers must ensure their goods are readily available in the market to protect their market share because consumers can replace their products with those of their competitors. The traditional supply chain does not help organizations to manage the constant market changes and evolving customer needs; instead, they require access to accurate and timely data to survive in the ever-changing business environment (Tissayakorn, Akagi, & Song, 2013). Information technology (IT) has, therefore, become a lifeline for FCMGs companies through the provision of comprehensive information at the right time to support effective decision making, improved business processes and increased efficiency. The IT revolution that began in the 18th Century has and continues to transform organizational management practices. The Internet is arguably the most significant technological development; it has contributed to the current Industry 4.0 technologies and its applications. IT has led to the creation of a virtual world, where people can communicate or do business with each other from any location in the world. Today, organizations have computer systems and software that store massive amounts of data and provide new communication systems and processes leading to the creation of a global village. IT utilization helps firms create new solutions and competitive advantages to succeed in the global competitive environment. According to Devaraj, Krajewski, and Wei (2007), IT supports effective decision-making processes, improves production efficiency through automation of activities and improves responsiveness to market changes.

IT has significant influence over the operational performance of companies. Oláh et al. (2018) defines IT as “the use of any computers, storage, networking, and other physical devices, infrastructure and processes to create, process, store, and exchange all forms of electronic data.” According to Çağliyan&Bedük (2012), companies use IT to collect and process information on the dynamic nature of the business environment in order to gain a higher competitive edge over their rivals.

Technology Acceptance Model 3 is one of the most popular theories used to explain the implementation of technological systems in organization (Marangunić, &Granić, 2015). In addition, Diffusion of Innovation Theory (DOI) developed by E. M. Rogers is another relevant school of thought that explains the implementation of IT systems in organizations as it explores

factors influencing the adoption of innovations, which refers to new ideas or products in a company (Libai, Mahajan, & Muller, 2017).

1.1.1 Industry 4.0 Technologies

The world is currently in the fourth wave of the industrial revolution that promises to open new doors for manufacturing companies through the use of IT in various ways. Industry 4.0 refers to the “intelligent networking of industrial products and processes” (Nagy et al., 2018). The technologies associated with Industry 4.0 are big data analytics, autonomous robotics, real-time simulation of activities, cybersecurity, augmented reality, additive manufacturing, system integration and Internet of things (IoT). Through IoT all IT resources in the company become interconnected; thus, they communicate with each other, enabling organizations to provide real-time responses to industrial happenings (Nagy et al., 2018). Already, some manufacturing companies have begun the adoption of industry 4.0, leading to the realization of numerous advantages (Liere-Netheler, 2017). For example, companies use the cloud system to store enormous data securely and use the information to support management systems and decisions.

In recent years, the Industry 4.0 technologies and applications have become a dominant force in the operational performance of manufacturers around the globe. They have been integrated into all the activities of manufacturing companies including logistics through transportation scheduling and vehicle tracking; procurement of materials through order processing and purchasing; operations where technology is used in inventory management and production scheduling; vendor relationship management that involves information sharing, creating long-term trust and commitment (Jadhav, 2015). Coordination of the supply chain activities helps companies to fulfill consumers’ expectation, reduce inventory costs, and improves strategic planning leading to better operational performance.

1.1.3 FMCGs Manufacturers in Kenya

FMCGs are arguably the largest and fastest-growing industry in the world (KPMG, 2016). FMCGs refer to high demand products that are sold at low prices albeit in vast quantities. Examples of FMCGs in Kenya include personal hygiene products like toothpaste, hair treatment, beauty products, food stuff like juices, alcoholic beverages, plastic goods, and small electronic appliances like batteries and light bulbs (KPMG, 2016). There is a high demand for FMCGs as they are used by millions of people every day. FMCGs are undifferentiated; thus customers can

easily switch from one company to the other without experiencing significant amount of costs.

Over recent years, the Kenyan FMCGs industry has experienced exponential growth. The observed increase is attributable to the entry of new local and international firms manufacturing and selling the products to consumers (Mwanza, &Ingari, 2015). Some of the well-known and top brands in the country include L'Oréal East Africa, Kevian Kenya, Kapa Oil, Bidco Oil Refineries, Coca Cola, HACO Industries, Unilever Kenya Limited and Nestle Foods Kenya among others.

Companies within this industry encounter many challenges particularly the low consumer satisfaction rate. The primary goal for any of the FMCGs manufacturer is responsiveness to customer's needs, timely provision of goods, and effectiveness in the operating practices. Therefore, FMCGs manufactures need access to market information in order to inform their decision-making processes and achieve a sustainable competitive advantage. L'Oréal East Africa is a multi-national company that has recently ventured into the Kenyan Cosmetics Industry, and it is expected to use its superior IT tools to make groundbreaking changes into the market.

L'Oreal East Africa Ltd was established in 2011 and manufactures and sells beauty products under the brand names Nice and Lovely, Versman, Dark and Lovely, Gold Touch, Garnier face products, Mixa Lotion and the premium make up line, Maybelline (L'Oréal Group, 2019). The company sells its products in Kenya, Burundi, Ethiopia, Rwanda, Uganda and Tanzania. L'Oreal East Africa Limited acquired Inter Beauty Products Limited in 2013 thus, attaining a bigger market share in the Kenyan Cosmetics Industry as well as incorporating the well-known local brands Nice and Lovely and Versman into their product portfolio.

L'Oreal is ranked as the largest business globally providing beauty and cosmetic products and as an acclaimed marketer of beauty products for both genders commanding presence in nearly all countries in the world. L'Oréal's biggest competitor in Kenya is Unilever.

1.2 Research Problem

IT tools are integral in the enhancement of the operational performance of organizations. FMCGs manufacturers strive to safeguard their position in the competitive industry by ensuring the availability of their products in the market at all times (Lawless, 2000). Manufacturing companies understand the difficulties of operating within the complex industry that is characterized by continuous change in consumer preferences, intense competition, diminishing

loyalty, and production of similar products. As a result, FMCGs manufacturers are keen on leveraging on Industry 4.0 to manage their supply and operational activities to improve their competitive advantage in the marketplace (Wasamba, 2008).

According to Jadhav (2015), IT helps companies to improve their effectiveness, operational performance and better decision-making processes. Al-Fawaer, Alhunity, and Al-Onizat (2013), argues that integration of IT in supply chain and operational management improves the rate of operational performance by streamlining activities in organizations and improving the relationship between all stakeholders involved in the process. Benefits of IT integration in manufacturing companies are efficient communication between stakeholders, transforming organizational process, optimization of supply chain, understanding all activities and processes taking place in a company (von Haartman, 2012).

Industry 4.0 is a new concept that has attracted much interest globally. Industry 4.0 also known as smart factory is the fourth wave of the industrial evolution that began in Germany to improve the competitiveness of the country's manufacturing sector. Industry 4.0 extends the functioning of advanced digital technologies leading to creation of a system that allows the interconnection of people and machines through information technologies (Lin et al., 2018). According to Mohammed (2018), Industry 4.0 resulted in the development of effective supply chains for manufacturing companies by increasing their flexibility in fulfilling individualized customer needs. For manufacturing firms, Industry 4.0 adoption is critical in their survival due to the constant environmental changes affecting their performance. Moreover, Industry 4.0 technologies lead to the realization of numerous benefits such as integration of services, lower costs, inventory reduction, and elimination of production wastes leading to better operational performance (Mohamed, 2018).

According to Nagy et al. (2018) IoT facilitates the capture of real-time data that supports efficient processes, thus manufacturers benefit from higher productivity, higher competitive edge, coordination and better financial performance. Fettermann et al. (2018) also found out that IoT improves critical operational functions in manufacturing companies for example JIT production and thus is linked to better productivity and efficiency. According to Wgner, Herrmann, and Thiede (2017) Industry 4.0 is critical in the development of lean production systems in organizations. Alcácer and Cruz-Machado (2019), argue that Industry 4.0 helps with the digitalization of all activities in manufacturing companies through the automation, vertical

and horizontal integration of services in organizations.

Although Industry 4.0 was first introduced in the Western countries, its implementation is highest in the Asian countries most notably China and Turkey. In Africa, Industry 4.0 is still in the early development stages and its implementation rate varies between countries and companies (Deloitte, 2017). There has been gradual adoption of Industry 4.0 by FMCGs manufacturers in Kenya; the trend is indicative of the growth in understanding and appreciation of the influence of these technologies and their applications. Industry 4.0 application has not been adopted in many companies, thus studies on these technologies are narrow (Manda, & Ben Dhaou, 2019). No study had been conducted to investigate how Industry 4.0 affects the operational performance of FMCGs manufacturers in Kenya. Therefore, the study aimed at bridging this gap by answering the research question “what is the impact of Industry 4.0 on operational performance of FMCGs manufacturers in Kenya.”

1.3 Research Objectives

The study objectives were:

- i. To establish the extent of adoption of Industry 4.0 technologies by Unilever and L’Oréal East Africa.
- ii. To determine the type of Industry 4.0 technologies used by Unilever and L’Oréal East Africa.
- iii. To establish the impact of Industry 4.0 technologies on the operational performance of Unilever and L’Oréal East Africa.

1.4 Value of the Study

The study outcomes would be valuable in various ways. Foremost, the study findings would help guide new researches on the impact of Industry 4.0 technologies on operational performance of organizations in the Kenyan manufacturing industry.

Secondly, the study could help companies to identify the type of Industry 4.0 technologies in the market that can be used to improve their performance level.

Besides, the outcome of the study would help companies to overcome the challenges faced in the integration of IT in their performance resulting in the fast adoption of industry 4.0.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The literature review focused on synthesizing past literature focusing on the impact of IT on operational performance of organizations. The section documents the type of IT resources used in organizations and how they relate to the operational performance measures.

2.2 Theoretical Literature Review

Various theories have been used to explain the impact of IT on organizational operational performance, however this study focused on two theories; Technology Acceptance Model 3 and Diffusion of Innovation Theory.

2.2.1 Technology Acceptance Model

TAM 3 is arguably one of the most popular theories used to explain the implementation of technological systems in organization. TAM 3 theorizes that two primary factors influence the utilization of IT resources in a company namely perceived ease of use and perceived usefulness of the system. According to Venkatesh and Bala (2008), perceived usefulness is the degree to which employees' belief that the IT resources improved their performance. Several factors influence perceived usefulness of information systems including subjective norm; job relevance of the target system; output quality of IT use; result demonstrability or observable outcomes of IT implementation; perceived ease of using the resources. High perceived usefulness of the IT systems results in their successful implementation in organization as people demonstrate the behavioral intention of employing the resources in their activities. Perceived ease of use is the second factor that influences IT implementation. Venkatesh and Bala (2008) defines perceived ease of use as the extent to which a person believes that the employing the IT systems will be free of effort. External factors influencing the perceived ease of using information systems include computer self-efficacy that is individual belief in the ability to use the tools; anxiety using the system; computer playfulness; perceived enjoyment of the system; objective usability of the system in completing tasks. Perceived ease of use positively influences the intention to use the system resulting in the implementation of the technology.

TAM 3 is a relevant theory in the study because it explains the factors influencing IT adoption in organizations. The theory shows that a company's decision to adopt a new technology like

Industry 4.0 is dependent on perceived usefulness and its ease of use. Moreover, the two aspects are linked to internal and external factors. Therefore, the study focused on these external and internal factors to determine the extent of Industry 4.0 adoption in the organizations.

2.2.2 Diffusion of Innovation Theory

The diffusion of innovation theory (DOI) is another relevant school of thought that explains the implementation of IT systems in organizations. DOI was developed by E. M. Rogers and it explores factors influencing the adoption of innovations, which refers to new ideas or products in a company. According to the theory, five elements affect the adoption of new ideas in organizations. One is the relative advantage of the innovation that is the perception that a new product is superior to the existing assets. Two is the compatibility of the innovation with existing organizational features like values, behavioral standards and customer needs. Three is the complexity of the innovation that is the ease of using the new products. Four is observability of the results produced by the innovation. Lastly is triability of the information system that is the ability to experiment the system before its implementation.

Undoubtedly, the DOI theory is relevant to the study and it was used to evaluate the difference in the Industry 4.0 innovation by Unilever and L'Oréal East Africa. The IT innovation adoption rate differs between companies. Some organizations are innovators meaning that they are in the frontline of trying new innovations, while others laggards that they are conservative and take a lot of time to embrace the changes introduced in the industry (Sahin, 2006). Therefore, the theory helped to determine the stage of Industry 4.0 adoption in the targeted manufacturing companies.

2.3 Industry 4.0 Technologies and Applications

Industry 4.0 is the latest stage in industrial revolution. It mainly focuses on real-time data, interconnectivity, machine learning and automation. This great focus of industry 4.0 is to have a better connected ecosystem of companies.

2.3.1 Autonomous Robots

Autonomous robots are a critical technology in Industry 4.0 that are transforming the manufacturing industry. Historically, robots have been an integral component in manufacturing firms to perform routine and repetitive tasks. Robotics technologies have been advanced through the different industrial waves including Industry 1.0 in 1784, Industry 2.0 in the 1870's, Industry

4.0 in the 1969's, and Industry 4.0 today (Karabegović , &Husak, 2018). Industry 4.0 increases the flexibility of robotics by enabling their automation, thus these technologies can be used with minimal human interventions. Autonomous robots have a human interface through which they receive instructions controlling their activities; and they are widely used in various organizational functions including logistics, production, and warehousing (Erboz, 2017). Advantages of autonomous robots are faster product development, increased efficiency, reduced errors, and better human and machine collaboration (Deloitte, 2019). As a result, the adoption of autonomous robots is key in improving operational performance.

2.3.2 Big Data and Analytics

Big data refers to the large and complex data sets generated by manufacturing companies. The size of big data varies from company to company; it may be a terabyte or petabytes depending on the size of operations. Big data is collected from varied sources including sensors, customers, manufacturing processes, logistic vehicles, and other technological devices in organizations (Wang et al., 2018).Big data analytics, on the other hand, refers to the analysis of large datasets to get new insights about industry trends, consumer needs and preferences. Also, big data analytics involves developing algorithms for predicting behaviors and reducing errors that could adversely affect a company's performance (Erboz, 2017). Advantages of using big data analytics are faster decision making, reduction of operational costs, and new product development (Erboz, 2017). Also, big data analytics leads to the development of new competitive advantages that improves their performance.

2.3.3 Augmented Reality

AR is a central technology in Industry 4.0. AR is an interactive technology that involves using computer generated display to represent the real environment, thus it enhances the users experience and understanding of their surroundings (Erboz, 2017). AR uses computerized simulations to represent real images. One of the most commonly used AR devices globally is Google Glasses that collects visual and audio information in the surroundings. However, AR has a broad application in the manufacturing industry as it is used to create the human-machine interface for communication between people and production machinery and equipment. According to De Pace, Manuri, and Sanna (2018), AR enhances user's understanding of the movements and forces of robots in the work environment. Therefore, AR promotes human-robot

collaboration. AR technologies used by manufacturing firms are smart glasses and gloves. Advantages of AR are smart manufacturing, monitoring work processes, reducing errors, and reduction of production time and costs.

2.3.4 Horizontal and Vertical System Integration

Horizontal and vertical system integration leads to the development of smart manufacturing. Vertical integration refers to the combination of physical infrastructure and information systems at different hierarchical levels in an organization to achieve production agility. Horizontal integration, on the other hand, is the interconnection of stakeholders in the supply chain (He, & Jin, 2016). Vertical integration is supported by the Cyber-Physical Systems (CPS). According to Sadiku et al. (2017), CPS refers to “engineered systems that are designed to interact seamlessly with networks of physical and computational components.” CPS comprises of three major components namely physical system, distributed cyber system, networking and communication networks. Also, Big Data is essential in the formation of integrated vertical and horizontal networks by ensuring that the organization reacts quickly to production changes. The cloud-based systems also contribute to vertical integration by connecting all the partners involved in production processes through a computerized platform. The results of vertical and horizontal integration are the creation of agile organizational processes.

2.3.5 Cloud Computing

Cloud computing (CC) is arguably the most well-known technologies of Industry 4.0. CC refers to subscription information storage resources that are available to organizations. CC supports the remote storage and access of data at any time or place. There are three types of CC namely; Platform as a Service (PaaS) which allows individual customers to access information in the cloud; Software as a Service (SaaS) where customers must subscribe to cloud services; Infrastructure as a Service (IaaS) where information storage capabilities are provided (Erboz, 2017). Advantages of CC are lower information storage cost, effective data management, flexibility, and improved efficiency (Alcácer, & Cruz-Machado, 2019).

2.3.6 Simulations

Simulation tools are an integral feature of Industry 4.0. Simulation tools are used to solve manufacturing challenges through detailed analysis processes. Simulations are undertaken using

real-life data that is collected from multiple areas of a company leading to development of effective solutions (Rodič, 2017). Besides, simulations help organizations to make appropriate decisions and overcome complex situations that arise in the constantly changing business environment (Erboz, 2017). Noteworthy, there has been a quick adoption of simulations in big manufacturing companies producing numerous products for different market segments.

2.3.7 Radio Frequency Identification and Barcode Scanners

RFID systems are critical IT resources in the manufacturing industry. RFID are automatic identification technological systems that collect, store, and process data used to increase production efficiency. According to Gengel et al. (2016), RFID has three elements including a tag which is a chip with an antenna; a reader which emits radio waves communicating the location of a device; middleware which manages the whole system. RFID system application areas in manufacturing companies include production whereby it monitors equipment and raw materials on the production floor; supply chain to provide real-time data on manufacturing inputs and outputs in transit and also used in inventory management to track the movement of raw materials and equipment in the warehouse.

Industry 4.0 is a key driver of RFID adoption in the manufacturing industry. RFID devices store real-time data on organizational processes that are the foundation of smart manufacturing including personnel management, inventory management, and automatic scheduling of manufacturing process (Wang, 2014). The benefits of RFID use in organizations are increased efficiency, easier management of activities, and production flexibility. According to Masum, Bhuiyan, and Azad (2013) other benefits of RFID are better product traceability, lower warehouse costs, effective inventory management processes, and development of new competitive strategies. Using RFID also improves the production process as companies can buy and monitor the movement of raw materials required for customized orders resulting in better customer service and reputation (Ivantysynova et al., 2009). Therefore, it is not surprising that RFID systems have attracted a lot of attention from companies worldwide.

2.3.8 Internet of Things

IoT is an emerging technological system that is founded within the fourth wave of the industrial revolution commonly known as Industry 4.0. Unlike the previous industrial movements that were based on improving mechanical processes in organizations, Industry 4.0 is supported by the

Internet and communication capabilities. According to Rghioui and Oumnad (2017), IoT refers to the interconnection of devices via the Internet and communication software that support the intelligent sharing of information in an organization. IoT allows for real-time transmission of data between devices, and this increases the rate of efficiency in a company. Patel and Patel (2016) describe IoT from three dimensions; one is the interactions from people to people through communication systems; people to machine, where employees automatically issue commands to the production machinery; machine to machine communication through the Internet. IoT characteristics are device interconnectivity, heterogeneity of devices, safety from unauthorized parties, and enormous scale of the system.

IoT is supported by several communication devices. Foremost is RFID that is used to capture automatic information of various objects in organizations. Secondly is cloud computing that is used to store big data that is collected through multiple sensor devices like RFID that is accessible through virtual machines; therefore, the information can be used to make critical decisions throughout the organization. Thirdly, is Wireless Sensor Networks (WSN) that refers to a system of sensors that monitors and collect information on the status of inventory among other processes (Patel, & Patel, 2016). Fourthly is middleware system that acts as the IoT interface through which all the devices interact with each other. IoT is the future of the manufacturing industry; the system have significant influence on organizational performance by affecting the efficiency levels and product innovation (Rghioui, &Oumnad, 2017). For example, consumer demand for Internet smart devices like kitchen appliances has increased in recent years. However, the primary interest of the current research is how IoT affects operational performance.

2.4 Operational Performance

Operational performance refers to quantitative measures of organizational processes like warehousing, inventory management, and order processing (von Haartman, 2012). Companies spend a significant amount of funds purchasing the latest IT systems to enhance their productivity. Therefore, companies need to measure the effectiveness of the IT systems to determine whether their purchase decisions were appropriate or not depending on their effectiveness level.

Operational performance measures the effectiveness of organizational strategic planning.

According to Devaraj, Krajewski, and Wei (2007), operational performance is usually measured along four dimensions namely product quality, which is measured by average production time; flexibility which is measured by a company's responsiveness to order changes; delivery, which is measured by lead time; cost that is measured by workers productivity. Hwang et al. (2014) used the SCOR model to develop the operational performance metrics used in monitoring and evaluating manufacturers, which include order fulfillment cycle time, cost of goods sold, price to make, perfect order fulfillment and inventory available for supply. Von Haartmen (2012) proposes the following operational performance measures; product quality, delivery lead time, volume flexibility, delivery dependability and production lead time.

Organizations have three management levels namely strategic, tactical, and operational levels. The strategic level focuses on long-term plans and performance, tactical level is concerned with the resource allocation to fulfill the strategic goals; tactical level encompasses the daily business activities undertaken to fulfill the strategic objectives. Examples of operational practices in manufacturing companies are just in time (JIT) management, total quality management (TQM), and outsourcing. The metrics used to measure performance level at the operational level include but are not limited to work in progress, finished goods in transit, and efficiency of the scheduling system (Hwang et al., 2014).

Operational performance of an organization is measured using four major elements. One is product quality that is measured in terms of durability, endurance and acceptance by consumers in the market. The quality performance measures are number of customer complaints, warranty claims, and customer satisfaction rates. Moreover, product quality should be consistent at all times to yield the expected results.

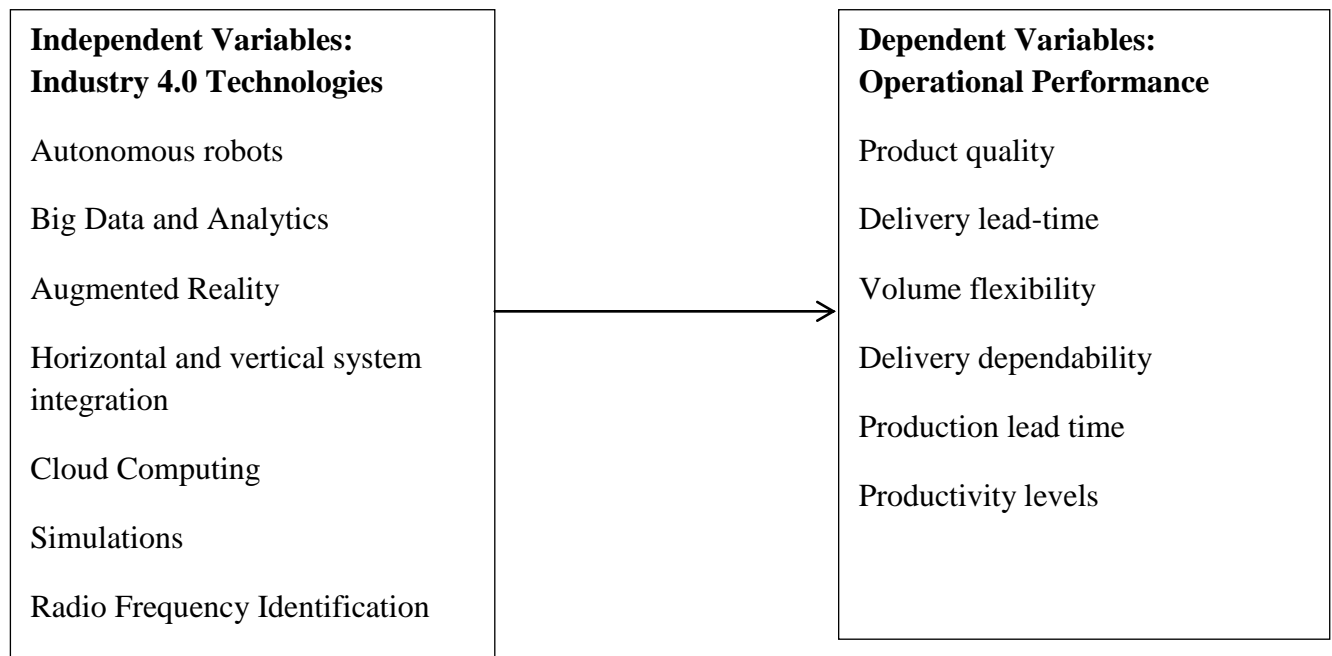
Secondly is product dependability that refers to a company's ability to deliver the right products on time. Dependability therefore focuses on timely product delivery and period taken to implement any required adjustment. According to Rasi, Rakiman, and Ahmad (2015), some of the metrics that can be used to measure dependability are lead time and on time delivery of products to consumers. Eshikumo and Odock (2017) underscores that the delivery period has direct influence over organizational effectiveness. Over time dependability influences customers loyalty to a company something that is very important for FMCGs manufacturers.

Thirdly is flexibility of operational practices of a manufacturing company. Flexibility goes hand in hand with changing consumer needs and preferences, and complying with the variations

influence organizational performance. Example of flexibility metric is the customers' waiting time for product improvement (Rasi, Rakiman, & Ahmad, 2015). Eshikumo and Odock (2017) note that production efficiency directly influences flexibility of production processes in manufacturing companies.

Cost is the last element of measuring operational performance. Rasi, Rakiman and Ahmad, (2015) defines cost as the amount of payment for the production of a single product unit. These costs are divided into two broad categories namely work costs which is measured by hourly labor rate; capital costs which refers to the amount of expenses incurred in purchasing raw materials among other types of input.

Conceptual Model



CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter highlights the procedural approach of conducting the study. The chapter was divided into the following sections research design, target population, sampling, data collection methods, data analysis, and ethical considerations.

3.2 Research Design

This study adopted a case study research design. According to Mills et al. (2017), a case study is one of the most popular qualitative research methods; it refers to an intensive and systematic study of a specific phenomenon. Case studies have several advantages including in-depth understanding of complex phenomenon, easy to use, less costly, and it does not require sampling. Through the case study, the researcher identified how Industry 4.0 influences operational performance.

3.3 The Population and Sample

The respondents of the study were the two study units namely, Unilever and L'Oréal East Africa. Equal representatives were selected from the two study units and they provided information regarding Industry 4.0 in their respective companies.

3.4 Data Collection

The research relied on primary data. The primary data was collected through an interview guide. The interview guide facilitated the collection of comprehensive information through interviews. The interview guide was divided into different sections evaluating the different aspects of Industry 4.0 used by the target population. The interview guide helped the researcher to understand the level of Industry 4.0 awareness in the manufacturing industry, the extent of adoption of Industry 4.0 technologies and the impact of Industry 4.0 technologies on the operational performance of FMCGs manufacturers in Kenya.

3.5 Data Analysis Method

Content analysis was used to interpret the data collected during the research. Content analysis refers to the process of making inferences from textual materials, oral communication or documents used in a research. Content analysis is systematic process involving four steps that is

decontextualisation, recontextualization, categorization, and compilation of information. Through the content analysis, the in-depth details of the interview were examined and presented in a simple and understandable format to help in evaluation of the level of Industry 4.0 awareness in the manufacturing industry, the extent of adoption of Industry 4.0 technologies and the impact of Industry 4.0 technologies on the operational performance of the two study units.

CHAPTER FOUR: DATA ANALYSIS, FINDING AND DISCUSSION

4.1 Introduction

This chapter focused on the presentation of the empirical results of the study. The purpose of the study was to find out the impact of Industry 4.0 on operational performance of L'Oréal East Africa and Unilever, the two largest FMCGs manufacturers in Kenya. Data was collected from 20 respondents using an interview guide, which was created in close reference to the research objectives. The use of the interview guide facilitated the collection of detailed information about the adoption of Industry 4.0 in the study units.

4.2 Extent of Industry 4.0 adoption by Unilever and L'Oréal East Africa

Based on the responses, there is a higher rate of Industry 4.0 adoption in L'Oréal East Africa compared to Unilever. All the respondents from L'Oréal believed that the organization knew about Industry 4; they defined Industry 4.0 as smart manufacturing, human-machine interactions, use of robotics and automation in the company and intelligent systems. These definitions are consistent with Nagy et al. (2018) description of Industry 4.0 as “intelligent about networking of industrial products and processes.”

Moreover, research respondents from L'Oréal knew about the steps being taken by the company to implement Industry 4.0. One the company was investing in new technologies including warehouse scanners, drones and system upgrade to increase amount of information processed per minute. Two L'Oréal had introduced a new training program that focuses on familiarizing employees with Industry 4.0; thus making it easier for them to work with the new technologies.

Figure 4.1: Adoption of Industry 4.0 in Unilever

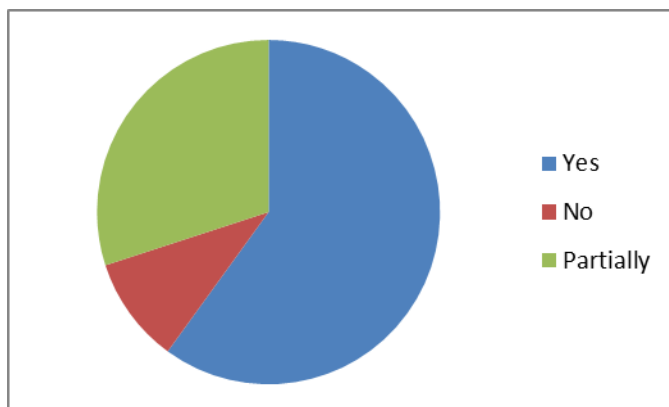


Figure 4.1 shows that respondents have different perceptions about the rate of Industry 4.0 adoption in Unilever. 60% of respondents believed that the company had fully implemented the technologies, 30% indicated the adaptation was partial, while 10% felt that the Unilever had not incorporated Industry 4.0 in its operations. Some of the respondents were aware of the meaning of Industry 4.0, but it was obvious that some of them had not heard about the concept before the interview. However, the respondents that were aware of Industry 4.0 in Unilever gave the same consistent definition of the technologies as the interviewees from L'Oréal East Africa.

Furthermore, respondents from Unilever were unaware of the company's plans to implement Industry 4.0 in its operations. According to the interviewees, no formal program or plan was describing how the company intended to adopt the new technologies. However, they stated that they had gone through training to learn new technical skills in the last two years due to the digital transformations occurring in the company. Examples of the digital transformations occurring at Unilever include automation of activities and the use of big data for product innovation processes. Undoubtedly, the ongoing digital transformation in Unilever is a sign that the company is in the process of adopting Industry 4.0 in its operations.

4.3 Type of Industry 4.0 technologies used by L'Oréal East Africa and Unilever

The study sought to establish the types of Industry 4.0 technologies used by the study units. Based on the responses, the two companies have implemented most of the Industry 4.0 technologies. The leading Industry 4.0 technologies in the two companies are big data and analytics, barcoding and cloud computing. There is a lower adoption rate of other Industry 4.0 technologies, namely horizontal and vertical system integration, warehouse scanners, drones and IoT. However, the research findings show that Unilever and L'Oréal East Africa are yet to implement Augmented Reality (AR), as neither company has adapted smart gloves and smart glasses technologies.

Industry 4.0 technologies are used in different departments in the two companies. Foremost, these technologies are used in the production process for various functions. Robots are used to perform repetitive tasks during the production process, for example, loading raw materials into the machines. The companies attach sensors to equipment and machinery on the production floor to monitor their performance. Moreover, the sensors transmit critical information about the

production process to the management and this is used as the basis for formulating production decisions.

Additionally, drones are used to monitor the progress of the manufacturing process, inspect the quality of goods and to transport raw materials from the warehouse into the production line. According to the respondents, Unilever and L'Oréal use big data to predict the demand for goods, thus the information is used to determine the production capacity. The adoption of these technologies is slowly leading to the development of smart factories in the two companies.

Both Unilever and L'Oréal use Industry 4.0 technologies to manage warehouse operations. Drones are one of the technologies used in warehouse management; it is used for transporting the finished products from factory to storage. According to one of the respondents, sensors improve warehouse operations by facilitating timely detection of system failure, thus preventing a breakdown on time. On the other hand, warehouse scanners are used to automate data collection of the companies' operations by skimming the labels from different distances through the help of drones. Scanners capture accurate information; thus, they minimize the risk of error during the order fulfillment process. Also, robots are used in the warehouse to stack the finished products into the storage area and palletizing orders in preparation for deliveries. As a result, these technologies have led to the creation of seamless operational systems in the warehouses. These findings are synonymous with those of Al-Fawaeer, Alhunity and Al-Onizat (2013) that established IT integration in organizations improves operational performance.

Additionally, big data and analytics are widely used in finance, IT and human resources (HR) for effective decision-making in the organization. The technology is commonly used in the HR department to narrow down job applicants and ensure that only the most talented people join and are retained in the organization. The organizations accomplish these by using surveys to carry sentiment analysis and pulse surveys to correct employees' information. Therefore, Unilever and L'Oréal use big data and analytics to predict employees' behavior which is consistent with the finding of Erboz (2017). However, big data and analytics adoption in the finance department is still at the infancy stage of the two companies despite its known advantages. The observation is proof of the slow Industry 4.0 adoption in African countries. For the IT department, cloud computing is used to store large amounts of data about the company; the information is accessible to all employees in the organization. Also, big data and analytics is used in quality

departments to determine whether the organization produces high-quality goods. Lastly, it is essential to note that vertical and horizontal integration of machines and equipment made it easier for the company to collect information.

The respondents linked the adoption of Industry 4.0 technologies with numerous benefits in the organization. Some of the advantages of Industry 4.0 in L’Oréal and Unilever are better business decisions, higher employee satisfaction rates, improved product quality, and higher efficiency. Moreover, these technologies increase the visibility of the organizational, operational system, improve customer satisfaction and reduce operational costs. For example, cloud computing reduces the amount of money spent on the data storage process.

Therefore, the study confirms the advantages of Industry 4.0 as noted by von Haartman (2017) including improving communication efficiency, simplification of organizational processes and optimization of the supply chain.

Furthermore, the study established that Unilever and L’Oréal encountered several challenges in implementing Industry 4.0 technologies. The challenges include high implementation costs, employees’ resistance, the inadequacy of infrastructure and high training expenses. Besides, some of the technologies were incompatible with existing systems; thus it was difficult for the employees to operate the whole system. As a result, Industry 4.0 adaption is still lower in the two companies.

4.4 Impact of Industry 4.0 on operational performance of Unilever and L’Oréal

4.4.1 Product quality

Industry 4.0 improves operational operating performance	
Agree	90%
Unsure	10%
Disagree	0

The respondents also answered questions regarding the impact of Industry 4.0 technologies on product quality. 90% of the respondents agreed that Industry 4.0 technologies aid in the

standardization of production processes leading to the output of consumer goods of uniform quality. The technologies help in minimizing errors during production, warehousing, packaging, and delivery of the final output to consumers. Moreover, Industry 4.0 facilitates the collection of big data regarding the manufacturing process; the information becomes the basis for decision-making in the organization. The use of Industry 4.0 in the two companies is consistent with the Patel and Patel (2016) research that states that organizations use sensors to gather data on inventory usage among other operational areas. Effective decision-making leads to the manufacture of high-quality products that are customized as per the clients' needs. Therefore, consumers would accept the companies' products.

4.4.2 Delivery Lead-Time

Industry 4.0 improves delivery lead-time	
Agree	100%
Unsure	0
Disagree	0

The researcher asked the respondents to describe how the adoption of Industry 4.0 affected the company's delivery lead-time. First and foremost, the technologies capture essential information about factors influencing the delivery lead-time that is used to predict the variable. Prediction of the delivery lead-time helps the companies to create a fixed schedule. As a result, the companies minimize time wastage in the receipt of raw materials because the supplier abides by the schedule; thus, there is the timely delivery of the final products. The use of Industry 4.0 technologies in the companies significantly improves delivery-lead time, which according to Eshikumo and Odock (2017) improves customers' loyalty as they are able to supply products into the market in a timely manner.

4.4.3 Volume Flexibility

The researcher evaluated the impact of Industry 4.0 on volume flexibility. One of the respondents revealed that sensor technology linked the communication system in the organization and facilitated the collection of real-time customer data in the market. Access to real-time data increased the supply chain's responsiveness to sudden changes in consumers'

demands. According to one of the respondents, automation of production processes reduced the change-over period from one production line to another when the focus is on customization of the final output. The findings were synonymous with the advantages of automation outlined by Deloitte (2019) namely better efficiency; reduced errors and human-machine collaboration leading to improved operational performance.

Big data and analytics were instrumental in the achievement of volume flexibility in the two companies. According to the respondents, big data was a powerful tool for forecasting product demand, thus the company had enough time to adjust production levels upwards or downwards depending on the findings. The big data is collected through IoT that facilitates the collection of real-time information (Nagy et al., 2018). Therefore, there is no doubt that Industry 4.0 technologies are associated with better operational performance.

4.4.4 Delivery Dependability

Industry 4.0 improves operational operating performance	
Agree	70%
Unsure	20%
Disagree	10%

The researcher assessed whether Industry 4.0 influenced delivery dependability in the company. 70% of the respondents strongly agreed that technologies affected the companies' ability to honor customers' orders. This is because the horizontal and vertical integration in Industry 4.0 creates a coordinated production and logistics systems that facilitate the quick production of organizational items. As a result, the company produces quality products as per the schedule. Furthermore, big data analytics helps companies to understand product demand trends and anticipate orders. Moreover, automation reduced delays in production and delivery processes. Therefore, the company has enough time to plan for production leading to dependable delivery. These findings are consistent with those of Muhammed (2018) who argues that Industry 4.0 aids in the development of effective supply chains that are characterized by delivery dependability

20 % of the respondents were unsure Industry 4.0 technologies contributed to delivery dependability. The respondents believed that better coordination of activities were inadequate in ensuring the timely delivery of products; they felt that the supply of raw materials influenced the organization's ability to honor its delivery promises into the company. Lastly, 10% of the respondents thought that Industry 4.0 did not affect delivery dependability because they had not noticed any significant changes since the integration of technologies into the company's activities.

4.4.5 Production Lead Time

Industry 4.0 improves production lead time	
Agree	80%
Unsure	20%
Disagree	0

The research respondents were required to indicate their agreements regarding the impact of Industry 4.0 on production lead time. 80% of the respondents agreed that Industry 4.0 reduced the production lead-time in various ways. They found out that drones and robots improved the speed of manufacturing and warehousing activities in the company resulting in the shortening of the production lead-time. According to Deloitte (2019), robots help to improve human and machine collaboration and this increases the speed of operations in organizations. Besides, cyber-physical systems help in the interconnection of factory activities that further helps to shorten the lead time. As a result, the customers are supplied with their preferred products on time, resulting in a high rate of customer satisfaction. 20% of the respondents were unsure about the relationship between Industry 4.0 technologies and production lead time. They felt the company spent more time on product customization processes than in the typical manufacturing processes. Although the product customization utilized the same system and procedures, there was a risk that the company took longer to complete the lifecycle for such products. Therefore, it was difficult to state that Industry 4.0 technologies improved product lead-time conclusively.

4.4.6 Productivity Levels

Industry 4.0 improves productivity levels	
Agree	100%
Unsure	0
Disagree	0

All the respondents agreed that Industry 4.0 technologies improved organizational productivity levels. The respondents had noticed that the introduction of a new technology corresponded with an immediate increase in the production capacity of their respective companies. Initially, the respondents felt intimidated by Industry 4.0 technologies and were afraid of their impact on their jobs. With time employees began to accept the technologies in their work; they were motivated since they reduced the amount of work pressure, stress and improved their safety.

Moreover, the Industry 4.0 technologies improved production efficiency through sound planning, facilitating communication between devices, tracking of machinery, preventing systems breakdown throughout the organization, and optimizing production levels. Besides, the rate of production errors reduced with the incorporation of Industry 4.0 technologies in the organization. These findings are synonymous with those of von Haartman (2012) who argues that IT integration improves efficiency in manufacturing companies by providing access to real-time inventory monitoring, among other functions.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the findings of the research on Industry 4.0 technologies and operational performance of FMCGs in Kenya, with specific reference to Unilever and L'Oréal East Africa. The conclusions of the study and recommendations from the study are also included in this section.

5.2 Summary findings

The rate of Industry 4.0 adoption differs between Unilever and L'Oréal. Noteworthy, L'Oréal is at the forefront of implementing Industry 4.0 technologies. The company has a clear strategy for Industry 4.0 implementation that is purchasing new technologies and creating an employee training program to help them learn how to use the devices. Conversely, there is low awareness of Industry 4.0 technologies in Unilever. Moreover, the company has not communicated its technological plan to employees. However, Unilever routinely organizes technology training for employees focusing on the use of modern technology applications in different departments. These findings prove that Industry 4.0 adoption is still low in African countries.

The leading Industry 4.0 technologies incorporated in the two companies are cloud computing, big data and analytics, and barcode scanners. The companies are in the initial stages of integrating the other Industry 4.0 technologies in their operations, including IoT, sensors, drones, autonomous robots, and horizontal and vertical system integration. However, it is essential to note that both companies are yet to adopt AR, including smart glasses and gloves, and simulation technologies. These technologies are used in all the organizational departments, including production, human resource management, warehouse management, finance, and quality improvement.

There is a significant positive relationship between Industry 4.0 technologies and operational performance in Unilever and L'Oréal. Industry 4.0 technologies improve product quality by minimizing production errors, product standardization and customization of orders to meet consumers' needs. The majority of the research respondents strongly agreed that Industry 4.0 technologies improve the delivery lead-time by collecting essential information predicting customer demands, reducing production period and minimizing time wastage within the supply

chain. Also, these technologies give organizations volume flexibility by making it easy to adjust production capacity upwards and downwards, while maintaining a high level of delivery dependability. Also, the study revealed that Industry 4.0 technologies improve productivity levels, while at the same time reducing the product lead time.

5.3 Conclusion

The study concludes that Industry 4.0 positively impacts operational performance for FMCGs manufacturers. The operational performance measures of Unilever and L'Oréal East Africa, including product quality, delivery lead-time, flexibility, delivery dependability, production lead time, and productivity levels remarkably improved with the implementation of Industry 4.0 technologies. The improvement in operational performance is attributable to the key advantages of Industry 4.0 technologies, including the collection of big data about the supply chain, eliminating errors, increasing visibility of the supply chain, improving operational efficiency, employee motivation, and customization of orders. As a result, Industry 4.0 technologies help Unilever and L'Oréal East Africa to fulfill the customers' demands by ensuring the availability of products in the market.

5.4 Recommendations

However, the adoption of Industry 4.0 technologies in Unilever and L'Oréal is still slow. The companies can improve the integration of the technologies in their operations by developing an updated industry 4.0 implementation plan and communicate the information to employees to improve their readiness for the change. Also, they need to develop effective strategies to overcome the challenges of Industry 4.0 implementation including employees' resistance, high cost of the technologies, and lack of qualified personnel to use the applications. Lastly, the companies should create formal Industry 4.0 training programs for the employees.

5.5 Limitation of the study

The study faced two major limitations. Foremost was the lack of previous studies on Industry 4.0 adoption in Kenya to provide a foundation for the research. The study explores a new area of technology adoption in organizations. Secondly, the study was limited to people working in Unilever and L'Oréal East Africa, thus the findings cannot be generalized to all the other manufacturing companies in the country.

5.5 Suggestions for further studies

Future studies should focus on identifying the benefits of Industry 4.0 on FMCGs in the market. The benefits should go beyond better operational performance by focusing on other metrics of organizational performance. Secondly, future studies are required to identify the challenges of Industry 4.0 use in organizations.

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APPENDICES

APPENDIX 1: INTERVIEW GUIDE

1. Are you aware of Industry 4.0?
2. Has the company adopted Industry 4.0 or made plans for future implementation?
3. Has the organization implemented the following Industry 4.0 technologies and how are they used?
 - a. Big Data and Analytics
 - b. Augmented Reality (IR)
 - c. Horizontal and vertical system integration
 - d. Cloud computing
 - e. Simulations
 - f. Radio Frequency Identification (RFID)
 - g. Internet of Things
4. Describe the benefits of using each of the Industry 4.0 technologies in the company
 - a. Big Data and Analytics
 - b. Augmented Reality (IR)
 - c. Horizontal and vertical system integration
 - d. Cloud computing
 - e. Simulations
 - f. Radio Frequency Identification (RFID)
 - g. Internet of Things
5. What are the measures of operational performance in the company?
6. How does the use of Industry 4.0 affect the operational performance of the company?
7. What are the challenges of implementing Industry 4.0 in the organization?
8. What is the future of Industry 4.0 in the company?