DEFINITION OF ICT

ICT is an acronym or abbreviation that stands for Information Communication Technology. ICT refers to a combination of computer applications and communication technology for gathering, processing, storing and disseminating of information. It generally looks at using computer knowledge to process data into information and making it available to the relevant people.

ICT is made of computer technology and communication technology. The computer technology is the tool for storing and processing information in digital form while communication technology helps to send, receive and exchange information through network systems with the help of various digital tools.

ICT includes the computer hardware, software, application of telecommunication technologies, projection devices, networks (LAN, WAN), digital cameras, compact disks (cds), digital video disks (dvds), cell phones, satellites, and fiber optics etc.

ROLE OF ICT IN BUSINESS

Quick and effective communication

Communication plays a very pivotal role in maintaining business relationships. These relationships can be between different business entities such as employees, suppliers and customers. Through using ICT, businesses can simplify the way to communicate. For example;

With *customers*- when you use communication tools like BOTS, apps like WhatsApp or messenger, customized apps like safeboda app, Uber app, Jumia app or free calling platforms like FaceTime or skype, social networking sites like Facebook, websites, it becomes easier to provide fast, efficient and global customer service. Once you download the Jumia app, they are able to update you about their products by sending catalogues to your email. With *employees*- you can also use communication tools like groups on IM

services or group calls via google hangouts, zoom etc., and this enables employees to speak to one another easily and pass on information faster.

ICTs make it possible to speak to people in real time, whether over a messaging app or video call on your PC, Tablet or even interactive display.

Global expansion of business

ICT has enabled many businesses to continue operating even without physical presence in most parts of the world. Through ICT, different businesses have been able to extend their services and reach as many customers globally. Telemedicine, online shopping-amazon, eBay, Jumia and many other business websites, entertainment (online concerts, Netflix) are some of the businesses that have been able to expand because of ICT.

Enhances effective decision making

The role of ICT in decision making can be seen in a number of tools such as ERP (enterprise resource planning) software and decision support systems. These show a company's performance data in real time which allows businesses to make more informed decisions. Such software presents an online dashboard with information about a company's finances, customers, inventory levels, sales and marketing trends. Employees usually access the dashboard and use that data to decide for example; which products to promote or stop selling, when to restock or make orders, which customers to engage or support etc.

Aids in Automation of business processes

ICT helps in developing automated processes for businesses. Processes like billing, tracking metrics, collecting customer data and more can be automated easily using ICT which will help a company to complete tasks quicker and cheaper.

In countries like Uganda, automation has played a very vital role in eliminating middle men to reduce costs and also improve efficiency. This automation often happens with the help of enterprise software and a centralized company database. Such software may

include; Inventory Management Software, Customer Relationship Management Software.

Rather than having to get workers to count and monitor inventory, companies can use inventory management software that checks real-time levels, provides helpful reports to managers and can even trigger orders when the supply is low. Businesses can also take advantage of fully featured Enterprise Resource Planning Software to make it easier to do accounting tasks, manage human resources, monitor the supply chain, generate invoices and make supply purchases.

Helps to improve business security and reduce risks of theft and loss of confidential information

Organizations that adopt ICT have databases comprising various information. This information can be related to business transactions, client details, employee details etc. Such information is very valuable to a business and as such businesses must do all it takes to protect it from unauthorized access to avoid legal issues that could cost a company. ICTs provide the right resources to store company information in a way that ensures maximum protection. For example, Virtual storage systems allow companies to store important information in a database in the cloud which increases security and allows for easy backups, internet enabled systems such as secure entry systems, these keep information safe by allowing a limited number of users to access it. They also help to ensure that company systems are not hacked and information is not wiped out owing to some problems.

Aides in marketing and advertising of a business to create awareness

Every business has marketing as one of its core functions. With the advancement in technology, marketing campaigns are becoming increasingly digital and more effective. ICT can aide marketing and advertising of a company's products in various ways including content creation, online advertising using social media (Facebook Ads), other platforms such as google Ads. With the rise of search engines like google, businesses are

able to conduct research online about consumer trends and the most profitable opportunities.

STRATEGIC USES OF ICT

ICTs can be strategically applied in various ways to enhance a business' competitive advantage. some of the ways include;

Customer lock-in through ICT: Many companies use ICT techniques to retain their already existing customers. Many of the industry leaders such as amazon, apple, Microsoft etc. have been able to retain their customers and gain a competitive edge over their competitors by utilizing ICT techniques. Mobile tech companies like apple and android devices use the concept of "data trap" to lock-in their customers. Both companies host content and applications on their marketplaces like appstore and google play store that cannot be transferred elsewhere. To switch from one mobile technology to another, one has to give up their purchased apps, movies or music tracks. Due to this reason, many customers prefer to use only one between apple and android phones as it is inconvenient to switch from one to the other.

Innovation through ICT: Many companies invest in Research and Development (R& D) in order to come up with new products in the market that would attract the customers' interest. Advancements in ICT make it essential to compete in the market because they push a company to acquire new skills and talents needed to cope up with an increasingly complex and ever changing market. For example; Uber has revolutionized the transport industry, by giving access to the cab-riding public the possibility of booking a cab through the use of a mobile app on their smartphones at their convenience. This kind of disruptive innovation technique spells simplicity and convenience at its best when booking a cab. Other innovative companies include safeboda, Jumia etc.

Differentiation through ICT: Businesses can stand out in their space by using new technology that nobody else is using. For example; safe boda has a mobile app which can be downloaded on the google play store or apple store. This app calculates the transport

fair based on distance which makes it less likely to cheat a customer. Safe boda also has cashless payments which is an alternative to paying physical cash for the rides and this has an advantage of paying 20% cheaper for all the rides you take. Their rides are also easily identifiable and trackable through their system. And not only that, they also use live chat, which many customers prefer because of the immediacy it provides. A customer is not just getting a ride, but the simplicity, safety and convenience that comes with it. Overall, adding technologies like these to your digital list gives customers a great reason to do business with you rather than your competitor.

Cost reduction through ICT: Cost reduction through ICT is a business strategy applied by businesses in order to reduce costs of products or services with an intention to improve the profitability. This involves a number of ICT generated changes such as automation of business processes that would reduce the number of staff who are manually handling business activities.

Automation will improve a business' operational efficiency, help a business gain competitive advantage by reducing cost of operation as well as cost for customers hence leading in the business market. For example; The e-immigration and e-passport system in Uganda now offers seamless and hustle-free solutions to serve the huge demand for passports. They systems are efficient since the applicant fills in their biodata online, pays the necessary fees through a payment framework integrated with URA then schedules to appear for photo and finger print capture. So this has made it easy, transparent and very accessible. Brokers / third parties/ middle men who have been extorting money from the public have been more or less eliminated. Previously work that was done by staff has been automated so such staff may either be laid off or channeled to focus on other tasks were their effort is needed more hence saving on time and other human costs.

DATA AND INFORMATION

DATA

Data refers to a collection of raw facts or figures about a given phenomenon, entity or business. Many businesses collect data about their customers, suppliers, employees,

products and services etc. and they highly rely on this data by transforming it into information that they need to gain insights into their business operations which later on guides their business activities. Data can be in form of text, numbers, observations, symbols or simply description of things, events or entities gathered with a view to drawing inferences.

Computers use binary digits of 0 and 1 to store data. A binary digit or bit is the smallest unit of data in a computer. So the binary numbers are made up of binary digits (bits) for example the binary number 1001 has 10 bits i.e. 1111101001. Human beings interact with the computer using computer programs which are sets of instructions and each instruction is translated into machine code/binary codes. These instructions are converted by a translator into binary digits that the computer can process. All software, music, documents etc. that is processed by a computer is stored in binary form.

DATA STORAGE UNITS CHART: FROM SMALLEST TO LARGEST

Unit	Value	Size
bit (b)	0 or 1	1/8 of a byte
byte (B)	8 bits	1 byte
kilobyte (KB)	1000^1 bytes	1,000 bytes
megabyte (MB)	1000^2 bytes	1,000,000 bytes
gigabyte (GB)	1000^3 bytes	1,000,000,000 bytes
terabyte (TB)	1000^4 bytes	1,000,000,000,000 bytes
petabyte (PB)	1000^5 bytes	1,000,000,000,000,000 bytes
exabyte (EB)	1000^6 bytes	1,000,000,000,000,000,000 bytes
zettabyte (ZB)	1000^7 bytes	1,000,000,000,000,000,000,000 bytes
yottabyte (YB)	1000^8 bytes	1,000,000,000,000,000,000,000,000 bytes

The smallest unit of data storage are bits. When 8 bits are combined, you get a byte. Bytes are used to store a single character, whether it's a letter, number or punctuation. All memory storage is expressed in terms of bytes, so although bits might be the foundation upon which data storage is built, bytes are the building blocks that truly denote the usability of any one storage solution.

Because storage is expressed in terms of bytes, all greater units are typically referred to by their shortened names. This means that you could keep adding more prefixes to talk about more and more data. Above terabyte (TB), we have petabyte (PB), Exabyte (EB), zettabyte (ZB) and yottabyte (YB)

FORMS OF DATA

Text data: This is data presented in form of human-readable sequence of characters and the words they form that can be encoded into computer-readable formats such as ASCII. Text data can be in form of plain text such as alphabetical letters, numbers, symbols and special characters.

Numerical data- This refers to any data in form of numbers and not in any language or descriptive form. For example; integers, whole numbers, decimals, fractions etc. It can be number of objects, number of sales made, count of money etc.

Image data- This refers to a photographic or trace objects that represent the underlying pixel data of an area of an image element, which is created, collected and stored suing image constructor devices. This data can be in form of graphics or pictures. It can be produced by scanning a surface with an optical or electronic device. Scanned documents in business such as invoices, contracts, appointment letters etc, aerial photographs and so on.

Audio data- This refers to data inform of sound. Specifically, digital audio data is sound that has been converted into digital form. For example, audio meeting recordings, audio music.

Video data- This refers to data in form of moving visual images. Files containing video data are a collection of images, audio and other data. Examples include; business videos such as marketing videos, tutorials on how to use company products and services.

Multimedia data- This refers to data of more than one medium. It's data that represents multiple forms of medium to capture information and experiences related to objects and

events. Common used forms of data are numbers, alphanumeric, text, images, audio and video. For example; a movie with subtitles, a web page with animations etc.

TYPES OF DATA IN A BUSINESS

Transactional data; This is data that is captured from transactions. It records the time of the transaction, the place where it occurred, the price points of the items bought, the payment method employed, discounts if any and other quantities and qualities associated with the transaction. This data is usually captured at the point of sale. For example; data collected from invoices, daily sales, returns, purchases, debits, payroll, trades, payments etc.

Master data; Master data represents data about the business entities that provide context for business transactions. The most commonly found categories of master data are parties such as customers, suppliers, employees, products/services, finances etc.

Customer data; This refers to all personal, behavioral and demographic data that is collected by marketing companies and departments from their customer base. For example; customer contacts, customer feedback, payment methods, offers, customer name and Id etc.

Machine data; This is digital data created by the activity of machines such as computers, mobile phones, embedded systems and other networked devices without any human intervention. Application, server and business process logs, call detail records and sensor data are prime examples of machine data.

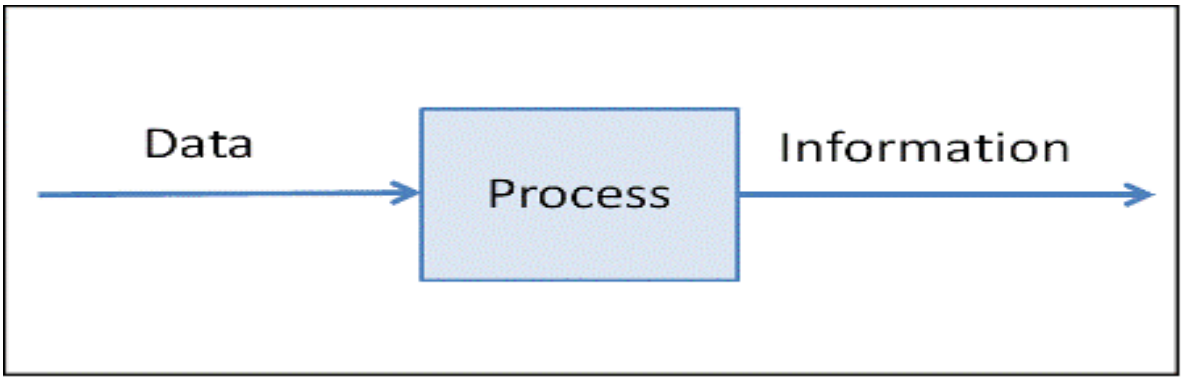
Reference data; This refers to data that is used to classify or categorize other data. For example; geographical locations like list of districts or cities in a country, country codes, computing data like a list of standard computing values like HTTP status codes etc

Quantitative data; This refers to data that can be quantified. It is in numeric form. It can be counted or measured and given a numerical value such as length in centimeters or

revenue in Ugx. This type of data tends to be structured in nature and is suitable for statistical analysis.

DATA PROCESSING

This is the process where raw data is manipulated and transformed into meaningful context that can be understood and utilized by the end users.



Data is entered into the computer as input system using computer hardware devices such as keyboards. It is then processed (manipulated and converted) into meaningful form using a computer's central processing unit. Activities such as classification, storing, summarizing, calculations and analysis are carried out on that data in order to transform it into a more meaningful and useful form which is information. This information can be retrieved by or communicated/disseminated to the end users.

Data processing is crucial for organizations to create better business strategies and increase their competitive edge. By converting the data into a readable format like graphs, charts, and documents, employees throughout the organization can understand and use the data.

STAGES OF DATA PROCESSING CYCLE

The data processing cycle is the set of operations used to transform data into useful information. The intent of this processing is to create actionable information that can be used to enhance a business. This cycle involves the following steps;

1. **Data Collection:** Data is pulled from available sources including social networks, connected devices, data lakes, data warehouses etc. The type of raw data collected has a huge impact on the output produced. Hence, raw data should be gathered from defined and accurate sources so that the information that comes out of it is valid and usable. Raw data can include monetary figures, website cookies, profit/loss statements of a company, user behavior etc.

2. **Data Preparation:** In this stage, data is cleaned up and organized. It is sorted and filtered to remove unnecessary and inaccurate data. It is checked for errors, duplication, miscalculations or missing data and transformed into a suitable form for further analysis and processing. This is done to ensure that only the highest quality data is fed into the processing unit.

3. **Data Input:** After the data has been cleaned it is then entered into its destination/a computer system for example into a CRM (Customer Relationship Management system) like salesforce or a data warehouse. At this stage, raw data is converted into machine readable form and fed into the processing unit. This can be in form of data entry through a keyboard, scanner or any other input devices.

4. **Processing**: At this stage, the raw data is subjected to various data processing methods using machine learning and artificial intelligence algorithms to generate a desirable output.

5. **Data output:** At this stage, data is finally transmitted and displayed to the user in a readable form like graphs, tables, vector files, audio, video, documents, etc. Employees of a business can now begin to access the data and put it to its intended use. For example, examining advertising patterns, medical diagnosis, determining customer needs etc.

6. **Data storage:** This is the final stage of the data processing cycle, where data and metadata are stored for further use. It is necessary for data to be stored properly for compliance purposes with data protection legislation like GDPR (General Data Protection Regulation). When data is properly stored, it can be quickly and easily accessed by members of the organization whenever needed.

IMPORTANCE OF DATA PROCESSING TO A BUSINESS

Data processing helps you make better decisions: When it comes to decision making in a business, there is nothing as persuasive as having data to back you up. Having data gives a business pivotal power to run all its activities. Businesses can use data to make decisions about; finding new customers, increasing customer retention, improving customer service, better managing marketing efforts, tracking social media interactions, predicting sales trends. Where there's data, employees are able to make smarter decisions about where to take their companies.

Data processing helps you understand performance: Collecting and processing data can help a business know how its performing in areas like marketing efforts, customer service, accounting and finance etc. this performance evaluation helps a business to know if its money invested is bringing in more money than its spending.

Data processing helps you solve problems: A company is able to track and review data from business processes to help uncover performance breakdowns in order to understand better each part of the process and where to fix or acknowledge which sections are performing well, for example; when a business experiences reduced sales for

their products or services, or increased customer complaints, you can only identify what went wrong by tracking and reviewing data about the products or services or customer complaints.

Data processing helps you understand customers: A business needs data about its customers, whether they like the products/services it offers or if their marketing efforts are effective. This helps them to come up with ways to give their customers a better experience.

Speed, Accurate and more reliable: It is important to make sure that the collection of facts and figures is done quite speedily and without making any errors. When data is collected and filtered through computers, there are no or negligible chance of errors. It is almost guaranteed that the further processes will be done with maximum possible accuracy. If the input data is accurate then the output is always accurate. Processing can be done at a greater speed and with higher accuracy when the right combination of softwares is used. Another importance of data processing is the major advantage when working in a competitive environment. It is not uncommon to have access to same data. Data and information with better quality is more reliable. Predictive modelling, data cleaning, data validation, batch processing is necessary for accurate data.

Cost reduction: Data once collected acts as an asset for any group and having it stored provides easy access to it when required. This eliminates the need to collect data again and again. Moreover, it is very easy and convenient to make copies of the stored data when stored in digital form. Sending or transferring the data is also much easier and eases the use of this data for research purposes. This directly helps in cost reduction. The cost or loss which a company might incur because of lack of information is also drastically reduced. This is so because processed data enables the company to take a wise and informed decision thus again saving on huge cost.

Digitization has made processes quite cost-effective. That is why students are using computers and laptops to prepare their assignments. Some even use online essay writing services and keep all the records in digital form instead of printed hard copies. Teachers

are also able to keep records on computers instead of taking piles of papers with them to check every day.

Storage and distribution is easy when data is processed: When we have piles of data, we need a huge place to store it and there is a huge chance of missing information and confusions. When the data is processed through computers, you do not need an extra room to store all those hard files and papers. All of your data is processed and labelled through a complete computerized setup so you do not need to get confused at any stage. It is easy to take out any information from a processed data instead of an unprocessed one. Having your data stored in a digital form rather than having the hard copies is another aspect which highlights the importance of data processing.

DATA PROCESSING METHODS

Manual data processing: Data is processed by hand in this data processing method. The entire process of data collecting, filtering, sorting, calculation and other logical operations are all done with human intervention without the use of any other electronic device or automation software. It's a low-cost method and requires little to no tools; however, it produces high errors and requires high labor costs and lots of time.

Mechanical data processing: Data is processed using machines and simple devices such as typewriters, calculators, printing press, etc. Simple data processing operations can be accomplished by this method. There are fewer errors compared to manual data processing, but the increase of data has made this method more complex and difficult.

Electronic data processing: Data is processed with modern technologies using data processing software and programs. A series of instructions are given to the software to process the data and produce the desired output. This method is the most expensive but provides the fastest processing speeds with the highest reliability and accuracy of output. It is more expensive but provides faster processing with the highest reliability.

DATA PROCESSING MODES

Batch processing: The collection and processing of data is done in batches where there is a huge quantity of data, thus reducing the cost of processing. Examples include payroll, examination and billing system. The main characteristic of this method of data processing is that different jobs of diverse users are processed in the order they are received.

Real-time processing: For a small quantity of data, real-time processing is done where data can be processed within seconds of data input. This mode is suitable when decisions to be made are instant and requires use of internet connection and all data is kept online. For example; tickets booking for flights, banking systems and movie tickets.

Online processing: As and when data is available, it is automatically entered in the CPU. This is useful for processing of data continuously for example; Barcode scanning.

Multiprocessing: This also goes by the name parallel processing, where data is fragmented into small frames and processed in two CPUs within a single computer system which increases efficiency. Examples include; Weather forecasting.

Time-sharing: Allocates computer resources and data in time slots to several users simultaneously. Here one CPU is sued by many users. All users share one CPU but time allocated to users might differ. As per allocated time, the processing takes place at various intervals for various users.

TAKE HOME ASSIGNMENT

Describe how the following systems process data.

- *Automated Car Parking System*
- *Automated Teller Machine (ATM)*

INFORMATION

Information is processed, organized and structured data. It provides context for data and enables decision making. For example, a single customer's sale at a restaurant is data – this becomes information when the business is able to identify the most popular or least popular dish.

Information assigns meaning and improves the reliability of the data, thus ensuring understandability and reduces uncertainty. When the data is transformed into

information, it is free from unnecessary details or immaterial things, which has some value to the business. Examples of information include; receipts, financial statements, transcripts/reports etc.

TYPES OF INFORMATION

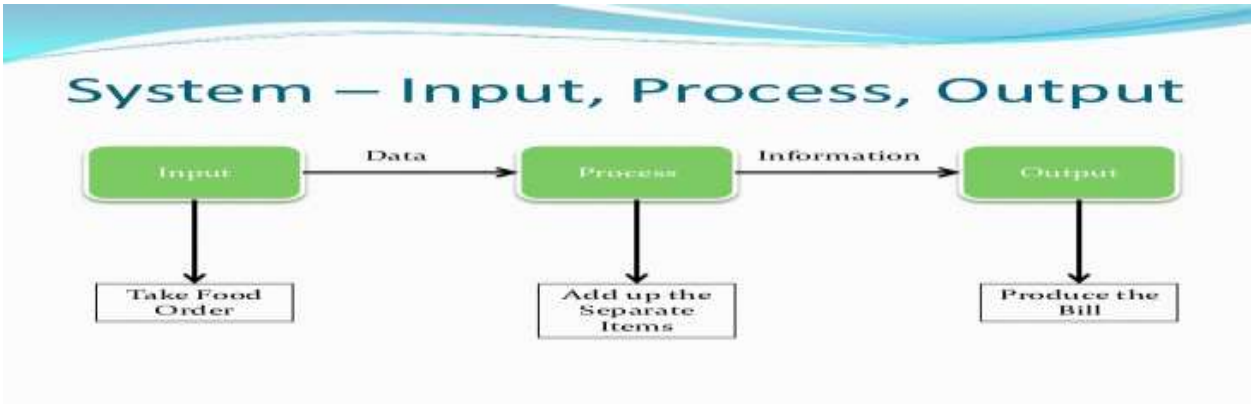
Strategic information; This refers to information used for gaining competitive advantage and formulating business strategies by organizations for example; sales, marketing research, product performance and financial analysis information.

Tactical information; This refers to information used by managers to measure the success of their functional processes in carrying out the enterprise strategies.

Operational information; This refers to the information about the day-to-day operations of the organization.

RELATIONSHIP BETWEEN DATA AND INFORMATION

Data refers to raw input that when processed or arranged makes meaningful output. Information is usually the processed outcome of data. When data is processed into information, it becomes interpretable and gains significance. As such, it becomes useful for businesses to make decisions, and it forms the basis of progress. *The illustration below explains the relationship further.*



COMPARISON BETWEEN DATA AND INFORMATION

Below is a distinct difference between data and information.

	DATA	INFORMATION
MEANING	Data is raw, unorganized facts that need to be processed. Data can be something simple and seemingly random and useless until it is organized.	When data is processed, organized, structured or presented in a given context so as to make it useful, it is called information.
What is it	It is just text and numbers	Refined data
EXAMPLE	Each student's test score is one piece of data.	The average score of a class or of the entire school is information that can be derived from the given data.
BASED ON	Records and observations	Analysis
FORM	Unorganized	Organized
USEFUL	May or may not be useful	Always
SPECIFIC	No	Yes
DEPENDENCY	Does not depend on information	Without data, information cannot be processed

QUALITIES OF GOOD INFORMATION

Information quality has three dimensions;

- Time
- Content

- Form

TIME DIMENSION

Timeliness: Information should be provided when needed.

Currency: Information should be up-to-date when it is provided.

Frequency: Information should be provided as often as needed.

Time Period: Information about the past, present, and future time periods.

CONTENT DIMENSION

Accuracy: Information should be free from errors.

Relevance: Information should be related to the information needs of a specific recipient.

Completeness: All the information needed must be provided.

Conciseness: Only the needed information should be provided.

Scope: Information can have a broad or narrow scope, or an internal or external focus.

Performance: Information can reveal performance by measuring activities accomplished and progress made.

FORM DIMENSION

Clarity: Information should be provided in a form that is easy to understand.

Detail: Information can be in detail or summary form.

Order: Information can be arranged in a predetermined sequence.

Presentation: Information can be presented in narrative, numeric, graphic or other forms.

Media: Information can be provided in the form of printed paper, documents, video displays, or any other media.

ICT FOR SUSTAINABLE DEVELOPMENT GOALS

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the UN in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. There are 17 SDGs and

these are integrated to mean that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability.

THE ROLE OF ICTS IN ACHIEVING SUSTAINABLE DEVELOPMENT GOALS (SDGS)

ICTs can help accelerate progress towards every single one of the 17 SDGs in the following ways;

Goal 1- No Poverty; The aim of this goal is to end poverty in all forms and dimensions by 2030. ICTs have been found to be an economic, social and political tool for the poor as it is open to all individuals, no matter the status. Use of radio, television, social media platforms, smart phones to record videos/audio by the poor will ensure that their demands reach authorities and decision makers directly. This is because ICTs increase the information flow between the population, government and other stakeholders and would reduce obstacles to people's participation in poverty eradication activities both at national and local level. Other ways ICTs can be used is through increased access to internet, Skilling through ICT to teach people how to use basic apps such as social media apps, mobile payment apps, Microsoft office, desktop applications like adobe publisher, content creation on you tube, TikTok, Facebook etc.

The impact of ICT on this goal is that; People are able to share ideas on important issues in the country, that include political debates, health issues, agriculture, education, environment and gender issues, which have a high impact on their lives. The power of information sharing helps to create public awareness and involvement. Platforms such as social media serve as an inclusive forum for people who have experienced poverty to share their experiences, concerns and opinions. Informing a wide range of audiences on poverty reduction issues. Providing an open forum to reflect different public views, including those of poor people. Scrutinizing and holding actors to account. Look for business opportunities. Earn income online. Access and share information about business, health etc.

Goal 2- Zero Hunger; The aim is to end all forms of hunger and malnutrition by 2030, making sure all people-especially children have sufficient and nutritious food all year. ICTs can help governments and developmental organizations to enhance food security and improve rural livelihoods through both knowledge and skills transfer, as well as improving the capacities of communities in agricultural productivity, pests control and easier access to markets. Use drones to map vast agricultural lands to predict the quality and quantity of harvests. QR codes on food items helping customers track products to the farm level. Software programs to analyze soil, determine fertilizer requirements, give advice on best seeds and deal with pests and diseases.

This will result into improved agricultural productivity. Facilitate access to better market information and financial services and products such as credit, savings and insurance, as well as weather information to ensure better capacity to predict rainfall and better preparedness for extreme weather events".

Goal 3- Good health and wellbeing; This goal aims to ensure healthy lives and promote wellbeing for all for all ages. ICTs can help patients to contact and access healthcare services remotely regardless of their proximity to a health center. Health care workers can, for example, learn and prepare for disease outbreaks, identify patient symptoms, follow established treatment protocols, perform remote diagnostics, access expert support and so on. Big Data analytics can help produce snapshots, analyze trends, and make projections about disease outbreaks, health service usage, and patient knowledge, attitudes, and practices. The impact of using ICTs in this goal would be reduced costs of providing healthcare, increased access to specialists, less chance of catching new disease and overall improved health.

Goal 4-Quality education; The aim of this goal is to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Use of video conferencing technology such as zoom, teams etc. These have special features like; Pre-recorded resources (webinars, lectures, etc.), A digital library, Live and pre-recorded webinars, Video recordings and/or live streaming of lectures, Group breakout sessions

during an online class or lecture, Text chats. E-learning platforms such as Mubsep, Muele (Makerere University). Radio and television –dedicated educational channels and radio stations to broadcast programs to supplement the school syllabus. Social media apps like Facebook, virtual reality. The use of these ICT tools can lead to increased learner motivation and engagement (students are able to learn and connect with each other), bring learners from all corners of the world into one space to conveniently share knowledge, allow for extra help with tutors in online meetings, students are able to use text chat to ask questions without interrupting the lecture or class, group work is still possible as well as group discussions and conversations, enables easy access to education materials, speeds up student registration, access to courses, enrolment options, viewing student marks, sitting exams etc.

Goal 5-Gender equality; This goal aims to achieve gender equality and empower all women and girls. Through mentorship programs for Girls in Computer Science. Girls entering the field of computer science are likely to face more resistance than in subject areas more heavily populated by females. Adults can bolster their resolve by providing examples of strong, successful females thriving in their careers. Whether by creating a mentorship program at the different education levels, bringing in speakers, or using female leaders as case studies, educators and parents can instill confidence in girls who pursue careers in historically male-dominated fields. Emphasis of STEM (Science, Technology, Engineering, Mathematics) education. Equipping women with digital devices such as smart phones. All of this and more promotes women empowerment, women are able to take up leadership positions in the IT field that is highly dominated by men, increases employment (high paying career choices) and productivity of women, reduces the skills gap, reduces occupational segregation, STEM helps young girls feel more comfortable using new technologies, helps break down gender stereotypes, pushes women to become problem solvers, connects and allows women to participate in business and improve their livelihoods.

Goal 6-Clean water and sanitation; To ensure availability and sustainable management of water and sanitation for all. ICTs are an enabler in the management of water as a natural resource. ICTs can facilitate the collection and analysis of data and information on water sources and potentially improve their management and enumeration. Technologies such as remote sensing and geographical information systems have been used by water authorities to track water usage and forecast river levels. These technologies are also applied in irrigation and water based early warning systems. ICTs and smart water management (SWM) systems are being applied to a variety of development projects for water management and sanitation. Smart water meters can provide individuals, businesses and governments with information about their own water use.

ICTs are helping both the providers as well as the consumers. Using ICTs in this goal leads to improved monitoring and managing of water losses, gives consumers better ways of reporting water quality or quantity problems, advanced monitoring allows for better planning and management, especially during cycles of drought and flooding, there is better management and monitoring of sewer systems, better understanding of the water system, detection of leaks, conservation, and monitoring of water quality.

Goal 7- Affordable and clean energy; This goal aims to ensure access to affordable, reliable, sustainable and modern energy for all**.** IoT (Internet of Things) connects all the elements of power production and consumption, improves visibility in the processes, and provides real control at every step of energy flow. Sensors and connected devices allow companies to access real-time energy data and transmit it to the power grid for advanced storage and analysis. Automation is particularly important when it comes to generating clean energy. In wind or solar, for example, IoT devices can help detect the most favorable conditions for energy production and automatically change the direction of turbines or panels. Using devices and their data for the monitoring and efficient working of these power generators enables for maximum efficiency to improve power output and reduce operating costs. Not only does IoT enable better operation control in this way, but it also

improves safety on the premises. As in the case for more reliable water supplies, maintenance for clean energy systems is also hugely improved with IoT. Generation, transmission, and distribution sensors enable remote asset monitoring and management, something of import when energy production plants are distributed and social distancing is mandatory. Meanwhile, better load management is possible thanks to new insights on voltage control, load switching, and network configuration. Ensuring access to affordable, reliable, and sustainable energy for all requires new efficiencies – and these are being made possible by IoT.

As a result, connected devices enable decision makers to build data-driven optimization strategies. Users are able to understand their energy consumption habits and adjust accordingly. Using devices and their data for the monitoring and efficient working of these power generators enables for maximum efficiency to improve power output and reduce operating costs. IoT enables better operation control. Improves safety on the premises.

Goal 8- Decent work and economic growth; The aim is to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. High speed internet, Mobile broadband and computing, E-commerce- Digital market places/platforms like Jumia are some of the ICTs that can be applied to create entrepreneurial activities and boost economic growth. This makes it easier for people to interact and exchange ideas, makes workers more productive, reduced foot traffic in shops and supermarkets, enables a business to tap into new markets, lowers cost of doing business.

Goal 9- industry, innovation and infrastructure; The aim is to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation**.** Mobile cellular services that increase connections between people**.** Mobile apps in transportation sector for example safeboda, uber**.** Online ticket booking**.** Mobile broadband networks**.** Digital infrastructure. All of these ICTs and more make it easy to access businesses online and also run businesses with faster and cheaper internet.

Goal 10- Reduced inequality; The aim is to reduce inequality within and among countries. Increasing broadband availability and adoption, increasing internet affordability, increasing digital skills to the most disadvantages groups. All of this will help to reduce the cost of doing business, open up doors for new opportunities to do business/ work and also increase house hold income among the poor population hence closing the inequality gap.

Goal 11- Sustainable cities and communities; This goal aims to make cities and human settlements inclusive, safe, resilient and sustainable. Smart cities use IoT devices such as; Smart utility meters, Smart transportation, Smart grids, Smart wastage management solutions, Smart air quality monitors, Wifi-ughub, Surveillance cameras. This in turn; Improves contact between citizens and city stakeholders. Reduces costs and resource consumption. Enables data collected to be used to improve infrastructure, public utilities and services etc., Ensures Public safety. Better traffic management. Leads to improvement in mobility and urban parking management. Improved urban planning and the environment. Improved air quality. Enhanced communication

Goal 12- Responsible consumption and production; The aim is to ensure sustainable consumption and production patterns. ICT strategies include; Use of software, computer systems and technology-based tools to replace any physical forms of communication or operation that directly or indirectly causes emission, pollution and unsustainable patterns of consumption and production. Environmental Informatics and Environmental Information Systems (EIS): to collect, gather, sort and analyze data and information related to environment. These ICTs help to reduce emission of computers and electronic devices. Enable energy efficiency of electronic products. Easy monitoring of the environmental changes, understanding complex systems, sharing of data and building consensus among stakeholders

Goal 13- Climate action; The aim of this goal is to take urgent action to combat climate change and its impacts. ICTs to boost this goal include; Weather satellites that track the progress of hurricanes and typhoons. Weather radars that track the progress of

tornadoes, thunderstorms, and the effluent from volcanoes and major forest fires. Radio-based meteorological aid systems that collect and process weather data, without which the current and planned accuracy of weather predictions would be seriously compromised. Earth observation-satellite systems that obtain environmental information such as atmosphere composition (e.g. CO2, vapor, ozone concentration), ocean parameters (temperature, surface level change), soil moisture, vegetation including forest control, agricultural data and many others. Terrestrial and satellite broadcasting sound and television systems and different mobile radio communication systems that warn the public of dangerous weather events, and aircraft pilots of storms and turbulence. Satellite and terrestrial systems that are also used for dissemination of information concerning different natural and man-made disasters (early warning), as well as in mitigating negative effects of disasters (disaster relief operations). As a result, these ICTs provide observational data that improves environment and climate monitoring, data dissemination and early warning. They safeguard life and property through the detection, forecasting and warning of severe weather phenomena such as local storms, tornadoes, hurricanes, or extra-tropical and tropical cyclones. Data from GOS are also used in support of environmental programs everywhere

Goal 14- life below water; Aim is to conserve and sustainably use the oceans, seas and marine resources for sustainable development. Use of satellite-based monitoring to track all fishing vessels in real-time to protect fisheries around the world. Use of detectors that automatically identify manatees (or sea cows) in ocean images. Instead of having researchers sift through thousands of aerial photos to spot the animals, they simply feed the pictures through an image recognition system that can identify the manatees' body shapes. As an impact, these ICTs provide fishing boat data so that researchers, law enforcement agencies and the public can keep watch on key trends such as frequency and monitor if any fishing boats venture into protected waters. This information helps conservationists track populations, identify the results of human interventions in manatee habitats and can play a key role in managing the future of this endangered

species. The software developed also shows promise for tracking other marine life as well, such as humpback whales and other ocean mammals.

Goal 15- life on land; The goal here is to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. Allocating and coordinating the use of the radio-frequency spectrum and satellite orbits allow satellite observations that play a significant role in monitoring oceans, marine life and terrestrial ecosystems. ICT makes improved monitoring and reporting possible for the conservation and sustainable use of land, as well as preventing biodiversity loss. This includes the use of big data to analyze short- and long-term trends and to plan mitigation strategies. Sensors, data collection and analysis also help in land restoration

Goal 16- Peace, justice and strong institutions; The aim is to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. Use of digital platforms (such as social media, blogs, podcasts and online forums), Advanced technologies such as big data, artificial intelligence (AI), Virtual reality and video games to more actively engage people in peace building. Online, interactive citizen service portals to enable citizens conveniently interact with the justice system for example, access to information and advice, paying fees and fines, make appointments for hearings for minor offenses. Back office and shared services can benefit from cloud and on-premises solutions built on Microsoft's Dynamics CRM and ERP platforms. Such services include financial and accounting systems as well as human resource management, procurement, training, and recruitment functions. Use of surveillance cameras, fingerprint and facial identification systems, x-ray machines, tracking devices, the labelling of documents, cyber security policies, and other solutions to tighten physical and cyber court security. With technologies such as SharePoint, Dynamics CRM, SQL Server and Power BI, people in the legal fraternity are able to search for, analyze and store legal documents. These processes can be automated and accelerated, resulting in faster and more informed

decision-making. Creation of digital knowledge platforms for both law firms and government entities which make it easy to obtain, view and use information. Virtual court rooms to secure testimonies, save money. This makes it much easier, and more trials could proceed to their conclusion. In the public and private sector, block chain technology, big data analytics, data mining, mobile applications, forensic tools are being employed to strengthen internal processes, prevent fraudulent practices and combat corruption risks.

These ICT tools boost security, peace and stability in a country, increase transparency, empower citizens and drive economic growth. They also help to obtain, communicate and transmit accurate and timely information, triggering appropriate responses.

Goal 17- Partnerships for the goals; The purpose of this goal is to strengthen the means of implementation and revitalize the global partnership for sustainable development. Billions of people are connected by mobile devices with unprecedented processing power, storage capacity and access to knowledge. This potential is multiplied by technologies such as artificial intelligence, robotics, big data processing, the Internet of Things, autonomous vehicles, 3-D printing, block chain, computers, video and radio communication, security and communication protocols etc. which allows several partners/countries to act collectively. Boosts knowledge sharing on mutually agreed terms. Interactive settings that allow a range of partners to define common questions and come up with mutually acceptable solutions, to pool and co-create new knowledge and to shape and test innovative solutions should go a long way to redefine and revitalize global partnerships for development. Improves coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism. Promotes the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favorable terms, including on concessional and preferential terms, as mutually agreed.