INFLUENCE OF ICT INFRASTRUCTURE ON KNOWLEDGE MANAGEMENT IN MANUFACTURING FIRMS IN UASIN GISHU COUNTY, KENYA

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Abstract

Knowledge has become a significant source of competitive advantage in today's knowledge economy. The objective of this research was to determine the influence of ICT Infrastructure on knowledge management in manufacturing enterprises in Uasin Gishu County. The sub-constructs of ICT infrastructure were digital information carriers, social-media, enterprise systems and Industry 4.0 technologies. The study was anchored on the Knowledge Based View theory of the firm. Literature evaluated indicated a beneficial association between ICT Infrastructure and knowledge management however, there were conceptual, contextual, and methodological gaps noted. Ex-post facto research design was used in this study. The target audience consisted of 142 managerial staff in 34 manufacturing enterprises encompassed in the Kenya Association of Manufacturers 2021 directory. A sample was chosen using a multistage random sampling process. In consequent sampling stages a formula devised by Miller and Brewer 2003 was used to derive an appropriate sample size. Structured questionnaires were

utilized whereas, face validity and content validity approaches were used in the validity tests. Reliability was checked using Cronbach's alpha whereas inferential statistics were used to test the hypothesis. The findings revealed that ICT infrastructure had a significant positive influence on knowledge management (β1=0.411, p=0.000). The study concluded that in order to remain relevant organizations should invest in ICT infrastructure and in particular those in use in the current 4th Industrial revolution. Finally, the study suggests that future researchers investigate the impact of ICT and other organizational practices on knowledge management in various industries in order to strengthen our country's economy.

Keywords: ICT Infrastructure, Digital information Carriers, Social media, Enterprise Systems, Industry 4.0 technologies, Knowledge Management

INTRODUCTION

Knowledge management is a critical source of success in organizations today. The business environment has become dynamic and volatile forcing businesses to compete on the basis of knowledge. Information Communication Technology (ICT) infrastructure on the other hand has become a critical enabler of knowledge management and its processes. The manufacturing sector in Kenya is one of the pillars of Kenya vision 2030, however it is seen as lagging behind compared to its international counterparts. Therefore, the purpose of this study is to determine how ICT infrastructure can be used in the manufacturing sector in Uasin Gishu County to improve knowledge management capabilities. The use of knowledge management is anticipated to produce superior benefits including increased productivity and improved capabilities like decision-making, intellectual leadership, innovation, growth and sustainability.

According to, Baharuddin, Izhar and Mohamad (2016) knowledge management commenced in Malaysia with the introduction of existing knowledge management methods, procedures, and applications by a few global corporations such as Microsoft and Helwett Packard (HP). Igbinovia and Ikenwe (2017) further claim that the 21st century has seen knowledge and knowledge management become an electromotive source of economic, social and educational advancement to any nation. The concept of knowledge is divided into two types. Tacit knowledge which exists in people's mind and gained from experience and explicit knowledge which is codified knowledge and processes, recorded in manuals and other repositories like journals, databases among others (Nonaka & Takeuchi, 1995). Knowledge management has been conceptualized differently by different scholars. This study will thus adopt the following meaning for knowledge management, that is, the process through which knowledge is captured, created, stored, shared and used in order to enhance decision making

and problem-solving capabilities (Dahri & Yunus, 2017; Cheruiyot, Jagongo, & Owino, 2012; Igbinovia & Ikenwe, 2017).

Industries and firms are increasingly adopting modern ICT infrastructure in order to enhance efficiency in knowledge management. ICT is defined as a wide range of computerized ICT infrastructure like computers and laptops, hand held devices, enterprise software, data storage, network and security which are crucial tools for advancing knowledge management and its processes (Hamad, 2018). Further, Bergeron, (2003) define ICT infrastructure as software in a network that support machine performance. In this study, ICT infrastructure has been adopted to mean all ICT hardware and software technologies and tools in use in today's organizations and more so in the manufacturing sector for knowledge acquisition, creation, storage and use. These ICT infrastructure indicators in this study includes all digital information carriers, social networking tools, enterprise systems and industry 4.0 technologies that automate processes thereby increasing efficiency and effectiveness of knowledge management. Lastly, the Industry 4.0 has been described as technologies for the factories of the future (Vernadat, et al., 2018).

The world is rapidly moving towards a knowledge economy with first world countries achieving the latter status as a result of having in place necessary ICT infrastructure that have led to the creation of service business models that enhance sustainability (Forcier and Rathi, 2013). According to, Nyori and Ogolla (2015), the manufacturing sector has evolved in the past few decades from mechanical processes to technological processes resulting in adoption of advanced manufacturing technologies. Cheruiyot, Jagongo and Owino (2012) opine that the manufacturing sector in line with the aspirations of Kenya vision 2030 is expected to yield a 10% annual growth rate thereby addressing the issues to do with unemployment, attracting foreign direct investment and generation of foreign exchange. The manufacturing sector in Kenya is thus expected to grow in leaps and bounds if it adopts agile ICT infrastructure tailored for the manufacturing sector to automate its processes and build its knowledge management capacity.

Background to the Study

ICT infrastructure is perceived as extremely important in knowledge management globally, particularly in today's turbulent and dynamic economic climate. Most of the developed countries use modern technologies to enhance knowledge management in their organizations. In Europe, the centrality of ICT infrastructure influence on knowledge management cannot be gain-said. In Italy for instance, there has been an increasing interest in academia and industry on the role that ICT, the cloud computing and Internet of Things (IoT) play in providing tools and platforms that enable stakeholders to share information and knowledge, which further enhance

innovation and competitiveness (Chiappa & Baggio, 2015). In Finland, social media is said to increase the connectivity of people within and across organizational boundaries, thereby increasing opportunities for acquiring and sharing knowledge that is useful for communication, innovation and decision-making. In Spain, Soto-Acosta, Gabriel and Nayaro (2016), note that in addition to application of emerging ICT, appropriate training and education will facilitate firm's knowledge management. ICT competency among knowledge workers is therefore, expected to accelerate the benefits of ICT infrastructure use in knowledge management.

IoT, emerging tactile internet, and Cyber Physical Systems (CPS) are the most recent trends influencing automation technologies in fourth generation industries (Industry 4.0) in the United States (Wollschlaeger, Sauter, & Jasperneite, 2017). These trends have the potential to automate processes in the industries through smart production. Adoption of these ICT infrastructure will consequently improve organizational knowledge management as previously labor-intensive production processes and physical instructions will be automated, resulting in the creation of intelligent goods and services. In addition, social media or corporate social media, crowdsourcing, and IBM Watson were found to be three growing collaboration tools useful where knowledge is unstructured (O'Leary, 2016). Unstructured data that is generated every day has the potential to create knowledge and insight that can guide in strategy and policy formulation. Facebook, Twitter, Pinterest, blogs, the Drupal content management system (CMS), and wikis are examples of social media tools in used in two public libraries in Canada (Forcier & Rathi, 2013). They are thought to provide an accessible way to improve knowledge management procedures for cooperation, communication, and promotion resulting in improved business performance and creativity.

Unstructured/semi-structured data from internal and external sources, which will facilitate better decision making, are considered to be the wave of the future in Malaysia, according to (Baharuddin et al. 2016). Internal and external data sources, which were once sufficient for competing are no longer adequate in today's unstable business climate. For this reason, cutting-edge technologies are being embraced, like the Internet of Things, crowdsourcing, and social media, to make use of massive amounts of unstructured and semi-structured data to produce actionable information to aid in decision-making. Similarly, Facebook, Instagram, YouTube, Twitter and RSS feed in Malaysia are tools found to be used to share knowledge in a government agency in Malaysia to reach out to a worldwide community of people with similar interests for knowledge sharing purposes and discussions (Dahri & Yunus, 2017). Social media continues to trend as an information and knowledge sharing tool in the global scene. Ghaleb, Mosleh and Al-ariki, (2016) corroborates the latter by suggesting that in future, the maximum

benefits of knowledge management will only be realized by organizations if their knowledge management systems are grounded in social networks.

Organizational websites, specialized portals with electronic databases, audio and video recordings, and multi-media presentations are some of the other ICT infrastructures that have been researched to capture and deliver information in the Indian agricultural sector to cater for the digital divide in the country (Yadav K., Sulaiman, Yaduraju, Balaji, & Prabhakar, 2015). In Turkey, issues brought about by these technologies such personal privacy, heightened complexity and exaggerated expectations were identified as bottlenecks to be addressed by management (Oja, Virtanen, Jalonen & Stenvall, 2015). According to Sigalla and Chalkiti (2014), use of ICT infrastructure has created security and privacy challenges in Australia since it is difficult to impose control over shared information and knowledge, particularly sensitive data. Therefore, it is crucial for organizational leadership to implement ICT policies and methods that govern use of ICT infrastructure so as to guarantee that crucial knowledge is secured and not lost or leaked to its rivals.

In the African context, adoption of ICT infrastructure for knowledge management purposes is rapidly gaining momentum. In Nigeria, effectiveness of any knowledge management practice is viewed to depend on effectiveness of people, processes, systems and web 2.0 which work together to achieve knowledge management objectives (Igbinovia & Ikenwe, 2017; Okonedo, 2013). In Botswana, modern ICT infrastructure like web-based technologies, enterprise system applications, wireless and mobile applications support knowledge management strategies, methods, techniques, and processes (Okike & Mbero, 2015). An ideal enterprise information system in South Africa is thought to include a single point of access to all sources of information to make it easier for employees to acquire pertinent information (Abdulla, Almalki & Blahmer, 2018). In Tanzania, Information Technology (IT) infrastructure is viewed as the most important tool to advance knowledge management because it enhances knowledge capturing, transformation, access and transfer in the knowledge management processes (Hamad, 2018). The ICT infrastructure studied in the African context fail to mention the use emerging technologies like the Industry 4.0 tools that are driving efficiency in the first world countries.

Knowledge management is establishing itself in many Kenyan enterprises. The knowledge-intensive industries, including the banking and insurance sectors, are said to have a thorough understanding of knowledge management techniques (Maseki, 2012). Even while some sectors may be trailing in the latter's adoption, ICT adoption is now practically a given for all enterprises and sectors. To produce, exchange, and apply knowledge pertinent to organizations, simple digital information carriers like a mobile phone, email systems, and search

engines are used. Organizational practices and technological infrastructure like internet technologies, appropriate information systems and social media were found to influence knowledge management institutionalization in the manufacturing sector in Kenya (Cheruiyot et al., 2012). According to Nguyo, Kimwele and Guyo (2015), ICT tools and infrastructure such as corporate emails, online discussion forums, web meetings, social communities, social media, and portals with fast and reliable internet were found to be essential drivers of efficient and effective knowledge exchange in state enterprises.

In order to maintain a competitive advantage in today's changing business climate, organizations must emphasize knowledge and knowledge management. From the global perspective there is a trend in conceptualizing ICT infrastructure in terms of emerging technologies operating in the 4th industrial revolution like IoT, Internet of Services (IoS), cloud computing, web 2.0 technologies, CPS, artificial intelligence, big data, integrated information systems among others (Wollschlaeger, Sauter, & Jasperneite, 2017; Vernadat, et al., 2018; Forcier & Rathi, 2013). Locally no study has been done with regards to Industry 4.0 technologies and their influence on knowledge management thus presenting a conceptual knowledge gap.

Statement of the Problem

In the current knowledge economy, knowledge is a critical success factor for many organizations. Knowledge and knowledge management is thus reported to play a key role in growth of the economy where its sustained growth is expected to increase efficiency in the use of resources, generate employment and increase the competitiveness of a country (KNBS, 2020). Globally Industry 4.0 technologies such as big data, cloud computing and IoT among others have created opportunities for real-time creation of knowledge and insight and automation of processes creating efficiencies and zero down time (Masila, 2021).

Knowledge management is not a new concept in Kenya. However, the manufacturing sector being labour intensive was seen as lagging in the adoption agile ICT infrastructure that facilitate knowledge management (Nyori & Ogolla, 2015). The manufacturing sector in Kenya is likewise said to be facing significant challenges in the last 15 years posing a threat of premature deindustrialization phenomenon (Kenya Association of Manufacturers & Kenya Business Guide, 2018). The sector also faces a challenge of lack of automation of its processes and consequently knowledge management that would result in production of globally competitive products, improved efficiency in use of resources and improved capabilities in decision making and innovation.

The recent Covid-19 Pandemic caused a lot of disruption in industries worldwide increasing ICT infrastructure adoption and further driving knowledge as king with focus being channeled to the customer. For instance, it saw the KAM launch an online e-commerce platform with an online directory to market locally manufactured goods thus creating a channel for sharing information on local products with the general public (Kariuki, 2020). Application of best practices in knowledge management coupled with agile ICT infrastructure solutions is therefore, expected to boost performance of manufacturing firms. Additionally, it will mitigate the social need of unemployment, reduce inefficiencies, automate processes, improve organizational capabilities like decision making, innovation and creating globally competitive products in terms of both quality and cost. The goal of this study is therefore, to look at the influence of ICT infrastructure on knowledge management in the manufacturing firms in Uasin Gishu County.

Research Objective

To establish the influence of ICT Infrastructure on knowledge management in manufacturing firms in Uasin Gishu County?

Research Hypothesis

H_{01} : ICT infrastructure has no significant influence on knowledge management in manufacturing firms in Uasin Gishu County.

THEORETICAL REVIEW

This study is based on firm's Knowledge Based View (KBV) paradigm. Grant (1996) proposed KBV theory, which was based on the Resource Based View of the Firm. According to the notion, innovation and creativity are assumed to be critical components that improve a company's ability to produce, manage, and exchange information. It also presumes that knowledge is the most strategic organizational resource capable of developing firm skills that result in better performance (Grant, 1996). Knowledge can be found from various sources. KBV theory also assumes that knowledge is embedded in multiple organizational entities such as firm structures, cultures, policies and routines, processes, systems, manuals and documents and even people (Grant, 1996). In addition, it is noted that for knowledge to make an impact in organizational performance it first needs to impact organizational capabilities like decision making and problem solving. Knowledge therefore, has the capability of creating competitive advantage resulting in superior performance. In addition, for this knowledge to create the desired outcomes, it has to be integrated into the organization via set coordination mechanisms that are based on such organizational practices (Grant, 1996).

Knowledge sources in an organization are diverse and ICT infrastructure is facilitating the knowledge management processes. Dihn, Rickenberg, Fill and Breitner (2015) assert that there is need to know where valuable information is located, how to structure information assessment, classification and conversion into organizational knowledge which can be enabled through use of Enterprise Content Management System applications. Therefore, organizations should have a mechanism for capturing and managing this valuable knowledge. In addition, Jalonen (2014), speculates that the transformation of information into useable knowledge is primarily dependent on the individual's tacit knowledge and its transformation into organizational explicit knowledge. This study will thus seek to examine how ICT infrastructure have been used to influence both tacit and explicit knowledge conversion into organizational knowledge.

Internal and external knowledge sharing are essential for boosting innovation and creativity. Today's knowledge economy makes it paramount for businesses to embrace ICT infrastructure for knowledge management purposes. Okike and Mbero (2015), insight that in a knowledge economy growth is attributed to information services and knowledge workers whose role is to capture, create and analyze data as well as manage the knowledge. Knowledge workers thus need to have the necessary skills supported by adequate and integrated ICT policies in order to optimize the knowledge management processes of firms.

KBV theory is relevant to this study as today's business environment is characterized by vast amounts of data generated every day. Modern ICT infrastructures like big data, social networking tools among others have made it possible for businesses to make sense of vast amounts of data generated converting it into business insights and knowledge that aid in decision making and problem solving. According to Jalonen, (2014), social media is considered as a tool that has transformed businesses, creating opportunities for acquiring, storing, sharing and using important information within and across organizational boundaries. Adoption of modern ICT infrastructure coupled with adequate ICT competencies and ICT policies is expected to boost the knowledge management capacity of manufacturing firms resulting in enhanced innovation, creativity and performance in terms of quality of products and profitability.

EMPIRICAL REVIEW

Forcier and Rathi (2013) investigated knowledge management and social media: A case study of two Canadian public libraries. The goal of their research was to look into the usage of social media technologies in the domain of knowledge management in two public libraries. Facebook, Twitter, Pinterest, blogs, Drupal content management systems (CMS), and wikis were among the social media technologies found to be used for disseminating information about marketing outside, connecting with the public, and collaborating inside public libraries. In both

situations, participants judged knowledge management to be a hazy idea. Finally, organizational knowledge was defined as a complex blend of common explicit and tacit knowledge. O'Leary (2016) investigated whether knowledge management was dead or dying in the United States. Thus, the study looked at the latter in the context of three developing ICT infrastructure (social network/enterprise social media, using crowdsourcing, and IBM's Watson system) and their prospective contributions to knowledge management. The study also sought to investigate the value produced by knowledge management.

The main finding revealed that firms facilitate collaboration through social media/ enterprise social media and crowd sourcing. In addition, corporations were increasingly incorporating social media and corporate social media into their knowledge management strategies. Furthermore, IBM watson (cognitive computing) was found to be instrumental in development and analysis of content. Crowdsourcing was used by firms to collaborate with both internal and external crowds where knowledge was unstructured and not frequently used. Google scholar analysis revealed a decreasing trend in knowledge management studies even though there were substantial studies still being published over the years. The study thus concluded that knowledge management was either dead or dying.

Sa'adah and Hidayah (2017), studied ICT infrastructure and Knowledge Management for organizational competitiveness: Understanding Policy and Practices. The conference paper investigated the Centre of IT and database (CITD) as a unit responsible for data management and the use of ICT infrastructure as an enabler of knowledge management processes among academia at Sunan Kalijaga State Islamic University in Yogyakatar. In light of policy and practices the study aimed at shedding light on budgeting, technology implementation and ease of use of technology. Findings included, competency heterogeneity and insufficient ICT skills regarding the ease of use of the ICT infrastructure, inadequate data accessibility and user friendliness as well as awareness among academicians on developing knowledge via ICT infrastructure and services provided by the University. The study recommended the need for ICT infrastructure implementation and improvement through increasing of servers to overcome access problem during peak hours.

Dahri and Yunus (2017) investigated the efficiency of social media as a knowledge sharing medium in a Malaysian government agency department of Chemistry. Findings showed that social networks are used as a knowledge management tool to connect with the global community of similar interest with a goal of encouraging discussions and sharing knowledge. The department was however, willing to share general information and activities like corporate social responsibility and training but not classified information. They suggest that this challenge could be mitigated by policy initiated by management dictating which information can be shared

and how it will be presented more attractively. Additionally, ICT infrastructure at the organization was found to only support core functions as the network was unstable and social network sites was restricted during office working hours. Senior management held a false perception that social media was untrustworthy, complicated and mostly used by the younger generation.

Acosta, Popa, and Marques (2016) performed research on social web knowledge sharing and innovation performance in knowledge intensive manufacturing SMEs in Spain. The most significant finding showed that from technological context, information system integration was positively associated with social web sharing and its effect on innovation performance in manufacturing SMEs. Information systems which are integrated are therefore an essential ICT infrastructure that enhance knowledge sharing over the web. Ghaleb, Mosleh and Al-ariki (2016), did a review on the role of social networking for knowledge management process in India. The study's goal was to look at firms that use employee social networks for communication and collaboration. The study defined enterprise social networks (ESN) as sites designed for the enterprise emulating functionality of social network sites. Further the social networks were revealed to provide tools for communication and collaboration features like profiles, blogging, benchmarking, rss, wikis and the creation of self-defined and self-managed communities. The study found that social networks play a role in sharing, transformation and collaboration of knowledge.

Matthew, Haruna and Kazarue (2020), conducted a study on multimedia information system, knowledge generation and ICT policy framework in Nigeria. They opine that to achieve smart operations, 21st Century firms should consider instituting and configuring ICT policies and ICT software (Matthew, Haruna, & Kazarue, 2020). ICT infrastructure identified included IoTs, cloud computing, user hand held devices and laptops, servers and database management systems. Their study concluded that software consolidation, adoption of ICT infrastructure, and technological innovation are required to alter the education industry in the twenty-first century. It thus recommends adequate budget and revenue allocation in ICT policy for improving ICT infrastructure. This study insights that academic sustainability hinged to free flow of knowledge in the digital spaces can only be achieved through implementation of information systems (federal multimedia digital library), e-learning and ICT policy implementation.

In Kenya, Nguyo, Kimwele, and Wario (2015) investigated the impact of ICT on knowledge sharing in state corporations: a case study of Kenya's national library service. The findings showed that ICT infrastructure and tools was responsible for a 65.2% increase in knowledge exchange in the state firm in question. Other findings revealed that ICT skills measured by ICT know how and ICT competency (employee experience in ICT, trainings and coaching and skill gaps identification) had an influence on knowledge sharing capabilities. The

study recommended that state corporations should make deliberate efforts to increase investment in ICT to enhance collaborative knowledge sharing and integrate policy frameworks on ICT and knowledge sharing. Cheruiyot, Jagongo, and Owino (2012) investigated the present state, problems, and variables influencing knowledge management institutionalization in Kenyan manufacturing organizations as a case study. Customer and employee interaction, as well as technological infrastructure such as computers, database management systems, social media, knowledge management systems, library or resource center, internet, and intranet, were discovered to improve knowledge access, transfer, and sharing. The study recommended that managers need to attach knowledge management to business strategy and create strategies on capturing lesson learnt, accessing lessons learnt as well as best practices which saves on costs arising from repeating mistakes and re-work.

Mbugua (2018) conducted research on ICT for Knowledge Management Processes (KMP) in the Kenyan public sector: A case study of the State Department of Infrastructure. The study's purpose was to determine the department's degree of KM and KMP awareness, ICT infrastructure that enable KMP, and difficulties. The findings demonstrated a broad understanding of knowledge management principles, categories, and value to the department. Knowledge production, codification, retention, sharing, and storage are among the processes highlighted. Emails, servers, desktop computers, mobile devices, and flash drives were recognized as the most common ICT infrastructure utilized for KMP. The challenges found revealed a lack of understanding about the use of ICT infrastructure for KMP. This study's ICT discovered that web 2.0 (such as blogs, wikis, linked in, facebook, and twitter) were not employed for KMP purposes. Among the study's suggestions is that the public sector develop a knowledge management strategy and policy based on the use of ICT for KM activities.

To take advantage of knowledge management techniques, the company makes use of shared internet-based technologies such the internet, intranet, extranet, e-mail, electronic database management systems, decision support systems (DSS), expert systems, groupware, wikis, and weblogs (Owiti, 2017). In today's enterprises, having access to the internet and other ICT infrastructures is practically necessary for effective communication. Additionally, email systems have established themselves as a normal and essentially necessary method of commercial communication. Local studies show that various ICTs have an effect on knowledge management in businesses. Without neglecting to participate in the present fourth industrial revolution, Kenya's manufacturing sector can also implement comparable tactics and techniques to improve their knowledge management capabilities. As a result, the sector will be able to improve the quality of its products and compete globally by applying best practices.

RESEARCH METHODOLOGY

Research Design

The study adopted an ex-post facto research approach to investigate the impact of ICT infrastructure on knowledge management in Uasin Gishu County industrial enterprises. According to, Punch (2014), an ex-post facto research design is one which variables in a study hold some of their variance in common and hence one variable accounts for some variance in another. Kothari and Garg (2014), describe experimental studies as involving hypothesis testing between variables of causal relationships that permit drawing of inferences. There is no manipulation of the independent variable in an ex-post facto research design, but its objective is to analyze probable cause and effect relationships between the variables under examination. This thus presents ex-post facto also known as causal comparative or quasi experimental research design as the most suitable and relevant to address the research question at hand.

Target Population

A population is a full set of subjects, that is, items or people who share similar features. The term "target population" refers to the entire set of participants to whom a study wants to generalize the research findings (Mugenda and Mugenda, 2008). The target population in this study was 34 manufacturing firms listed in KAM directory (2021) operating in Uasin Gishu County.

A sampling frame also referred to as population frame has been defined as the list with ultimate sampling entities like firms, people, households or any other unit of analysis (Mugenda A. G., 2008). The sampling frame contained 34 manufacturing firms with the unit of analysis being the firm. In addition, the informants were senior managerial staff who work in these manufacturing firms. The senior management staff were considered knowledgeable on the study's key constructs in line with recent literature on the subject area. Chief executive officers, heads and deputy heads of departments were informants for studies done on knowledge intensive manufacturing firms (Acosta, Popa, & Marques, 2016; Mbugua, 2018; Cheruiyot, Jagongo, & Owino, 2012).

In addition, in Mintzberg management theory, managers are considered as spokespersons of firms whose part role includes transmitting and communicating the organization's information to people outside of the organization (Wael, 2014).

Sampling Size and Sampling Technique

A sampling design is defined as techniques for selecting items or subjects to be observed for a given study (Kothari & Garg, 2014). In research, sampling is used because it is sometimes impossible to interview every person of the target population. When faced with time,

financial, and logistical restrictions, Mugenda and Mugenda (2008) say that sampling allows a researcher to obtain a representative sample to gather knowledge about an entire population.

This study utilized multistage random sampling technique. According to, Kothari and Garg (2014), a multistage random sampling technique is a further development of cluster sampling principles which involves two-stage sampling design or more where samples are selected randomly at every stage. A stratified sampling strategy was employed to generate a sample during the first sampling step. This is in line with the view that to obtain a representative sample in a heterogeneous group a stratified sampling technique is recommended (Kothari & Garg, 2014). Firms were stratified into sectors thereafter; a sample size was derived using Miller and Brewer (2003) formula. With a population of 34 firms the sample size was found to be 31 firms as shown below. As indicated in Table 1, a stratified random sampling procedure was employed to choose a sample that was proportionate to the size of each stratum.

$$n = \frac{N}{1+N(e^2)}$$

Where:

n = sample size

N = the population size (N = 34 in the current study)

e = margin of error or level of precision assumed alpha = 5%

n = 34/ (1+ 34*(0.05*0.05))

n = 34/ (1+ 34*0.0025)

n= 34/1.085

n= 31

Table 1 Sampling distribution table (1st Stage of sampling)

Population	Firms	Sampling Proportion	Sample Size
Food & Beverage	14	0.91	13
Chemical & Allied	2	0.91	2
Textile & Apparel	4	0.91	3
Plastics & Rubber	7	0.91	6
Building, Mining & Construction	3	0.91	3
Timber, wood & Furniture	3	0.91	3
Metal & Allied	1	0.91	1
Total	34		31

Source: Adapted from KAM (2021)

After determining a sample size, the stratified random sampling approach was employed in the second sampling step to identify respondents who would participate in the study. In this sample step, the informants were 142 senior management personnel from manufacturing enterprises. Miller and Brewer (2003) provided a mathematical procedure for calculating sample size, which is illustrated below.

$$n = \frac{N}{1+N(e^2)}$$

Where:

n = sample size

N = the population size (N = 142 in the current study)

e = margin of error or level of precision assumed alpha = 5%

n = 142/ (1+ 142*(0.05*0.05))

n = 142/ (1+ 142*0.0025)

n= 142/ (1+0.355)

n= 142/1.355

n=104.79

As a result, the needed sample size was determined to be 105 senior management personnel from 31 manufacturing enterprises as shown in Table 2.

Table 2 Sampling distribution table (2nd Stage of Sampling)

Population	Management Staff	Sampling Proportion	Sample Size
Food & Beverage	62	0.73	45
Chemical & Allied	13	0.73	10
Textile & Apparel	16	0.73	12
Plastics & Rubber	19	0.73	14
Building, Mining & Construction	12	0.73	9
Timber, wood & Furniture	15	0.73	11
Metal & Allied	5	0.73	4
Total	142		105

Research Instruments

To collect data for this investigation, standardized self-administered questionnaires were employed. A questionnaire is described as a tool that consists of a series of questions written or typed in a certain order on a form or set of forms and sent to individuals with the request to answer the questions and return the questionnaire (Kothari & Garg, 2014). The study used a

relevant validity test that included content validity, in which the research instrument was exposed to the opinions of professional experts and supervisors in the fields of strategic management, knowledge management, and ICT. A pilot test was carried out to determine the research instrument's validity and reliability. The pilot research was performed among 14 management personnel from three organizations, which corresponded to the recommended 10% of the target population (Creswell & Creswell, 2017). The three companies were all located in Uasin Gishu County.

The degree to which a questionnaire or research instrument delivers consistent results after repeated trials has been defined as reliability (Mugenda & Mugenda, 2003). Cronbach's alpha was utilized in this study to assess the validity of the research instrument. The reliability test was carried out using SPSS software and the findings are reported in Table 3 below.

Table 3 Reliability Tests Results

	Items	Cronbach's Alpha	Action
Knowledge Management	26	.936	Reliable
ICT Infrastructure	12	.900	Reliable

Data Processing and Analysis

The data analysis strategy followed a systematic procedure in order to arrive at reliable findings. According to Kothari and Garg (2014), raw data must be prepared in advance for analysis through questionnaire verification, editing, coding, categorization, tabulations, data cleaning, and data modifying. This study adopted the latter approach as the data preparation process. Data analysis through use of Pearson correlational analysis and inferential statistics such as multiple linear regression was adopted to examine the association between variables.

To test hypotheses and assess the sort of relationship that exists between the dependent and the independent variable, linear regression was utilized. The regression model used to assess the association between the predictor factor and the dependent variable is shown below.

$Y = \beta_0 + \beta_1 X_1 + e$

Whereby;

Y = Knowledge management in manufacturing firms in Uasin Gishu County

β_0 = constant

β_1 = coefficient for ICT Infrastructure Variable

X_1 = ICT Infrastructure Variable

FINDINGS AND DISCUSSIONS

Correlation Analysis

Pearson correlation analysis was adopted to determine whether the study variables are related and the nature of their relationship. Outcome of the analysis could either be positive or negative and the statistical correlation coefficient was used to determine the strength of the relationship as shown in Table 4.

Table 4 Pearson Correlation Test Results

		Knowledge Management	ICT Infrastructure
Knowledge Management	Pearson Correlation	1	.448[**]
	Sig. (2-tailed)		.000
	N	78	78

According to the study's findings, ICT infrastructure has a favorable link with knowledge management (r=.448) as shown in Table 4.

Simple Linear Regression Analysis

Simple linear regression analysis was performed to generate a model that predicts the influence of ICT infrastructure on knowledge management. The regression analysis results are presented in the regression model summary Table 5 and overall regression model Goodness of Fit Table 6.

The regression model summary revealed that R^2 was 0.201, indicating that ICT infrastructure explains up to 20.1% of the variation in knowledge management in manufacturing enterprises in Uasin Gishu County whereas 79.9% of the variations in the dependent variable is as a result of factors not included in the study.

Table 5 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig. F Change
1	.448[a]	.201	.191	.36821	.000

a. Predictors: (Constant), ICT Infrastructure

b. Dependent Variable: Knowledge Management

Assessing the Fit of Regression Model

The analysis of variance results in Table 6 indicates the goodness of fit of the provided regression model. The model fit was statistically significant (F= 19.123, p=.000). The data exhibited a fair match using simple linear regression. It also indicates that ICT Infrastructure influences knowledge management in manufacturing firms in Uasin Gishu County.

Table 6 ANOVA[a] Results of regression model Goodness of Fit

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.593	1	2.593	19.123	.000[b]
	Residual	10.304	76	.136		
	Total	12.896	77			

a. Dependent Variable: Knowledge Management

b. Predictors: (Constant) ICT Infrastructure

Regression Coefficient

The outcome of the simple linear regression was used to test the research hypothesis that ICT infrastructure influence knowledge management in manufacturing firms in Uasin Gishu County. The significance threshold used for this study was 5 percent. The outcome displayed in Table 7 indicated that the influence of ICT Infrastructure on Knowledge Management was positively significant (p = 0.000).

Table 7 Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	2.567	.384		6.686	.000
	ICT Infrastructure	.411	.094	.448	4.373	.000

Dependent Variable: Knowledge Management

Predictor (Constant) ICT Infrastructure

The linear regression model thus generated was:

$Y = 2.567 + 0.411 X_1 + \varepsilon$

Results in Table 7 show that ICT infrastructure has a significant influence on knowledge management in Uasin Gishu County manufacturing enterprises (p<0.05). The ICT Infrastructure therefore has a strong beneficial influence on knowledge management in industrial enterprises

in Uasin Gishu County. Additionally, from the regression model generated for knowledge management, a unit increase in ICT infrastructure variable would result in a 0.411 unit rise in knowledge management (β =0.411, p=0.000). This finding was in tandem with Nguyo, Kimwele, & Wario (2015), Forcier & Rathi (2013); Drosos, Chalkias, Skordoulis, & Manadale (2016); Wolschlaeger, Sauter, & Jasperneite (2017) and O'Leary (2016), noting that ICT infrastrucutre like social media tools, cloud based applications, ERP, CRM, analytics, online discussion forums, emails and portals, increased connectivity and have all contributed positively to knowledge management processes.

CONCLUSIONS

The study concluded that ICT infrastructure adoption positively influence knowledge management which further derives many benefits to the organizations such as improved capabilities in decision making and problem solving, increased efficiency in use of resources, intellectual leadership and growth among others. Secondly, success of knowledge management in manufacturing firms has also been attributed presence of ICT competencies among knowledge workers in manufacturing firms. ICT skills is a much sought-after skill in the knowledge economy where manufacturing processes are rapidly being automated through use of modern technologies for instance artificial intelligence and internet of things at play in the Industry 4.0 revolution. We expect to see a shift in roles of manufacturing workers which was previously largely manual. Lastly, from the descriptive statistics of ICT adoption rates, we found out that manufacturing firms in Uasin Gishu County had adopted the advanced enterprise systems and Industry 4.0 technologies to a low extent compared to social media and digital information carriers like emails and computers. From this observation we can conclude that in order for our local manufacturing firms to compete with global firms there is need for adoption of more modern technologies.

Recommendations for Policy and Practice

The study recommends that the management of manufacturing firms should prioritize adoption of modern ICT infrastructure. Modern ICT infrastructure linked to Industry 4.0 are expected to produce high quality products with smart and efficient processes that can compete globally. Social media and e-commerce also should be considered as strategic resources capable of driving growth and success of a company as it has revolutionized how businesses are run by breaking physical boundaries of a business. Local, regional and international communities have now become additional customer segments that were not possible to reach especially for small and medium size companies. The study also recommends a need for an

integrative policy generation process involving private-public stakeholders both small and large in addressing current challenges experienced in the manufacturing sector such as double taxation, high cost of electricity and production among others in order to fast track economic growth in Kenya and to counter the current risk of de-industrialization in Kenya.

Limitations of Current Research

It's possible that the study won't be easily generalizable to manufacturing enterprises in other places because it's limited to the position of manufacturing businesses in Uasin Gishu County. Secondly, to provide a better platform for confirming these findings, a research with a bigger sample than the one employed in the current study should be done. Lastly, this study was limited to only one knowledge management enabler, that is ICT infrastructure other studies can explore other enablers.

Scope for Further Research

In the wake of the global pandemic of Covid-19, the world's economy was adversely affected resulting in businesses and industries swiftly turning to ICT infrastructure solutions to manage their knowledge in order to remain sustainable, however, technologies alone may not be enough to achieve optimal knowledge management. Organizational practices like leadership and organizational culture for instance are viewed as enhancers of knowledge management. Knowledge management should therefore be taken as a holistic concept that requires support from people, systems and processes. Whereas this study focused on ICT infrastructure influence on knowledge management, more research needs to be conducted on how organizational practices influence knowledge management not only in the manufacturing sector but all industries to create a strong economy for our nation.

REFERENCES

Abdulla, M., Almalki, M. & Blahmer, H. (2018). Collaborative Knowledge Management. *Journal of Fundamental and Applied Sciences*, *10*(4S) 292-297.

Acosta, Popa, & Marques. (2016). Social web knowledge sharing and innovation performance in knowledge-intensive manufacturing SMEs. *The Journal of Technology Transfer*.

Baharuddin, M. F., Izhar, T. A., & Mohamad, A. N. (2016). A framework of Knowledge Management Systems (KMS) for dynamic Decision Making (DDM). *International Journal of Academic Research in Business and Social Sciences, 6*(4), 287-294.

Bergeron, B. P. (2003). *Bioinformatics computing*. Prentice Hall Professional.

Cheruiyot, C. K., Jagongo, A., & Owino, E. O. (2012). Instituionalization of Knowledge Management in Manufacturing Enterprises in Kenya: A case of selected enterprises. *International Journal of Business and Social Science*, *3*(10) 127-138.

Chiappa, G. D., & Baggio, R. (2015). Knowledge transfer in smart tourism destinations: Analyzing the Effect of Network Structures . *Journal of Destination Marketing & Management* in press doi:10.1016/j.jdmm.2015.02.001.

Creswell, J. W., & Cresswell, J. D. (2018). *Research Design Qualitative, Quantitative and Mixed Methods Approaches.* Thousand Oaks, California 91320: SAGE Publications.

Dahri, A. F., & Yunus, A. M. (2017). The effectiveness of social mediaas knowledge management sharing tool in Governement Agency: A case study. *International Journal of Academic Research in Business and Social Sciences, 7*(12), 1189-1199.

Dihn, T. L., Rickenberg, T. A., Fill, H. G., & Breitner, M. H. (2015). Enterprise Content Managment Systems as a Knowldege Infrastructure- The Knowledge based Content Management Framework (KBCM). *International Journal of e-Collaboration, 11*(3), 49-70.

Drosos, Chalkias, Skordoulis, & Manadale. (2016). The Role of Information Technology and Knowledge Management in Higher Education. *Paper presented at 2nd International Conference on Lifelong Education and Leadership for ALL-ICLEL 2016* (pp. 395-403). Sakarya, Turkey: ICLEL Conferences.

Forcier, E., & Rathi, D. (2013). Knowledge Management and Social Media: A case of two Public Libaries in Canada. *Journal of Information and Knowledge Management, 12*(4), 1350039 (10) pages.

Ghaleb, Mosleh, & Al-ariki. (2016). The Role of Social Networking in Knowledge Management Process: A Review. *International Research Journal of Engineerigng and Technology (IRJET), 3*(12), 1004-1006

Grant, R. M. (1996). Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal*, 109-122. doi:doi:10.1002/smj.4250171110

Hamad, W. B. (2018). The role of ICT in knowledge management processes: A Review. *IJESC International Journal of Engineering Science and Computing, 8*(3), 16373- 16380.

Igbinovia, M. O., & Ikenwe, I. J. (2017). Knowledge Management Processes and Systems. *Journal of Information and Knowledge Management, 8* (3), 26-38.

Jalonen, H. (2014). Social Media And Emotions In Organisational Knowledge Creation. *Proceedings of the 2014 Federated Conference on Computer Science and Information Systems. 2*, pp. 1371-1379. ACSIS DOI: 10.15439/2014F39

Kariuki, J. (2020, May 21). E-shops becoming the norm as Covid-19 bites. *Business Daily*, p. 14.

Kassim, N. A., Baharuddin, M. F., & Samad, Z. A. (2016). Knowledge Management Practices and Organizational Performance in Malaysian Gorvernment Institution. *International Journal for Infonomics (IJI), 9*(4), 1233-1238.

Kenya Association of Manufacturers (2021) *Kenya Manufacturers & Exporters Directory 2021*. Adafric Communications Ltd.

Kenya Business Guide (2018). Kenya Business Guide Report 2018. *www.kenyabusinessguide.org*

Kenya National Bureau of Statistics (2020), Economic Survey 2020.

Kothari, C. R., & Garg, G. (2014). Research Methodology Methods and Techniques. New Delhi: New Age International (P) Limited, Publishers.

Maseki, C. (2012). *Knowledge management and performance of commercial banks in Kenya.* (Master's thesis, University of Nairobi) E-repository. http://erepository.uonbi.ac.ke/bitstream/handle/11295/14530

Masila, A. N. (2021, April). Industry 4.0 and Potential Opportunities. *Engineering in Kenya*(002), pp. 18-20.

Matthew, U. O., Haruna, K., & Kazarue, J. S. (2020). Multimedia Information System (MIS) for Knowledge Generation and ICT Policy Framework in Education. *International Journal of Information Communication Technologies and Human Development. 12* (3), 28-58

Mbugua, N. (2018). Information Communication Technologies for Knowledge Management in Kenya: A Case of the State Department of Infrastructure Kenya. (Masters thesis, University of South Africa, Pretoria) Electronic thesis and dissertations. https://uir.unisa.ac.za/handle/10500/24510

Miller, R. L., & Brewer, J. D. (2003*). A-Z of Social Research*. London: Longman.

Mugenda, O. M., & Mugenda, A. G. (2003). *Research Methods.* Nairobi-Kenya: African Centre for Technology Studies (ACTS).

Mugenda, O. M., & Mugenda, A. G. (2008). *Social Sciences Research: Theory and Principles.* Nairobi: ART Press.

Nguyo, P. M., Kimwele, M. W., & Wario, G. (2015). Influence of ICT on knowledge sharing in state corporations in Kenya: A case of the Kenya National Libarary Service. *International Academic Journal of Information Systems and Technology, 1*(4), 1-21.

Nonaka, I., & Takeuchi, H. (1995). The Knowledge Creating Company:: How Japanese Companies Create the Dynamics of Innovatio. *USA: Oxford University Press*.

Nyori, G. M., & Ogolla, J. M. (2015). Advanced Manufacturing Technology Adoption in Manufacturing Companies in Kenya. *International Journal of Research In Engineering and Technology*, *4*(10), 356-369

Oja, Virtanen, Jalonen, & Stenvall. (2015). The Effects of the Internet of Things and Big Data to Organizations and Their Knowledge Management Practices. *Research Gate*. doi:10.1007/978-3-319-21009-4_38

Okike, E. U., & Mbero, Z. (2015). Information Technology (IT) Knowledge Management system stage model: Aproposal for today's workplace. *IJCSI International Journal of Computer Science Issues, 12*(5), 193-202.

Okonedo, S. A. (2013). A Survey of the Awareness and Use of Web 2.0 Technologies by Library and Information Professionals in Selected Libraries in South West Nigeria. *International Journal of Library Science*.

O'Leary, D. E. (2016). Is Knowledge management dead (or dying)? *Journal of Decision Systems*, *25*(S1) 512-526. and Technology). Digital Repository. http://ir.jkuat.ac.ke/handle/123456789/613

Owiti, J. O. (2017) *Use of Information Communication Technologies in Knowledge Management.*

Punch, K. F. (2014). *Introduction to Social Research Qauntitative and Qualitative Approaches.* 1 Oliver's Yard 55 City Road London: SAGE Publications Ltd.

Sa'adah, M., & Hidayah, S. N. (2017). ICT and Knowledge Management for organizational competitveness: Understanding Poilicy and Practices. *Advances in Social Science, Education and Humanities Research (ASSEHR), 66. 227-232*

Sigala, M., & Chalkiti, K. (2013). Investigating the exploitation of web2.0 for knowledge management in Greek tourism industry: A utilisation-importance analysis. *Computers in Human Behavior Journal*, Article in Press. http://dx.doi.org/10.1016/j.chb.2013.05.032

Soto-Acosta, Gabriel, & Nayaro. (2016). Relationship between new ICTs for Knowledge management.

Vernadat, F. B., Chan, F. T., Molina, A., Nof, S. Y., & Panetto , H. (2018). Information Systems and Knowledge Managment in Industrial Engineering: Recent advances and new perspectives. *International Journal of Production Research, 56*(8), 2707-2713. doi:10.1080/00207543.2018.1454615

Wael, S.Z. (2014) Mintzberg management folklore. *www.researchgate.net*

Wollschlaeger, M., Sauter, T & Jasperneite, J., (2017). The future of Industrial Communication: Automation Networks in the Era of the Internet of Things and Industry 4.0. *IEEE Industrial Electronics Magazine*, March 2017.

Yadav, K., Sulaiman , R. V., Yaduraju, N. T., Balaji , V., & Prabhakar, T. V. (2015). ICTs in knowledge management: the case of the Agropedia platform for Indian Agriculture. *Knowledge Management for Development Journal, 11*(2), 5-22.