INFLUENCE OF AUTOMATED QUEUE MANAGEMENT SYSTEM OPTIMIZATION ON PERFORMANCE OF NATIONAL CEMENT COMPANY LIMITED

John Kiplagat
Master of Information Communication Technology Management, Jomo Kenyatta University of Agriculture and Technology, Kenya

Dr. Peter Waweru Kamaku
Jomo Kenyatta University of Agriculture and Technology, Kenya

Dr. Samson Nyang'au Paul
Jomo Kenyatta University of Agriculture and Technology, Kenya

International Academic Journal of Information Systems and Technology (IAJIST) | ISSN 2518-2390

Received: 4th October 2020

Published: 17th October 2020

Full Length Research

Available Online at: http://www.iajournals.org/articles/iajist_v2_i1_221_244.pdf

Citation: Kiplagat, J., Kamaku, P. W. & Paul, S. N. (2020). Influence of automated queue management system optimization on performance of National Cement Company Limited. *International Academic Journal of Information Systems and Technology*, *2*(1), 221-244

ABSTRACT

Manufacturing firms in Kenya operate at low technical efficiency, raising doubts about the sectors' capacity to meet the goals of Kenya's Vision 2030. They experience unregulated traffic movement, willful delays, and time wastage and inefficiency due to low adoption of technology. The study aimed to determine the Influence of automated Queue Management System Optimization on the performance of National Cement Company Limited in Kenya. Therefore, the specific objectives of the study were; to determine the influence of reliability and flexibility level; security Level; and staff training on automated Queue Management systems on the performance of the National Cement Company. Data was collected using a questionnaire and interview guide among 105 staff of the company. Both qualitative and quantitative methods were used to analyse the data. The findings revealed a positive and significant correlation between the independent variables and the dependent variable. The study, therefore, concluded that reliability and flexibility level; security level and staff training positively influence the performance of the National Cement Company. Consequently, it was recommended that the company enhance the reliability and flexibility of the automated systems; enhance the security level at the IT department, and regularly train their staff on basic and advance ICT skills. This will ease the use of the queue management system. Besides, it was recommended further studies to be done to establish other factors that influence the performance of the National Cement Company and further studies to be conducted in other organizations.

Key Words: *automated queue management system, optimization, performance, National Cement Company Limited*

INTRODUCTION

In the United Kingdom for example in the past five years, manufacturing companies have been facing difficulties of lengthy queues. These problems often occurred in the ports when collecting and dropping cargo, border crossings, weighbridges, toll stations, and truck movement in manufacturing industries and it became worsen when the time reaches peak hour (Chang, 2016; Islam, & Olsen, 2014; Morrell, 2016). Thus, a queue management system must handle and organized queue formation in the most efficient way. Queues are very common in computer systems. It helps in calculating the service facilities with one and more than one server. Once a customer is served in the queuing system, he leaves. If the system service is busy, then the customer directly goes into the waiting system of computers. In the waiting area there are display systems which are ideal for managing truck queues in congested environments like fuel depots, ports, and warehouses (Richards, 2017; He, & Chen, 2018; Preece, Rogers, & Sharp, 2015, & Smith, & Kerbache, 2017).

In the United States, Queue management systems have reported maintaining a queue with order and efficiency using Electronic Quality Control (EQC) system-1 and Electronic Quality Control (EQC) system-2 with display components. Some systems also use an automatic moving belt at the entry queue and at the site/service window on which people can stand and can go comfortably till the exit point without any chaos. The software program running in the

controller associated with the waiting queue belt works as an object detection or human presence detection module (Bylayat, Nahid, Moqbull & Habibur, 2011; & Ahmed, & Huda, 2011).

Further, in India, the adoption of queue management has seen gate-in to gate-out time reduced by almost 50%, parking yard detention reduced by almost 30-40% due to improved scheduling and the parking yard became congestion-free due to quick loading and exit of truck. Cement manufacturing has integrated Radio-frequency identification (RFID) technology to ease the daily activities of the cement manufacturing companies (Indian cement review, 2015). Trips are allotted automatically based on immediate truck availability at the loading bay through alerts sent to drivers and their prompt response, thus preventing non-productive hold-ups during loading. Each trip is automatically generated when the tagged truck is detected through RFID at loading and completed when its tag is read at the destination. Real-time mapping data from company-owned trucks is uploaded to the central server via General Packet Radio Service (GPRS) (Essen, 2018).

In Nigeria, manufacturing industries have developed one method of truck selection which involves the application of queuing theory to the haul cycle. Queuing theory was developed to model systems that provide service for randomly arising demands and predict the behaviour of such systems. A queuing system is one in which customers arrive for service, wait for service if it is not immediately available, and move on to the next server once they have been serviced. For modelling truck-shovel systems in a mine, haul trucks are the customers in the queuing system, and they might have to wait for service to be loaded and wait at the dumping locations (Okoro, 2016).

One of the major issues in the analysis of any queuing system is the analysis of delay. Delay is a more subtle concept. It may be defined as the difference between the actual travel time on a given segment and some ideal travel time of that segment. This raises the question as to what the ideal travel time is. In practice, the ideal travel time chosen will depend on the situation; in general, however, two travel times seem best suited as benchmarks for comparison with the actual performance of the system. These are the travel time under free-flow conditions and travel time at capacity. Most recent research has found that for highway systems, there is comparatively little difference between these two speeds. That being the case, the analysis of delay normally focuses on a delay that results when demand exceeds its capacity; such delay is known as queuing delay and maybe studied using queuing theory. This theory involves the analysis of what is known as a queuing system, which is composed of a server; a stream of customers, who demand service; and a queue, or line of customers waiting to be served (Kushner, 2013).

In Egypt, there is a comparison between Petri net (PN) and queuing network tools to determine the optimum values for a flexible manufacturing system (FMS) measure of performance. The queuing theory was presented by Tsarouhas (2011) to calculate the total processing time for the processing time per pizza line at the workstation in food production lines. McGuire (2010) proposed and tested a model that defines the psychological processes that mediate the relationship between perceived wait duration (PWD) and satisfaction. Caputo and Pelagagge

(2011) reported that of the scarce literature existing on modelling material delivery to assembly lines, kitting has received greater attention. However, most available models utilize queuing theory to analyze dynamic performances of kitting systems and kit-replenished assembly systems. Mehmood and Lu (2011) reported that Markov chains and queuing theory are widely used analysis, optimization, and decision-making tools in many areas of science and engineering. Real-life systems could be modelled and analysed for their steady-state and time-dependent behaviour. Diaz (2010) presented financial engineering derivative interest rate swap as well as new scheduling applications including inventory management and queuing models.

In South Africa, the Markov chain has been applied extensively in manufacturing. The Markov chain has been extensively presented as the best approach to model the non-deterministic cases. Pillai and Chandrasekharan (2008) discussed the material flow of production systems at the absorbing state of the Markov chain characterized by the uncertainty of scrapping and reworking tasks. According to the fact that the arrival and service rates are usually exponentially distributed, a service delivery system can be handled using a combination of a Markovian approach and queuing theory. Industrial performance on service delivery systems, such as restaurants, emergency departments, and airport checking terminals are faced with the tough task of processing an increasing demand of customers. At the same time, customers must decide finally either to accept or reject. Authors observed that a longer delivery time leads to a lower price. The reason for this reduction is possibly the leave of customers or the rejection of the service after a long waiting time.

In Kenya, there are seven cement manufacturing firms namely: Bamburi Cement Limited, East African Portland Cement Company, Athi River Mining Cement Manufacturing Company, Mombasa Cement Company, Savannah Cement, Ndovu Cement Company Limited, and National Cement Company Ltd. More than 90% of all cement manufacturers in Kenya today are located within Machakos County and mainly in the Athi River. The establishment of these firms in the Athi River area is due to several reasons among them being; a ready market, cement ready market in Nairobi and Machakos among many other adjacent towns in Kenya, infrastructure in form of roads running from Mombasa to the hinterland, including Rwanda and Southern Sudan, there is also the railway line, relatively cheaper land in Athi River and the black cotton soil not suitable for agriculture. Besides, there is an abundance of pozzolana, the bluestone used for building which is an ingredient in the final stage in grinding cement. Gypsum, also an ingredient for the final mix, is also readily available from Kajiado, Isinya and Konza nearby, and the improvement of the roads in the area has helped to ensure easy transport, there is no doubt that cement companies in this part of Kenya will always continue to flourish (KAM, 2013).

Manufacturing has the potential to advance socio-economic development through increased and diversified exports reduced import bills, and enhanced employment creation. As such, policy interventions towards promoting the competitiveness of the manufacturing sector should aim at strengthening technology transfer and innovation. Interestingly, deliberate and smart adoption of ICT into key areas in manufacturing including supply chain reduce if not eliminate these factors that reduce competition, but also ensure the implemented strategies are effective to yield the desired results (Omae & Ateya, 2011). The current study focused on the benefits

of such ICT technology in the cement manufacturing by assessing the influence of queue system optimization on the performance of national cement company limited (Miriti, Wanjau & Omondi, 2018).

STATEMENT OF THE PROBLEM

Manufacturing firms in Kenya operate at a technical efficiency of about 59 percent compared to their counterparts in Malaysia that average about 74 percent (Achuora, Guyo, Arasa, Odhiambo, 2015), raising doubts about the sector 's capacity to meet the goals of Vision 2030 (RoK, 2007). They are faced with unregulated traffic movement, willful delays, and time wastage and inefficiency. This is because the level of technology adoption by cement manufacturing companies in Kenya is still very low (Nyori & K'Obonyo, 2015). Besides, few studies have been done addressing the issue. For example, Cachon and Zhang (2006) considered a model with two servers where the demand allocation was distributed according to their performance. Bowling et al. (2004) used the Markov chain approach to study the optimal process means for multi-stage production systems. Ray and Jewkes (2004) introduced a model to study the effects of demand and price in service delivery systems. They claimed that this model can enhance the ability to utilize the capacities of servers and then increase throughput. This study sought to analyze the influence of Queue management system optimization on the performance of the national cement company limited in Kenya to shade more light on the issue.

GENERAL OBJECTIVE

The general objective of this study is to determine the influence of automated Queue Management System Optimization on the information technology performance of National Cement Company Limited in Kenya.

SPECIFIC OBJECTIVES

1. To determine the influence of reliability and flexibility level of automated Queue Management System on the Performance of the National Cement Company.
2. To analyse the influence of the security Level of the automated Queue Management System on the Performance of the National Cement Company.
3. To determine the influence of staff training on automated Queue Management systems on the performance of the National Cement Company.

THEORETICAL FRAMEWORK

Process Theory

The application of process theory on information technology and the business value was initially proposed by Soh and Markus (2012). Their process theory model suggests that investments in IT projects, applications, and skill bases represent the creation of IT assets in an organization. Successful deployment of IT assets leads to redesigned processes, improved

decision-making, and improved coordination. The model further argues that IT infrastructure, rather than directly impacting aggregate firm performance, may instead support critical processes that improve firm performance. The process theory view of IT payoff is that firms derive business value from intermediate operational and management processes. As IT continues to permeate the organization, the authors argue, automation has a greater impact on the processes and eventually on the organization.

Complementing the process theory models were the findings of Barua, Sophie Lee & Whinston, (1996) who presented a theory of business value complementarity. Using the process model the authors argue that the value of having more of one-factor increases by having more of another complementary factor. The authors suggest that organizational payoff is maximized when several factors relating to IT, organizational structure, business processes, and incentives are changed in a coordinated manner in the right direction by the right magnitude to move toward an ideal design configuration.

Applying the process theory to the notion that IT exerts indirect effects on firm performance via process variables, the current study proposes that automation of the queue system using RFID technology cannot succeed if done in isolation. Thus, even with the automation of the queue system performance of national cement company limited may differ depending on other factors such as human resource development among others. The theory is therefore significant and relevant to these study findings since it elaborates investments on IT staff training and its influence on National Cement Company limited performance.

Information Theory

The theory was originally proposed by Shannon in the 1940s as a mathematical theory of communication to deal with problems of transmission electrical engineering. According to Beckstead and Beckie (2011), the central issue of focus in this theory is quantity information and uncertainty. According to Budd (2010) anything that would be information is communicative and inherently includes exchange. Budd (2010) posits that exchange requires real language, signs, and the act of communicating entails as an intentional purpose and connects human and organization intentionality to the construction of informative actions for the benefit of all players. Related to information theory is the Signaling theory which assumes that information is not equally available to all parties at the same time leading supply chain disruptions.

The interdependence nature of tasks performed by supply chain participants and interactions among organizations creates uncertainties to which organizations must respond (Cegielski, Jones-Farmer, Wu, & Hazen, 2012). Among departments that participate in supply chain management, there is a requirement for information sharing, collaboration, and connectivity if firms are to perform at an optimal level (Sanders, Autry & Gligor, 2011). Uncertainty is a major factor among supply chain members as it creates a gap of disconnect between the information available and the information available for decision making in business organizations. Uncertainty being a state of limited knowledge in which it is not possible to exactly describe possible future outcome with certainty (Hubbard, 2010) creates a fertile ground for the

bullwhip effect along the supply chain. The theory is significant and relevant to these study findings since it provides a basis for how a queue management system provides reliable information that ensures free information flow and firm performance. It also shows how information flow is linked to the performance of the company.

Expectancy Theory

The expectancy valance theory was proposed by Vroom in 1964. As a behavioral motivational theory, it explains why actors make decisions and assert that behavioral choices are a function of the expectancy-the probability of realizing the desired outcome, and valance-the value attached to the desired outcome (Chen, Ellis & Holsapple, 2015). It holds that behavioral choices are dependent upon the motivational force which is a function of the valance of anticipated outcome (Pinder, 1984). It is premised on the understanding that individuals adjust their behavior concerning anticipated satisfaction of valued goal, usually, the highest positive or lowest negative motivational force, and performance is influenced by expectations concerning future events (Chen, Ellis & Holsapple, 2015). Drawing on expectancy theory, cement manufacturing firms comprises of rational, thinking, reasoning individuals who make choices in a way that maximizes expected utility (Vroom, 1964), and the monetary gains from the supply chain automation initiatives are anticipated future outcome that can motivate the firms to perform.

This theory aligns itself with the automation of queuing system initiatives with expected and anticipated outcomes. The ability of the cement manufacturing firms to adopt automation in their supply chain processes determines the firms' future success (Zaniboni, Fraccaroli, Truxillo, Bertolino & Bauer, 2011). The theory is significant and relevant to these study findings since it offers useful insights into the flexibility and reliability of queue management systems. The expectancy in this study represents flexibility and reliability and the valance is the desired performance of National Cement Company Limited.

Queuing Theory

Queuing theory was engineering by Erlang in 1909. Queuing theory has been developed largely in the context of telephone traffic. Queuing theory is a branch of applied probability theory used to describe the more specialized mathematical models for waiting for lines or queues. Assumptions of queuing theory are that it uses Queuing models to represent the various types of Queuing systems that arise in practice. The models enable finding an appropriate balance between the cost of service and the amount of waiting. Queuing models find applications in a wide variety of situations that may be encountered in health care, engineering, and operations research (Gross and Harris, 1998).

Critics show that queuing networks find a wide application in many spheres of life such as manufacturing systems, computer networks, telecommunications, transport, logistics, and the like. A series of interconnected stations for serving in which each user, after departing from a station, can pass into another one or exit from the whole system is called the networked queuing system. The probability and statistical methods are the most frequently used tools for system

performance determination. Queuing systems can be described as called upon by entities (users) who ask for services. In each serving system, we can distinguish the arrival process, service process, and one or more service stations or servers. The general assumption is that one station cannot at the same time serve two or more arrival entities. If the station is busy, the user must wait for the service. At the very moment when the station becomes free, the entity is taken over from the queuing according to the pre-defined rules – discipline in the queues – and its service is done. During the service, the entities can pass from one or more service states before departing from the system.

Queues are usually characterized by the arrival pattern (Poisson, deterministic or a general distribution), Service pattern (constant, exponential, hyper exponential, hypo-exponential or general distribution), number of servers (single server or multiple servers), maximum system capacity (number of customers in a system can range from one to infinity), population size (queue can have infinite or finite length) and queue discipline (order of service delivery can be First In First Out (FIFO), random order, Last In First Out (LIFO) or priorities). To incorporate these features, Kendall (1953) introduced a Queuing Notation A/B/C/X/Y/Z in where: A is the inter-arrival time distribution, B is the service time distribution, C is the number of servers, X is the system capacity, Y is the population size and Z is the queue discipline.

Queuing theory is important to the study since it aligns itself with the reliability of the automated queue management system. The ultimate objective of the analysis of queuing systems is to understand the behavior of their underlying process so that informed and intelligent decisions can be made by the management. The application of queuing concepts is an attempt to minimize cost through minimization of inefficiency and delays in a system. Various methods of solving queuing problems have been proposed.

EMPIRICAL REVIEW

Influence of Reliability on Automated Queue Management System Performance

The reliability of the Queue management system focuses on the reliability of the technology used. The main focus is on the ability of readers to identify codes from tags for the first-time using RFID. The potential interferences of barcodes make optical barriers such as objects placed between barcode and reader or dirt. Also, they are unreadable under extreme atmospheric conditions such as steam or when vertical damage occurs. Barcode readers are sensitive to dirt, dust, or another foreign object obstructing the lens. But 2D barcodes can be read even if part of the tag is destroyed. Passive RFID tags can interference with environments or fields and various materials such as liquids and metals that affect the transmission of radio frequency (Nayak, Singh, Padhye & Wang, 2015).

Active tags are less susceptible to interference. Despite this, they can be read under extremer weather conditions than barcodes. It is not clear whether tags, that could not be read, can be entered manually as barcodes. Reliability seems to be solved these days by knowing RFID physics (Schlosser, 2004). But there is no universal solution for the implementation of RFID based queue management systems at all. It is always necessary to fit based queue management

systems to meet company needs as far as 100 percent reliability. And because there are numerous types of RFID tags the selection of proper RFID tag systems is essential. It is better to start with smaller projects and obviously in detail defined problems rather than to fail (Sweeney, 2005).

The reasons why the reliability of RFID based queue management systems became important are at most actual and are implicitly involved in numerous polemics about the security and reliability of RFID based queue management systems (Karygiannis, Eydt, Barber, et al., 2007; Rieback, Crispo, & Tannenbaum, 2006a; Thorton et al., 2006; Wyld, 2005; Rieback, Crispo, Tanenbaum, 2006b; Macaulay, Abeysinghe, 2004; Bono, 2005). Explicitly we can see the reasons in existing precedence about potential serious impacts that are mentioned later in this chapter (Shepard, 2005).

Obe (2017) found out that the Automation of queuing management system showed good reliability. Two of them are related to the increased abilities of security and reliability of the identification systems. These two properties of identification technologies are equally important for their use in supply chain management (Vladimír 2010). According to Mattii (2017), reliability can be increased through engineering and redundancy techniques.

Rahmati, Zhong, Hiltunen, and Jana, (2007) found out that the reliability of tag identification is affected by several factors, including the inter-tag distance, the distance between the tag and antenna, the orientation of the tag concerning the antenna, and the location of the tag on the object. The reliability of RFID based queue management system reliability can be significantly improved with the application of simple redundancy techniques (Rahmati et al., 2007). Naresh (2007) found out that a radical decrease in the readability of tags, while the numbers of the tools are increased gradually. And, when the tools were taken across the RFID portal with gradual increasing velocity, the readability reduced. These results prove that both the tested parameters influence the reliability of RFID based queue management technology for tool tracking. Modrák and Knuth (2009) reported that RFID technology has several advantages for managing and collecting object's data or tracking it as it moves through the supply chain (SC). The research findings therefore intents to determine the reliability of the queuing system used in cement manufacturing companies.

Influence of Security Level on Automated Queue Management System Performance

Security of RFID based queue management system in supply chain management can be seen from many aspects including inventory location, privacy issues, third-person attacks, software and hardware protection, encryption, and tracking the origin of goods (very important for food safety) (Modrák, & Knuth, 2009). The system security threads can be classified as sniffing, tracking, spoofing, denial of service, or replay attacks. In the field of cryptography new low-power algorithms like stream ciphers (Finkenzeller, 2003), block ciphers (Feldhofer, Dominikus, & Wolkerstorfer, 2004), lightweight protocols for authentication (Vajda & Buttyan, 2003), and public key cryptographic primitives have been created. Other techniques like trusted RFID readers or access control mechanisms that are located either on a tag like hash locks (Weis, Sarma, Rivest, & Engels, 2004) pseudonyms (Juels, 2004) or of the tag can

prevent unauthorized threats and attacks too. Off the tag RFID access control mechanisms are RFID Guardian (Rieback, Gaydadjiev, Crispo, et al., 2006), RFID Enhancer Proxy (Juels, Syverson, & Bailey, 2005), The Blocker Tag (Juels, Rivest, & Szydlo, 2003) and FoeBud Data Privatizer. The easiest way remains to deactivate the RFID tag permanently through "frying," "clipping" (Karjoth & Moskowitz, 2005), or "killing," or temporarily using sleep/wake modes (Spiekerman & Berthold, 2004) or Faraday cage.

Porter and Heppelmann, (2015) reported that until recently, IT departments in manufacturing companies used to be responsible for safeguarding the firms' data centers, business systems, computers, and networks. However, with the introduction of the Smart Industry whereby products and machines become smart and part of a digital network where data is shared via internet applications, the game changes dramatically. All smart connected devices or machines may be a point of network access and form a source of cyber risk. Cyber risk can be defined as: "a multitude of different sources of risk affecting the information and technology assets of a firm" (Biener, Eling, & Wirfs, 2015). The identified sources of risk can be grouped in hacker attacks, virus transmissions, and data breach, and cyber extortion. Hackers can among others take over the control of a product (e.g. car or aircraft), change specifications of products, or tap sensitive data that moves between the manufacturer and customer. The increased risk of cyber-attacks drives companies to develop contingency plans to mitigate their exposure. Important is to have up-to-date machines and IT-infrastructure, since outdated software increase the risk of cyber-attacks. Furthermore, key assets and core processes should be prioritized and protected accordingly, and regular training and simulations should be given to facilitate short-term reactions to cyber-attacks (McKinsey Digital, 2015). Next to that, to guarantee data privacy for customers, data policies must reflect government regulations and transparently define the type of data collected and how it was used internally and by third parties (Porter & Heppelmann, 2015).

Arslan, Kardaş, Çolak, and Ertürk (2018) noted that the use of RFID based queue management technology is increasing across a range of different industries, the associated security and privacy issues need to be carefully addressed. Because RFID tags come in different flavors, there is no overall, generic RFID security solution. Some low-cost passive and basic tags cannot execute standard cryptographic operations like encryption, strong pseudorandom number generation, and hashing. Some tags cost more than basic RFID tags and can perform symmetric-key cryptographic operations. Organizations wishing to use RFID technology need to therefore evaluate the cost and security implications as well as understand the limitations of different RFID technologies and solutions. Xiao, Gibbons, and Lebrun (2009) assert that security has not historically been the focus of technology standards for RFID based queue management systems and their components. With the increasing usages of RFID in the manufacturing industry potential security threats and compliance risks in the future are enormous. It is necessary to pay attention to the standardization of RFID based queue systems.

Borgohain and Sanyal, (2015) noted that Radio Frequency Identification based queue technology system still has a long way to go for mainstream adoption due to its several drawbacks in terms of security. Adoption of security measures by compromising its re-writable feature or any of its other features brings down the whole technology to the level of the existing

technologies like bar code and in the same way retaining the various features of RFID at the cost of its security makes the technology less favorable for adoption in the market. As such development of specific measures that address its security drawback without compromising its various features should be pushed forward for a sustainable future of this technology on the mainstream market.

Influence of Flexibility Level of Automated Queue Management System Performance

Flexible queuing systems arise in a variety of contexts, including manufacturing (Liberopoulos, Papadopoulos, Tan, Smith & Gershwin, 2006), telecommunication networks computer systems, and service operations. In manufacturing, there is often flexibility in routing jobs to functionally equivalent machines or production lines. These machines may vary by speed or cost. In telecommunication, flexibility arises from the availability of multiple links to which incoming calls can be routed. Different links may carry different capacities or provide different response times (Altiok, 2012). Similar issues arise in large computer systems with multiple users and multiple servers. The flexibility derives from the ability to dynamically route users to different servers and to share computing capacity among different customers (Davis, & Borland, 2018).

Mindila, Rodrigues, McCormick, & Mwangi (2016) argued that by treating strategic flexibility as queue systems provides a methodology within which models based on known theories in strategic management are employed and tested using system dynamics. Mindila et al., (2016) presents ICTs as interventions at the influence points and presents a generic strategic flexibility system dynamic model that brings to play the impact of ICT. Vatankhah (2013) reported that RFID-enabled manufacturing systems using Unified Modeling Language (UML) diagrams that ensure systems integration with more flexibility and reconfigurability, using efficient algorithms and effective tools and applications for implementing RFID-enabled architecture for the FMS.

According to Zhou, (2003), Liu, Zhang, Ni, & Tseng, (2004) reported that Multi-agent systems (MASs) for resolving centralized manufacturing control problems have drawn wide interest in many kinds of literature (Zhou, 2003). It provides more flexibility and quicker reactions to the control systems in a dynamic changing environment such as mass customization manufacturing environment. A flexible system is a manufacturing system in which there is some amount of flexibility that allows the system to react in the case of changes, whether predicted or unpredicted. This flexibility is generally considered to fall into two categories, which are further divided into numerous subcategories. With the increased competition in the marketing world, flexibility is essential for a manufacturing company. Mostly manufacturing system managers do not understand the significance of FMSs with a discrete material-handling device (MHD). The success or failure of managers in directing the production rate depends largely on his ability to understand the financial aspects of their jobs (Jain, Maheshwari, & Baghel, 2008).

Vlad, Graur, Turcu, & Popa, (2009) reported that the introduction of RFID technology in the manufacturing environment provides the basis for implementing much more agile systems by providing continuous, real-time information relating to the movement of physical items. The

components traceability, enabled by RFID technology, may be used to increase the degree of automation of the system calibration process at the shop floor level.

An interesting aspect relating to the calibration process of a complex reconfigurable system is how to automatically determine the production facility's positions and the optimum routes between them, especially when the system is consisting of a big number of production facilities, routers, and switches (Vlad et al., 2009). An important attribute of the first come first serve queuing system is the flexibility it provides for adjusting the number of service providers as the demand for service provision increases during different times of the day (Hatzakis, Nair & Pinedo, 2010). Wachira (2013) state technology advancements offer banks the flexibility to select appropriate tools and applications that suit the different needs of customers. Remote queuing, which allows customers to join a queue from any phone or Internet-connected device (Robinson, Muller, Noke, Lim, Glausi, Cluff & Fullerton, 2012).

Influence of Staff Training on Automated Queue Management System Performance

The UNESCO (2008) ICT competency standards for personnel describe three approaches: technological literacy, knowledge deepening, and knowledge creation (Singh, 2010). These approaches are part of a development continuum, and each approach has different implications for the manufacturing industry, and changes in the queue system play a unique, but complementary role in logistics and supply chain management. The system requires new personnel roles and new strands for personnel education. Personnel development is seen as a crucial component here. It ideally coordinates personnel's sophisticated professional skills with the pervasive use of technology (Arrigo, 2018).

Digital competence is the most recent concept describing technology-related skills. During the recent years, several terms have been used to describe the skills and competence of using digital technologies, such as ICT skills, technology skills, information technology skills, 21st-century skills, information literacy, digital literacy, and digital skills (Ilomäki, Kantosalo, & Lakkala, 2011). Digital competence is grounded on basic skills in ICT, i.e. the use of computers to retrieve, assess, store, produce, present, and exchange information, and to communicate and participate in collaborative networks via the Internet (Maimone, 2018).

Digital competency represents a person's ability to perform tasks effectively in a digital environment; digital means information represented in numeric form and primarily use by a computer, and literacy includes the ability to read and interpret media, to reproduce data and images through digital manipulation and to evaluate and apply new knowledge gained from digital environments (Claro, Salinas, Cabello-Hutt, San Martín, Preiss, Valenzuela, & Jara, 2018). Digital competence consists of a variety of skills and competences, and its scope is in several areas: media and communication, technology and computing, literacy, and information science. Digital competence consists of 1) technical skills to use digital technologies, 2) abilities to use digital technologies in a meaningful way for working, studying, and for everyday life in general in various activities, and 3) abilities to critically evaluate the digital technologies, and 4) motivation to participate in the digital culture (Ilomäki, Kantosalo, & Lakkala, 2011).

According to Spillane (2018), institutions should allocate a reasonable budget for investing in ICTs development in its departments for ICT skills training of experts and employees, facilities and systems that fit the needs of those organizations. To accomplish this, a clear regulatory framework involving policies that support effective ICTs management systems development within the institution must be put in place. Al-Zahrani (2006) found out that the Civil Defense and Industrial Sector still fall short of achieving this target. The majority of the staff in the two sectors were not taking any courses in the use of ICT systems in emergency management. These issues include the quality of courses was insufficient to improve staff skills in using ICT systems, and ICT courses for use in emergencies were not available. The main aim of any organization is to provide enough staff training to enable them to use systems that embrace new technology effectively and efficiently. Therefore, the study sought to assess the role of personnel training on the queue management system and how it influences the performance of the National Cement Company.

RESEARCH METHODOLOGY

The study used descriptive research since it intended to describe the optimization of the queue management system in the National Cement Company. Creswell, (2012) pointed out that the main aim of a descriptive research design is to provide an accurate and valid representation of the factors or variables that pertain to or are relevant to the research question. He further adds that this kind of research is more structured. The target population therefore for the study included the heads of sections and staff working at National Cement Company Limited. Furthermore, the target population was narrowed down to staff working in National Cement Company limited located in Machakos County: operations management; logistics & transport. The population was divided into 9 strata to ensure equal representation and the sample size was at each stratum. For example, under, Admin=105(48/290) =17 respondents, Packing plant=105(97/290) =35 respondents and IT=105(3/290) =1 respondent. Simple random sampling was then used to select individuals in each department in the company. In this method, a list of all employees in the selected department was obtained from the human resource. The staff names were written to give every employee a chance to participate in the study, simple random sampling procedure without replacement was used to sample 17 respondents from 105 employees at admin, 35 respondents from 105 employees at the Packing plant, and so on. The respondents from this study, therefore, were 105 respondents. Two main instruments were used to collect data for the purposes of the study. An employee questionnaire was administered to collect staff opinions with regards to the queue management system and performance of National Cement Company Limited. Ahead of the section interview schedule was used to interrogate views of heads of sections involved in the supply chain for purposes of triangulating employees' views. Data that was collected from the staff within the selected departments were first coded and entered into the Statistical Package for Social Science (SPSS) Version 22. Next, data were screened and cleaned for missing values and outliers. The Statistical Package for Social Sciences (SPSS) generated descriptive statistics (Frequencies, percentages Means, and standard deviations). It also aided in calculating the inferential statistics (correlation analysis). The correlation analysis was used to measure the degree of relationship between the independent and dependent variables. The data for the qualitative

analysis was first transcribed and then initial codes are generated in a theory driven manner. The third step involved discovering recurrent themes among the codes and then a review of the themes was made to assess the evidence associated with respective themes. The themes selected were finally defined and named and triangulated with the results of the questionnaire. The multiple regression equation used for the study was as shown below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where: Y = Performance of National Cement Company; B0 = Constant; β1, β2, β3, β4, = Coefficients of determination; X1 = Reliability and flexibility level of automated Queue Management System; X2 = Security Level of automated Queue Management System; X3 = Staff training on automated Queue Management System; ε = Error term

RESEARCH RESULTS

Reliability and Flexibility Level

The first objective sought to determine the influence of reliability and flexibility level of the automated Queue Management System on the Performance of the National Cement Company. The results of the descriptive statistics show that most of the respondents strongly agreed with the statements posed concerning reliability and flexibility level as shown by a high aggregate mean of 4.60. Most respondents strongly agreed that the automated Queue Management System was working and ensure the reliability and flexibility of the queue management system in the National Cement Company during uptime and downtime for the last 5 years. They also strongly agreed that the turnaround time has been enhanced using an automated queue management system which takes less than an hour to process and loads a truck irrespective of size in the National Cement Company.

Besides, the majority of the respondents strongly agreed that the Queue Management System can respond to the changes of dispatch demand in the National Cement Company and that the Queue Management System can operate efficiently at different capacities of the number of tracks in National Cement Company Limited. Finally, most of the respondents strongly agreed that the Queue Management System effectively schedules the trucks in the national cement company limited. The results of the regression analysis revealed that there exists a positive and significant correlation between the reliability and flexibility level of automated Queue Management System on the Performance of National Cement Company.

Security Level

The second study objective sought to determine the influence of the security level of the automated Queue Management System on the Performance of the National Cement Company. The results of the descriptive analysis show that most of the respondents strongly agreed with the statements posed about security level as demonstrated by the high aggregate mean score of 4.45. The majority of the respondents strongly agreed that the access rights credentials present in the queue Management System have ensured the confidentiality of information in the

National Cement Company limited over the last five years. They further strongly agreed that there have been consistent controls of software and hardware access in the Queue Management computer systems over the past five years at national Cement Company limited.

Most of the participants strongly agreed that the encryption and tracking of goods in transit from national cement company limited has been enhanced using a queue management system over the last five years and that the security measures in the Automated Queue management system are adequate to prevent unauthorized access. Besides, most of the respondents strongly agreed that the queue management system has the ability to respond to the changes in demand and that the queue management system can operate efficiently at different capacities. Finally, most of the respondents strongly agreed that the Queue management system is designed in a way that can enable adjustments and other changes to the business process. The findings of correlation analysis revealed that there exists a positive and significant correlation between the security levels of the automated Queue Management System and the Performance of the National Cement Company.

Staff Training

The third objective sought to determine the influence of staff training of automated Queue Management System on the Performance of National Cement Company. The results of the descriptive analysis show that the majority of the respondents were in agreement with the statements posed concerning staff training. Most of the respondents agreed that they have been trained regularly on the importance and use of the queue management system in relation to company performance at National Cement Company Limited. Most of the respondents also agreed that their basic ICT skills developed with time through training at national cement company limited has eased their use of the queue management system.

Besides, most of the respondents strongly agreed that their ICT skills have advanced over the past five years through training at national cement company limited which has eased my use of the queue management; their experience using the automated Queue management system helps me to use the systems effectively to enhance company performance; and that their experience using the automated Queue management system helps me to use the systems effectively to enhance company performance. The results of the correlation analysis revealed that there exists a positive and significant correlation between the staff training of the automated Queue Management System and the Performance of the National Cement Company.

INFERENTIAL STATISTICS

Correlation analysis was performed to determine the correlation between reliability and flexibility level, security level, staff training, and performance of the national cement company. Pearson's product-moment correlation (r) was used to determine the relationship between the independent variables and the dependent variable to assess both the direction and strength. Each of the independent variables and dependent variables where correlation coefficient (r=between +1 and -1) measures the strength and direction of a linear relationship between each

of the independent variables and dependent variables. The correlation matrix is shown in Table 1.

Table 1: Correlation analysis matrix

		Performance	Reliability & Flexibility	Security Level	Staff Training
Performance	Pearson Correlation	1	.390**	.296**	.330**
	Sig. (2-tailed)		.000	.004	.001
	N	92	92	92	92
Reliability & Flexibility	Pearson Correlation	.390**	1	.474**	.037
	Sig. (2-tailed)	.000		.000	.725
	N	92	92	92	92
Security Level	Pearson Correlation	.296**	.474**	1	.332**
	Sig. (2-tailed)	.004	.000		.001
	N	92	92	92	92
Staff Training	Pearson Correlation	.330**	.037	.332**	1
	Sig. (2-tailed)	.001	.725	.001	
	N 92		92	92	92

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

The correlation analysis results presented in Table 1 shows that Pearson's correlation between Reliability and Flexibility and performance (r) = 0.390, which means the strength of the correlation is weak. The p-value is 0.000, which is less than the 0.01 significant level. Thus, there is a positive and significant correlation between the reliability and flexibility level of the automated Queue Management System on Performance of National Cement Company at r =0.390 and P =0.000. This implies that an increase in reliability and flexibility level of the automated management system leads to a significant increase in the performance of the National Cement Company. These findings support the findings by Obe (2017) and Mattii (2017) whose findings imply there is a positive relationship between reliability and performance.

The results show that (r) between Security Level and performance = 0.296. This implies that the strength of the correlation is weak. The p-value is 0.001, which is less than the 0.01 level of significance. Therefore, the findings revealed that there is a positive and statistically significant correlation between the Security Level of the automated Queue Management System on Performance of National Cement Company at r =0.296 and P = 0.001. This implies that an increase in the security level of the automated Queue Management System increases the performance significantly. This shows the importance of the security of the automated Queue Management System in the manufacturing company. This supports a previous study by Porter and Heppelmann, (2015) who noted that with the introduction of the Smart Industry whereby products and machines become smart and part of a digital network where data is shared via internet applications, the game changes dramatically.

Finally, the Pearson's correlation (r) between staff training and performance is 0.330. This implies that the strength of the correlation is weak. The p-value is 0.004, which is less than the 0.01 significant level. Therefore, the results of the correlation analysis revealed that there exists a positive and statistically significant correlation between staff training on the automated Queue Management System and the performance of the National Cement Company at r =0.330 and P = 0.004. This implies that the more staff are training on the automated Queue Management System, the more the company performance. It also means that staff training is a prerequisite for company performance. This supports a previous study by Claro et al., (2018), who found that digital competency represents a person's ability to perform tasks effectively in a digital environment.

A multi regression analysis was also conducted to test the predictive power among the variables of the study. The results of the regression analysis are presented in Table 2, 3 and 4.

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.502[a]	.252	.227	1.06077

The results presented in Table 2 show that the independent variables of the study, that is, reliability and flexibility level; security level, and staff training contribute to 25.2% of the performance of the National Cement Company as indicated by R Squared. This means that apart from the reliability and flexibility level and the security level of the systems, as well as staff training, other factors also determine the performance of the company.

Table 3: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.447	3	11.149	9.908	.000[b]
	Residual	99.020	88	1.125		
	Total	132.467	91			

The findings presented in Table 3 shows that the significant value of the model is 0.000. This means that model was statistically significant in predicting the way reliability and flexibility level, security level, and staff training influence the performance of the National Cement Company. The F critical at 0.01 level of significance is 2.58, but the F calculated is 9.908. The fact that the F calculated is greater than the F critical at a 0.01 level of confidence shows that the overall model of the study was significant.

The results presented in Table 4 shows the coefficient of the multi regression equation. Therefore, the equation; $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$ becomes

$$Y = 3.363 + 0.304\ X_1 + 0.010\ X_2 + 0.152\ X_3 + \varepsilon$$

Where: X_1 = reliability and flexibility level; X_2 = Security Level; and X_3 = staff training; and Y = performance of National Cement Company.

Table 4: Coefficient of determination

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	**3.363**	2.154		1.561	.122
	Reliability & flexibility	.304	.087	.371	3.508	.001
	Security Level	.010	.069	.016	.146	.884
	Staff Training	.152	.048	.311	3.149	.002

This regression equation implies that when all the independent variables are held constant at zero, the performance of the National Cement Company would be 3.363. This further shows that other factors contribute to the overall performance of the company. The equation also means that when other independent variables are held constant, a unity increase in reliability and flexibility would lead to a 0.304 increase in the performance of National Cement Company; a unit increase in security level would lead to a 0.010 increase in the performance of National Cement Company and a unity increase in staff training would lead to a 0.152 increase in performance of National Cement Company. Therefore, the most significant factor is reliability and flexibility level followed by staff training and then by security level.

CONCLUSIONS

The first objective sought to determent the influence of reliability and flexibility level of the automated Queue Management System on the Performance of the National Cement Company. The findings revealed that there is a positive and significant correlation between the reliability and flexibility level of the automated Queue Management System on the Performance of the National Cement Company. Therefore, it is concluded that the reliability and flexibility level of the automated Queue Management System positively influences the performance of the National Cement Company. This implies that an increase in the reliability and flexibility level of the automated Queue Management System leads to an increased in the performance of the company.

The second objective sought to analyze the influence of the security Level of the automated Queue Management System on the Performance of the National Cement Company. The results show that there is a positive and significant correlation between the security Level of the automated Queue Management System and the performance of the National Cement Company. Therefore, it is concluded that the security level of the automated Queue Management System positively includes the performance of the National Cement Company. This means when the security level of the system is enhanced, the performance of the National Cement Company also increases.

The third objective was to determine the influence of staff training on automated Queue Management systems on the performance of the National Cement Company. The results revealed that there exists a positive and significant correlation between staff training on automated Queue Management System and the performance of the National Cement Company.

Therefore, it is concluded that an increase in staff training on automated Queue Management System also leads to increased performance of the National Cement Company.

RECOMMENDATIONS

The study concluded that reliability and flexibility level positively influence the performance of the National Cement Company. It is, therefore, recommended that the reliability and flexibility of the automated systems be enhanced to boost the performance of the company. The study also concluded that the security level of the automated Queue Management System positively influences the performance of the National Cement Company. Thus, it is recommended that the security level should be enhanced in IT departments in the National Cement Company, use of security systems this will safeguard the firms‟ data centers, business systems, computers, and networks. Lastly, the study found out that staff training positively influences information technology performance. Therefore, it is recommended that the National Cement Company should establish a company policy that ensures that they regularly train their staff on basic and advance ICT skills this will ease the use of the queue management system.

The performance of the National Cement Company and other manufacturing companies is crucial for the Kenyan government to achieve its vision in 2030. Therefore, it is recommended that the government establish a policy that would ensure that all manufacturing companies in Kenya adopt technology in their operations to enhance their operations and logistics.

REFERENCES

Ahmed, S. A. & Huda, K.T. (2011), Automatic Queuing Model for Banking Applications, Automated Queue Management System. *International Journal of Advanced Computer Science and Applications, 2*(7), 23-34

Altiok, T. (2012). *Performance analysis of manufacturing systems*. Springer Science & Business Media.

Al-Zahrani S., (2006). An Information Management System Model for the Industrial Incidents in Saudi Arabia: A Conceptual Framework Based on SDLC Methodology, *Journal of Computer Science 2*(5): 447-454.

Arrigo, E. (2018). The Key Role of Retail Stores in Fast Fashion Companies: The H&M Case Study. In *Contemporary Case Studies on Fashion Production, Marketing, and Operations* (pp. 121-137). Springer, Singapore.

Arslan, A., Kardaş, S., Çolak, S. A., & Ertürk, S. (2018). Are RNGs Achilles' heel of RFID Security and Privacy Protocols? *Wireless Personal Communications*, *100*(4), 1355-1375.

Ary, D., Jacobs, L. C., Irvine, C. K. S., & Walker, D. (2018). *Introduction to research in education*. Cengage Learning.

Barua, A., Sophie Lee, C. H., & Whinston, A. B. (1996). The calculus of reengineering. *Information Systems Research*, *7*(4), 409-428.

Beckstead, J.W. & Beckie, T.M. (2011). How Much Information Can Metabolic Syndrome Provide? An Application of Information Theory: Clinical Prediction Models, *Journal of Medical Decision Making, 31,* 79-92.

Beveridge, D.J., and Wang N., (2018) *Methods and systems that collect and manage latency data in an automated resource-exchange system.* U.S. Patent Application 15/637,943, filed March 1, 2018.

Bhandari, R. (2014). Impact of technology on logistics and supply chain management. *Journal of Business and Management, 2*(3), 19-24

Bi, H. H., & Lin, D. K. (2009). RFID-enabled discovery of supply networks. *IEEE transactions on engineering management*, *56*(1), 129-141.

Biener, C., Eling, M., & Wirfs, J. H. (2015). Insurability of Cyber Risk: An Empirical Analysis. *The Geneva Papers on Risk and Insurance Issues and Practice*, *40*(1), 131–158.

Blanchard B. S.., (2009). *Logistics engineering and management* (4ed.). Englewood Cliffs, N. J., Prentice-Hall.

Boddy, D., McCalman, J., & Buchanan, D. A. (Eds.) (2018). *The new management challenge: Information systems for improved performance*. Routledge.

Borgohain, T., & Sanyal, S. (2015). Technical Analysis of Security Infrastructure in RFID Technology. *arXiv preprint arXiv:1505.00172*.

Boschetti, L., Stehman, S. V., & Roy, D. P. (2016). Stratified random sampling design in space and time for regional to global scale burned area product validation. *Remote Sensing of Environment*, *186*(1), 465-478.

Brockmeier, O. (2000). *Automated Loading and Unloading of the Stratasys FDM 1600 Rapid Prototyping System* (Doctoral dissertation, Virginia Tech).

Bryman, A., & Bell, E. (2015). *Business research methods*. Oxford University Press, USA.

Budd, J. M. (2017). *Six Issues Facing Libraries Today: Critical Perspectives*. Rowman & Littlefield.

Busey, A. T., Chen, A. D., Jonas, I. U., Daniels, D. J., & Lamm, B. E. (2017). *U.S. Patent Application No. 15/691,626*.

Cegielski, C.G.L., Jones-Farmer, A., Wu, Y. & Hazen, B.T. (2012). Adoption of cloud computing technologies in supply chains: An organizational information processing theory approach, *International Journal of Logistics Management*, *23*(2), 184-211.

Chang, J. F. (2016). *Business process management systems: strategy and implementation*. Auerbach Publications.

Chaplin, D. D., Cook, T. D., Zurovac, J., Coopersmith, J. S., Finucane, M. M., Vollmer, L. N., & Morris, R. E. (2018). The Internal and External Validity of the Regression Discontinuity Design: A Meta-Analysis of 15 Within-Study Comparisons. *Journal of Policy Analysis and Management*, *37*(2), 403-429.

Chen, L., Ellis, S., & Holsapple, C. (2015). Supplier Development: A knowledge management perspective. *Knowledge and Process Management*, *22*(4), 250-269.

Chen, Y. C., Chu, C. N., Chen, R. S., Sun, H. M., & Ju, P. H. (2018). RFID-based bonded warehouse for Science Park. *International Journal of Radio Frequency Identification Technology and Applications*, *5*(1), 1-23.

Christensen, C. M. (2006). The ongoing process of building a theory of disruption. *Journal of Product innovation management*, *23*(1), 39-55.

Claro, M., Salinas, A., Cabello-Hutt, T., San Martín, E., Preiss, D. D., Valenzuela, S., & Jara, I. (2018). Teaching in a Digital Environment (TIDE): Defining and measuring teachers' capacity to develop students' digital information and communication skills. *Computers & Education*, *121*(1), 162-174.

Dakin, J. P., & Brown, R. G. (Eds.). (2017). *Handbook of Optoelectronics: Applied Optical Electronics (Volume Three)*. CRC Press.

Davis, M., & Borland, D. (2018). *U.S. Patent No. 9,876,735*. Washington, DC: U.S. Patent and Trademark Office.

Emerson (2018). *Manage Material Movement by Truck Syncade Logistics Truck Movement* Emerson Process Management.

Essen RFID (2018) *Global cement manufacturing company deploys an RFID-enabled* Truck Movement Optimization System

Fisher, W.P. Jr (2007). *Rasch Measurement Transaction.* Transaction of the Rasch Measurement SIG American Educational Research Association. Vol. 21 No.1, p. 1095

Ghazali Darusalam (2008). Validity and Reliability in Quantitative and Qualitative Studies. *Journal Institute Perguruan Islam. Apri*l

Golub, B., & McAfee, R. P. (2011). Firms, queues, and coffee break a flow model of corporate activity with delays. *Review of Economic Design*, *15*(1), 59-89.

Goluby, B. & Preston McAfeez, R. (2011), Firms, Queues, and Coffee Breaks: A Flow Model of Corporate Activity with Delays, *Springer-Verlag 15*(1),59-89.

Hackenbroich, G., Bornhövd, C., Haller, S., & Schaper, J. (2006). Optimizing business processes by automatic data acquisition: RFID technology and beyond. In *Ubiquitous and pervasive commerce* (pp. 33-51). Springer, London.

He, Q. C., & Chen, Y. J. (2018). Revenue-maximizing pricing and scheduling strategies in service systems with flexible customers. *Operations Research Letters*, *46*(1), 134-137.

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evidence-based nursing*, ebnurs-2015.

Hubbard, D. W. (2014). *How to measure anything: Finding the value of intangibles in business.* New York: John Wiley & Sons.

Hugos, M. H. (2018). *Essentials of supply chain management*. John Wiley & Sons.

Ilomäki, L., Kantosalo, A., & Lakkala, M. (2011). What is digital competence?. Linked portal.

Indian cement review (2015) *Fleet Management: Moving With Speed*

Islam, S., & Olsen, T. (2014). Truck-sharing challenges for hinterland trucking companies: a case of the empty container truck trips problem. *Business Process Management Journal*, *20*(2), 290-334.

Jain, M., Maheshwari, S., & Baghel, K. P. S. (2008). Queueing network modeling of a flexible manufacturing system using mean value analysis. *Applied Mathematical Modelling*, *32*(5), 700-711.

Jamshed, S. (2014). Qualitative Research Method-Interviewing and Observation. *Journal of Basic and Clinical Pharmacy. 5*(4):87-8.

Jisha P. S., Sasikumar R., and Antony J.K., (2013). Optimization OF Outbound Logistics System Of Cement Manufacturing Company *International Journal of Innovative Research in Science, Engineering and Technology*, *2*(1), 12-18.

Kim, B. (2018). *Supply Chain Management: A Learning Perspective*. Cambridge University Press.

KNBS (2018) Economic Survey (2009 and 2012)

Krejcie and Morgan M., (1970) *Educational And Psychological Measurement*, 30, 607-610.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and psychological measurement*, *30*(3), 607-610.

Lamm, T., & Elkind, E. N. (2018). Delivering the Goods: How California Can Create the Sustainable Freight System of the Future.

Lert Jr, J., (2017) *Automated system for transporting payloads*. U.S. Patent Application No. 15/699,700.

Lewis, P. W. A., & McKenzie, E. (2017). *Simulation Methodology for Statisticians, Operations Analysts, and Engineers (1988)*. Chapman and Hall/CRC.

Liberopoulos, G., Papadopoulos, C. T., Tan, B., Smith, J. M., & Gershwin, S. B. (2006). *Stochastic modeling of manufacturing systems*. Springer, New York, NY.

Liu, M. R., Zhang, Q. L., Ni, L. M., & Tseng, M. M. (2004). An RFID-based distributed control system for mass customization manufacturing. *International Symposium on Parallel and Distributed Processing and Applications* (pp. 1039-1049). Springer, Berlin, Heidelberg.

Mahulo E., (2015). *Supply Chain Management Practices And Performance Of Cement Companies In Kenya* (Masters Dissertation, COHred, supply chain management, JKuat).

Maimone, F. (2018). An Integrated Approach to Facilitate Knowledge Sharing Among and Beyond Cultural Barriers, Using Social Media. In *Intercultural Knowledge Sharing in MNCs* (pp. 157-189). Palgrave Macmillan, Cham.

Mangan J., (2012) *Global logistics and supply chain management* (2nd Ed.).New York: Wiley Publisher

Markus, M. L., Sia, S. K., & Soh, C. (2012). MNEs and information management: structuring and governing IT resources in the global enterprise. *Journal of Global Information Management (JGIM)*, *20*(1), 1-17.

Mattii H., (2017). *RFID Reliability*, Research Report 51st Meeting of the IIFIIP 10.4 WG

McFarlane, D., & Sheffi, Y. (2003). The impact of automatic identification on supply chain operations. *The international journal of logistics management*, *14*(1), 1-17.

McKinsey Digital. (2015). Industry 4.0 - how to navigate digitization of the manufacturing sector. *McKinsey & Company*, 1–62. https://doi.org/10.1007/s13398-014-0173-7.2

Michelman, P. (Ed.). (2018). *What the Digital Future Holds: 20 Groundbreaking Essays on How Technology Is Reshaping the Practice of Management*. MIT Press.

Mindila, A., Rodrigues, A., McCormick, D., & Mwangi, R. (2016). ICT Powered Strategic Flexibility System Dynamic Model: A Pillar for Economic Development in Micro and Small Enterprises. In *Geospatial Research: Concepts, Methodologies, Tools, and Applications* (pp. 967-987). IGI Global.

Miriti, J. K., Wanjau, K. L., & Omondi, H. R. (2018). Performance of Incubator Centre's in Kenya: The Pivotal role of Entrepreneurial Management. *International Journal of Research in Business and Social Science (2147-4478)*, *7*(1), 49-59.

Modrák, V., & Knuth, P. (2009). Security and Reliability of RFID Technology in Supply Chain Management. In *Encyclopedia of Information Science and Technology, Second Edition* (pp. 3377-3382). IGI Global.

Mohamud, A. A. (2016). Automated Queuing and The Experience Of Kenya Commercial Bank Retail Customers In Nairobi Kenya.

Morrell, P. S. (2016). *Moving boxes by air: the economics of international air cargo*. Routledge.

Mwangangi, P. W. (2016). *Influence of logistics management on the performance of manufacturing firms in Kenya* (Doctoral dissertation, COHred, supply chain management, JKuat).

Nardi, P. M. (2018). *Doing survey research: A guide to quantitative methods*. Routledge.

Naresh K., (2007). *Reliability Test of an RFID System For Tool Management On Construction Sites*, unpublished Master Of Science Thesis, Graduate Studies of Texas A&M University

Nargundkar, R. (2008) *Marketing Research: Text and Cases* 3rd edition, p.38

Nayak, R., Singh, A., Padhye, R., & Wang, L. (2015). RFID in textile and clothing manufacturing: technology and challenges. *Fashion and Textiles*, *2*(1), 9.

Ndung'u, N., Thugge, K., & Otieno, O. (2011). Unlocking the future potential for Kenya: The Vision 2030. *Office of the Prime Minister Ministry of State for Planning, National Development, and Vision, 2030*.

Niemi, T., Nurminen, J. K., Liukkonen, J. M., & Hameri, A. P. (2018). Towards Green Big Data at CERN. *Future Generation Computer Systems*, *81*(1), 103-113.

Njoroge K.G., and Kabare K., (2016). Role of fleet management on supply chain performance in logistics firms based in the Nairobi industrial area, Kenya, *the Strategic Journal of Business and Change Management, 3*(24), 402-425.

Nyori, G. M., & K'Obonyo, P. (2015). Advanced Manufacturing Technology Adoption in Manufacturing Companies in Kenya. *World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, *9*(10), 3601-3613.

Obe. O.O., (2017). Automated vehicle queuing management system, *International Journal of Scientific & Engineering Research*, *8*(8), 646-649

Omae, O., & Ateya, I. (2011). Use of ICT in Manufacturing to Achieve Vision 2030. *Sustainable Research and Innovation Proceedings*, *3*.

Porter, M. ., & Heppelmann, J., (2015). How Smart Connected Products are Transforming Companies. *Harvard Business Review*, 97–114.

Preece, J., Rogers, Y., & Sharp, H. (2015). *Interaction design: beyond human-computer interaction*. John Wiley & Sons.

Rahmati, A., Zhong, L., Hiltunen, M., & Jana, R. (2007). Reliability techniques for RFID-based object tracking applications. In *Dependable Systems and Networks, 2007. DSN'07. 37th Annual IEEE/IFIP International Conference on* (pp. 113-118). IEEE.

Rajiv B., (2011). Impact of Technology on Logistics and Supply Chain Management, *Journal of Business and Management, 1*(2) 19-24

Ramesh, B., Baul, U., & Srinivasan, V. (2016). An approach to bolster up the logistic link of the supply chain in cement industries through value engineering techniques. *Indian Concrete Journal*, 79, 128-138

Rao, J. N. (2015). *Small-Area Estimation*. John Wiley & Sons, Ltd.

Richards, G. (2017). *Warehouse management: a complete guide to improving efficiency and minimizing costs in the modern warehouse*. Kogan Page Publishers.

Robinson, J., Muller, P., Noke, T., Lim, T. L., Glausi, W., Cluff, J., & Fullerton, L. (2012). *U.S. Patent No. 8,117,281*. Washington, DC: U.S. Patent and Trademark Office.

Sanders, N.R., Autry, C.W. & Gligor, D.M. (2011). The Impact of buyer firm information connectivity enablers on supplier firm performance: a relational view. *International Journal of Logistics Management*, *22*(2), 179-201.

Sarah, A., & Year, I. (2003). Information technology & governance. *2nd Year NALSAR University of Law, Shamirpet*.

Singh, J. P. (2010). *United Nations Educational, Scientific, and Cultural Organization (UNESCO): creating norms for a complex world*. Routledge.

Smith, J. M., & Kerbache, L. (2017). Topological network design of closed finite capacity supply chain networks. *Journal of Manufacturing Systems*, *45*, 70-81

Spillane, J. J. (2018). Use Of Technology To Combat Poaching: Solution Or Problem? Unpublished Master of Business Administration Open University Of Tanzania

Truck Movement is a Logistics solution for managing material movement by truck (Emerson, 2018).

Vatankhah B.A., (2013). *An RFID-Based Distributed Control System for Flexible Manufacturing System*, unpublished Master of Science Eastern Mediterranean University

Vlad, V., Graur, A., Turcu, C. E., & Popa, C. (2009). Enhancing the flexibility of manufacturing systems using the RFID technology. In *Advanced Information Networking and Applications Workshops, 2009. WAINA'09. International Conference on* (pp. 630-635). IEEE.

Wachira (2013) state technology advancements offer banks the flexibility to select appropriate tools and applications that suit the different needs of customers

Xiao, Q., Gibbons, T., & Lebrun, H. (2009). RFID Technology, Security Vulnerabilities, and Countermeasures. In *Supply Chain the Way to Flat Organisation*. InTech.

Zaniboni, S., Fraccaroli, F., Truxillo, D. M., Bertolino, M., & Bauer, T. N. (2011). Training valence, instrumentality, and expectancy scale (T-VIES-it) Factor structure and nomological network in an Italian sample. *Journal of Workplace Learning*, *23*(2), 133-151